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First Theme:

Fiqh (Jurisprudence of Islam), Administrative and Human Studies

Social and Economic Dimensions of Street Vendors in the Central District of Madinah: An Empirical Study

Abdalla Mohammed Abdel-Rahman

The Custodian of the Two Holy Mosques Institute for Hajj and Umrah Research
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Abstract

Recent decades have witnessed in many countries of the world a remarkable growth in the phenomenon of street vendors, which has become one of the problems and negative phenomena that overcast a shadow on many of the social and economic aspects of lifestyles and living conditions. The current study focuses on the social and economic dimensions of the street sellers in Medina central district.

This study is one of the descriptive field studies, which used a set of data and other theoretical perspectives to explain the phenomenon of street vendors and activities. Among the most important of these are economic, legal, organizational, and finally sociological aspects to analyze the phenomenon. The field study was conducted during Ramadan 1436 AH, on a sample of street vendors (550) case, and on a sample of other officials . In summary, the present study was keen on both theoretical and practical aspects to monitor the social and economic dimensions of the phenomenon of street vendors in the central area of Madinah. On the other hand, this study aimed to put forward a set of findings and recommendations and to provide a range of alternatives solutions offered to treat the phenomenon of street vendors in Medina Central area, whether in the current phase or in future.

Full text is available in Arabic section under title

الابعاد الاجتماعية والاقتصادية للبائعين الجائلين بالمنطقة المركزية في المدينة المنورة: دراسة ميدانية

The Impact of Infectious Diseases on the Performance of the Hajj - A Doctrinal Study

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Abstract

This paper aims to explain the Jurisprudential rule in preventing the pilgrim who is infected with an infectious disease from doing his pilgrimage rituals. The paper also discusses the obligatory rules in allowing or preventing the infectious disease patient from performing the pilgrimage. Results indicated that the infectious disease patient must perform his/her rituals as long as the needed health security measures are taken to keep the disease spreading contained, otherwise it is forbidden for the pilgrim to perform his/her pilgrimage rituals since it will cause a catastrophic health issue to other Muslims. Infectious diseases vary in its harmful effect and the possibilities of the prevention of its spreading. If the infectious disease can be contained or controlled, then it is prohibited to prevent the infectious disease patient from performing his rituals, otherwise a prevention is a must. It is also allowed for the decision maker to prevent pilgrims from a certain country, which is known to have been affected by an uncontrolled infectious disease, from doing their pilgrimage as a security measure to prevent this kind of disease to spread among pilgrims. The paper illustrates the importance of keeping up to date with the new developments in the medical research for those who give religious opinions (Muftis) to the decision makers. This paper is considered to be the jurisprudential work, which provides the concerned authorities with the religious information to take preventive measures against infectious diseases patients, particularly with those patients who argue their way into performing the rituals. The researcher definitely recommends to take preventive measures against infectious diseases.

Full text is available in Arabic section under title

أثر الأمراض المعدية في أداء فريضة الحج دراسة فقهية

Crisis Management and its Role in the Security and Safety of the Two Holy Mosques Visitors

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Abstract

Kingdome of Saudi Arabia has been honored to serve the pilgrims who come from all over the world to perform Hajj and Umrah. The custodian of the Two Holy Mosques and the Saudi government have made commendable efforts to provide comfort and reassurance for pilgrims and visitors of the House of God. Yet with all the preparations and efforts made, some bad incidents may occur, which cannot be avoided. Thus crisis management quality is one of the topics that attract the attention of researchers in the field of Hajj programs management. This paper has been allocated to address this important. In this paper, the crisis management aspects are discussed. The concept of crisis management and its objectives, features, characteristics and the stages of the crisis and its causes are illustrated. The paper also shows some international experiences in crisis management and how to use them. A dedicated section about Hajj crises management is illustrated, where the researcher studied varieties of crises in the pilgrimage, and challenges faced by the pilgrimage crisis management. The author suggested ways to deal with crises during Hajj using thinking skills and at the end of this section, the author addressed the role of contingency plans in overcoming the difficulties. In conclusion, the study outlined certain recommendations including; (1) building entrepreneur and preventive technical project based on comprehensive and accurate data base to accommodate all services provided to the visitors of the House of God, (2) The availability of an early warning system characterized by highly technical and technological competence to ensure accuracy and safety, (3) support scientific research centers and encourage their coordination in their preparation for recent studies on the subject, (4) Intensifying external coordination to raise awareness of the visitors and cultivate the culture of compliance to the instructions, and (5) Enhance feedback and evaluation of training programs offered to crisis management work teams. That was part of crisis management and its role in the security and safety of the visitors of the House of God in hope of moving inward from theorizing to real application.

Full text is available in Arabic section under title

إدارة الأزمات ودورها في أمن وسلامة وفد اللّه

Experience of KAMC in Managing Patients of the Hajj Caravan: A Cross Sectional Study

Emad Y. Khayat, Ayeshah K. Dawood, Flordeliz J. Labbay, Doaa Abdelmoety, Hashim Mahdi, Soha A. Elmorsy

King Abdullah Medical City

Abstract

King Abdullah Medical City (KAMC) is a tertiary healthcare center, committed to providing high quality services through its specialized centers at the maximum standard of patient safety and satisfaction. KAMC Hajj Caravan service gives the opportunity for some KAMC Hajj patients who fulfill strict clinical criteria, to attend the Hajj ritual in Arafat. The aim of this serial cross-sectional study is to summarize the Hajj Caravan data, and describe patient experience with this service, so that data can be used for future planning. Clinical data from caravan patients were collected for years 1435 and 1436 H. Questionnaires about satisfaction provided before, during and after service were distributed to all patients. Eighty-eight patients attended the caravan (33 in 1435 H and 55 in 1436 H); 72% were males and their age ranged from 25 to 79 year (mean ± SD: 59.8±9.9). Patients belonged to 33 different countries and spoke more than twenty languages. More than 70% of the patients were from the cardiac center. Diabetes and hypertension were reported in 60% of patients. More than 80% of the patients were chronically on medications. Almost all patients were subjected to liver and kidney function tests before caravan and more than 80% were subjected to cardiac function tests, ECG, and echocardiography. Almost all patients had an abnormality of one or more types. All patients returned from caravan in a stable condition and none of them experienced sun stroke, dehydration, syncope or loss of way (direction). All patients responded to the satisfaction questionnaire. The overall mean satisfaction score was 4.2±0.18 out of 5.0 with a statistically significant increase in 1436 H as compared to 1435 H (4.2±0.15 versus 4.1±0.19, respectively, $p<0.001$). In conclusion, KAMC Hajj caravan is a unique service that is labor and resource extensive but leads to high patient satisfaction and so helps KAMC to fulfill its mission.

Full text is available in Arabic section under title

تجربة مدينة الملك عبدالله الطبية في إدارة المرضى بقافلة الحج: دراسة مقطعية

Recognise the Cognitive and Behavioral Trends to Apply for the Roles and Responsibilities of Emergency Medical Service Providers of Phase Preparedness to Disasters in Hajj Season 1436H

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Abstract

The researcher aims to recognize the cognitive and behavioral trends to apply for the roles and responsibilities of emergency medical service providers during the preparedness phase in responding to disasters in hajj season 1436H. This research is conducted on the different ambulance teams that participated in Hajj season 1436 AH in Makkah city, Almshaier zone and the operation room of Saudi Red Crescent Authority. This research is a qualitative, descriptive and analytic study that used the innovative questionnaire as a main tool for collecting the data.

Readiness, preparedness and individual understanding of the emergency medical service providers' tasks and responsibilities are the most important factors affecting the response process in emergency and disaster cases. This study was conducted on a random sample of 22% of the total number of emergency medical service (EMS) providers in hajj period 1436 AH. The result shows that 74% of the participants have already participated and worked in previous Hajj seasons. The result also shows that 54% of the participants have read the prepared plans of emergency and disaster response. However, 40% of the participants have not read any emergency plans and 6% of the participant were non-specific. In addition, result shows that 25% of the EMS providers have been trained theoretically and practically to responding to emergency and disaster cases, while 31% have never received any training. In the same context, 31% of the EMS providers have been trained theoretically and 8% practically. The primary role of the emergency team is the transportation process from the disaster scene to the receiving medical facilities and providing the emergency medical care and taking the advantage of the time factor to reduce the waiting time of EMS team in the disaster scene and also taking the advantage of using as little as possible medical equipment in the disaster scene to prevent delays in the transfer process. In contrast the result shows a behavioral index that 77% of the EMS workers agree to use all medical equipment of the ambulance while 19% disagree and 4% is non-specific.

The Cognitive and behavioral side of the participants form a negative reflection that shows absolute differentiation between pre-preparedness and training, as well as understanding the tasks and responsibilities of the disaster response, which leads to a negative impact on the EMS performance during facing and responding to disasters.

The researcher recommends the importance of activating the training and qualification systems for participants in emergency and disaster response in accordance with pre-prepared plans as well as improving the practical skills through exercise training in conjunction with other emergency organizations.

Full text is available in Arabic section under title

الاتجاه السلوكي والمعرفي لتطبيق مهام ومسئوليات مقدمي

الخدمات الطبية الطارئة في مرحلة التأهب والتحضير

للاستجابة لمواجهة الكوارث

Human Crowds and Gatherings Organizational Management and its Role in the Seasons of Hajj and Umrah in Saudi

(An explanatory study for the opinions of a sample of works in the Mistry of Hajj)

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Abstract

This article analyses as to what is the reality of the human crowd management in the Hajj and Umrah seasons, and to see the organizational role in maintaining the security and safety of pilgrims and protect them from the risk in the seasons of Hajj and Umrah annually in the Kingdom of Saudi Arabia. This research follows a descriptive and analytical methodology to explain and clarify the nature of human crowds and gatherings in the Hajj and Umrah seasons. Several challenges affects the crowd management during Hajj and Umrah seasons in Saudi Arabia; (1) At the arrival some pilgrims have to wait for long time at the airport for various procedures before they reach their place of residence, (2) Overcrowding causes problems such as loss of relatives and group members, and uncontrollable situations as a result of the large numbers of people, (3) Potential Hajj and Umrah seasons' accidents, including "fire" and "stampede". To avoid the fire problem, the Government of Saudi Arabia decided to make all tents for pilgrims non-flammable in the city of Mina in 1997, (4) Problems related to health aspect and procedures that apply to the pilgrims coming for Hajj or Umrah, and (5) The running away of some pilgrims who then stay illegally within the territory of the Kingdom.

Full text is available in Arabic section under title

إدارة الحشود والتجمعات البشرية ودورها التنظيمي في

مواسم الحج والعمرة في المملكة العربية السعودية

Medication Management and Storage During Hajj: A Cross Sectional Study

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Abstract

Medication safety is a very important aspect of medical safety. Most of Hajjis would invariably need medications during their pilgrimage period, either as a part of chronic disease treatment or for the treatment of intercurrent illness. Some medications may be dangerous to consume or may have narrow safety margins or dangerous drug interactions. Also some medications may require special conditions of storage. This prospective, cross sectional study aims at evaluating how Hajjis from different nationalities and backgrounds manage and store their medications during Hajj. Investigators approached Hajjis from a variety of missions where they collected information about the medications they consumed and kept and photos were taken after obtaining the Hajjis' approval to document the medication storage conditions. During the Hajj season of 1436 H (2015), 328 Hajjis were approached. They mostly belonged to the following missions: American, Australian, French, Indonesian, and Nigerian, in addition to 12 other countries. Fifty four percent of the interviewed Hajjis carried some form of medication. The most commonly encountered medication classes were: antihypertensives, antidiabetics, analgesics, and medications for a variety of gastrointestinal disorders. Five percent of Hajjis carried injectable medications and 46% of medications kept needed special conditions of storage. Generally speaking, most of the interviewed Hajjis were well aware of the indications and uses of their medications and the majority had quantities that were sufficient for their period of stay. Some injectable medications, however, were stored under non-optimum conditions and even for those needing room temperature storage, this was not exactly applicable at the high temperatures encountered during the time of pilgrimage. The presence of some form of formal pharmaceutical care service to Hajj

missions may be a good idea to prevent and solve a lot of problems and to enhance medication safety.

Full text is available in Arabic section under title

التعامل مع الأدوية وتخزينها خلال موسم الحج – دراسة مقطعية

Medical Bandages for Muhrim (A Person in the State of Ihram)- An Applied Study

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Abstract

The aim of this research is to provide evidence in light of the contemporary jurisprudence regarding patients who need to put on medical bandages, suggested by doctors while in Ihram. In order to achieve this goal, the authors define the medical bandage, identify its forms in our contemporary age, then jurisprudentially describe them through giving scientific evidences from the scholars' written books, after arranging their placement on the different body parts (e.g. head, face, hands, legs and the rest of the body). Results discussed the application of the contemporary jurisprudential rules of provisions related to the medical bandages to be used by a broad cross-section of people today. It also discusses the concept of medical quality of the lace industry and its shape. The urgent need for a huge amount of medical bandages of various types to be used by a large segment of people during the Hajj and Umrah seasons have also been illustrated. The authors highlighted the scholars' sayings in the validity of using such ligaments while wearing the Ihram. Finally, the authors recommended to track all forms of the modern medical issues related to Hajj and Umrah and try to explain it more to the reader and to monitor the new developments of its treatments.

Full text is available in Arabic section under title

أحكام الأربطة الطبية للمحرم - دراسة تأصيلية تطبيقية

Legitimate Controllers of Jurisprudential Hajj Issues

Naif Jamaan Juridan

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Abstract

The Pilgrimage (Hajj) is the worship that is subjected to frequent and modern updates, which need careful scientific consideration since its jurisprudential judging which will have a great impact on both individual and community. The one who is looking to investigate these new updates will find that there is no identical way to decide if the modern issue is initially new in Hajj, or a matter of scientific methodology through legitimate disciplines. So present paper aimed to investigate such conceptions regarding new coming updates and so I divided it into two parts. In the first part, I have mentioned the hajj modern issues, description and rooting of Hajj updates according to the knowledge and description of the former scholars, in the modern era, and the rules guiding these updates, which have legitimate text and the believing concerns issues and independent judgment. In the second part, I have described legitimate methodology of the Hajj modern issues, such as methodology that avoiding inconsistency views of different scholars to follow the easiest methodology, and how to applicate the easiest method in characterizing the Hajj modern issues, the effectiveness of the complex methodology upon judgment of new updates as well as methodology of avoiding acceptance of permission judgments. I have found at the end a collection of features to describe legitimacy of the modern updates; first not to be mentioned previously by scholars or not to be influenced after mentioning; it should be one of the new matters that has serious and broad effectiveness; also there should be no clear evidence that it was described; also it should have no legitimate text, no believing concerned issues and no independent reasoning or judgment. At the end of the study, I got a number of legitimate methodologies to investigates new updates methodology to avoid inconsistency views of different scholars to take the easiest methodology and methodology of principle to apply the easiest in addition to effectiveness of complex methodology upon judgement regarding updates as well as methodology of avoiding acceptance permissions. Also will include methodology that avoiding resultant of accepting permissions. It is recommended to activate these legitimate methodologies for nomenclature of the new upcoming hajj issues according to legitimate disciplines whenever they were investigated.

Full text is available in Arabic section under title

الضوابط الشرعية لبحث نوازل الحج الفقهية

Self-discipline in the Pilgrimage (Concept - its Assets - its Effects)

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Abstract

The pilgrims have a large responsibility to the success of the pilgrimage season and the achievement of its legitimate purposes, through the discipline of manners and personal commitment to its provisions, and the observance of etiquette, without the need for violating the guidance and commitment to what needs to be bound by it. Pilgrimage is a unique event where millions of Muslims perform their rituals at the same time and place, it is their duty to strive very diligently and take into account their fellow pilgrims, do not hurt anyone, show compassion and avoid overcrowding, cooperate with each other and with authorities, try not to make any conflict, show sympathy and should not scramble, otherwise, the aim of their Hajj will not be achieved. Pilgrimage is not only performed by adults but also by children, women and elderly people, therefore we should follow the discipline and behave in positive manners to help and protect the weak and vulnerable pilgrims. It is not intended that the Hajj self-discipline is committed during the Hajj only, but the intention is to follow this discipline even after Hajj in normal life. The spiritual enlightenment gained during the Hajj should appear in our life afterwards and should control our words and deeds and even intention to achieve sincerity.

Full text is available in Arabic section under title

الانضباط الذاتي في الحج (مفهومه – أصوله – آثاره)

Combining the Intention in Performing Hajj and Umra - A Comparative Jurisprudence Study

Murtada A. M. Abdularahim
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College of Education and Science, Taif University

Abstract

The significance of this research lies on its efforts to explore the opinions of jurisprudents and scholars of the Prophetic Hadiths. Moreover, it looks at how jurisprudents dealt with this issue and what they favored according to the logical and textual guidance. The research question is whether it is allowed to combine more than one act of worship at a time. This study is made of an introduction, four topics and a conclusion. The introduction addresses the significance of the study, questions, previous studies, objectives research method employed in this study and the plan of the study. The first topic, concern Identifying the research terms and related expressions. It is divided into two parts. The second topic, discusses the attitude of jurisprudents towards the issue of combing the intention in worship. The third topic, lists the cases of intentions combination and their governing rules. The fourth topic, combins the intentions in performing Hajj and Umra. It consists of; (1) combining the intention of Tawaf Alefada with the intention of Tawaf Al Wadaa, (2) combining the intention of Tawaf and Sai' for those performing hajj, (3) combing the intention in sacrificing, and (4) combining the intention of the obligatory Hajj and vowed Hajj. Finally, the conclusion contains the research findings and recommendations. An indexed bibliography is attached to this article.

Full text is available in Arabic section under title

تشريك النية في الحج والعمرة (دراسة فقهية مقارنة)

Cases of Responsibility for the One Performing Hajj on Behalf of Another

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Abstract

The person performing hajj on behalf of others shoulders a great responsibility, which he should fulfill carefully and with great caution. Thus, they should do their best to perform hajj according to the will of those who appointed him. The proxy should be familiar with the rites of hajj in general to know what is right and what is wrong. He should be aware of the responsibility of performing the proxy of hajj and he has to act in a way as he is performing hajj for himself. Using a comparative jurisprudence method among the four major jurisprudent schools, this study addresses the issues of responsibility shouldered by the one performing hajj on behalf of another. He is responsible for performing hajj in a sound way. He has to return the money back if he didn't perform the hajj. He has to return the amount leftover, if there is any left. He has to offer a ransom if he disobeyed the person who appointed him. He is to offer a sacrifice / immolation if he committed any act prohibited in the state of Ihram. He is to slaughter an animal as a penalty if he hunted during Ihram or had sexual intercourse with his wife during Ihram.

Full text is available in Arabic section under title

حالات اشتغال ذمة النائب عن غيره في الحج

دراسة فقهية مقارنة

Second Theme:

Health & Environmental Studies

The Impact of Climate Changes on the Health of Pilgrims and Umrah Visitors

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Abstract

Climate change (e.g. increasing air temperature and relative humidity) can cause considerable health effects, such as heat injuries, dehydration, and heat strokes. These phenomena are the most problematics during hajj seasons in Makkah, due to the large number of pilgrims and visitors. The present study aims to evaluate the impact of climate change on human health during Hajj and Umrah seasons, and to determine a suitable heat index for human health. In addition, it suggests suitable solutions to make Hajj seasons safer and free of heat risks. In this study, temperature and heat stroke data were collected in the hajj seasons during 1425-1435 H (2005-2014) and compared with the year of 1436 H (2015). The health data were provided by the Ministry of Health, while meteorological data were recorded via the automatic weather stations distributed in Makkah. The maximum air temperature was recorded during Hajj season 1436H (2015), while the lowest one was recorded during hajj 1425 (2005). Moreover, the highest number of heat stress cases (1737) were found during 1436H, while only one case found during 1432H. Both the highest air temperature and highest number of patients (61.6%) were recorded on the tenth and eleventh of Zulhijjah, 1436 H. A sample of 358 patients was randomly studied, showing that among the patients there were more males (50.3%) than females and the most dominant age group was 51-70 years old (52.2%). The highest number of patients were Egyptian followed by Indian, Pakistani, Chinese and Nigerian. About 19% of patients had chronic diseases, 73.5% of the patients had high body temperature, 14.2% had low serum sodium (Na) level, and 21% had low blood pressure. About 4 % of the patients died while 53% were recovered. Furthermore, it is expected that temperature will further increase during the next 10 years, therefore, it is advised to

take precautions like providing shading using umbrellas and tents, increasing the amount of drinks and good nutrition for all pilgrims during the Hajj season.

Full text is available in Arabic section under title

الأثر الصحي للمتغيرات المناخية بين الحجاج والمعتمرين

Seasonal Influenza Vaccine Uptake and Determinants of the Vaccine Receipt among Healthcare Workers in King Abdullah Medical City in Makkah during Hajj Season 1436 H (2015 G)

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Abstract

Seasonal influenza vaccination of health care workers (HCWs) is essential for patient safety, their own safety and for the safety of hospital operation. However, despite its strong recommendation for all HCWs, studies indicate a low rate of vaccine uptake. Recently, a mandatory vaccination policy was adopted for HCWs running the Hajj health care facilities. This paper aims to assess rates of and factors affecting influenza vaccine uptake among HCWs. A cross sectional survey was carried out during October 1-16, 2015 at King Abdullah medical city in Makkah, Saudi Arabia. A questionnaire was used to assess the uptake of seasonal influenza vaccine among HCWs and to examine potential predictors of compliance with the vaccine uptake. Out of 500 HCWs approached for participation, 447 returned valid self-reported questionnaires with a response rate 89.4%. Overall, 88.3% of the participants reported receiving influenza vaccine during 2014-2015 season, significantly higher than 2013/2014 season (61.2%) and 54.5% for 2012/2013 season. Uptake was significantly higher among nurses (93.3%) compared to physicians (86.9%) and other health professionals (83.1%) (p=0.012). To capture factors independently associated with the compliance of influenza vaccine uptake; the multivariate logistic regression model revealed that reading influenza vaccine circulars/guidelines (OR: 1.94; 95%CI 1.29-2.93; p<0.01), intention to receive the vaccine next season (OR: 4.45; 95%CI 2.00-9.91; p<0.001), nurse' assignment (OR: 3.54; 95%CI 1.76-7.71; p<0.01) and other HCWs (OR: 2.65; 95%CI 1.30-5.40; p<0.01) compared to physicians, longer length of practice (5-9 years) compared to those with <5 years practice (OR: 1.85; 95%CI 1.14-3.00; p<0.05); and age >40 years (OR: 2.69; 95%CI 1.30-5.58; p<0.01) were factors independently found to be associated with the compliance of vaccine uptake. Our results show a proper uptake of seasonal influenza vaccine during 2014/2015 season,

after adoption of the new policy of mandatory vaccination. Still orientation programs are needed to correct HCWs' misconceptions about the vaccine. Based on large effect size, we strongly recommend to extend the mandatory vaccination policy to all health facilities in the Kingdom.

BACKGROUND

Seasonal influenza is an acute viral infection caused by influenza virus. Infected individuals are highly contagious and can transmit influenza for 24 hours before they are symptomatic. It is associated with high rates of morbidity and mortality; among vaccine-preventable diseases, influenza causes by far the most deaths, outpacing all other vaccine preventable diseases combined. Hospitalized patients are frequently more vulnerable to influenza than general population [1-2].

Health care workers (HCWs) can be a key source for influenza transmission in hospitals as they are exposed to both infected patients and patients in high risk groups [1]. Influenza outbreaks in hospitals can directly increase morbidity among patients as well as HCWs and have indirect consequences of disturbances in the normal function of the health care system; lack of HCWs, work overload, fewer elective admissions, fewer operations and income loss due to work absenteeism [3].

Seasonal influenza vaccination of HCWs is a core component of patient safety programs, it is recommended for all HCWs [4-5], and can reduce patient morbidity and mortality, increase patient safety and reduce work absenteeism in the health care [6-8]. Vaccination of HCWs should be considered part of a broader infection control policy for health-care facilities [4].

Vaccination coverage among HCWs varies substantially between different studies and countries, with lower rates of uptake mostly reported. In a cross sectional survey in 27 European countries the vaccination coverage in HCWs ranged between 13 and 89% and uptake rates are commonly less than 35% and often less than 25% [8]. In the United States, the Centers for Disease Control and Prevention (CDC) influenza season report from 2014-15 showed that 77.3% of all health care workers reported having had an influenza vaccination, with an increase of 13.8 percentage points compared with the 2010–11 season estimate. This percentage increment in the vaccine coverage was attributed mainly to the more hospitals adopted the mandatory vaccination policy [9].

In neighboring countries, the uptake of seasonal influenza vaccine among health care workers is low; reported 24.7% in Emirate, 46.4% in Oman and 67.2% in Kuwait [10] and 19.4% in Qatar [11]. The trend of the vaccine uptake in Saudi Arabia is also low. In 2014, 38% coverage rate was reported among HCWs in 6 major hospitals [12], not far away from a coverage rate (34.4%) reported in another study in 2010 [13].

Mandatory polices of seasonal influenza vaccination of HCWs are being increasingly adopted by health care institutions and public health authorities in particular in United States, where influenza coverage rates increased from 71% in 2007 to 98% in 2008 [4].

In Saudi Arabia, during Hajj seasons, health care settings are providing medical care for high-risk groups of patients; most of them are elderly, with comorbid conditions. In response to this vulnerability, Ministry of Health (MOH) mandated seasonal influenza vaccination for all health care workers in health care settings providing health care for pilgrims.

No previous studies were carried out to assess seasonal influenza vaccine uptake among HCWs in King Abdulla Medical City, likewise, there is a need to assess the effect size of the mandatory vaccination policy. The aims of this work were to assess the uptake rates of seasonal influenza vaccine among HCWs and to identify determinants of compliance with the vaccine uptake and reasons that inhibit or motivate vaccination.

METHODS

Study design and Setting

The study was a cross-sectional survey, carried during October 1-16, 2015, among health care workers (HCWs) in King Abdulla Medical City (KAMC), a tertiary care, 550-bed hospital, located in holy Makkah, Saudi Arabia. The hospital run by more than 3150 personnel; of them 574 physicians, more than 900 nurses and 720 other HCWs directly involved in patient care. The hospital admitted 11329 inpatients and received 155204 outpatient visits during 2014.

Subjects

The eligible participants were health care workers who are engaged in direct patient care, including physicians, nurses and other health care workers (pharmacists, laboratory personnel, therapists, technicians and other staff directly involved in patient care.

Sample

The investigators received a complete list of the eligible health care workers. A representative stratified random sample was undertaken from the eligible population. Sample size was determined before study initiation and calculated conservatively to allow for maximum sample size, assuming a 50% influenza vaccination uptake among the respondents with a margin of error of 5% and 95% confidence level. Consequently, a sample of 327 HCWs was sought. Anticipating 60-70% response rate, 500 questionnaires were distributed taking into consideration a balanced proportion of HCWs according to assignment, departmental affiliations and work shifts.

Survey instrument and administration

An anonymous structured questionnaire was constructed based on in the literature review and previous research findings. The questionnaire included the demographic, professional and work practice characteristics of the respondents; receipt of seasonal influenza vaccine during 2014/2015, 2013/2014 and 2012/2013 seasons; vaccine availability, provision of instructions and guidelines; beliefs, attitudes and concerns about influenza vaccine. Included in the last section questions sought to assess respondents' knowledge about influenza disease and vaccine facts and uptake recommendations. The instrument was reliable for internal consistency with calculated Cronbach's alpha coefficient at 0.78. The consenting subjects, self-completed the questionnaire after distribution to the eligible HCWs with a briefing for the study objectives by trained coordinators who did not have medical or administrative responsibilities in the hospital during the study (6 last year medical students).

Pilot study

The questionnaire was pre-tested and piloted with a convenience sample of 20 HCWs with similar professional and demographic characteristics to the study population to ensure clarity and ease of administration. Based on respondents' recommendations, some changes were incorporated to simplify and improve the final questionnaire.

Ethics

The Ethical Committee of King Abdulla Medical City approved the study protocol and the final questionnaire, with approval number 15-216.

Statistical analysis

Statistical analysis was carried out using EpiInfo 7 program. We generated descriptive statistics for all survey items. A binary outcome variable was created to reflect compliance of the subject with seasonal influenza vaccine uptake. A compliant subject was defined as "the subject who received seasonal influenza vaccine regularly without interruption for the last three seasons; 2014/2015, 2013/2014, and 2012/2013". A bivariate analysis with Chi-square test and t test as appropriate was done to explore factors associated with HCWs receipt of the vaccine with demographic, professional and practice characteristics, as well as knowledge and attitude towards influenza vaccine. A multivariate logistic regression model with backward selection and cut-off point of <0.2 was developed to capture predictors independently associated with the compliant behavior of seasonal influenza vaccine receipt. Odds ratios (ORs) and their 95% confidence intervals (CIs) were reported as measures of association between predictors and outcome of interest. All statistical tests were two-tailed and the p-values of 0.05 or less were considered statistically significant.

RESULTS

Respondent data and Influenza vaccine uptake

In total, 500 questionnaires were distributed and 447 were returned complete, representing a response rate of 89·4%. The characteristics of the respondents are summarized in Table 1.

Overall 394/447 respondents (88·3%) reported receiving a vaccination in 2014/2015 season, significantly higher than 2013/2014 season 273/47 (61.2%) (p=0.014) and 243/447 (54.5%) for 2012/2013 season (p<0.01) (Figure 1).

Uptake was significantly higher in the last season among nurses (93.3%) compared to physicians (86.9%) and other health professionals (83.1%) (p=0.012). There was no difference in the demographic characteristics of the vaccinated or unvaccinated respondents in 2014/2015 season. The mean age of respondents for the two groups were 32.35±7.78 and 32.50±7.89 and the length of practice were 7·46±6·17 years and 7·61±6·24 years (p =0·185), for the two groups respectively.

Variables associated with respondents' vaccination uptake

The potential predictors for compliance of seasonal influenza vaccine uptake were examined on bases of the compliance definition postulated in the present study as "the subject who received seasonal influenza vaccine regularly without interruption for the last three seasons; 2014/2015, 2013/2014, and 2012/2013 seasons).

Table 2, presents the results of logistic regression analysis. In the univariate logistic regression analysis with the potential predictors, we found that: nurses were significantly more compliant to receive vaccination regularly than physicians (OR: 2.29; 95%CI 1.37-3.84; p<0.01); respondents with longer length of practice (5-9 years) compared to those with <5 years practice (OR: 1.80; 95%CI 1.15-2.83; p<0.05); intention to receive the vaccine next season (OR: 5.02; 95%CI 2.32-10.87; p<0.001); reading MOH vaccine circulars/guidelines (OR: 2.47; 95%CI 1.67-3.63; p<0.001); self-efficacy of belief having sufficient knowledge about the vaccine (OR: 1.63; 95%CI 1.11-2.41; p<0.05); recommending the vaccine to family members (OR: 1.95; 95%CI 1.14-3.33; p<0.05) and participants agreement for mandating the vaccine to all HCWs (OR: 5.02; 95%CI 2.32-10.87; p<0.001).

In the multivariate logistic regression analysis intended to capture predictors that are independently associated with the compliance of vaccine uptake; the model revealed that: reading MOH influenza vaccine circulars/guidelines (OR: 1.94; 95%CI 1.29-2.93; p<0.01), intention to receive the vaccine next season (OR: 4.45; 95%CI 2.00-9.91; p<0.001), nurses compared to physicians (OR: 3.54; 95%CI 1.76-7.71; p<0.01), other HCWs compared to physicians (OR: 2.65; 95%CI 1.30-5.40; p<0.01), longer length of practice (5-9 years) compared to those with <5 years practice (OR: 1.85; 95%CI 1.14-3.00; p<0.05), and age >40 years (OR: 2.69; 95%CI 1.30-5.58; p<0.01) were the

factors that were independently found to be associated with the compliance of vaccine uptake.

Reasons for acceptance or declining to receive seasonal influenza vaccine

Table 3, presents the most frequent reasons cited by the respondents for having and not having seasonal influenza vaccine. The most cited reasons for being vaccinated were: self-protection (81.5%), to protect patients (74.4%), as an institutional requirement (55.6%), to prevent cross infection (45.7%), and having household children contact (32.2%). The most cited reasons for not getting the vaccine were: the misconception that the vaccine causes influenza (38.5%), concerns about vaccine efficacy (32.7%), trust in/wish to challenge natural immunity (21.2%), the vaccine was not available (11.5%), not all strains of the virus are covered (9.6%) and prior experience of severe localized reaction in previous vaccination (9.6%).

DISCUSSION

The study was a cross-sectional survey among health care workers in King Abdulla Medical City (KAMC); a tertiary care, 550-bed hospital, located in holy Makkah, Saudi Arabia, serving pilgrims among other patients during Hajj and Umrah seasons.

Most of the Hajj population presented at health services are vulnerable elderly with comorbidities [14] exposed to a stressful physical conditions that puts them among other conditions at a higher risk of getting the highly contagious influenza infection with its serious complications [15-16].

Prevention and control of nosocomial influenza entail multiple measures; vaccination of HCWs is advocated by World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC) to prevent influenza transmission in healthcare settings [4-5].

It was prudent to adopt the mandatory vaccination policy to reach an acceptable level of vaccination coverage among HCWs to ensure patient safety and prevent any drop in hospital operation may occur due to an influenza outbreak [2].

This study provides an evidence of success of this strategy to increase influenza vaccine uptake by all HCWs. A proper coverage rate (88.3%) was achieved for the last season 2014/2015, with an increase of 33.8 percentage points compared to the 2012/2013 season before adoption of this strategy; a coverage rate touches the US standards (90%) [17] and exceeds the European's Union goal (75%) [18]. This strategy proved effective in other reports [9,19-21] and have a strong a rational and ethical background [22].

The study results showed that mandatory vaccination in 2014/2015 season masked almost all predictors of the voluntary vaccination found in the previous seasons, which

entail that mandatory vaccination policy defeated the barriers of suboptimal vaccination among HCWs.

In spite of the good coverage rate last season, an important misconceptions and inadequate knowledge about seasonal influenza vaccine were present. The participants attained a suboptimal knowledge score about influenza and vaccine (16.03±5.86 out of 33 point); 42.2% of them reported having insufficient knowledge about the vaccine and a considerable percentage of HCWs having misconceptions about vaccine side effects (38.5%) and vaccine efficacy (32.7%) which imply that orientation programs are crucially needed to correct the misconception and knowledge gap of the HCWs.

Good knowledge about influenza vaccine is not only important for sustaining good uptake of the vaccine among HCWs, but also important for the commitment of the HCWs to prescribe the vaccine to the vulnerable target groups of patients and risky healthy people. Vaccination of physicians together with their opinions on the effectiveness of the vaccine was a predictor of vaccination coverage in their patients [23-24].

Taking into consideration the important predictors of influenza vaccine uptake highlighted by the present study; planning for the next seasonal influenza vaccine campaigns and organization of the orientation programs will be more successful when giving more emphasis on and more attention to physicians, younger HCWs, and supplementing all HCWs with the guidelines and official circulars concerned with influenza and influenza vaccine.

CONCLUSION

The results of the current study showed a proper seasonal influenza vaccine uptake among HCWs during 1414/1415 season coinciding with the adoption of the new policy of mandatory vaccination. This maximizes both patient and HCWs safety along with putting the hospital operation in a better situation against any drop due to influenza virus outbreaks.

Still orientation programs are needed for clarifying HCWs' misconceptions about influenza vaccine and help to maintain satisfactory level of vaccine uptake. These programs should address evidence-based arguments about vaccine safety and efficacy

The large effect size of mandatory vaccination policy seen in the present study, strongly suggest extending this policy to all health facilities in the Kingdom of Saudi Arabia.

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Table 1: Characteristics of the participants (n=447)

	Overall N (%)	**Vaccination status 2014/2015 season**		
		Vaccinated n (%)	**Unvaccinated n (%)**	***p***
Assignment				0.0121
- Physician	99 (22.1)	86 (86.9)	13 (13.1)	
- Nurse	193 (43.2)	180 (93.3)	13 (6.7)	
- Other HCWs	155 (34.7)	128 (83.1)	26 (16.9)	
Gender				0.160
- Male	221 (49.4)	200 (90.5)	21 (9.5)	
- Female	226 (50.6)	194 (86.2)	31 (13.8)	
Age in years				0.125
- <=25	53 (11.9)	46 (86.8)	7 (13.2)	
- 26-30	197 (44.1)	174 (88.8)	22 (11.2)	
- 31-35	80 (17.9)	65 (81.3)	15 (18.8)	
- 36-40	62 (13.9)	59 (95.2)	3 (4.8)	
- >40	55 (12.3)	50 (90.9)	5 (9.1)	
Median (Mean±SD)	30 (32.35±7.78)	30 (32.50±7.89)	29 (31.29±6.96)	0.294
Education (highest degree)				0.290
- Less than Bachelor	27 (6.0)	22 (81.5)	5 (18.5)	
- Bachelor	262 (58.6)	235 (90.0)	26 (10.0)	
- Postgraduate (Dip/Master)	80 (17.9)	67 (83.8)	13 (16.3)	
- Postgraduate (Board/PhD/MD)	78 (17.4)	70 (89.7)	8 (10.3)	
Length of practice in years				0.384
- <5	168 (37.6)	143 (85.6)	24 914.4)	
- 5-9	152 (34.0)	137 (90.1)	15 (9.9)	
- =>10	127 (28.4)	114 (89.8)	13 (10.2)	
Median (Mean±SD)	6 (7.46±6.17)	6 (7.61±6.24)	5 (6.40±5.54)	0.185
Marital Status				0.099
- Single	169 (37.8)	147 (87.5)	21 (12.5)	
- Married	269 (60.2)	241 (89.6)	28 (10.4)	
- Others (Divorced, widowed)	9 (2.0)	6 (66.7)	3 (33.3)	
Have Children under 16 year				
- Yes	179 (40.0)	162 (90.5)	17 (9.5)	0.244
- No	268 (60.0)	232 (86.9)	35 (13.1)	
Have any chronic disease				0.181
- No	385 (85.9)	337 (87.5)	48 (12.5)	
- Yes	63 (14.1)	57 (93.4)	4 (6.6)	
Average patients seen per working day				0.800
- <5	134 (30.3)	116 (86.6)	18 (13.4)	
- 5-9	97 (21.9)	87 (89.7)	10 (10.3)	
- 10-14	75 (17.0)	67 (90.5)	7 (9.5)	
- 15+	136 (30.8)	119 (87.5)	17 (12.5)	
Knowledge Score about influenza and vaccine. Median (Mean±SD)	16 (16.03±5.86)	16 (15.80±5.98)	16 (15.80±5.98)	0.315
Vaccinated 2013/2014 season				0.003
- Yes	273 (61.2)	251 (63.7)	22 (42.3)	
- No	173 (38.8)	143 (36.3)	30 (57.7)	
Vaccinated 2012/2013 season				0.014
- Yes	243(54.5)	223 (56.6)	20 (38.5)	
- No	203 (45.5)	171 (43.4)	32 (61.5)	
Intend to receive the vaccine next season				
- Yes	383 (86.8)	353 (90.5)	37 (9.5)	<0.001
- No	58 (13.2)	30 (58.8)	21 (41.2)	

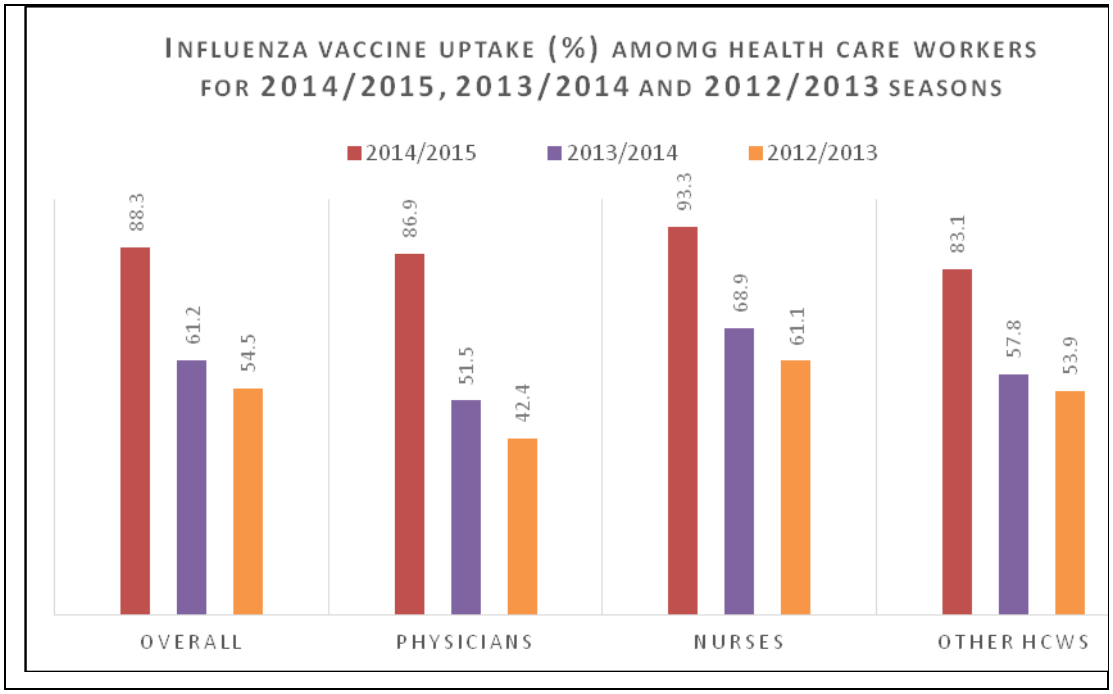

Table 3: Most frequent reasons cited by HCWs for acceptance or declining to receive seasonal influenza vaccine in King Abdulla Medical City, Holy Makkah, 2015.

Reason	**Frequency**	**Percent**
Reasons for Influenza Vaccine Uptake (n= 394)		
- Protect myself	321	81.5
- Protect patients	293	74.4
- Required by my institution	219	55.6
- Prevent cross- infection	180	45.7
- Having children contact at home	127	32.2
Reasons for Influenza Vaccine Avoidance (n=52)		
- The vaccine causes influenza	20	38.5
- Concern about vaccine efficacy	17	32.7
- Trust in/Wish to challenge my natural immunity	11	21.2
- The vaccine was not available	6	11.5
- Not all stains are covered	5	9.6
- Prior experience of severe localize reaction	5	9.6

Table 2. Logistic regression analysis of demographic, professional and institutional factors associated with Compliance with Seasonal Influenza Vaccine Uptake among 447 Health Care Workers, in King Abdulla Medical City, Makka, KSA, 2015.

Variables	Vaccination Compliance#		Univariate OR (95% CI)	Adjusted OR (95% CI)
	NO [n (%)]	YES [n (%)]		
Assignment				
- Physicians	70 (70.7)	29 (29.3)	1	1
- Nurses	99 (51.3)	94 (48.7)	2.29 (1.37-3.84)**	3.54 (1.76-7.12)**
- Other HCWs	96 (61.9)	59 (38.1)	1.48 (0.86-2.55)	2.65 (1.30-5.40)**
Gender				
- Male	133 (60.2)	88 (39.8)	1	
- Female	132 (58.4)	94 (41.6)	1.08 (0.74-1.57)	
Age in years				
- < 40	229 (61.2)	145 (38.8)	1	1
- =>40	36 (49.3)	37 (50.7)	1.62 (0.98-2.69)	2.69 (1.30-5.58)**
Length of practice in years				
- < 5	112 (66.7)	56 (33.3)	1	1
- < 5-9	80 (52.6)	72 (47.4)	1.80 (1.15-2.83)*	1.85 (1.14-3.00)*
- => 10	73 (57.5)	54 (42.5)	1.48 (0.92-2.38)	1.56 (0.86-2.84)
Marital Status				
- Single	108 (63.9)	61 (36.1)	1	
- Married/Others	157 (56.5)	121 (43.5)	1.37 (0.92-2.02)	
Education (highest)				
- Less than Bachelor	20 (74.1)	7 (25.9)	1	
- Bachelor	142 (54.2)	120 (45.8)	2.42 (0.99-5.90)	
- Postgraduate degree	103 (65.2)	55 (34.8)	1.53 (0.61-3.83)	
Have a chronic medical condition				
- No	233 (60.5)	152 (39.5)	1	
- Yes	33 (52.4)	30 (47.6)	1.39 (0.82-2.38)	
Have children under 16 years				
- No	163 (60.8)	105 (39.2)	1	
- Yes	102 (57.0)	77 (43.0)	0.85 (0.58-1.25)	
Intend to receive the vaccine next season				
- No	50 (86.2)	8 (13.8)	1	1
- Yes	213 (55.5)	171 (44.5)	5.02 (2.32-10.87)***	4.45 (2.00-9.91)***
The vaccine is available at my workplace all the time				
- No	89 (63.1)	52 (36.9)	1	
- Yes	172 (57.3)	128 (42.7)	1.27 (0.84-1.93)	
Read/offered MOH circular/guidelines				
- No	170 (68.8)	77 (31.2)	1	1
- Yes	94 (47.2)	105 (52.8)	2.47 (1.67-3.63)***	1.94 (1.29-2.93)**
Feel have sufficient vaccine knowledge				
- No	124 (66.0)	64 (34.0)	1	
- Yes	140 (54.3)	118 (45.7)	1.63 (1.11-2.41)*	
Believe the vaccine is valuable in influenza prevention				
- No	75 (64.1)	42 (35.9)	1	
- Yes	189 (57.8)	138 (42.2)	1.30 (0.84-2.02)	
I recommend the vaccine to the target groups				
- No	56 (65.9)	29 (34.1)	1	
- Yes	209 (57.7)	153 (42.3)	1.41 (0.86-.2.32)	
I recommend the vaccine to my family members				
- No	56 (71.8)	22 (28.2)	1	
- Yes	209 (56.6)	160 (43.4)	1.95 (1.14-.3.33)*	
All HCWs should receive the vaccine (agreement)				
- Uncertain/Not agree/Strongly disagree	51 (69.9)	22 (30.1)	1	

- Strongly agree/Agree	214 (57.2)	160 (42.8)	1.73 (1.01-.2.98)*	
I have concern about the vaccine side effects or efficacy				
- No	119 (59.2)	82 (40.8)	1	
- Yes	146 (59.3)	100 (40.7)	0.99 (0.68-.1.45)	
Knowledge of influenza disease and vaccine Score [out of 32 points] Median (mean ±SD)	16 (15.80±5.98)	16 (16.37±5.66)	1.07 (0.98-1.05)	

Abbreviations: OR= Odds Ratio; CI= Confidence Interval; HCWs= Health Care Workers.

#Received vaccination in the last 3 seasons.

* p<0.05; ** p<0.01; *** p<0.001. (Final Model -2*Log-Likelihood: 534.09; Interactions=5; X2 =55.80, df=7, p<0.001).

Evaluation of Thai Precooked Frozen Meals Presented at Hajj Season 1435 H

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Abstract

Food is preserved against contamination, physical, chemical and biological changes. Freezing is one of the preserving methods that inhibits the growth of microorganisms which cause spoilage and food borne illness. Thai meal Manufacturers used freezing method to preserve cooked meals presented to Thai pilgrims during Hajj season 1435 in Mina camps. The meal is heated in water bath and then served with rice. Food safety follow-up at a rate of three rebounds per meal was conducted: the preparation, cooking, packaging and presentation. Temperature study was done for the meal in its various stages. A random panel test was conducted to evaluate the taste, flavor, texture and overall acceptability of food provided and the degree of meal temperature. The study found that the frozen meal is easy to prepare, safe, clean and less likely to be contaminated. The meal was found to have good acceptance flavor, taste, texture and overall acceptability ranged between 82 and 94% of the total pilgrims who were surveyed. Some of the negative aspects of the meal taste were noticed among them: some components are not in line with the Thai taste,additionally it was difficult to differentiate between recipes due to the small fonts on carton Pack. The study came up with some recommendations that will develop and bridge the gaps that accompanied the experience.

Introduction

Food is preserved to protect it from contamination, physical, chemical and biological changes. Food is physically and chemically unstable; one of the most important methods of its preservation is freezing. The purpose of frozen storage of food is to extend its shelf life and to limit microbial and enzymatic activity which causes food deterioration (Makarios et al., 1993). Freezing is reported to be one of the easiest, quickest, most versatile and most convenient methods of preserving foods. Properly frozen foods maintain more of their original color, flavor and texture and generally have

more of their nutrients than foods preserved by other methods (Robinson, 2013). Manufacturers of Thai meals used freezing to preserve cooked meals presented to Thai pilgrims during Hajj season 1435 in Mina camps. The cooked frozen Thai meals were served to11 thousand pilgrims for 5 days, three meals per day during their stay at Mina. There were 39 different recipes that can be categorized to: Fish and seafood, vegetables, chicken, and meat; packaged in a (5Kg lightweight plastic pouches designed for heating in the microwave). The meal is heated to the boiling point by simply placing the frozen package in clean boiling water, and moisture steams the food inside plastic pouch in one simple step; heating up takes about 45-55 minutes for sea food and chicken, 35- 40 minutes for vegetables. The components of the package are poured into saucepan, distributed to seven dishes and then served with steamed rice in a single use aluminum foil dish. The food safety practice during delivery of raw materials, storage, preparation and packaging, presentation was controlled by focusing on hazardous points namely: personal hygiene, temperature control and cross contamination control. It is important to prevent temperature fluctuations during transportation and storage, and to avoid thawing and re-freezing, to maintain the quality of frozen food (Boonsumrej, et al, 2007). Overall quality and shelf life of frozen food is the composite result of the above concurrently occurring actions the rates of which depend on storage temperature. It is important to test food taker response to food composition, sensory evaluation measures to what extend is the food accepted or needs to be improved. However, the objectives of the current study are:

1- To study the meal temperature throughout the different stages (receiving, storage, cooking, packaging and presentation);

2- Sensory evaluation to determine the Thai pilgrims' acceptance of the meals;

3- To discuss the advantages and disadvantages of the experiment.

Materials and Methods

Thermal test

A food thermometer was used to measure meal temperature according to method described by (USDA, 2011). The thickness of the probe was approximately 1/ 8 of an inch and took about 10 seconds to register the temperature on the digital display. Since the semiconductor is in the tip, thermistors can measure temperature in thin foods, as well as thick foods. Because the center of a food is usually cooler than the outer surface, the tip was placed in the center thickest part of the food and was held until a constant temperature was maintained. The test was performed to meals on delivery and after 3 and 6 hours of receipt and after cooking and packaging and when presented to pilgrims.

Food safety control

A check list for good health and good manufacturing practice was used to follow-up procedures of food safety was done at a rate of three rounds per meal covering the preparation, cooking, packaging and presentation (Plate1). The follow up concentrated in cleanliness, hand washing, wearing of personal protection equipment (PPE) and uniform. The previously listed points focuses on over 100 elements, which have been checked per round.

Questionnaire and Sensory evaluation

A questionnaire was presented to some pilgrims (about 200), who were questioned in order to detect their general acceptance and sensory evaluation of the presented meals, including: if the pilgrim was familiar with the presented meal, general acceptance, taste, flavor, texture and meal temperature. The questionnaire also contained other personal information: age, sex, education, and frequency of coming to Hajj. Observations and recommendations of pilgrims were recorded.

Observations

Negative and positive observations were extracted from pilgrims' observations, food safety officers and camps mangers. The advantages and disadvantages were set according to food safety , negative environmental impact of the meal in form of waste and losses, reliability and acceptance.

Results and discussion

Meal temperature

The temperature test of the meal at the different stages of handling is presented on Table1. Temperature and time are critical points when we deal with food handling and serving from the obtained results the temperature zone of cooked meal was maintained according to (USDA, 2011) which recommended minimally 60°C for hot foods. The average time between packing and serving was ranged between15 and 65 minutes which falls in the time recommended by (USDA, 2011). The temperature of the frozen meal at delivery was found to be between -14 and -17°C, which is less than the recommended temperature for frozen foods; as there were no room or power source in Mina site for keeping 3000 Kg of frozen meal nor refrigerators for melting, the meal was kept at room temperature for 6 hours before reheating.

Table 1: Meal temperature at different stages of handling

Meal	At receipt	After 3hrs	After 6hrs	After cooking	After packing
Rice	-	-	-	94	73
Vegetables	-14	- 11	-6	92	71
Sea food	-17	-11	-5	87	69
Octopus	- 15	-10	-6	91	68
Fish	-16	-9	-4	93	70
Chicken	-15	-10	-5	89	69

Food safety

Throughout the auditing using the check list accredited by the local health authorities of Holy Makkah, only minor errors were detected by the food safety officers, these good results might be due to the good intensive training given to the working staff, and for the close follow up and advices offered by the food safety officers.

Questionnaire and sensory evaluation

All of the respondents were familiar with the presented meals. This finding implies that frozen Thai meal presented kept the original general features of the fresh meals, this fact was stated by (Makarios et al., 1993) who reported that the proper frozen food retains most of its characteristics when cocked or heated. Meal taste evaluation resulted in 39% good, 55% moderate and only 5% of the respondent did not like the meal and rated it as bad (Fig.1), however the overall taste evaluation was acceptable . Regarding the flavor and texture the preferences of pilgrims were close to each other as illustrated in (Fig. 2 and Fig. 3) respectively, only 17% and 15% of the respondents evaluated the texture and flavor as bad, respectively. According to this finding the meal flavor and texture were accepted by over 84% of the Thai pilgrims. For the meal temperature 39% of the pilgrims felt the meal was hot while 55% of them felt it was moderate hot, only 6% felt the meal was cold (Fig. 4). However, the time between packing the meal and delivering it to pilgrim ranged between 15 and 35 minutes, this time falls in the range of the 2hrs of using the food after cooking recommended by (USDA, 2011) and many other food safety institutions like KSA ministry of health.

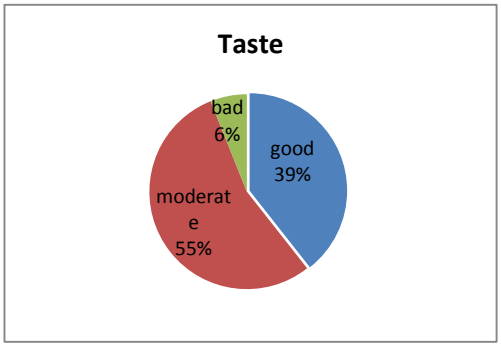
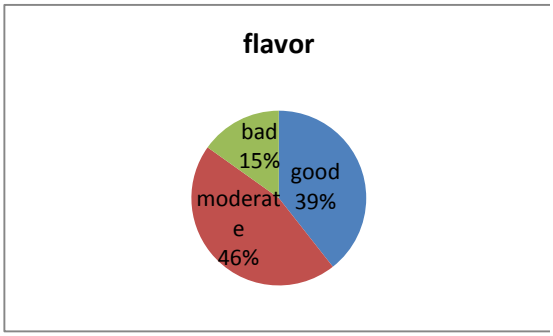


Fig: 1



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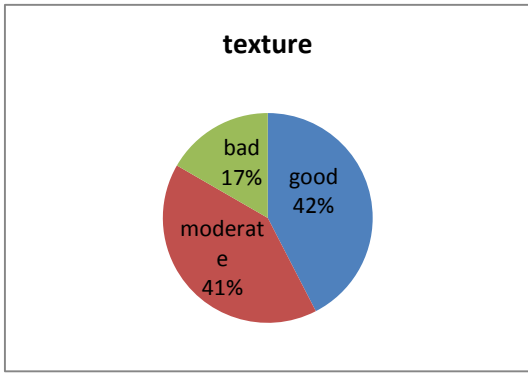

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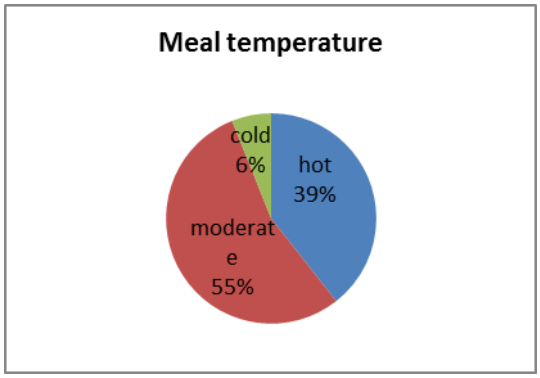

Fig: 4

Plate: 1

Plate: 2

Advantages

1- Ease and speed of preparation.

2- Clean and less likely to be contaminated and cross contamination risks is very low.

3- National food for Thai pilgrims.

4- High nutritional value, seafood is increasingly recognized as a healthy dietary component by consumers worldwide, offering high quality protein, omega-3 fatty acids, essential micronutrients and minerals. (Iwamoto et al., 2010).

5- The excess bags can be refrozen and reused.

6- Two layers of packing bags are excellent protection from damage.

7- There is a diversity of recipes (39) different recipes; three recipes were served per meal.

8- There is no local component added, which reduces the risk of contamination.

9- The refuse is limited to carton and plastic bags only.

10- Chiefs of the three camps under study were of Thai roots

Disadvantages

1- Intensity of the spicy taste of some meals is not belonging to Thai taste; Furthermore sugar was added to some recipes which go with Indonesian taste.

2- The packaging carton is weak as it holds three plastic bags 5Kg each.

3- It was very difficult to differentiate between the carton packs' contents the pack content was written with small font (Plate2).

Conclusions and recommendations

Recent years have seen tremendous advances in food technology, including improvements in industrial process, food safety monitoring techniques and nutritional quality. Among these efforts is food freezing technology which contributed to the welfare of human. It can be concluded that the experiment of serving precooked Thai meals in Mina camps was very successful: ease of preparation, safety monitoring, nutritional value and pilgrims' acceptance were fair enough to recommend the experiment to be applied in the future hajj seasons and to apply the experience in other Asian nationalities.

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Accessed 12/11/2015.

A Survey on Noise Pollution in the City of Makkah

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Abstract

By definition, noise pollution takes place when there is either excessive amount of noise or an unpleasant sound that causes temporary disruption in the natural balance. The main reasons of noise pollution are industrialization, poor urban planning, transportation, and ongoing construction activities. Noise pollution is considered one of the persisting problems faced by the residents as well as visitors of the Holy City of Makkah. In general، the main reasons of elevated level of noise pollution in Makkah Al Mukarramah are its high traffic, population density and the extensive construction projects being undertaken presently. The present paper reviewed previous studies and research papers published on the effect and health implications of noise pollution on the global level in general and in Saudi Arabia in particular. Emphasis was placed on studies carried out on noise pollution in the city of Makkah Al Mukarramah. This research paper studied the occurrence of different types of noise pollution, their causes, and health implications in Makkah Al Mukarramah. The levels of noise pollution determined in Makkah Al Mukarramah were compared with the allowable noise pollution levels stipulated by the international regulatory agencies (45-55 dBA). The results of the present study showed that the noise pollution in Makkah Al Mukarramah region greatly exceeded the local (50-60 dBA) and international allowable pollution levels (70 dBA) and may have significant impact on the health of residents and visitors. The study recommends that further research studies should be undertaken in future in Makkah region to monitor noise pollution on a regular basis. It is also recommended to establish centers for monitoring and follow up the extent of noise pollution in order to find appropriate solutions.

Full text is available in Arabic section under title

مسح عن التلوث الضوضائي في مدينة مكة المكرمة

The Environmental and Economic Value of Waste Recycling in Makkah

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Abstract

Every year, millions of Muslims gather in the Kingdom of Saudi Arabia (KSA) for worship, i.e. Hajj (Pilgrimage) and Umrah. The Makkah city landfills receive about 2.4 thousand tons of municipal solid waste (MSW) every day. While, these quantities become 3.1 and 4.6 thousand tons per day during the Ramadan and Hajj respectively. All of the collected MSW is disposed to landfill sites untreated, which results in greenhouse gas (GHG) emissions as well as water and soil contamination. The government considers reuse and recycling as optimum techniques for waste management following source reduction. However, the current waste recycling has been carried out mostly by informal sectors and only few recyclable materials such as paper, cardboard, metals and plastics are recycled (10-15% of total waste). The waste pickers or waste scavengers take the recyclables from the waste bins, containers and dumpsites. There is an immediate need to develop public-private partnership (PPP) to improve MSW management system in Makkah city including waste reuse and recycling. It is theoretically estimated that only by recycling glass, metals, aluminium and cardboard, climate will be saved from 5.6 thousand tons emission of methane (CH4); a major source of GHG emissions and 140.1 thousand Mt.CO2 eq. of global warming potential (GWP) with carbon credit revenue of worth 67.6 million SAR. Similarly by recycling above-mentioned recyclables, a net revenue of 113 million SAR will be added to the national economy every year only from Makkah city. Moreover, technically, the waste recycling does not require high-skill labour, complex technology and thus can be easily carried out in any urban areas like Makkah city.

Key Words: Waste recycling; Municipal solid waste (MSW); Hajj and Umrah; Makkah city; Greenhouse gas (GHG), Global warming potential (GWP)

Introduction

Every year in Kingdom of Saudi Arabia (KSA), millions of Muslims come to perform religious rituals of Hajj (Pilgrimage) and Umrah. The central places of worship are Al-Haram that consists of Holy Mosques in Makkah and Medina and Al-Masha'ir that includes Mina, Arafat and Muzdalifah areas in Makkah (Nizami et al., 2015a). The number of pilgrims visiting KSA has been significantly increased over the past few decades due to the continuous expansion in the two Holy Mosques in Makkah and Medinah, advancement in transportation, increased security and reduced overall cost and time (El Hanandeh, 2013). The current King Abdullah expansion project of the two Holy Mosques is the largest in history, when completed, will result in an increase in the number of pilgrims to more than 5 million in a year (Arab News, 2015; Rehan et al., 2016).

In KSA, 15.3 million tons of municipal solid waste (MSW) was produced during 2014 (average 1.4 kg/capita/day) that is estimated to double to 30 million tons per year by 2033 due to the current population growth rate of 3.4% per annum (Nizami et al., 2015b, c). The Makkah city produces 2.4 thousand tons of MSW every day. While, these quantities become 3.1 and 4.6 thousand tons per day during the Ramadan (the month of fasting) and Pilgrimage time (Nizami et al., 2016). The highest waste generation occurs during 8-13 Zulhijjah (the month of Pilgrimage) and last ten days of Ramadan (Abdulaziz et al., 2007). More than 23,000 municipality workers and 450 scouts participated only in cleaning operations for the gathering of 2.1 million Muslims in 2014's Pilgrimage (Hazaimeh, 2014). Most of the collected MSW is disposed to landfills, thus resulting in air, water and soil pollution (Ouda et al., 2015; Nizami et al., 2015c).

The KSA government has adapted an integrated municipal solid waste (IMSW) approach in 2014 to optimize the economic and environmental value of waste through reuse and recycling practices (Ouda et al., 2013; Nizami et al., 2015b). The concept of waste recycling is getting significant attention nowadays, as it saves the energy that will otherwise be utilized in raw material's extraction, transportation and manufacturing, and generating huge economic benefits (Morris, 1996; Sadef et al., 2015). Therefore, recycling has become an integral part of modern sustainable waste management system (WMS) of many developed countries (Metin et al., 2003; MfE, 2007).

In KSA, waste recycling is mainly carried out at a limited scale by informal sector (Nizami et al., 2014a, b). The most recyclable materials are paper, metals, cardboard and plastics that collectively present 10-15% waste recycling of total MSW. The waste scavengers or waste pickers take these recyclable materials either directly from source or municipality placed bins/ containers or dumpsites (Abdulaziz et al., 2007). Still, many other recyclable materials such as glass, aluminum cans, steel cans and

plastic bottles that carry high economic and environmental values are not placed in the waste recycling stream. According to Arab News (2012), a loss of 75 billion SAR occurs every year to the economy of Arab countries, especially to KSA with 40 billion SAR due to the absence of recycling schemes and projects.

There is a strong need to develop public-private partnership (PPP) through formal and informal sectors to improve the waste recycling practices in KSA, particularly in Makkah and Medina. This paper aims to evaluate the economic and environmental value of waste recycling in Makkah city with ambition to solve the waste-landfilling problems and generate economic and environmental benefits to the society.

Methodology

The economic and environmental values of waste recycling in Makkah city are calculated based on the fractions of recyclable materials such as glass, metals, aluminium and cardboard (Table 1). The energy-saving concept of Morris (1996) was used for estimating the energy savings from the recycling of these materials into same or other materials. The energy production efficiency through utilizing different resources and process technologies were also considered in the calculation of energy savings. Based on Morris (1996) findings, the energy-saving values of 5517, 64155 and 38600 MJ/ton were assumed for recycling of glass, metals and cardboard respectively. As the aluminium production process is highly energy intensive in comparison to other metal's production processes, therefore, it has been considered separately for energy saving's calculations. The recycling of aluminium into tin or other purposes contain an average energy-saving value of 336499 MJ/ton (Morris, 1996).

The overall recycling scheme of Makkah city can be more economic and environmentally beneficial if integrated in a sustainable way. In order to do that, a material recovery facility (MRF) is recommended and discussed that how it will work and will deal the recyclable materials (Figure 1). Nowadays, the aluminium is extensively used in transport industry, food and medicine, packaging, construction, electronics and electrical power transmission. Recycling of used aluminium products has been a characteristic feature of the global aluminium industry. Therefore, prospects of aluminium recycling in Makkah city is given special attention in the discussion section. Similarly, the use of polyethylene terephthalate (PET) bottles is also increasing in Makkah city. Therefore, the recycling approaches to deal PET bottles with sustainable methods are explained under the discussion section.

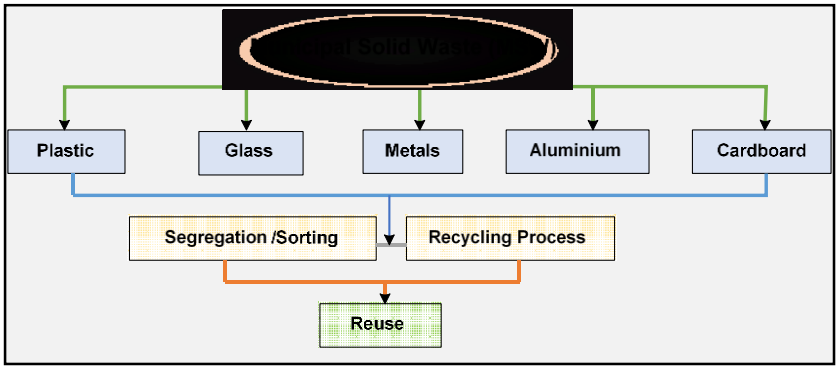

Figure 1. A recommended recycling approach for Makkah city

Table 1. Makkah waste composition* (Nizami et al., 2015a,b,c; Abdulaziz et al., 2007; Nizami et al., 2016)

Waste type	Average waste (%)[a]	Waste quantities per year (thousand tons)
Food	50.6	489.69
Plastic	17.40	168.39
Paper & Cardboard	18.6	180.00
Textile, wood, leather	4.06	39.29
Glass	2.9	28.07
Metal	2.71	26.23
Others	3.73	36.10
Total	100.00	967.76

*,[a], The values of waste quantities are average percentage values of different reported values. The waste composition and their quantities vary significantly at different times of the year in Makkah city; during Hajj, Ramadan, Umrah months and normal days. The values also change with locations such as Mina, Muzdalifah, Arafat, inside Holy Mosque and its surrounding areas.

Results and Discussion

Economic and Environmental Value of Waste Recycling in Makkah

There are significant economic and environmental benefits for the Makkah city by recycling only 12.21% of Makkah MSW, including the recyclable materials such as cardboard (6.6%), glass (2.9%), metals (1.9%) and aluminium (0.81%). It is theoretically estimated that up to 140.1 thousand Mt.CO2 eq. global warming potential (GWP) will be achieved with savings of 5.6 thousand tons emission of CH4 (a major GHG). The value of revenue based on carbon credit and landfill diversion is 12.2 and 67.6 million SAR respectively. A net revenue of 113 million SAR will be added to the national economy every year only from recycling practices in Makkah city (Table 2). Technically, the waste recycling does not require high-skill labor, complex technological and can be carried out in any urban areas like Makkah city. Moreover, the typical capital and operational cost of recycling procedures is very economical with values of $0.38-$0.74 and $3.92-$5.45 respectively in comparison with other waste disposal methods (Table 2).

Table 2. Technical, environmental and economic values of waste recycling (Ouda et al., 2013; Ducharme, 2010; Ouda et al., 2015; Nizami et al., 2016)

Technical Value	
Suitable Waste	Glass, Metal, Aluminium, Cardboard, Plastic
Technology Requirements	Low
Labour Skills	Low level
Geographical location	Urban/Industrial Area
Environmental Value	
CH_4 emission potential (tons)	5,605
GWP (Mt. CO_2 eq.)[a]	140,119
Economic Value	
Capital cost (ton/yr)[b]	$0.38-$0.74
Operational cost (ton/yr)[b]	$3.92-$5.45
Revenue from Carbon Credits (x 10^6 SAR)[c]	12.2
Saving from Landfill diversion (x 10^6 SAR)	67.6
Gross revenue (x 10^6 SAR)[d]	125.1
Net revenue (x 10^6 SAR)	113.6

[a] Based on GWP of 25 for methane (CH_4).

[b] Recycling capital and operational cost based on plant capacity to handle 1000 t/day, considering 10 year life time of the facility and other equipments (Metin et al., 2003).

[c] At a cost of US $ 23.20/tonne of CO_2.

[d] The revenue from recycling materials (glass, metal, aluminium and card board) is calculated by using their resale value from MfE (MfE, 2007).

Development of Material Recovery Facility (MRF) in Makkah

For urban cities like Makkah, MRF holds great importance in managing mixed waste to maximize the recovery of recyclables (plastics, papers, glass, metals) from MSW. Moreover, the MRF helps in processing organic fraction of MSW (OFMSW) into a suitable feedstock for biological conversion processes/technologies such as anaerobic digestion (AD) and composting to generate renewable energy (biogas) and value-added product (organic fertilizer). For an effective and efficient recycling program in Makkah city, MRF should incorporate waste sorting, processing, storage, and load-out phases in their design plan. An MRF can deal with the dirty as well as clean waste. The mixed MSW of Makkah city will be treated at a dirty MRF, otherwise source-separated waste (SSW) will be sent to the clean MRF. As SSW is not practiced in any city of KSA, including the Makkah. Therefore, it is advisable to establish dirty-MRF to enhance recovery of recyclables from the urban waste stream. However, if SSW is implemented and in place in Makkah, will save more energy and economic inputs to segregate and separate the recycled materials from mixed MSW.

Recycling of Aluminium Materials in Makkah

Aluminium is one of the best metals for recycling as it does not degrade during the recycling process and requires significantly less energy to recycle than it does to make primary aluminium. In fact, recycled aluminium requires only 5% of the energy required to make primary aluminium, and has identical properties as the parent metal. The recycling of used aluminium products has been a characteristic feature of the global aluminium industry, especially in Europe and North America. They have developed robust collection systems for aluminium recycling and use in aircraft, automobiles, bicycles, boats, computers, cookware, wire and beverage cans (Zafar, 2015a).

The consumption of aluminium products is growing fast in Makkah city and is the second most widely used metal after iron. Millions of beverage cans are used by pilgrims during the Hajj and Umrah, with majority ending up in landfills. Therefore, the high market value of aluminium will provide an attractive economic incentive if recycled in Makkah city. Moreover, the aluminium will find widespread use in food packaging industry of Makkah. With millions of pilgrims visiting the Makkah city every year, it is not difficult to estimate the amount of aluminium packaging being thrown in garbage

bins. Like cans, aluminium packaging is also a good candidate for recycling. However, it needs to be separated from other packing materials before recycling. Modern waste sorting facilities are usually equipped with eddy current separators to extract aluminium fraction from rest of the packaging materials. Other technologies used for extracting aluminium from complex packaging products are repulping, mechanical separation, pyrolysis and thermal plasma process (Zafar, 2015a; Nizami et al., 2016).

Recycling of Polyethylene Terephthalate (PET) Plastic Bottles in Makkah

Disposal of PET plastic bottles has emerged as a major challenge in Makkah city, where plastics make up a major fraction of the MSW. Hundreds of thousands of plastic water and soft drinks bottles are used every year in Makkah. Recycling of PET plastic bottles, if implemented in Makkah city, will begin with collection and sorting after delivery to an MRF facility. For recycling and manufacturing the same products again, sorting and grinding are not sufficient techniques for PET bottles and containers, as they may contain contaminants/additives that require further processing. These items may include caps, labels, the plastic cups at the bottom of many carbonated beverage bottles (Zafar, 2015b).

Conclusion and Recommendation

The KSA's aluminium and PET bottle industry can be significantly benefited from recycling initiatives in Makkah and Medina and other large urban cities such as Jeddah, Dammam and Riyadh. Both are long-term viable option for KSA, as they will reduce the need for precious raw materials and fossil fuels. Moreover, if the recyclable materials such as cardboard, glass, metals and aluminium are recycled and stopped to going into landfills, it will not only reduce the operational and environmental overburden of waste on land resources, but also generate huge economic revenue with collectively, around 113 million SAR every year. The recycling approach if implemented and practiced in Makkah city for the development of a material recovery facility (MRF), will open-up new channel of research, business and job creation for the local people.

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Electrical Characteristics of Holy Zamzam Water

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Abstract

Holy Zamzam water is the most important water to all Muslims in the world. Total mineral concentration is ideal for human use so it is the standard to all water in the world. Electrical characteristics of Holy Zamzam water are experimentally studied in this work including voltage-current (V-I) characteristics and conductivity of water samples. AC voltage is stressed to various water samples in Electrical Power Laboratory of College of Engineering, AlJouf University, Saudi Arabia. Total amount of minerals in Holy Zamzam Water is higher than those found in drinking water in markets and lower than water samples from Nature-Well in AlQurayyat, Dumat AlJandal Lake and Red Sea water. Also, bottled Holy Zamzam Water in markets has total amounts of minerals less than that found in Holy Zamzam Water taken from Haram Mosque. These results are in agreement with previews works.

Keywords – Holy Zamzam water, conductivity, concentration of total minerals, V-I characteristics.

INTRODUCTION

Holy Zamzam Well is located inside the Holy Mosque in the city of Makkah, which is in the western province of Saudi Arabia. The well is four thousand years old and the story of its formation is well known to Muslims. It is approximately 40 meters deep and surrounded by hills of igneous rocks. Drinking water from Zamzam well has special significance for Muslims (Naeem et al., 1983; El-Zaiat, 2007; Solymar et al., 2004 and Khalid et al., 2014). Millions of Muslims drink this water as sacred water, especially during Pilgrimage and Umrah each year. There are various types of drinking water available in Saudi Arabia: tap water, spring water, bottled and mineral water (Al-Zuhair et al., 2006 and Abu-Samn, 1982). The water from wells in Saudi Arabia is often high in mineral contents (Mohamed et al., 1987 and Alshikh, 2013).

In this work, electrical characteristics, such as *V-I* characteristics and conductivity of water samples of Holy Zamzam water are measured with comparison to other types of water.

EXPERIMENTAL SET-UP AND TECHNIQUE

A. Experimental Set-Up

Experimental model was setup in Electrical Power Laboratory of College of Engineering, AlJouf University, Saudi Arabia to measured *V-I* characteristics and conductivity of different types of water samples. The details of the set-up are described, Figure 1:

- AC variable power supply, 0 : 1-kV, to adjust the applied voltage to the circuit.
- Variable resistance, 0 : 1-kΩ to limit the current flow in circuit.
- Water resistance, PVC tube with 1-m length and inner diameters of 1-in, 1.5-in and 2-in, respectively.
- Ammeter and voltmeter to record current and applied voltage, respectively.

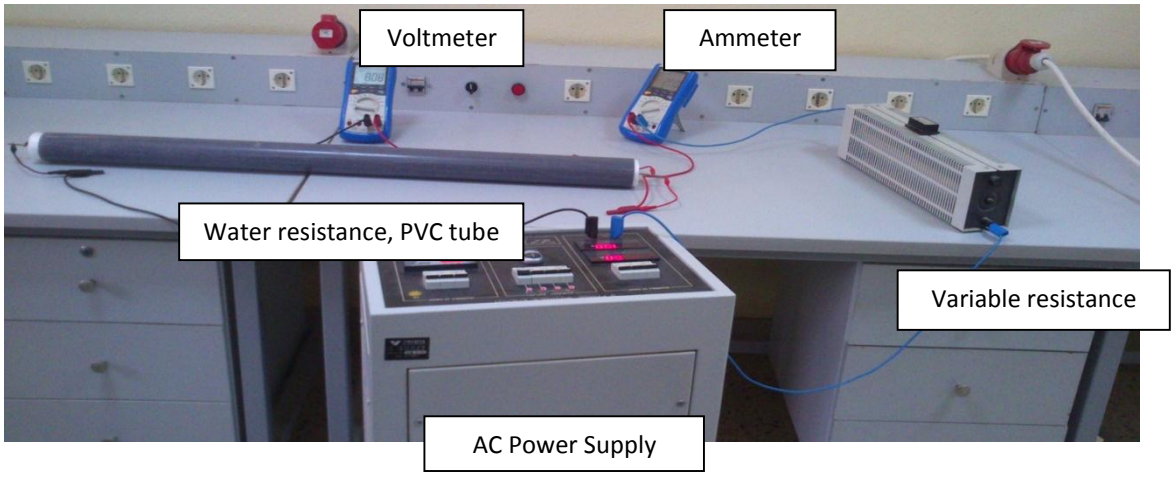


Figure 1.Experimental model in Electrical Power Laboratory (AlJouf University, Saudi Arabia).

B. Experimental technique

As shown in Figure 1, the collected water samples (7-water samples) were put in PVC tubes and closed carefully from both ends. This tubes were stressed by applied

voltage gradually. PVC tube was changed with other diameter and the process was repeated. Meters will record voltage and currents. Variable resistance is used to limiting current in the circuit.

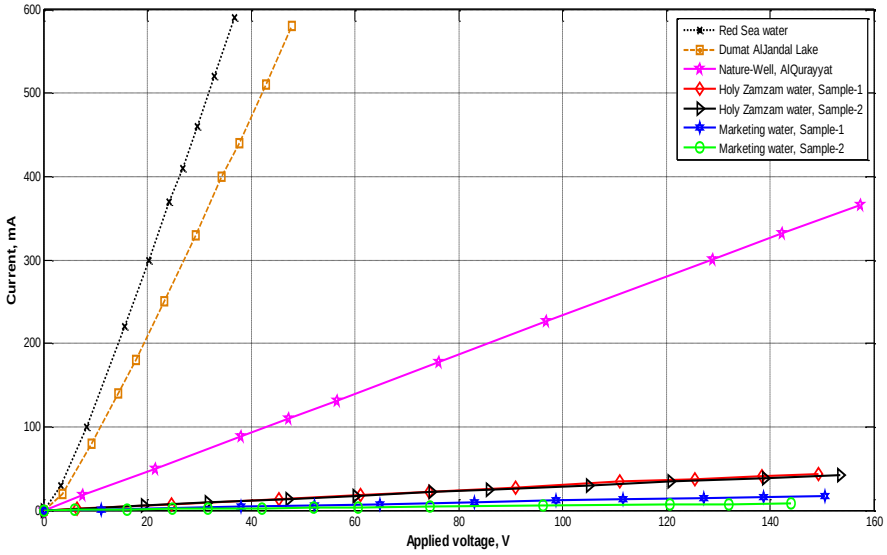
RESULTS AND DISCUSSION

Figures 2, 3 and 4 show *V-I* characteristics of Holy Zamzam water along with other water samples stressed by AC, 2-in, 1.5-in or 1-in diameters. When the same voltage stress is applied to water samples, current will be pass higher through samples of high conductivity.

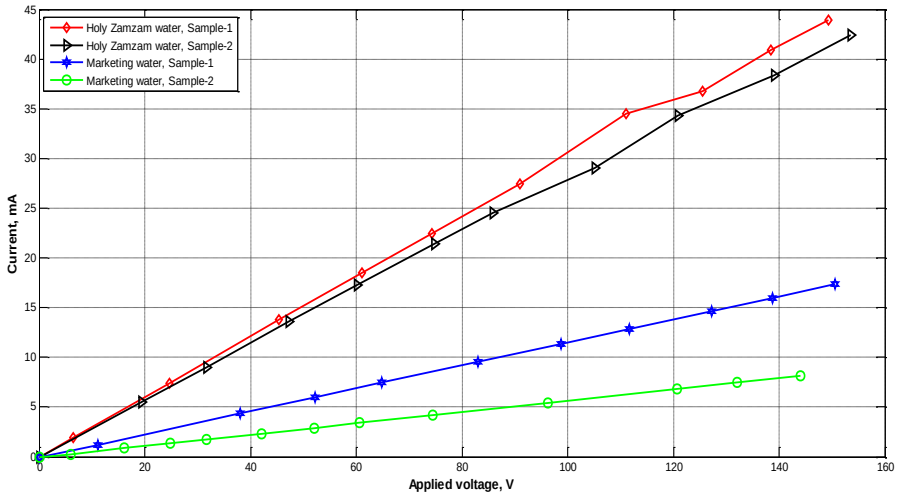
Figure 2-a shows that Holy Zamzam water samples have lower conductivity than Red Sea water, Dumat AlJandal Lake water and Nature-Well water in AlQurayyat, this means, Holy Zamzam water has lower concentration of total minerals than these types of water. Also, Holy Zamzam water samples have higher conductivity than Marketing water samples for drinking, this means that Holy Zamzam water has higher concentration of total minerals than bottles water available in the market.

Figure 2-b shows Holy Zamzam water, sample-1, from Haram Mosque has higher conductivity than that of bottled Holy Zamzam water, sample-2, available in markets. This is due to extra filter operation applied to market bottled Zamzam water, which reduces total mineral concentration.

Figures 3 and 4 show V-I characteristics of water samples stressed by AC, 1.5-in and 1-in diameters, respectively. Conductivity of water samples decreased due to decrease in cross-sectional area of PVC tube.



(a)



(b)

Figure 2. V-I characteristics of Holy Zamzam water with other water samples stressed by AC, 2-in Diameter.

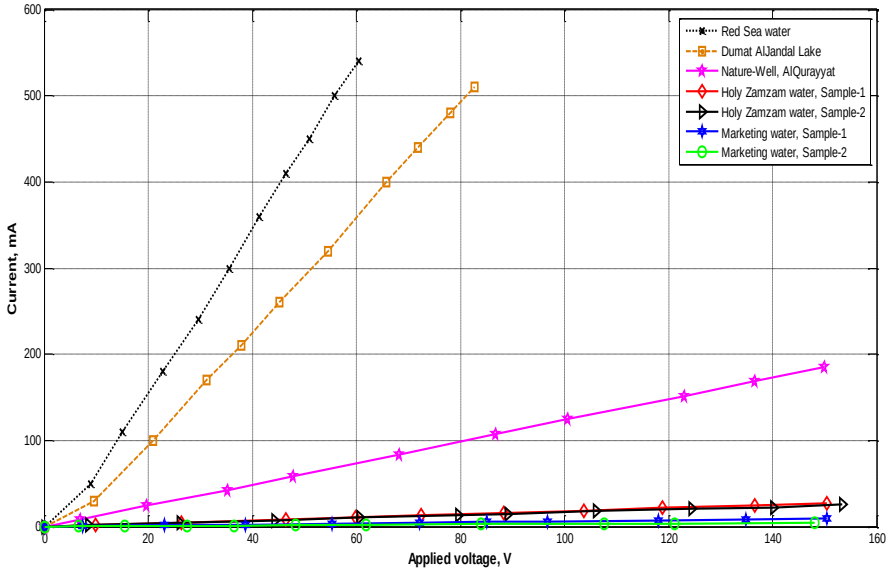


Figure 3. V-I characteristics of Holy Zamzam water with other water samples stressed by AC, 1.5-in Diameter.

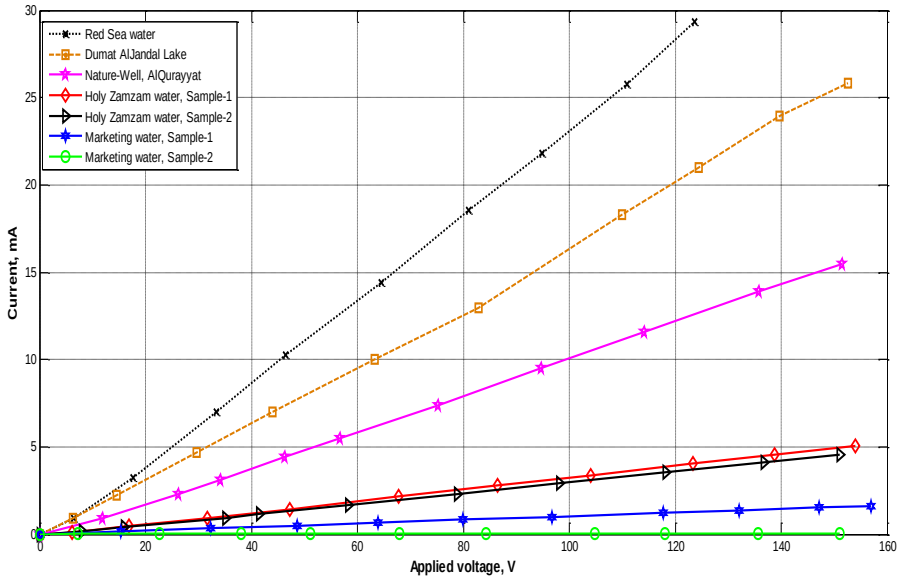


Figure 4. V-I characteristics of Holy Zamzam water with other water samples stressed by AC, 1-in Diameter.

CONCLUSION

Electrical characteristics of Holy Zamzam water were studied experimentally, the results can be concluded as:

- Experimental results show that Holy Zamzam water has conductivity greater than that found in marketing samples and less than salted water which is in agreement with previous works.
- Sample of Holy Zamzam water from Haram Mosque has high conductivity than Holy Zamzam bottled water in markets due to filter process.
- For any other sample of water, if we found its V-I characteristics, if its curve is close to Holy Zamzam water, it means that water is drinkable. Also, if the curve is too far away from Holy Zamzam water curve, this means that water is undrinkable.

ACKNOWLEDGMENT

The authors would like to thank *Prof. Mazen Abdel-Salam* of Assiut University, Egypt for his interest in this research work. The supports of AlJouf University are highly acknowledged.

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Studying the Development of Key Performance Indicators (PIs) for the Saudi Project of Utilization of Hajj Meat in Camels and Cows slaughter house (Moisem 4)

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Abstract

Key Performance Indicators (PIs) have been developed after field study for the most important working committees of the Saudi Project for Utilization of Hajj Meat through successive steps in the slaughterhouse of camels and cows (Moisem 4) that can be applied in the project performance assessment in the same slaughter house and are considered starting point to develop PIs in the other sheep slaughterhouses project. The most important PIs are derived from the responsibilities to the various committees, which can be summarized through total numbers of animals that have been received and examined, and the number of rejected camels and cows compared to the accepted ones. Also PIs has been developed from inventory of smuggled animals compared to non-smuggled into the same barns. The number of carcasses also played an important role as a PI compared to the number of condemned cases, as well as to the total capacity of the refrigerators there. The ratio of carcasses that are handled to the number of sold ones during the same season. PIs have been developed from the ratio between the man-power of personnel to the whole total number of animals in the slaughter. For example, the number of butchers compared the number of animals that have been slaughtered. The ratio of the committees members compared to the size of the work through the numbers of animals or carcasses account. Some selected items developed by the administrative board of project were also used as PIs. The proposed PIs will be applied next year (God willing) on the same slaughterhouse to evaluate the performance of committees and determine the quality of achieved tasks with the performance improvement and proposing recommendations of mechanisms to implement them.

Full text is available in Arabic section under title

دراسة وضع مؤشرات أداء مشروع المملكة العربية السعودية

للإفادة من الهدي والأضاحي بمجزر الجمال والأبقار

Saudi Arabia's Efforts in Protecting pilgrims from sunstroke during Hajj (Pilgrimage) Rituals in the Holy Places

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Abstract

Most of pilgrims coming to the Holy Mosque in Makkah suffer from the big discrepancy in climate compared to their homelands, that makes them more likely to get heatstroke due to the climate changes. This research aims to identify the efforts exerted by the Kingdom of Saudi Arabia for the protection of pilgrims and alleviation of the effects of such suffering. Through a survey study it is proved that there are several physiological factors (e.g., age, gender, chronic diseases), nutritional factors (e.g., lack of fluids intake, eating of extra fatty foods, drinking a lot of stimulants such as coffee and tea), environmental factors (e.g., lack of air conditioning in the place, walking for long distances in the hot weather) and some other unhealthy behaviors (e.g., sitting on the floor, delaying in reporting the heat stroke case, and the difficulty of transporting the heatstroke patient to the nearest health center) that lead to increasing the problem despite the great efforts exerted to avoid it. The study proposes some recommendations that may contribute in decreasing heatstroke cases in the forthcoming years.

Full text is available in Arabic section under title

جهود المملكة العربية السعودية في وقاية الحجاج من أشعة الشمس بالمشاعر

Assessing the Health Standards of Public Toilets in the Holy Sites

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Abstract

During Hajj, millions of Muslim pilgrims gather in the holy sites (Arafat, Muzdalifah and Mina) in Holy Makkah. The management of these gatherings and crowds requires a tremendous effort and great potential by the concerned Saudi authorities, as Saudi Arabia is one of the most prominent countries that manage human crowds and mass gatherings worldwide. It holds the responsibility for providing various essential services and facilities to the pilgrims, such as public toilets and bathrooms. The study aimed to assess the mandatory health standards for public toilets in the holy sites in Makkah (Arafat, Muzdalifah and Mina), in a view to control contamination during Hajj season. Randomly selected 224 toilets were assessed for the availability of essential hygienic items. Also contaminations of doorknobs were assessed for contaminating pathogens by taking surface swabs for bacterial culture. Minimum inhibitory concentration (MIC) of polyhexamethylene guanidine substance against four contaminating pathogens was also evaluated. The results showed that there were no effective hand hygiene procedures and no sufficient soaps and disinfectants in toilets. Additionally, there were no hand-driers and even no instructional hand washing brochures were available. Also there was a lack of ventilation and lighting, especially in Arafat toilets followed by Muzdalifah and Mina. It was found that there were long queues in Muzdalifah toilets followed by Arafat and Mina. The highest contamination was noted in Muzdalifah toilets followed by Arafat and Mina. The results showed that (MIC) values of polyhexamethylene guanidine toward isolates were 0.047% for Gram positive bacteria and E.coli and 0.0934% Pseudomonas aeruginosa. It was concluded that additional efforts are required to improve toilets hygiene and their number in holy sites, such as increasing the number of toilets, providing a means of hand washing together with instructional hand washing signs as well as soap and appropriate disinfectants. Also, Polyhexamethylene guanidine agent is recommended for its efficacy and safety.

Keywords: Toilets, Holy sites, Mina, Muzdalifah, Arafat, health requirements,Hajj.

Full text is available in Arabic section under title

التقييم الصحي لدورات المياه بالمشاعر المقدسة

Effect of the Environment on the efficiency of fabric tents and its lifespan in Mina City

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University faculties in Al-Laith, Umm Al-Qura University

Abstract

Mina is one of the largest city of tents worldwide, where millions of pilgrims live for few days during Hajj. The tents made of glass fiber coated with Teflon are one of the largest projects, which have been established in 1418 H to comfort the pilgrims. The importance of this study is due to the rareness of research in the Tents and because of repeated complaints from (Muttawifs) and pilgrims regarding the distortion of fabric tents. The aim of this research is to measure the effect of environmental conditions on physical and mechanical properties of fabrics tents, and determine its performances and lifespan. In this research, tests of tent fabrics were carried out and statistical analysis was used to evaluate the results of tests. Some results of projects tent fabric during its three stages showed increasing weight per square meter, thickness, elongation in both direction, air permeability and water permeability, but tensile strength for tent fabric decreased. The best samples were achieved in second stages of project. Samples of tent fabric in third stage had lifespan up to ten years depending on aftercare. Tensile strength of fabric is the main property, which affects the lifespan. It confirmed that environmental conditions affected the lifespan of tent fabrics. This study recommends testing the tent fabric in Mina City periodically with schedule using plastic gloves to avoid the negative effect of glass fibers. More research is needed to ensure that Teflon has no negative effect on environment in thermal case. We are in great need for more research to find alternative smart tent fabric suitable for the environment of Mina City.

Full text is available in Arabic section under title

أثر البيئة على كفاءة أقمشة الخيام بمنى وعمرها الاستهلاكي

Characters and Applications of Green Disinfectant During Hajj

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Abstract

Microbial contamination is one of the common problems in high populations and mass gathering such as Hajj and Umraa seasons. So applicable solutions are in need such as finding of new formula of a powerful and effective disinfectants and sanitizers. So that this review article suggested the mixing of two disinfectants, Poly hexamethylene hydrochloride guanidine and French clay, to form a unique, safe and effective new product known as green disinfectant. The new product has the chemical and antiseptic characters of both substances. According to the previous researches; the green disinfectant can be environmental friendly and can be used in various purposes. It is a new formula of disinfectant with a wide scope of applications in food processing plants, logistics, kitchens, swimming pool sanitizers, cosmetics, leather preservatives, fibers and textiles. It can be used also as disinfectant for abattoirs, air conditions, and contact surfaces. Green disinfectant has unique characters; it is free of heavy metal and phenol compounds, and any other harmful, toxic or irritant compounds. This new product highly soluble in water, odorless, non-toxic and has no side effects on public health and hygiene. Finally, this paper suggests that mixing of the two compounds in different concentrations, then to be evaluated for its effectiveness to be applied as general disinfectant during seasons of hajj and Umraa.

Key words:PHMG, French clay, Disinfectant, Antiseptic, Hajj and Umraa

Introduction

It has been proven that Poly hexamethylene biguanide hydrochloride (PHMG) is a powerful bactericide. In recent years the resistance of microorganisms has increased (Ouahiba et al., 2010). To reduce food poisoning with the resulting epidemic diseases, the development and use of new bioactive molecules that can act more effectively on new resistant microorganism generations is essential (Ouahiba et al., 2010). PHMG is a cationic biocide marketed worldwide, due to its excellent antimicrobial activity, chemical stability, low toxicity and reasonable cost (Gustavo et al., 2011; Vitt et al., 2015). Effectiveness against cellular organisms is due to the very basic biguanide

group attached to a flexible spacer, a hexamethylene group. Maximal biocidal efficiency is obtained when six methylene groups are used as spacer between biguanide groups. It was concluded that PHMG was the most widely used antiseptic when prolonged use is needed and/or when prolonged contact is feasible (Kaehn, 2010). PHMG binds to the negatively charged phosphate head groups of phospholipids at bacteria cell wall, causing increased rigidity, sinking non-polar segments into hydrophobic domains, disrupting the membrane with subsequent cytoplasmic shedding culminating in cell death. PHMG can be found in swimming pool sanitizers, cosmetics, leather preservatives, contact lens disinfectants, cleanser in agriculture and food handling, in treatment of hatching eggs, fibers and textiles and technical fluids like cutting oils and glues (Kaehn, 2010).

PHMG disinfectant known to be a biocide, odorless, non-corrosive, non-irrigative and nontoxic to humans and animals, fast at low concentrations and with a broad spectrum of action (Oulé et al., 2008). It was demonstrated that PHMG is an effective sporicidal disinfectant with great potential for use in hospitals, laboratories, food industries and households (Oulé et al., 2012). It was found that PHMG killed MRSA (methicillin-resistant Staphylococcus aureus) and E. coli at concentrations as low as 0.04 and 0.005 % (w/v), respectively, within 1.5 min (Oulé et al., 2008; 2012). PHMGH has been proved to be bactericidal and fungicidal. Hence, it could probably serve as a fungicidal disinfectant for the treatment of cocoa beans after harvesting (Mathurin et al., 2012).

PHMG showed bactericidal advantages over chlorhexidine digluconate against ESKAPE pathogens Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumanii, Pseudomonas aeruginosa, and Enterobacter species). Some study support the further development of covalently bound PHMG in sterile-surface materials and the incorporation of PHMG in novel disinfectant formulas (Zhou et al., 2015).

French clay is a natural bioorganic material and contains a compounds of valuable elements with several important include calcium, silicium, several important mineral oxides, magnesium, potassium, dolomite, silicium, manganese, phosporous, copper, and selenium. Green Illite and Montmorillonite clays are the best known of the clays for overall well being. Their main properties are the following: absorbent, adsorbent, purifying, and calming. French Green Clay is a potent remedy with highly absorbent properties (Dextreit et al., 1987). French green clay belongs to a subcategory of clay minerals known as illite clays, the other two major groups being kaolinite and smectite clays. Illite clays are usually formed by weathering or by changes produced in aluminum-rich minerals by heat and acidic ground water.

Chemical and physical specification

Its chemical name is Poly hexamethylene biguanide hydrochloride (PHMG); IUPAC Name is Homo-polymer of N-(3-Aminopropyl)-Imidodi-carbonimidi-cdiamide. Its empirical formula is (C8H17N5)n.nHCl (where n=1-40). It has off-white to pale yellow powder as physical form with strong ammonia smell at 20° C and 101.3 kPa and/or very pale yellow to pale yellow, lumpy solid; no obvious odor, and/or Pale-yellow glass-like solid (technical grade PHMG) (ANSES, 2013). The molecular weight of PHMG is higher than 700 g/mol (submission), 2670 – 2960 (weight average molecular weight), and 3686 – 4216 (weight average molecular weight). It contain impurities/accompanying contaminants such as: water content (3 – 5 %) and trace metal contents (in ppm, w/w) in PHMG (Cd (< 0.25), Cr (< 0.25– 0.7), Co (< 0.25), Fe (14 – 40), Pb (< 2), Zn (370 – 540), As (< 2), and Hg (< 0.2)) (Oule´ et al., 2012; SCCS, 2015).

The French clay was not sensitizing. Its chemical formula was given as (KH3O)(AlMgFe)2(SiAl)4O10[(OH)2(H2O)], but there is considerable ion substitution. It occurs as aggregates of small monoclinic grey to white crystals (Pough, 1988). Due to the small size, positive identification usually requires x-ray diffraction analysis. Illite occurs as an alteration product of muscovite and feldspar in weathering and hydrothermal environments. The cation exchange capacity (CEC) of illite is smaller than that of smectite but higher than that of kaolinite typically around 20 – 30 meq/100 g. Illite is highly absorbent clay (30% - it absorbs 30% of water) and has a relatively low re-mineralization power (12%). Cationic (ionic) exchange rate, alongside their sorptive properties, is one of the most important factors of clays. In fact, each type of clay exchanges mineral elements with the environment they are in and has a certain coefficient of absorption which varies from one clay to another (Elmore, 2003).

Synthesis and mechanism

PHMB can be synthesized by different routes, but usually is obtained by poly condensation of sodium dicyanamide and hexamethylenediamine in two steps Roth and Brill, 2010).

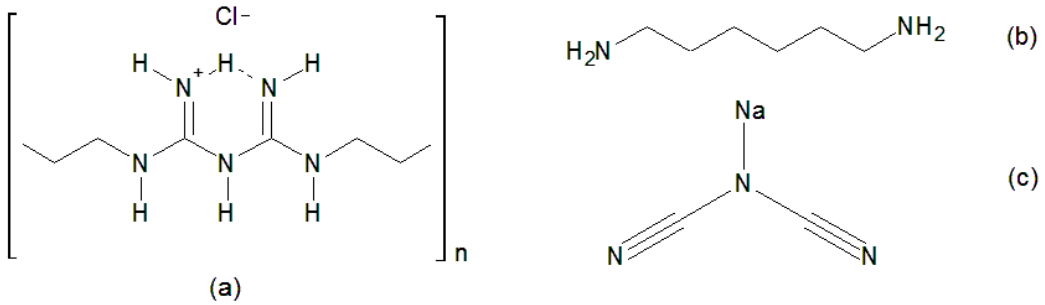
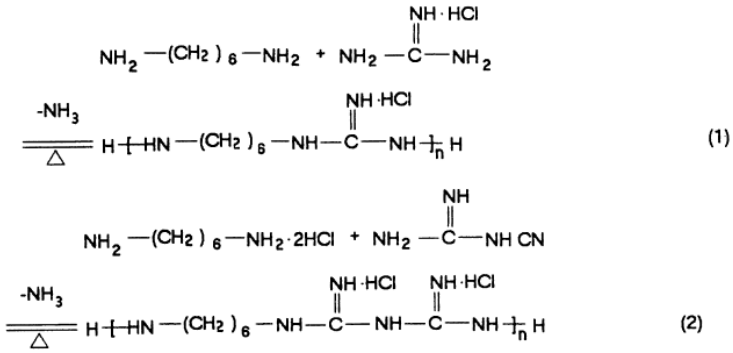


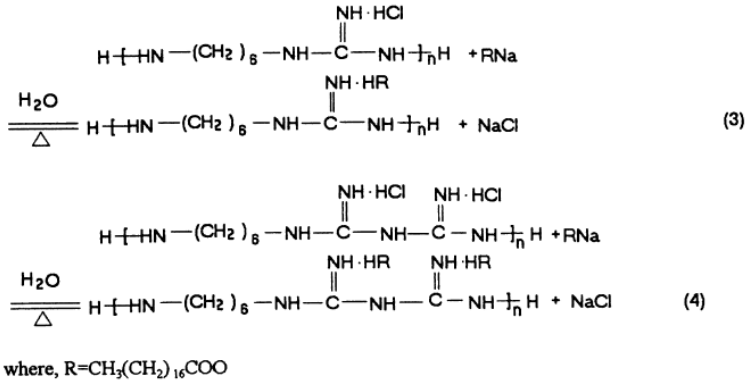
Figure . Schematic structure of mono-protonated PHMB with chloride as counter-ion (a) and monomers: Hexamethylenediamine (b) and sodium dicyanamide (c).

In addition, PHMB can be synthesized by mixing equimolar amounts of hexamethylenediamine and guanidine hydrochloride in a round-bottomed three-necked flask, which is equipped with a mechanical stirrer and vacuum system. The mixture reacted at 100 °C for 60 min, and then at 170 °C for a certain time. During the reaction, by-product ammonia is neutralized by bubbling through aqueous HCl. Thereafter the reaction continued on the condition of removing ammonia by vacuum system. At the end of reaction, the slightly yellow, viscous liquid solidifies upon cooling giving PHMG samples (Wei et al., 2009).



Scheme 1. Scheme of the polycondensation.

Finally, PHMB can be synthesized by cooligomerize equimolar amounts of guanidine hydrochloride and 1,6- hexamethylenediamine for 2h at 1208 ºC until liberation of NH_3 was completed, and then polymerized at 1608 ºC for 4, 5, 6 and 8h to prepare poly hexamethylene guanidine hydrochloride in the form of viscous mass which solidified after cooling. Equamolar amounts of dicyandiamide and hexamethylene diamine hydrochloride were poly condensated at 1808 ºC for 6, 8, 10 and 12h in the melt of monomers and poly hexamethylene biguanidine hydrochloride was obtained (Zhang et al., 1999).



Scheme 2. Scheme of the precipitation reaction.

Mode of action

The mode of action of PHMG antimicrobial biocide was elucidated by transmission electron microscopy: the cell envelope was broken, resulting in cell content leakage into the medium (Oulé et al., 2008; Zhou et al., 2010). It was shown that PHMG derivatives strongly affected dehydrogenases activity in *S. aureus* than in *E. coli* (Walezak et al., 2014). Polymer C4, C6, and C8 displayed gradually increased biocidal activity with the increased alkyl chain length of the repeat unit of the polymer, and Polymer C8 had higher activity than Polymer C8 (benzene). The novel Polymer C8 also exhibited higher biocidal activity than Polymer C6 (PHMG) against Gram-negative and Gram-positive clinical strains and reference bacteria for disinfectant.

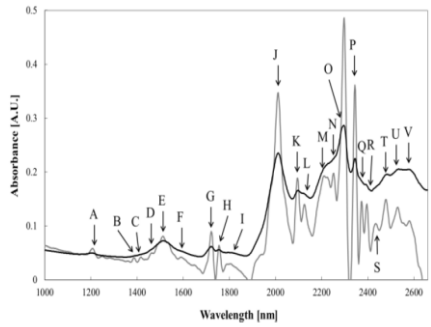
Infrared absorption spectrum of PHMG was obtained by near-infrared spectroscopy (NIR). The most important are those located at 2,000–2,400 nm range, corresponding to nitrogen-related vibrations, including combination bands due to nitrogen-carbon bonds in the biguanide pseudo-aromatic ring (Table). Remaining bonds are due to methylene groups and residual hydration water. Bands associated to chlorine ion are not present, but the —bonded behavior of some vibrations may be due to chloride interference on –N–H vibrations (Workman and Weyer, 2008; Gustavo et al., 2011).

French green clay has anti-inflammatory as well as antiseptic or bactericidal properties. It is interesting that a group of Italian researchers reported in 2002 that French green clay powder is as effective as salicylic sugar powder in preventing infection of the umbilical stump in newborns. The clay powder was found to be superior to powders containing colloidal silver, antibiotics, or fuchsine (Elmore, 2003). It is claimed that French green clay absorbs toxins from the stomach and intestines as well as neutralizing radioactivity in the body (Katsumata et al., 2003).

The absorbent power of this clay is extraordinary. Clay has the power to attract and either absorb or stimulate the evacuation of toxic and non-useful elements. Its absorbent power has contributed to the elimination of the chemical taste of chloride in Paris water. Clay considerably reduces the toxicity of harmful substances.

Table 4. Peak assignment for near-infrared spectrum of pure PHMB [20].

Peak	Wavelength (nm)	Bond (Vibration)	Remarks
A	1,206	C–H (3ν)	Methylene
B	1,388	SiOH	Quartz subtrate
C	1,416	C–H	Methylene combinations
D	1,436	N–H (2ν)/C–H	Primary amine/methylene combination
E	1,464	N–H (2ν)	Secondary amine
F	1,590	O–H (2ν)	Water, bonded
G	1,722	C–H (2ν)	Methylene
H	1,756	C–H ($2\nu_s$)	Methylene
I	1,804	O–H	Combination from water, bonded
J	2,012	N–H/C–N	Combination from $-[N(H)]_2-C=N-$
K	2,096	O–H (3δ)	Water
L	2,126	N–H/C=N	Combination from $-[N(H)]_2-C=N-$
M	2,210	N–H/C–N/C=N	Combination from $-[N(H)]_2-C=N-$
N	2,252	N–H	Bonded, from amides
O	2,298	N–H	Bonded, from amides
P	2,344	C–H (2ν) & C–H (δ)	Combination, from methylene
Q	2,372	C–H ($2\nu_s$) & C–H (δ) & C–C (ν)	Combination, from methylene
R	2,396	C–H (ν)/C–C (ν)/C–H (δ)/C–C (δ)	Aromatic biguanide ring
S	2,434	C–H (ν)/C–C (ν)/C–H (δ)/C–C (δ)	Aromatic biguanide ring
T	2,478	C–H (3δ)	Aromatic biguanide ring
U	2,530	C–N ($2\nu_a$)	C–N–C from biguanide
V	2,580	C–H (ν)/C–H (ω)/C–C (ω)	Aromatic biguanide ring



Safety

It is a new generation of disinfectant with a wide scope of applications in agriculture and food processing plants, logistics, kitchens and so on. Its ability to give long-lasting protection puts it in the top position as a unique disinfectant in providing long-lasting, total bio safety to the user. PHMG is free of heavy metal and phenol compounds, and any other harmful, toxic or irritant compounds. Because of these features, PHMB is an environmentally friendly product. PHMG has outstanding bactericide, fungicide and virucide properties (Roth and Brill, 2010). Its performance and extremely low toxicity make it the best option in Bio-safety for chicken houses, livestock farming, feed stocks, slaughterhouses, food and feed storage facilities, transport vehicles, food processing units, kitchens and so on, in addition it can work at low concentrations very fast with a broad spectrum of action because of its relatively safe status, its wide acceptance and its exploitation for potential multi-purpose functional use (Oulé et al., 2008). Several studies have been done in Côte d'Ivoire on Papaya regarding viral diseases (Diallo et al., 2007), maturation of the fruit (Yao et al., 2011). For wound dressings, Wright et al., 2003 compared the effectiveness of a silver dressing to a dry gauze dressing

containing PHMG (Kerlix AMD). Results demonstrated reduction in bioburden with both dressings when tested in an in-vitro bactericidal assay. Using a Kirby-Bauer zone of inhibition study, the gauze was not as effective. This was believed to be due to a tight bond between the dressing and PHMG, which was not released and therefore did not result in killing beyond the edge of the dressing (Wright et la., 2003). It was suggested that the PHMG in the gauze resulted in a decrease in the number of organisms present in the wound (Motta et al., 2004). Also, improve the preservation of fruit and vegetables such as papaya (Koffi-Nevry et al., 2011). PHMG behaves as a low-foaming surfactant, with a critical micellar concentration near 5×10^{-2} mol dm^{-3} in water at 293 K. It is easily processable to films, but water balance is crucial to mechanical stability since water is a plasticizer: High water contents led to sticky, mechanically unstable films; completely anhydrous film is very brittle and hygroscopic (De Paula et al., 2011).

French clay hasn't particular risk. It was stable and inert product with none hazardous decomposition, no carcinogenic, mutagenic, teratogenic, neurotoxic effects. Where it doesn't decompose itself. Also, it hasn't irritating skin. It hasn't other precaution for the protection of the environment. The clay will remove any bacterial infection and impurities from the site through absorption (Pezzati et al., 2002).

Recent research indicates that French Green clays have an ability to bind mycotoxins in the digestive system of animals as well as several bacteria in-vitro. "In experiments, the clay killed up to 99 per cent of superbug colonies within 24 hours. Control samples of MRSA (methicillin-resistant *Staphylococcus aureus*) grew 45-fold in the same period. The clay has a similar effect on other deadly bacteria tested, including *Salmonella*, *E. coli*, and a flesh-eating disease called buruli, a relative of leprosy which disfigures children across central and western Africa. It has been classed as "an emerging public health threat" by the World Health Organization (WHO)." The effectiveness of the French green clays, which are mostly made of minerals called smectite and illite.

Conclusion and Recomendations

Both PHMG and French clay have a powerful bactericidal activity. This review article suggested a new noval formula with different concentrations of substances, PHMG and French clay. The new product expect to be one of the most effective disinfectant that can be applied in the food processing plants in Makkah Al-Mukaramah and Madina Al-Monaurah especially during hajj and Omrah seasons.

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Emissions of Greenhouses Gases and Total Suspended Particulates (TSP) from Slaughter House During Hajj Season in Makkah, KSA

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Abstract

Air quality in a slaughterhouse in Makkah, KSA was investigated over four consecutive Pilgrimage (Hajj) seasons (2012 through 2015). For simplicity, average of the three years' data was presented in the present manuscript. Methane and CO2 were the most dominant pollutants inside slaughterhouse, while TSP, CO2 and O3 were the most dominant pollutants outdoor. Methane emissions were higher indoor (2975 mg CH4 m-3) than outdoor (1678 mg CH4 m-3). The ratio of methane indoor to outdoor was almost 1.8. On the other hand, O3 and TSP concentrations were higher outdoor (74 ppb and 1054 µg m-3, respectively) than indoor (52.4 and 789.9 µg m-3, respectively). Air quality inside and outside slaughterhouse is characterized by high concentrations of PM, N2O and Methane, which are above the permissible levels set by WHO.

Introduction

Impact of continual discharge of untreated slaughterhouse wastewater on water quality and soils was investigated thoroughly (e.g. Benka-Coker &Ojior, 1995, Al-Fattly, 2013). This is due to the fact that during the operations of the slaughterhouse the waste generated is of liquid and solid nature. However, air quality in and around slaughterhouses is yet to be studied.

Slaughterhouses are important source of ammonia (NH3), nitrous oxides (N2O), methane (CH4), and carbon dioxide (CO2) to the atmosphere (Barton et al., 2013). Methane (CH4) is many times more potent than CO2, which is responsible for nearly as much climate change as all other non-CO2 greenhouse gases put together (Hansen & Sato, 2001; Climate Change–Methane–Sources & Emissions, 2010). Gaseous nitrogen compounds (NOx, N2O, and NH3) are known to cause severe

environmental problems. Ammonia can lead to soil acidification and eutrophication of aquatic systems, NOx promotes ozone formation in the troposphere, and N2O is a greenhouse gas and contributes to stratospheric ozone depletion, greenhouse gas and contributes around 18% of the greenhouse effect (Climate Change–Basic Information, 2010).

Globally, efforts are being made to control greenhouse gas (GHG) emission from various sources; waste sector is one of them (Air Pollution Prevention and Control Act, 2006)

Millions of Muslims from all over the world visit the Kingdom of Saudi Arabia to perform Pilgrimage to Makkah (Hajj) every year and stay in Mina, an area adjacent to the Holy city of Makkah. One of their religious obligations during Hajj is to perform sacrifice by slaughtering an animal. In line with its policy to continuously improve the facilities for Hajjis (pilgrims), the Government of Saudi Arabia has constructed a new modern slaughterhouse on the periphery of Mina. This is by far the largest sheep slaughterhouse in the whole world with a capacity to slaughter in excess of 500,000 sheep in three days, during the period of the Hajj.

Slaughterhouses may cause air and water pollution apart from causing nuisance to the residents of locality. In contrast to slaughterhouses in the region which are quite old (Slaughterhouse polluting the environment, 2012), Saudi ones are relatively new and updated yearly. They have adequate basic amenities (proper flooring, ventilation, water supply, lair age, etc.). They are relatively hygienic.

The arid climate of Saudi Arabia enhances the process of degeneration of any tissue material remaining as a waste in the premises of the slaughterhouses. Therefore, the slaughterhouse premises always give a particular stink. In order to avoid this stinking odour, proper ventilation of slaughtering halls, washing of the floors with non-poisonous disinfectants and if needed the use of aerobic deodorants must be practised at each slaughterhouse. However, microbial contamination, impact on air quality and impact on public health of the slaughterhouses is yet to be investigated.

In this study, the animal-excretal inputs and slaughtering applications will be quantified.

The practical implications of these emissions will be described in relation to climate change, and strategies for reducing these emissions will be highlighted.

The aim of the present study was to evaluate air quality and aerobiology during Haj season at slaughterhouses around Makkah.

Materials and Methods

Location and description

There are three main slaughterhouses located near Makkah (21°25'21"N 39°54'35"E) (Fig.1). The slaughterhouse used in this study spreads over a site of 1 km long and $^1/_2$ km wide and has a 110/13.8 kV electrical power substation located on the North end.

In the present study, we have selected the most recent established one (Municipality Slaughterhouse at Al Kakiyah) (Table 1). Saudi Arabia has opened what it says is the world's biggest slaughterhouse, in preparation for the Muslim sacrifice of hundreds of thousands of cattle and sheep at the climax of the pilgrimage or Hajj to Mecca (The Muaissem slaughterhouse, with a size of 500000 m2).

Table 1. Slaughterhouses in the Holy City of Makkah

Slaughterhouse	**Total area**	**Year of Establishment**	**Objective**
Municipality Slaughterhouse **(**Kakiyah near old vegetables & fruits market**)**	Approx. 50.000 m^2	2009	Provides edible slaughtered meat to butcher shops and meat markets in the Holy City of Makkah
Automatic Makkah Slaughterhouse	Approx. 6.000 m^2	1996	Provides services to citizens, residents and Makkah visitors
Al-Aseelah Slaughterhouse	Approx. 152.000 m^2	1997	Provides services to citizens, residents and Makkah visitors

Figure 1. Location of the slaughterhouse

Air and Microbial sampling

Air quality was monitored with a fully integrated air quality monitoring station “AQM 65”. It continuously measures common gaseous air pollutants, particulate matter, noise and meteorological parameters such as rainfall, temperature, humidity, pressure, wind speed and direction.

Bacteria were collected on Agar Media (Anderson, 1989).

Results and Discussion

Results presented in this paper are from Al- Kakiyah slaughterhouse and are the average of three years.

Methane and CO2 were the most dominant pollutants inside slaughterhouse, while TSP, CO2 and O3 were the most dominant pollutants outdoor.

Methane emissions were higher indoor (2975 mg CH4 m-3) than outdoor (1678 mg CH4 m-3).The ratio of methane indoor to outdoor was almost 1.8.

On the other hand, O3 and TSP concentrations were higher outdoor (74 ppb and 1054 µg m-3, respectively) than indoor (52.4 and 789.9 µg m-3 respectively) (Table 1).

There was no significant (P ≥0.05) difference in CO2 and N2O concentration indoor and outdoor, although their concentrations were slightly higher inside the slaughterhouse.

Table 2. Concentrations of major pollutants in the study area

Pollutant	**Indoor**	**Outdoor**	**I/O**
Methane (mg CH_4 m^{-3})	2975	1678	1.77
N_2O (mg N m^{-3})	0.784	0.699	1.12
CO_2 (ppm)	401	389	1.03
O_3 (ppb)	52.4	73.6	0.71
TSP (µg m^{-3})	789.9	1054	0.75

In addition to methane, CO2 is also a significant product of the anaerobic microbial decomposition of organic matter. Collectively, the mixture of these two gases is commonly known as biogas. Typically, biogas also contains trace amounts of hydrogen sulfide, ammonia, and water vapor. The energy content of biogas depends on the relative volumetric fractions of methane and CO2 .

Gaseous emissions of N are much higher from grazing animals than from housed animals. However, N2O emissions are believed to be high, and can be 20 times higher than from European systems (Klimont 2001). However, this may result in higher NH3 volatilization losses (Velthof et al. 1996). Several techniques, such as incorporation, deep and shallow injection, slit injection, slurry dilution, trailing shoe, band spreading, and sprinkling are available to reduce the amount of NH3 volatilization (Klimont 2001).

Table 2 Microbial concentrations (colony m3) inside and outside slaughterhouse (n= 30 + 1 SE)

Microbes	**Indoor**	**Outdoor**
Actinomycetes	245.7 + 12.7	128.6 ± 16.6
Bacteria	5672 ± 465.9	3656 ± 178.9
Fungi		
- Aspergilus	287.9 ± 28.6	367.8 ± 42.7
- Penicilium	311.5 ± 26.7	432.8 ± 52.7
- Yeast	211.9 ± 19.7	2.7 ± 31.2

Table 2 showed that microbial contamination is higher indoor than outdoor. Actinomycetes were 245 and 129 colony/m3 inside and outside slaughterhouse, respectively, (189% higher indoor), while bacteria showed 155% increase indoor rather than outdoor.

The three types of fungi (Aspergilus, Penicilium and Yeast) which were investigated followed the same pattern.

Such high concentrations inside slaughterhouse indicates poor aeration and poor hygiene (ACGIH, 1999; Ensign, 2007). Moreover, high humidity inside slaughterhouses exacerbate the problem.

Slaughterhouses in KSA emit higher amount of methane as compared to their western counterparts due to larger size and productivity. There is need for the further refinement of emission factor by extensive and well-calibrated experimentation by including all potential livestock source categories. There is also a need to study manure management systems practiced in different parts of India for their methane and nitrous oxide generation potential. As the livestock contributes to the national economy, food security and social needs of the nation, the main emphasis should be on technological options for reducing rumen fermentation and increase the efficiency and utility of livestock by improving fodder quality.

In conclusion air quality inside and outside slaughterhouse is characterized by high concentrations of PM, N2O and Methane, which are above the permissible levels set by WHO (WHO, 2008).

CONCLUSIONS

Based on the work carried out for the central slaughterhouse in Makkah, the following aspects can be mentioned as general conclusions:

- The impression exists that housekeeping could be improved, in particular with respect to reduction of the flow of blood at the slaughter points, cleaning of the stables and manure treatment.
- The water usage must be improved.
- There is a need of installation of a sludge treatment system.
- Ventilation should be improved

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Environmental and Economical Vision of Treatment of Wastes by Plasma Gasification in Makkah

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Abstract

This paper describes an environmental and economic assessment of plasma gasification, development of a plasma-chemical reactor equipped with plasma torches for the innovative and environmentally friendly gasification and verification of waste streams with a view to their sustainable energetic and chemical valorization in Kingdom Saudi Arabia (K.S.A), especially in the pilgrimage season in Makkah. This is a major challenge due to the amount of wastes, which was estimated about 750 thousand tons in 1435 H, and is growing at a rate of 3-5 percent annually. According to statistics, the value of waste in Saudi Arabia ranges from 36 billion to 40 billion riyals. Data on waste quantity was made available by the local holy Makkah municipality, general administration of cleanliness, and quality management and performance evaluation for all months, especially for zulhijjah and Ramadhan months from 1414H to 1436H. The target of Plasma Gasification project for the treatment of (MSW) in Makkah is only two months of the year (Ramadhan (9) and Zul Hijjah(12)). Through this study, it was possible to get the produced gas efficiency of waste-to-gas gasification process through the analyzes of plasma energy recovery using plasma gasification of solid waste with a comprehensive vision and environmental costs account for processor plasma gasification of solid waste as well as the calculation of the expected profits. The electrical energy consumed was estimated, where electric power generation system of the process of gasification processor estimated 5,000 kW; 2000 kW for Consumable system, and 3000 kW sold out. Taking into account the fact that the number of workers up to 14 individual working 24 hours on two shifts for 330 days per year for the processor with a capacity of 100 tons of solid waste per day and for the amount of sales of electricity 23.8 million kilowatts estimated per hour per year as the unit cost of electricity sales 84 Halalas Saudi per kWh. The estimated profit from the sale of electricity was 19.62 million Saudi Riyal per year as well as the estimated profits of solid waste treatment 30 million SR per year and gross profit per ton of solid waste annually 1200 Saudi Riyal per ton. Total income of 39.6 million riyals per year.

Full text is available in Arabic section under title

رؤية اقتصاديه وبيئية لاستخدام البلازما في معالجة النفايات في مكة

Generation Rate of Solid Waste and its classification on Housing of Visitors- Madinh, 1436H

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Abstract

Annually, Medina receives about 9 million visitors in addition to its population of (1.34 million people) which is expected to be increased to 15 million visitors in 20 years. Accordingly, it is expected to generate large amounts of household solid waste (especially during Ramadan and Hajj seasons), which amounted to nearly half a million tons in 1436 AH. Thus, the need for proper solid waste management system in Medina appeared which requires a continuous development and research for new methods for waste: collection, transport, storage and waste treatment in environmentally safe methods. This study aims to determine the rate of waste generation per visitor per day in visitors' hotels in Medina, according to their nationality and the Tawafa establishments, as well as the waste components and its average percentages which is a first step to identify and develop solid waste management system in Medina and to find the best alternatives for this system.

Field work was conducted during seasons of Ramadan and Hajj 1436H to estimate the rate of solid waste generation per visitor per day according to the nationalities of visitors in visitor's hotels in Madinah (especially Central Region). The study included nine different nationalities and fourteen nationalities distributed all over the Tawafa establishments during Ramadan and Hajj seasons 1436H respectively.

On Ramadan season 1436H, the Saudi visitors produced the highest amount of waste per visitor (1.94 kg/visitor/day while the visitors from non-Arabic African pilgrims Tawafa establishment produced the lowest amount of waste per capita (0.61 kg/visitor/day). While during the Hajj season 1436H, the highest rate of generated waste was for visitors from Tawafa establishment of Turkey and the Muslims of Europe (2.53 kg/visitor/day), while the lowest rate was found for Saudi visitors and visitors from Gulf Cooperation Council (0.84 kg/visitor/day). It was observed that, the amount of waste generated by visitors from the same nationality is different, as this depends on many factors such as food catering method but the results here give a general indication. Based on the above, it is clear that the number of waste containers that should be provided to the same number of visitors from different nationalities might be double. This study concluded that the largest component of the generated waste

is organic waste (food residue) which represented 59% and 39% of the total waste generated during Ramadan and Hajj seasons 1436H, respectively. While the second largest component is plastic by 26% for the season of Ramadan and 32% for the Hajj season 1436H.

Thus, it is recommended to study visitors' catering services in Medina hotels to investigate the reasons for the high percentage of organic waste and ways of reducing it. Also, it is recommended to examining how to take advantage of the plastic and the possibility of recycling plastic and sorting it at the source of generation. Finally, the study recommends to determine the number of containers required to store the generated waste in visitors' hotels based on what quantity of waste each visitor produce per day as well as providing sensors linked to a control Room to warn officials if a container is full.

Keywords: solid waste, generation rate, housing visitors, Foundation, containers.

Full text is available in Arabic section under title

معدل تولد النفايات وتصنيفها بإسكان الزائرين بالمدينة المنورة

1436 هـ

Rainstorms and its Economic Losses for the City of Makkah: A Case Study of the 11/9/2015 Event

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Abstract

This paper describes an environmental and economic assessment of plasma gasification, development of a plasma-chemical reactor equipped with plasma torches for the innovative and environmentally friendly gasification and verification of waste streams with a view to their sustainable energetic and chemical valorization in Kingdom Saudi Arabia (K.S.A), especially in the pilgrimage season in Makkah. This is a major challenge due to the amount of wastes, which was estimated about 750 thousand tons in 1435 H, and is growing at a rate of 3-5 percent annually. According to statistics, the value of waste in Saudi Arabia ranges from 36 billion to 40 billion riyals. Data on waste quantity was made available by the local holy Makkah municipality, general administration of cleanliness, and quality management and performance evaluation for all months, especially for zulhijjah and Ramadhan months from 1414H to 1436H. The target of Plasma Gasification project for the treatment of (MSW) in Makkah is only two months of the year (Ramadhan (9) and Zul Hijjah(12)). Through this study, it was possible to get the produced gas efficiency of waste-to-gas gasification process through the analyzes of plasma energy recovery using plasma gasification of solid waste with a comprehensive vision and environmental costs account for processor plasma gasification of solid waste as well as the calculation of the expected profits. The electrical energy consumed was estimated, where electric power generation system of the process of gasification processor estimated 5,000 kW; 2000 kW for Consumable system, and 3000 kW sold out. Taking into account the fact that the number of workers up to 14 individual working 24 hours on two shifts for 330 days per year for the processor with a capacity of 100 tons of solid waste per day and for the amount of sales of electricity 23.8 million kilowatts estimated per hour per year as the unit cost of electricity sales 84 Halalas Saudi per kWh. The estimated profit from the sale of electricity was 19.62 million Saudi Riyal per year as well as the estimated profits of solid waste treatment 30 million SR per year and gross profit per ton of solid waste annually 1200 Saudi Riyal per ton. Total income of 39.6 million riyals per year.

Full text is available in Arabic section under title

العواصف المطيرة وخسائرها الاقتصادية على مدينة مكة المكرمة: دراسة حالة ليوم 2015/9/11م

Care of Diabetic Pilgrims

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Abstract

Hajj “pilgrimage” is the fifth pillar of Islam. It is one of the largest mass gatherings in the world. During the Hajj event, which takes place in the month of Zulhijjah (12th month of Islamic Calendar), more than 2.5 million people gather from 180 countries in the Holy City of Makkah, Kingdom of Saudi Arabia (KSA). Moreover, a large proportion of pilgrims are elderly and from south Asian origin with a high prevalence of diabetes. Hajj is an arduous and physically challenging event. During Hajj the pilgrims have to change their normal routine as they need to travel through places where the geography, weather, diet and habits are different. therefore, diabetics, who depend on a stable routine would predictably be significantly affected. One observational study reported a diabetes prevalence of 31% amongst pilgrims, admitted to a tertiary hospital in Makkah during the Hajj season. This may also reflect higher morbidity in diabetic pilgrims. Therefore, health improvement measures for pilgrims with diabetes would go a long way in reducing mortality and morbidity during the Hajj. This article discusses various risk factors, their effects on diabetes and their managements.

Introduction

Hajj (pilgrimage) is the annual religious event taking place in Makkah, Saudi Arabia.It is one of the largest human gatherings in the world; when more than 2.5 million Muslims gather from >183 countries each year[1]. Hajj is considered the hardest among the other Islamic rituals. A significant number of pilgrims are elderly and may suffer from chronic medical conditions such as diabetes mellitus, which may be exacerbated during Hajj[2]. The Hajj in 2005 hosted around 170,000 people with diabetes with a reported prevalence of 21% amongst travelers from France[3]. Also, pilgrims from the UK are of south Asian descent, with a diabetes prevalence of 14%[4]. Moreover, an observational study reported a diabetes mellitus prevalence of 31% amongst pilgrims admitted to a tertiary hospital in Makkah during the Hajj season[5]. During Hajj, a lot of changes in the person’s life (e.g. geography, weather, diet and physical activities), would significantly affect medical conditions, such as diabetes mellitus which depend on a stable routine[6]. Diabetes has been reported as a leading cause of morbidity and

mortality during Hajj[7]. Thus people with diabetes should have enough time to consider a management plan for their disease.

Objectives

Pilgrims travelling to Makkah include people with chronic diseases particularly diabetes face multiple challenges in the form of acute complications, which could be avoided by adopting appropriate measures. This article evaluated the risk factors faced by diabetic pilgrims and suggested a proper management plan and health education.

Specific clinical diabetic problems during Hajj

People with diabetes mellitus are at a greater risk of illness, as a result of the condition itself, but also due to the altered daily routine and increased physical exertion that may affect diabetes control. There is an Increase in physical activity during Hajj which may precipitate patients for the acute complications[2]. Many diabetic pilgrims are admitted to hospitals suffering from diabetic complications, cardiovascular diseases, renal disease, retinopathy or diabetic foot, which may impact their abilities to perform physical activity during the Hajj trip[8]. Intercurrent illness, particularly respiratory infection, lack of adequate supply of medications or monitoring instruments and limited access to specialist medical care facilities may precipitate hyperglycemic crisis such as diabetic ketoacidosis or non ketotic hyperglycemic hyperosmolar state[1]. The dangers of hypoglycemia could be fatal while treating diabetic ketoacidosis during Hajj with an insulin drip instead of an infusion pump. Some diabetics suffer from hypoglycemic episodes with no apparent cause[9]. In addition, the loss of normal routine of balanced diet to match a strenuous exercise may result in hypoglycemia especially at times of prayer[10]. Diabetic patients are more likely to become dehydrated, develop heat –related illness such as heat exhaustion and heat stroke, but may also develop problems of advanced diabetic complications such as renal disease particularly in diabetic nephropathy[11].

Many diabetic patients will have asymptomatic coronary artery disease, such as co-morbidities coupled with age and the physical strain associated with the performance of Hajj offer a valid explanation for the recent emergence of cardiovascular diseases as the most important cause of death during Hajj[12].

Diabetic foot was one of the most common causes for admission to a surgical ward over two consecutive years' study[13]. People with diabetes are more likely to get foot infections, blisters and ulcers due to diabetic neuropathy as a result of walking barefoot for long distance. Diabetic patients with peripheral vascular disease are at particularly increased risk often compounded by the problems of poor healing and the increased risk of infections[14]. Skin infections [both fungal and bacterial] are recognized

complications of diabetes particularly in patients with poorly controlled diabetes and poor hygiene[15].

Management of people with diabetes intending to perform Hajj

Having diabetes should not stop people from performing Hajj but keeping well during Hajj is a real challenge for patients with diabetes. Thus, pre-hajj screening and intervention during and after returning from hajj has shown to reduce overall mortality and hospitalization rates.

Pre-hajj caring:

People with diabetes mellitus planning to perform pilgrimage (Hajj), should be aware of the possible effects of heat, physical exertion, crowds, and altered routine on their health. They should discuss with their health professionals their fitness for performing hajj and construct a management plan that should focus on optimizing diabetes control, and surveillance and management of complications including foot disease, peripheral neuropathy, peripheral vascular disease, retinopathy and nephropathy, and co-morbid conditions such as hypertension, hyperlipidemia and ischemic heart disease. Additionally diabetic pilgrims should specifically learn about symptoms and signs of hypoglycemia and how they should be treated and to keep their blood glucose level on the hyperglycemic side for the period of Hajj. Also, diabetic pilgrims should be advised to secure enough of their medication, needles, pens, and monitoring instruments[16] (glucometer, test strips and urine ketone sticks to evaluate for ketoacidosis). Emergency kit may be required that include easily accessible carbohydrate sources to counter hypoglycemia and bring the necessary medication in proper containers (preferably with a temperature monitor) for carrying injectables such as insulin, glucagon and glucagon-like peptide-1 receptor agonists with written record, giving the generic names in case further supplies are needed. All the diabetic pilgrims should be advised to wear comfortable protective shoes with daily inspection of feet hygiene. Proper education should encourage the diabetic pilgrims to improve their physical fitness before setting off on the Hajj[17], due to the positive role of exercise and physical activities in improving both morbidity and mortality in diabetic patients and those with cardiovascular diseases[18]. It is important to raise the immunization coverage of meningococcal and pneumococcal and haemophilus influenza vaccine to acceptable level to prevent outbreaks[19]. Patients should be provided with identifying medical wristbands and medical card that documents the medical history, allergies and medications and a letter detailing the need to carry needles and syringes in their hand luggage. Finally a post-hajj appointment should be arranged.

During hajj

People with diabetes should declare their condition to their Hajj representative and travelling companions and inform them on how to recognize and assist them in case they suffer from hypoglycemia. They should obtain a map of all health-care centers and Saudi Arabian Ministry of Health online Hajj portal, to encourage them to find out the nearest one in case of emergency. To avoid dehydration and hypovolemia, the pilgrims should avoid staying in the sun unnecessarily and should use an umbrella or should stay in the shaded areas as much as possible[20]. In addition, pilgrims particularly diabetics with nephropathy should be encouraged to drink plenty of sugar-free, caffeine-free drinks and water (at least two liters of water), depending on the weather. In case of diarrhea or vomiting the patient must be presented to a health facility where dehydration can be treated promptly, thus avoiding any deterioration of renal function. They must not be prescribed medication as these might affect renal function adversely[21]. To avoid food poisoning all pilgrims should eat only with their fellow pilgrims (in your own Hajj group) and be advised to drink bottled water. Pilgrims should protect themselves from Inter-current illnesses particularly respiratory infections that influence blood glucose level by keeping good personal hygiene and using facial masks especially in crowded areas to reduce the chance of infection. All pilgrims should regularly monitor their blood glucose as recommended by their doctors with appropriate adjustment, should eat regular meals and take mid-morning snacks to avoid hypoglycemia. If there are any signs or symptoms of hypoglycemia, patients should stop diabetic medication and take glucose tablets or gel, sugared drinks and glucagon injections. Sick patients with diarrhea can substitute solid foods with carbohydrate containing fluids and should never stop insulin or oral anti-diabetic medicines even if they can not tolerate solid food.

Diabetic patients should wear comfortable shoes with good ankle support when permissible and avoid walking long distance barefoot or using opened shoes at all times. When walking in the Mosque, it is permissible to wear leather socks, which will offer some protection. If they develop feet problems they should seek medical advice immediately to prevent worsening of the problems and they should use moisturizers regularly to avoid feet dryness especially after wudu. The diabetic hypertensive patients should also be advised to either self-monitor or go to the country health mission and check their blood pressure regularly and adjust the antihypertensive dose accordingly. Moreover, they should be advised not to share their personal items with others, and to avoid contact with infected person and maintain a good personal hygiene[22].

After hajj:

Post-hajj consultation should assess the general condition with focus on either pre-existing or new complications particularly diabetic foot. Also, this appointment should focus on medication changes compared to pre-hajj plan.

Conclusions

Hajj is considered a real challenge for patients with diabetes mellitus, for their doctors and attendants (or companions). However, keeping pilgrims in a healthy shape during hajj is one of the main tasks of health professionals, which will assist them in; evaluating the pre-hajj plans, hajj management and intervention and improve health education.

Finally, Saudi government represented by the Ministry of Hajj in collaboration with the Ministry of Health make great efforts in maintaining the health of the pilgrims and the reduction of the spread of epidemics. This is achieved through yearly updated requirements and recommendations according to the international epidemiology situation.

The following requirements and recommendations issued by Saudi government for pilgrims intending to perform Hajj 2015 (1436H) is an example of these efforts:

- Required vaccines “according to the country” must be met before issuing entry visa for Hajj or Umrah
- The Saudi Ministry of Health recommends that elderly people, pregnant women, children those suffering from chronic diseases (e.g. heart diseases, kidney diseases, respiratory diseases and diabetes), and persons with immune deficiency (congenital and acquired) and tumors to postpone the performance of Hajj and Umrah for their own safety.
- The ministry also advises all pilgrims to comply with health guidelines to curb the spread of respiratory diseases.
- The implementation of wide-scale health education programs in pilgrims’ countries and at the Hajj sites. The programs deal with health precautions to be taken, particularly in case of sun strokes and contagious diseases. Prevention methods are also highlighted.
- To mitigate the risk of heat exposure during this journey, the government provides complimentary water distributed from refrigerated trucks, more air conditioned sites (tents at Mina), and optional performance of rituals at non peak hours (not mid-day) is encouraged

- The hospitals and health centers in and around the holy sites are adequately staffed and equipped for the large gathering. The medical facilities offer high quality of care, and services are offered free to pilgrims.

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Conversion of Plastic Waste into Energy and Value-Added Products in Makkah City

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Abstract

Millions of Muslims from all over the world visit the Holy Cities of Saudi Arabia: Makkah and Madinah every year to perform Hajj and Umrah. The rapid growth in urbanisation and local population of Makkah city along with ever increasing number of visitors result in huge municipal solid waste (MSW) generation every year. Most of this waste is currently dumped into landfill sites without any treatment, thus causing environmental and health issues. For example, on average around 2.4 thousand tons of waste is dumped into Makkah city's landfill sites every day that increases to around 3.1 and 4.6 thousand tons per day during Ramadan and Hajj periods, respectively. Around 23% on average of this waste is plastic waste in the form of plastic bottles, water cups, food plates and shopping bags (Abdul Aziz et al. 2007). A pilot scale catalytic pyrolysis process has been used to convert plastic waste into liquid fuel at Center of Excellence in Environmental Studies (CEES) of King Abdulaziz University, Jeddah. The produced liquid fuel has been found to have high energy value of around 40 MJ/Kg, viscosity of 0.9 mm2/s, density of 0.92 g/cm3, flash point of 30°C, pour point of -18°C and freezing point of -64°C, characteristics similar to conventional diesel. Thus the produced liquid fuel has the potential to be used in several energy related applications such as electricity generation, transportation fuel and heating purposes. It has been estimated that the plastic waste in Makkah city in 2016 could produce around 87.91 MW of electricity with net revenue of 297.52 million SAR. This is projected to increase up to around 172.80 MW of electricity and a total net revenue of 584.83 million SAR by 2040.

Keywords: Pyrolysis technology; Plastic Waste; Liquid Fuel; Makkah; Hajj (Pilgrimage); Umrah; Greenhouse Gas (GHG); Sustainable Environmental Solution (SES)

Introduction

Makkah city has one of the world's largest mosque (Masjid-ul-Haram) and is the centre and holiest place for billions of Muslims all over the globe. Every year, millions of people from all over the world visit Makkah to perform Hajj (Pilgrimage) and Umrah. The number of visitors are increasing with an annual rate of 1.19% from 1993-2014 due to a vast expansion in the Masjid-ul-Haram, increased facilities such as advancement in accommodations, health services, transportation, food and security services Apart from increasing visitors, the local Makkah population is also increasing at a significant rate of 3.15% due to rapid urbanization (Nizami et al. 2015a).

In Makkah city, around 2.4 thousand tons of MSW was produced during the normal days in 2014, which increased to 3.1 and 4.6 thousand tons per day during the Ramadan and Hajj seasons respectively (Nizami et al. 2015a; Nizami et al. 2014b). The plastic waste is the second largest waste stream (around 23%) and consist of plastic bottles, water cups, food plates and shopping bags etc. (Nizami et al. 2015a). Most of this waste is currently dumped into landfill sites without any treatment. The plastic waste causes disposal and environmental challenges over landfills due to its clogging effects, very slow biodegradation and presence of toxic additives etc. (CDSI, 2011; Ouda and Cekirge, 2014).

The Saudi government is improving its services and waste management practices with time. Recently the government initiated the practices of reducing, recycling and reusing concepts to limit the MSW generation (Ouda et al., 2013). However, the rapid rate of waste generation in a limited time and space like during Hajj and Ramadan seasons requires special procedures to be implemented close to the waste sources in Makkah city (Nizami et al., 2015b). Moreover, the selected techniques for the treatment of such huge waste must also be economic and environment friendly (Nizami et al. 2014a; Nizami et al., 2015c; Nizami et al. 2016; Sadaf et al. 2015). Pyrolysis technology has the potential to treat the second largest waste stream of plastic in Makkah city into liquid fuel and other valuable products (Ouda et al., 2015; Rehan et al. 2016).

This paper is the first of its kind to propose a sustainable solution for treating the huge plastic waste produced in Makkah city, especially during Hajj and Umrah seasons. A technical, environmental and economic analysis of converting all the plastic wastes into liquid fuel and other valuable products using pyrolysis technology is given. Furthermore, the energy contents of liquid fuel and potential of generating electricity from this renewable source has been calculated for next 25 years up to 2040.

Methodology

Pyrolysis process is a thermal process in which different types of plastic can be converted into liquid fuel and other valuable products at high temperatures in a closed reactor with no oxygen. A small pilot scale (20 L reactor capacity) pyrolysis process has been set-up at the Center of Excellence in Environmental Studies (CEES) at King Abdulaziz University (Figure 1). Basically the plastic waste is cut into small pieces and heated up in the reactor at temperature range of 400-600°C. The plastic is melted and then vaporised into organic vapours that move from reactor into catalytic chamber and then through condenser unit, in which they are liquefied using a chiller unit. The detailed design and specification of this process can be found in previous work (Miandad et al. 2016).

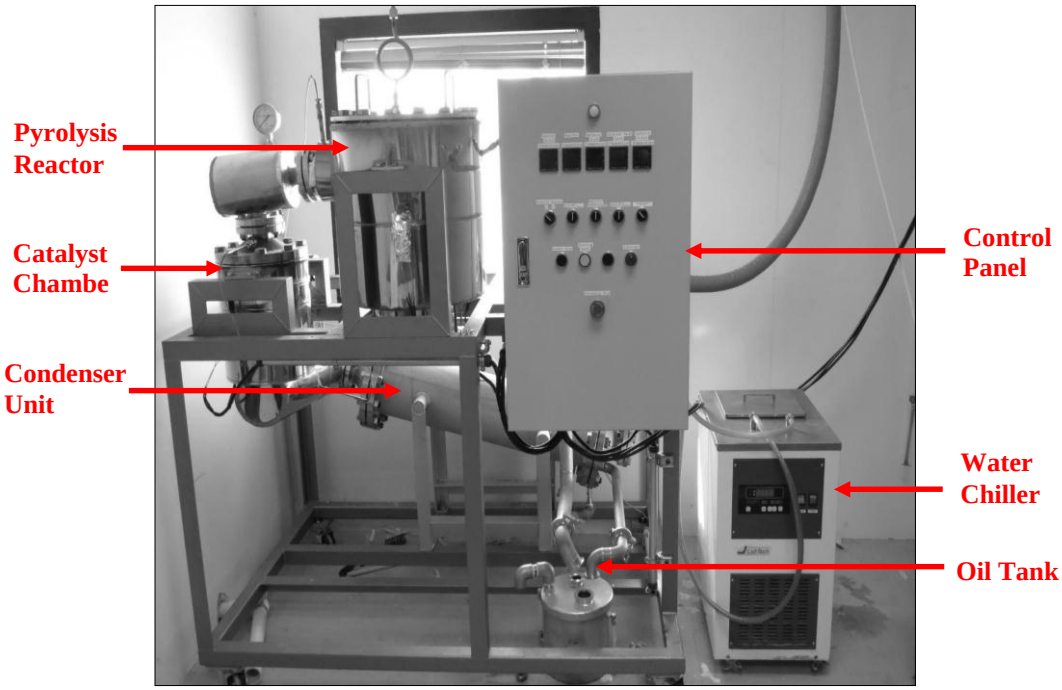

Figure 1: Pilot scale batch catalytic pyrolysis process at CEES (Miandad et al. 2016)

Different types of plastic waste such as polyethylene (PE) (both high density and low density polyethylene), polyethylene terephthalate (PET), and polystyrene (PS) have been treated and converted into liquid fuel, char and gases. The plastic products include plastic plates, glasses, bottles, shopping bags etc. The plastic waste was collected from different sources including household, canteens, hotels and Jeddah landfill sites. Each plastic type was studied separately as well as a mixture with other plastic types to study their effect on the yield and quality of produced liquid fuel and other by-products.

The quality of the produced liquid fuel has been further assessed by its energy contents, viscosity, density, pour point, freezing point etc. As per the focus of this paper, the energy contents in terms of high heating values (HHV) of the liquid fuel produced from different plastic types and different process conditions have been extensively studied using a state-of-the-art automatic bomb calorimeter from Koehler.

Results and Discussion

Plastic waste generation rates in Makkah city

The waste produced in Makkah city is significantly increasing every year due to increase in local population and the number of pilgrim visitors every year. The annual increase in the rate of Makkah population (3.15%) and in the number of pilgrims (1.19%) together with total MSW waste produced in 2014 was taken from previous published work (Nizami et al. 2015a). The total MSW estimated to be produced in 2016 is around 1.414 million tons; of which 0.937 million tons by 1.833 million local people, 0.123 million tons by 2.155 million Hajj pilgrims and 0.123 during Ramadan. The waste calculations were based on 1.4 kg/person/day for 365 days by local population, 1.9 kg/person/day for 30 days by Hajj pilgrims and 2/3 of waste during hajj for 30 days by locals and visitors in Ramadan (Nizami et al. 2015a). The MSW was then annually projected from the year 2016 up to 2040 to reach 2.244 million tons. The plastic waste stream accounts for about 23% which makes 0.263 and 0.516 million tons of plastic waste in 2016 and 2040 respectively.

The King Abdullah expansion project of Masjid-ul-Haram is expected to be completed by 2020, which will significantly increase the capacity for worshipers, resulting in increased number of visitors. However, due to the lack of accurate data for new capacity and expected increase in visitors, currently the annual increase rate is taken as normal 1.19% based on published data (Nizami et al. 2015a). Nevertheless, the actual figures will ultimately result in more waste and thus further increasing the potential of the current proposed solution for waste treatment by producing more electricity and economic benefits.

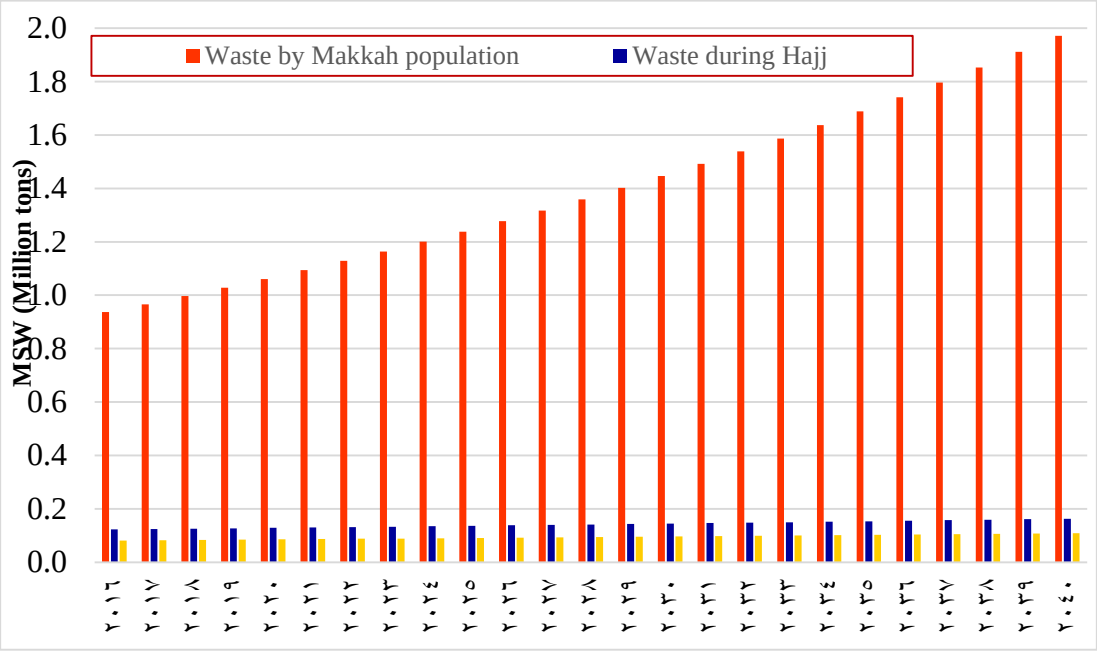

Figure 2: Perojection of total MSW generation by Makkah population, during Hajj and Umrah seasons from 2016-2040

Production of liquid fuel from plastic waste

Different types of plastic waste has been successfully treated in pyrolysis process and converted into liquid fuel and char. Although a range of process conditions such as temperature, retention time, feed stock type and composition and so on have been studied in detail and the results are published earlier (Miandad et al. 2016). The optimum pyrolysis process conditions have resulted in an average liquid fuel yield of around 80%. This means the total plastic waste of 0.263 million tons has the potential to produce 0.210 million tons of oil in 2016. The amount of liquid fuel will increase every year due to increase in plastic waste and will reach up to 0.412 million tons from the 0.516 million tons of plastic waste in 2040.

The produced liquid fuel has been found to have high energy value of around 40 MJ/Kg, viscosity of 0.9 mm2/s, density of 0.92g/cm3, flash point of 30°C, pour point of -18°C and freezing point of -64°C, characteristics similar to conventional liquid fuel (Miandad et al. 2016). This fuel thus has the potential to be used in a number of energy related applications such as electricity generation, transportation fuel and heating purpose.

Electricity generation from pyrolytic liquid fuel

The high HHV of 40 MJ/Kg of liquid fuel produced from plastic waste using pyrolysis process has a great potential to be used for electricity generation. So for, 0.8 Kg of liquid fuel has around 32 MJ or 8.89 KWh (since 3.6 MJ are equivalent to 1 KWh) of

energy potential. Thus the total amount of 0.263 million tons of liquid fuel has energy potential of 2334000 MWh of energy potential. This means it is possible to generate around 87.91 MW of continuous power supply with standard 33% electricity generating plant. This power capacity will again increase every year and will reach up to 172.80 MW in 2040 (Figure 3).

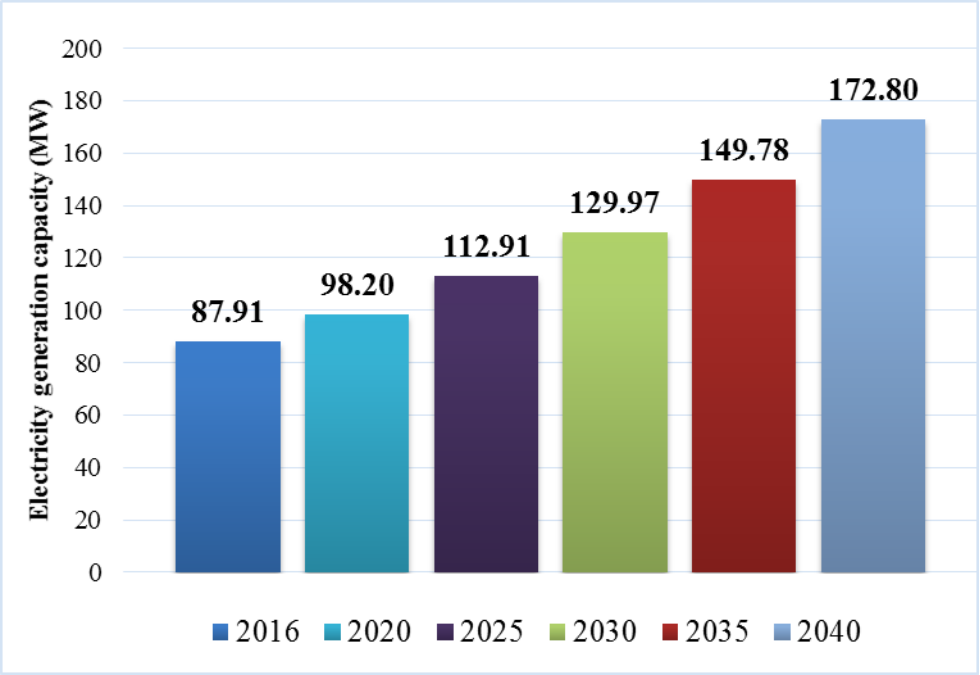

Figure 3: Electricty generation capacity from pyrolysis technology utilizing the complete plastic waste stream from 2016-2040

Economic and environmental benefits of pyrolysis technology

The proposed pyrolysis technology has the potential to operate at large scale and treat and convert all the plastic waste in controlled conditions into liquid fuel and useful products. This will not only help to reduce the environmental pollution but also will generate significant economic benefits. Currently only the main economic benefits such as savings from landfill diversion, electricity generation from pyrolytic produced liquid fuel and carbon credits are considered. The landfill diversion savings were calculated on the basis of savings of 572.36 SAR per ton of waste to be landfilled. The savings from electricity was based on the current price of 0.26 SAR per KWh. Finally the GHG emissions were calculated by using the method proposed by Intergovernmental Panel on Climate Change (IPPC) and Carbon credit value of 23.20 US$ per ton CO2 equivalent is considered for GHG emission savings (Noor et al. 2012). Using these parameters, the savings of 150.26, 120.13 and 27.13 (total 297.52) million SAR from landfill diversion, electricity generation and carbon credits

respectively would be possible in 2016. This economic benefit will increase every year and will reach up to 295.36, 236.14 and 53.33 (total 584.83) million SAR respectively in 2040 (Figure 4).

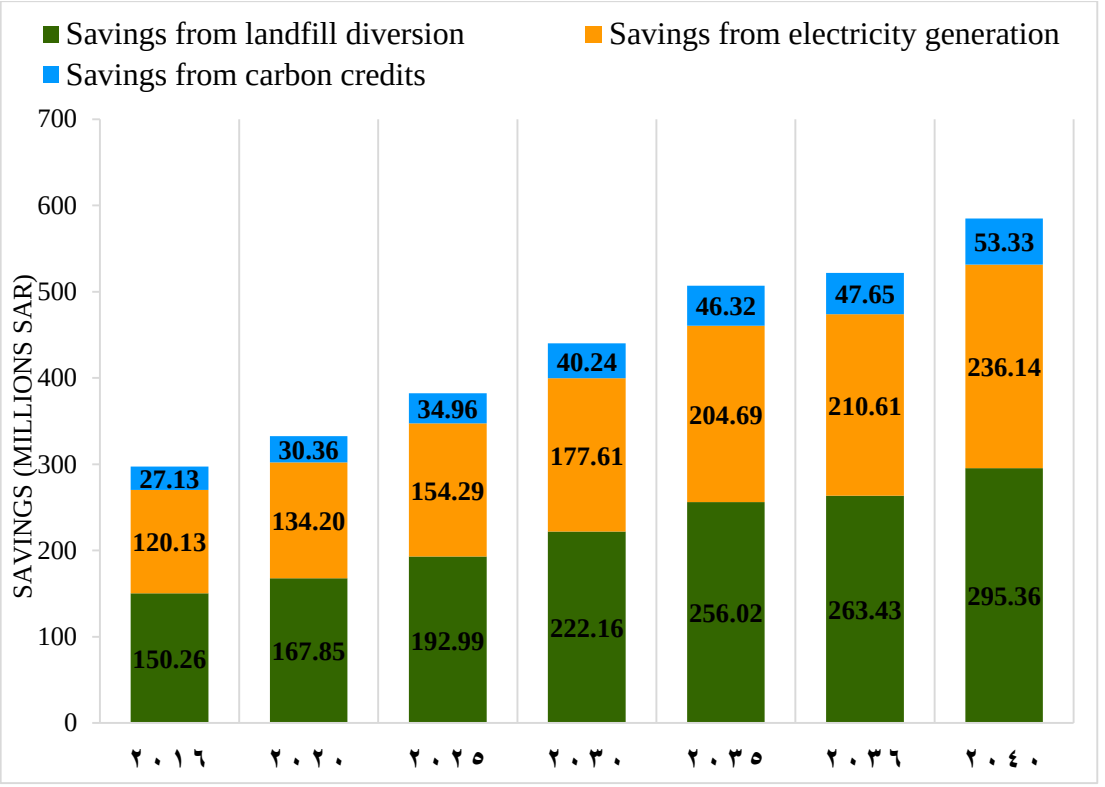

Figure 4: Potential savings in millions SAR from landfill diversion, electricty generation by liquid fuel and carbon credits from 2016-2040

The produced liquid fuel can be further treated and utilized for other energy demanding applications or in transportation. The produced char with some modification has a wide of range of applications including wastewater treatment and air purification from toxic pollutants and thus it can generate significant amounts of revenue. The land saved from waste dumping can be utilize for agriculture or other useful meanings. The reduced GHG emissions will ultimately contribute and help to tackle the global warming and climate change effect at a significant level. Nevertheless, the improved environmental conditions will certainly improve the public health, saving millions of SAR every year.

Conclusions

The potential of pyrolysis technology to treat all the plastic waste produced in Makkah city has been studied. A pilot scale pyrolysis process with a capacity of 20 L has been set up and used to convert plastic waste into liquid fuel and other useful products such as char and gases. The liquid fuel produced from thermal cracking of different types of plastic waste has an average HHV of 40 MJ/Kg. The liquid fuel other characteristics such as viscosity (0.9 mm^2/s), density (0.92 g/cm^3), flash point (30°C), pour point (-18°C) and freezing point of (-64°C) were found to be similar to conventional diesel. The MSW generated in Makkah city by the local population, pilgrims and during Ramadan has been estimated to be 1.141 million tons in 2016 and projected yearly to reach up to 2.244 million tons in 2040. The plastic waste stream is around 23% of the MSW and if all the plastic waste is treated by pyrolysis process, it has the potential to produce around 87.91 MW of electricity from 210.02 million kg of produced liquid fuel and savings of 150.26, 120.13 and 27.13 (total 297.52) million SAR from landfill diversion, electricity generation from liquid fuel and carbon credit, respectively. The electricity generation and the savings from pyrolysis technology will increase every year as the Makkah population, pilgrims and MSW increases. This is projected to increase up to around 172.80 MW of electricity and a total income of 584.8 million SAR by 2040. The pyrolysis technology seems a promising and sustainable solution to treat the plastic waste stream of Makkah city. However, more in depth studies are required including factors like socio-economics, local conditions, culture and current practices to be carefully considered before taking the final decision on adapting the pyrolysis technology.

Further Research

- The produced liquid fuel can be further treated to clean and improve its quality.
- A detailed feasibility study including economic, environmental and technical aspects of pyrolysis technology is needed for understanding the full potential and benefits of adapting this technology is Makkah to treat all plastic waste.
- A complete material and energy balance of pyrolysis process at industrial scale would help detailed feasibility study.
- A comprehensive study to highlight the detrimental impacts of plastic waste, on environment and human beings, as dumped in landfill sites would help the decision maker in taking the right decision.
- Undertaking Life Cycle Assessment (LCA) on plastic materials and pyrolysis technology for under pinning the benefits and environmental benefits of this technology.

- Investigation of socio-economics, local conditions, culture and current practices together with the above recommended research areas is also very important to be carefully considered before taking the final decision on choosing the pyrolysis technology as a sustainable solution for treatment of waste in Makkah city.

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Inspection of Quality of the Food Produced in the Kitchens of Medina, Saudi Arabia During Hajj and Umrah seasons

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Abstract

The increasing rates of food production and meals in kitchens, notably in the city of Medina in order to meet the growing needs for visitors during the Hajj and Umrah seasons. This is likely to increase the chances of a deficiency or imbalance in the application of the health requirements prescribed for both workers based processors, setup for the production and delivery of food, or for the requirements of the general cleanliness of the facility or tools, equipment and devices used in the production and transportation... etc. This may lead into producing food that does not meet the standard measures for food preparation or requirements of food safety, or both together, which may cause food poisoning, or food transmitted diseases.

Therefore, food safety and suitability for human consumption depends on several key factors, ranging from the safety of raw materials and materials used as inputs in the production and passing through the stages of processing and preparation, manufacturing and the end of production of a food product and transportation and storage or Supply it to the consumer. Therefore, all the previous stages must take place under conditions consistent with the health requirements established to ensure the safety of a food item. The aim of this study was to clarify the applicability of the requirements of health and the quality of food provided by those kitchens for visitors during the Hajj and Umrah seasons. This study included the assessment of health requirements for many of the kitchens in Medina during the last three years, as part of the periodic inspection undertaken by the laboratory management and Environmental Research, Medina Municipality, to collect a large number of food samples from Kitchens that have been evaluated and analyzed bacteriologically and chemically, in order to find out their suitability for human consumption. The analysis included bacteriological detection of Coliform bacteria, Escherichia coli and Fecal group. In addition to detect the presence of certain types of bacteria, the most important of which are bacteria Salmonella sp. and Staphylococcus aureus. In addition to that the chemical detection process for repeated frying oil using the Rancidity test, and the chemical evaluation of water used in preparing food to the Saudi standard specifications. The results indicated bacteriologist analysis of the food tested and chemical analysis of water and oils used in frying process to decrease food

contamination by rate of (20.36%) in the year 1436 H, compared to the year 1435 H (25.20%); 1434 H (31.02%). This decrease in food contamination reflects the wide spread application of the health requirements to increase the quality of food produced in the kitchens of Medina.

Full text is available in Arabic section under title

الرقابة على جودة المواد الغذائية المنتجة من مطابخ الاعاشة في المدينة المنورة خلال موسمي الحج والعمرة

Third Theme:

Engineering & Urban Studies

Smart Pedestrian Paths for Transforming Solar Energy and Walking Energy of The Two Holy Mosques Visitors into Electrical Energy

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Abstract

Energy is an essential component in any civilized society. Fossil fuel - oil, coal, and natural gas comprises 90% of the energy consumed today. Being depleted and causing environmental pollution, the problem became global. Conference recommendations and concerned institutions, including OPEC and the International Energy Agency, called for innovation and increasing reliance on intelligent cities with sustainable infrastructure, as well as mitigating carbon emissions. The Two Holy Mosques (in Makka and Madina) are on the world's list of top occupied buildings. Millions of people gather inside and in surrounding plazas at the same time. This implies providing huge energy for lighting, escalators, air conditioning and other operational requirements. Two important elements are available in both mosques, but not implemented for generating clean energy: visitors' walking kinetic energy (currently 8 million visitors for Hajj and Omra, to become 15 million per year after development projects are completed). The KSA is second in Arab countries (to Algeria) in the amount of annual incident solar radiation. This research aims to propose utilizing smart pedestrian paths for generating green energy using visitors' kinetic energy and solar energy to contribute to reducing reliance on fossil energy and its environmentally polluting emissions.

Keywords: Smart Pedestrian Paths, Sustainable Energy

Full text is available in Arabic section under title

مسارات المشاة الذكية لتحويل طاقة المشي لزوار الحرمين

والطاقة الشمسية لطاقة كهربية

A Methodology for Developing and Enhancing Facilities and Services for Hajj and Umrah

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Abstract

Engineering management and facilities services fit with the engineering and administrative style to develop and improve facilities in Hajj and Umrah services for the attention paid to human beings tangible resources and the required services. The descriptive method and the personal field experience in the related Hajj & Umrah (H&U) works and business has been implied in this research. It discusses issues such as planning, engineering, and quality management of the facilities and services needed in the H&U season. Important physical and nonphysical factors including people, places, processes, time, and technology must be considered in all planning and operation stages of H&U works. Facilities management is recommended as a methodology to develop and improve the H&U event.

Full text is available in Arabic section under title

منهجية لتطوير وتجويد مرافق وخدمات الحج و العمرة

Location Based Scheduling to Jamarat Bridge

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Abstract

Hajj is a set of activities (nusok), which are obligatory for all pilgrims. During Hajj Muna area witnesses a large number of the activities, which are; stoning, sleeping, haircut, and sacrifice. Stoning is considered one of the most difficult nusok. Scheduling (tafweeg) is the administrative solutions to control crowed in Jamarat area and help pilgrims complete stoning safely and comfortably. Every year, the staff of Jamarat scheduling, in the Ministry of Hajj, prepare the groups movement schedules during the pilgrimage rituals. The field services offices usually take care of the implementation of the schedule procedures. In spite of this, it is noticed that it is difficult to control pilgrims to stone on their times due to the lack of control mechanism. This study which depends on secondary and field data intends to introduce the Location Based Scheduling as a suitable tool.

Full text is available in Arabic section under title

التفويج المكاني إلى جسر الجمرات

A Practical Vision for Increasing the Capacity of the Hajj

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Abstract

This paper provides a practical vision to increase the capacity of the Hajj to accommodate up to five million pilgrims, which can be implemented gradually without the need for huge funds or mass resources. The basic requirements for pilgrims are not luxury. The use of the same camp and site for several groups of pilgrims sequentially increase the capacity. Utilization of Islamic schools of thought (Religious Jurisprudence) into multiple pilgrimage programs, scheduling pilgrims to perform hajj rituals, reducing crowds at peak times, and benefiting from all available places at the same time will increase the Hajj capacity. Preliminary reservation for pilgrimages programs allows proper planning for the coming years and helps better preparation for the required resources. Given the social characteristics of pilgrims, the basic organizational unit should be the load of a large bus, accompanied by a tour guide from their own people; to ensure effective communication between pilgrims and their Hajj organizers. By issuing a license for Hajj campaign organizers and developing an accurate system for their evaluation and ranking; the Ministry of Hajj can ensure their cooperation for implementing Hajj programs and serving the pilgrims in much better way. Pre-reservation of shuttle-buses helps to disintegrate huge crowds before gathering. Using technology for scheduling, booking and operating shuttle buses, and for prioritizing buses on Makkah roads, pilgrims can be transported from door to door to their destinations in Almashaeer, the Grand Mosque, and their accommodations; in a short time without discomfort of long walking, waiting, or concerns of getting lost. Developing multi-stories tents, should increase the capacity of Mina and Arafat, and provide pilgrims with a suitable accommodation environment for a reasonable cost. Using Mobile (Portable) Services Units for various purposes within transportation system, can make available all necessary services with satisfactory quality at all locations during Hajj. Thus, with God's help, the integration of suggested services,

should allow gradual increase in the number of pilgrims, and provide them with good service within a spiritual and safe environment.

Full text is available in Arabic section under title

رؤية عملية لزيادة الطاقة الاستيعابية للحج

Measurling Hajj Crowd Perceotion Levels Among The Southeast Asian Pilgrims

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Abstract

Mina is one of the three holy areas that pilgrims visit for a minimum of three days when performing Hajj rituals. This makes Mina a very crowded place that may reach up to 2.5 million pilgrims daily due to its spatial constraints during the Hajj. As people contribute to the state of crowded place, environmental psychology studies have posited that perceived crowding affects their behavior. Therefore, this paper focuses on crowding perception and measures the overall crowding perception, the perceived human crowding and the perceived spatial crowding. The study adopted survey questionnaire in soliciting information from pilgrims. A random size of 128 pilgrims in Mina from the Southeast Asia Hajj group was selected for three days (10th, 11th and 12th of Zul-Hijjah). Three different statistical tests have been applied to the collected data which included independent sample t-test, a correlation analysis, and a linear regression analysis. The outcome established that pilgrims witness significant effect of crowd perception during their stay at Mina. The implication of this finding determines the level to which the pilgrims feel secure from crowded conditions while performing their rituals.

1. Introduction

The ability to understand and predict crowd behavior in mass gathering, such as the Hajj, allows effective and competent management[1]. In fact, it will assist in providing crowd management and crowd control strategies by building upon the understanding of crowd nature. This will, in turn, increase safety for event participants.

In any crowded setting, perceived crowding levels usually vary among individuals. Some individuals feel crowded, whereas others do not feel crowded, even though they are at the same crowd settings[2]. Also, the literature suggests that perceived crowding can differ between males and females and, hence, impact on their responses [3]. Females with high level of crowd perception, in particular, can withdraw from the crowd or feel helpless in a crowded situation. In contrast, males can react differently. For instance, males can use aggression to cope with crowding conditions[4].

Consequently, this study aims to explore the overall levels of crowding perception and its causes in terms of human and spatial perceived crowding. In this regard, three objectives were set out in order to achieve this aim, namely; to reveal significant differences in the levels of crowding perception, perceived human crowding and spatial human crowding across gender with a focus on Southeastern Asian pilgrims. The relationship between the respondent's crowding perceptions, perceived human crowding and spatial crowding and to identify the greater indicator of perceived crowding will then be examined.

In achieving these objectives, the study utilized quantitative method in the research. Moreover, this study has found that there is a significant difference in the pilgrims' levels of perceived crowding across gender. Also, this paper clearly differentiates between the overall perceived crowding, human perceived crowding and spatial perceived crowding and exhibit their different levels among the pilgrims. Finally, the results of this paper show that human perceived crowding is a major predictor of the pilgrims overall perceived crowding.

These findings will guide future researchers in two dimensions of perceived crowding as potential areas to minimize the effect of crowding. Moreover, it is important for Hajj planners to note that not only physical settings of Mina affect pilgrims' experience of crowding, but also the pilgrims' level of perceived crowding.

2. Background Studies

- Significance of Mina rituals during Hajj season

Pilgrims gather in Mina at the first and fourth stages of Hajj (Figure 1). The first stage consists of one day and one night. In this stage, pilgrims stay at Mina without conducting any rituals, but prepare for the departure to Arafat, the next stage of the ritual. The fourth stage consists of three to four days[5]. Pilgrims return from Arafat after spending the night at Muzdalifah, the third stage. After sunrise on the first day of the fourth stage, the pilgrims start their rituals at Mina by going to Jamarat Bridge to perform the first ritual which is pelting the symbol of Devil that is called Aqaba using small stones[6][1]. After that, there are three rituals that pilgrims will perform based on their mode of Hajj (Ifrad, Tamattu and Qiran)[2]. These rituals are: to sacrifice an animal,

[1] There are three stoning locations at Jamarat Bridge: the small, medium and the large which are also called the Aqaba.

[2] Ifrad is performing the Hajj alone (without Umrah). Tamattu is completing Umrah rituals and emerging in the state of sanctity and on the first stage of Hajj pilgrims pronounce Ihrarn, for the Hajj. Qiran is combining Umrah and Hajj in one state of sanctity.

to shave or shorten the hair and to perform Twaf[1]. After that, pilgrims return to their tents to rest.

From noon on the second day until the end of this stage, pilgrims commute daily from their tents at Mina to Jamarat Bridge to stone the three symbols of the Devil. The stoning time begins at noon and extends to the following morning.

No.	Date (from the twelfth month of the Hijri calendar)	Place (Holy site)
1	8th (day and night)	Mina
2	9th (noon to Sunset)	Arafat
3	9th [night to (10th before sunrise) it is allowed for some cases to move earlier from Muzdalifah to Mina]	Muzdalifah
4	10th after sunrise–12th or 13th before sunset	Mina
5	After 12th or 13th	Makkah

Figure 1 Abstracted stages of Hajj. Source: Tayan, O., Al BinAli, A. M., & Kabir, M. N. (2014). Analytical and Computer Modelling of Transportation Systems for Traffic Bottleneck Resolution: A Hajj Case Study. Arabian Journal for Science and Engineering, 39(10)

- **Dimensions of Perceived Crowding**

There are two dimensions of perceived crowding, human crowding and spatial crowding[7].Human crowding arises from the number of individuals and the extent of social interaction in the same physical environment. In many settings such as during festivals, it is perceived as a positive crowding when the number of participants are sufficient[8]. Furthermore, the relationship between perceived human crowding and individual experience of crowding is a kind of vacillating relationship; sometimes it is positive and sometimes it is negative[9][10].

Meanwhile, spatial crowding is defined as the degree to which an individual feels restricted in a given physical movement [8]. It is caused by factors such as a restriction of movement within a given environmental setting, shortage of available physical space, or by the layout of the environment. It is an indicator of the physical (human and non-human) obstacles that prevent the individual from achieving his goal. Therefore, it has a negative relationship with an individual's crowding experience [2].

The perceived crowding offers an opportunity to understand and predict the effect of a crowded situation on the crowd[11]. In addition, understanding the behavior of

[1] Tawaf is an act that takes place at the Grand Mosque which includes moving around the Alkaba (God's House) seven times.

individuals will minimize the effect of problems caused by the negative perception of crowding[12].

Despite the value of understanding crowding perception in crowded settings, so far there has been a very little discussion about understanding the nature of crowds in the Hajj. For instance, Ghani et al. measured three psychological components of Malaysian pilgrims, namely: observable crowd behaviors, emotions and cognitions, as psychological components of crowd behavior in the Hajj[13]. In addition, Alnabulsi & Drury focused on crowd density and safety using social identity theory, and claimed that crowding has a positive impact on pilgrims when they are in a group that share the same social identity[14]. Halabi considered worshippers' behavior from the social perspective at the Grand Mosque, inside and outside the building, that control their preferences and activities at the Grand Mosque[15]. Nevertheless, these studies did not address the issue of crowding situation's effect on pilgrims' behavior and different levels of crowding perception.

Therefore this study assumed that pilgrims from the Southeast Asia Hajj group would differ in their perceived crowding. Also, it assumed that the two dimensions of perceived crowding would have different and significant effect on the overall perceived crowding. This effect would be moderated by the gender of the pilgrim.

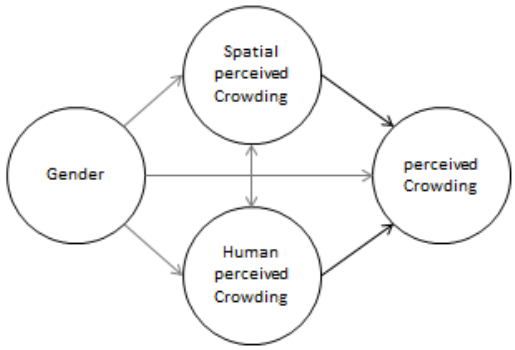

Figure 2 Model of perceived crowding proposed and tested in this paper

3. Research Methodology

- Study location

Of all the Hajj's holy sites, Mina was selected as the location for this study. In particular, it focuses on the camp area dedicated for pilgrims from South East Asia. The main reason of selecting Mina is due to pilgrims' period of stay. Pilgrims stay at Mina for a minimum period of three days as part of the Hajj rituals[16]. Second, the spatial constraints of Mina that make it a crowded site was considered. Last, this study investigated pilgrims' perceived crowding levels at routes between the tent blocks in

Mina, especially the routes leading to Jamarat Bridge which was recently expanded, and where most of the overcrowding situations occur.

- Respondents and Data Collection Procedures

Data were collected on a simple random basis from 128 pilgrims (female n= 43 and male n= 85) from Southeast Asia Hajj groups in Mina during the 2015 Hajj season. During the three days (10th, 11th and 12th of Dhul-Hijjah), three numerators, who speak English and Malay, were trained and assigned to collect data in Mina. On the first day, data were collected over two time periods. The first period was between 7:00 am and 12:00 pm. The second period was between 11:30 pm and 2:30 am. On the second and third day, data were collected between 11:30 am and 7:30 pm. These data collection periods were designed to capture the pilgrims' crowding experience to and from the Jamarat Bridge.

- Instruments and Measurement of Variables

Data were collected using an on-site survey questionnaire that consists of 4 parts. However, the data used in this paper were extracted from the first and third parts of the survey form. The first part includes socio-demographic questions such as age, gender, marital status and level of education. The third part contains crowding perception measurements. In the questionnaire, perceived crowding was measured using an easy to fill out and a widely used measure that was developed by Shelby & Heberlein[18]. It is a 9 point scale (responses of 1 or 2= not at all crowded, 3-4 = slightly crowded, 5-7 = moderately crowded, and 8-9 = extremely crowded).

For human and spatial perceived crowding, this study adopted and developed measurements proposed by Byun & Mann[19], Li, Kim, & Lee [7], and Machleit, Kellaris, & Eroglu [20], that were originally designed and developed for retail settings.

Nevertheless, due to pilgrims limited available time to complete the questionnaire in Mina, the human perceived crowding measure was further developed to become a single item measure containing four options: a) Mina routes seem very crowded to me, b) Mina routes were a little too busy, c) There was not much traffic in Mina routes, and d) There were many pilgrims but it did not feel crowded. Similarly, spatial perceived crowding was developed to be a single item measure with four options: a) In Mina routes I felt suffocated, b) In Mina routes I felt cramped, c) Moving around in Mina routes was inconvenient, and d) Moving around in Mina routes was convenient. The pilgrim can select one option from the four options that best describes how he or she felt in Mina routes. The questionnaire was written in English and then translated to Malay language by a professional translator. To validate the instrument, the questionnaire was reviewed by three academicians who use both languages and are familiar with the field of study.

4. Results

Analysis was conducted using the Statistical Package for the Social Sciences (SPSS) for Windows version 22.0 (SPSS Inc., Chicago, IL, USA). In this regard objective one was achieved using independent-Sample t test. Thereafter objective two was tested using correlation analysis to find the relationship between gender, experience, and level of education and the respondent's crowding perception, perceived human crowding and spatial human crowding. Finally, objective three was established using linear regression analysis to test the effect of perceived human crowding and spatial human crowding on perceived crowding levels.

- Frequencies

Figure 1 displays the basic results of perceived crowding frequencies reported by pilgrims from the South East Asia Hajj group. This figure highlighted that approximately 44% of respondents felt extremely crowded and 41% felt moderately crowded. This indicates that most of the respondents experienced high levels of perceived crowding.

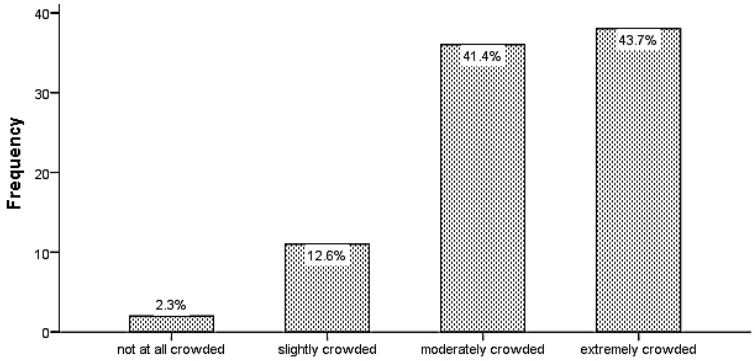

Figure 3: Pilgrims levels of perceived crowding.

Correspondingly, Figure 2 displays the basic results of perceived human crowding. The percentage of respondents that reported Mina routes to be very crowded was 43%. In addition, 33.6% of the respondents stated that Mina routes were a little too busy. In contrast, 17.2% of respondents mentioned that there were a lot of pilgrims, but they did not feel crowded. Thus, almost two thirds of respondents felt crowded due to perceived human crowding.

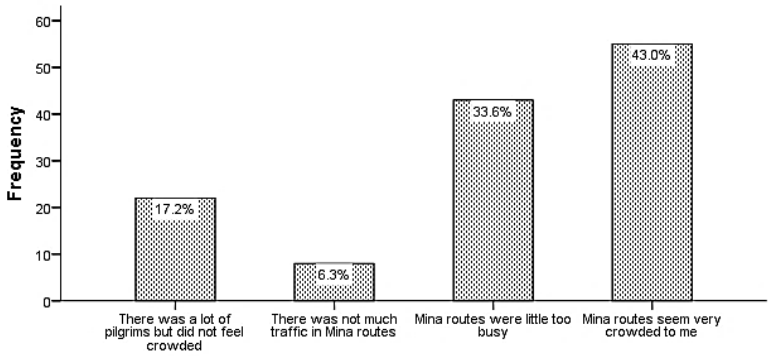

Figure 4: Pilgrims perceived human crowding.

In contrast, Figure 3 shows the frequencies of perceived spatial crowding as indicated by respondents. 36.7% of respondents felt that moving around in Mina routes was inconvenient. Moreover, 23.4% of respondents felt suffocated. These numbers represent pilgrims' movement difficulties in Mina routes due to overcrowding conditions. On the other hand, 28.1% of respondents reported that moving around in Mina routes was convenient. This outcome shows that some of the respondents can smoothly navigate their way around in Mina without suffering from high perceived spatial crowding.

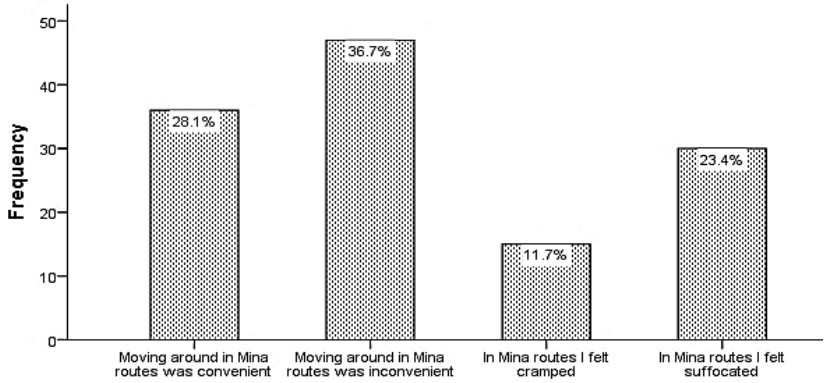

Figure 5: Pilgrims perceived spatial crowding.

- Analysis results of objective 1: the levels of crowding perception, perceived human crowding and spatial human crowding across gender in Southeastern Asian pilgrims.

The results of the t-test in Table 1 show that significant differences exist in terms of gender on perceived crowding, perceived human crowding and spatial perceived crowding levels. In terms of perceived crowding, the mean score of female ($\bar{x}$ = 8.54) was significantly higher than Male ($\bar{x}$ = 5.71) and with significant level of.009 (F=7.248,

p<.05). Whereas, in perceived human crowding, the mean score of female ($\bar{x}$ = 2.98) was fairly lower than male ($\bar{x}$ = 3.05) with level of .459 (F=.551, p>.05) which indicates that there was no significant difference across gender. Similarly, in perceived spatial crowding, the mean score of female ($\bar{x}$ = 2.28) was almost lower than the male ($\bar{x}$ = 2.32), with a significant level of .615 (F=.254, p>.05). Interestingly, these results show that the female pilgrims perceived conditions to be more crowded than the males.

Table 1: Levels of crowding perception, perceived human crowding and spatial human crowding across gender in Southeastern Asian pilgrims.

	Perceived crowding					Perceived human crowding					Perceived spatial crowding				
Gender	N	Mean	SD	F	Sig	N	Mean	SD.	F	Sig	N	Mean	SD	F	Sig
Female	28	8.54	1.201	7.248	.009	43	2.98	1.035	.551	.459	43	2.28	1.098	.254	.615
Male	59	5.71	1.885			85	3.05	1.122			85	2.32	1.136		

- Analysis results of objective 2: the relationship between the respondent's crowding perception, perceived human crowding and spatial human crowding.

Table 2 displays the correlations of the respondent's crowding perception, perceived human crowding and spatial crowding. Based on the analysis approach, each of the dimensions reported its own mean. The mean for crowding perception was ($\bar{x}$ = 6.62), perceived human crowding ($\bar{x}$ = 3.02), and perceived spatial crowding ($\bar{x}$ = 2.30). In this study, the correlation between perceived human crowding and spatial human crowding was a significant and positive correlation as its score was (0.323, p< 0.01). Hence, the more pilgrims perceived human crowding, the more perceived spatial crowding they experienced.

Table 2: Relationship between respondent's crowding perception, perceived human crowding and spatial human crowding

		Mean	SD	1	2	3
1	Perceived Crowding	6.62	2.147	1.00		
2	Perceived human crowding	3.02	1.090	.088	1.00	
3	Perceived spatial crowding	2.30	1.119	-.009	.323**	1.00

* Correlation is significant at the 0.05 level (2-tailed).**Correlation is significant at the 0.01 level (2-tailed).

- Analysis results of objective 3: the effect of perceived human crowding and spatial human crowding on perceived crowding levels.

Table 3 reported the results of a linear regression analysis that were used to test the effect of perceived human crowding and spatial human crowding on perceived

crowding levels. The results indicate that the effect of perceived human crowding β (t=0.888, p>0.05) on perceived crowding was greater than the effects of perceived human crowding β (t=- 0.365, p>0.05). Therefore, perceived human crowding is a significant predictor of perceived crowding.

Table 3: Effect of perceived human crowding and spatial human crowding on perceived crowding levels

Dimensions	Perceived crowding			
	Standardized Coefficients β	t	Sig.	R2
Perceived human crowding	.102	.888	.377	.009
Perceived spatial crowding	-.042	-.365	.716	

5. Discussion

It was found that the Southeast Asia pilgrims viewed crowding in three variations: levels of perceived crowding, perceived human crowding, and perceived spatial crowding. Remarkably, the majority of them (85%) felt Mina was a crowded place to perform the Hajj rituals for a three-day-stay due to its spatial constraints. These numbers represent that pilgrims perceived high level of crowding while they are in Mina. This clearly means that almost half of the respondents among the pilgrims perceived that the human crowding in Mina caused them inconvenience while performing Hajj. Although the Jamarat Bridge has been expanded, human crowding is still going on and that has to be resolved for a better Hajj performance. In an attempt to understand this phenomenon, the result of perceived level human crowding and spatial crowding were highlighted in which both results acquired were then investigated in-depth to verify which of them was the grass-roots cause of the crowding which occurred. From the aspect of human crowding, 43% of the respondents stated that Mina routes were very crowded to them and their perception of the crowding through the human evaluation was negative. Whereas, at the perceived spatial aspect, 36.7% felt that moving around in Mina routes was inconvenient.

Moreover, it was found that gender has a very large effect on the perceived crowding and no significant effect on either human or spatial perceived crowding. These results show that the female pilgrims perceived more crowding than the males. Logically, since the perceived crowding consists of human perceived crowding and spatial perceived crowding, the effect of gender on the perceived crowding should be extended to its dimensions. However, when studying the effect of gender on human perceived crowding and spatial perceived crowding, it was discovered that the human and perceived crowding levels among males contradicts the effect of gender on the perceived crowding. Therefore, the correlation between perceived human crowding

and spatial perceived crowding support each other in the sense of having a similar influential effect. This study found that there is a significant positive correlation between perceived human crowding and perceived spatial crowding (0.323, $p < 0.01$) in which there are high levels of perceived human crowding associated with higher levels of perceived spatial crowding. In spite of this strong correlation between human perceived crowding and spatial perceived crowding, this study has found that human perceived crowding is a greater predictor of perceived crowding than the spatial dimension.

6. Conclusion

Conclusively, this paper discovered that pilgrims' perceived human crowding is an effective dimension in understanding the effect of crowding on pilgrims during Hajj. This outcome implies the need for understanding and predicting crowd behavior in mass gatherings generally, and in the Hajj season specifically. This kind of understanding allows for effective and competent management in order to improve the safety system for the pilgrims.

Although this paper indicates the importance of human perceived crowding dimension at the Hajj, more investigation is needed to determine other factors which affect human perceived crowding. The Hajj includes a wide range of pilgrims from different age groups, education and cultural backgrounds in addition to levels of services and mode of transportation. All are potential areas for further investigation to develop the proposed model in this paper.

Acknowledgments

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New Technology for Designing Energy-Saving Tents

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Abstract

Tents are widely used in the HAJJ season for accommodation of the pilgrims in MENA and ARAFAT. Also tents are widely used in Saudi Arabia for different purposes. The tents development project in MENA is considered as one of the largest projects that have been implemented in the holy sites of MENA to achieve more security and safety for the pilgrims. In this huge project, it was relied on using the Teflon-coated glass fiber tissue covered in fabric tents for its high resistance to ignition and the lack of the emission of toxic gases. The MENA-tents use the desert air conditioning systems, which require permanent maintenance in order to keep an optimal temperature inside these tents. This is necessary in the upcoming HAJJ seasons which coincide with the high temperature seasons. The present scientific paper presents modern technology by covering the external surfaces of the tents with a layer of Phase Change Material (PCM) that is contained in a plastic frame fixed on the surface of the tent. This material absorbs the solar energy in the daytime while it changes its state to the liquid phase. After the temperature is lowered under the melting temperature, the PCM emits the absorbed heat energy again to the atmosphere leading to maintain a nearly constant temperature inside the tents appropriate for the human life. The theoretical as well as the experimental results obtained showed the effectiveness of the PCM used to cover the roofs of the tents in obtaining a comfortable internal temperature inside the tents. This can be reflected in reducing of the water supply and saving the electrical energy required for air condition systems.

Full text is available in Arabic section under title

تكنولوجيا جديدة لتصميم خيام موفرة للطاقة

The Use of Renewable Energies in the Facilitation of Performance for the Hajj Rituals at Al-Jamarat Bridge

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Abstract

The aim of this paper is to present innovative solutions in order to make it easier for pilgrims to perform their Hajj with ease and reduce the rate of the stampede and the deaths that occur during the stoning ritual. The pilgrims are required to throw stones towards the Aqaba during the Hajj by using the Jamarat Bridge in Mina area located in Makkah. The paper suggests a design of cooling and movement systems on the Jamarat Bridge, using new and renewable energies allowing the pilgrims to perform their Hajj with ease especially the elderly, disabled, and the ill ones. As they need a moderate temperature and comfortable ways to move them inside the bridge in a safe and environmental friendly systems. The proposed innovation has several features using solar energy, wind energy, and kinetic energy, which can be created from the movement of the pilgrims over the Jamarat Bridge. All of these energies will be converted to electrical energy to feed the cooling units and store the rest in batteries, which can be used in electrical cars. The design consists of solar energy, which converts the solar radiation to electrical power. In the same time, wind turbines will be used to convert the wind energy to electrical energy. Finally, the piezoelectric transducers will be used at the Jamarat Bridge to convert the kinetic energy of the pilgrims to electrical energy.

Full text is available in Arabic section under title

استخدام الطاقات المتجددة في التسهيل من أداء مناسك الحج على جسر الجمرات

Comparing Characteristics and Opinions of Southern Mashaaer Train Users during the Period 1434H until 1436H

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Abstract

It is known that Time and place are two important factors in performing Hajj rituals. This appears clearly during Efadah from Arafat to Muzdalefah movement in which more than two millions pilgrims leave Arafat during 6 hours only. Efadah movement included management and development of transport modes. Management of transport modes included prohibiting vehicles with less than 25 seats from entering Mashaaer and encouraging pedestrians who are able to walk. In addition, managing transport modes included shuttle bus service to be applied for first time during Hajj between Arafat and Muzdalefah and Mina. This system has been introduced since 1416h. Developing transport modes has noticed using southern Mashaaer train since 1431h for transporting domestic pilgrims. After this year, train transport included domestic pilgrims and some of southern Asia pilgrims. In this way, train has become one of public transport modes during Hajj.

This research is very important because it aims at comparing characteristics and opinions of train users during the period 1434h until 1436h. This research helps in identifying pros and cons. This research recommends; (1) It is necessary to improve the offered service and offer more training to the working team, (2) Increasing manpower is required for tickets inspection, (3) Increasing electric means such as escalators and elevators, (4) Providing train stations with all kinds of services such as toilettes, drinking waters, more seats, ….etc., (5) Shortening walking distances to arrive at the train stations through improving distribution of land use around train route and providing transport means for transporting pilgrims, especially old and handicapped who are far away from train stations, (6) Reducing waiting times at train stations through using time tables showing departing time for every pilgrim, (8) Reducing pilgrims density inside the train, (9) Using all means that help in controlling pilgrims moving toward train stations to help prevent crowds at train stations, (10) Increasing number of trains to absorb the increasing demand, (11) Increasing guidance signs, (12) Providing the train with more seats for old and handicapped

pilgrims, (13) Making maintenance faster in case of breakdown, and (14) Providing more translators with different languages.

Full text is available in Arabic section under title

مقارنة خصائص وآراء مستخدمي قطار المشاعر الجنوبي

في الفترة من 1434هـ حتى 1436هـ

Fourth Theme:

Awareness & Media Studies

The Effect of A Group Counselling Program to Increase the Social Communication in Sample of Female Guides in Makkah Al-Mukarmah

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Abstract

On the basis of given the importance of the rehabilitation and development associated with the role of Saudi women skills in the career of Twafa (guiding pilgrims through hajj) according to the controls legitimacy. The current study aimed to reveal the effectiveness of group counselling program for female Guides, which is based, in its entirety, to train them in the proper social communication with pilgrims. The study included a sample study (30) female Guides in different institutions, who have been trained on the techniques and skills of social communication and proper what should be the good professional relationship between Guides and pilgrims to facilitate receiving instructions and understanding and work easily and with flexibility. Through this development, our aim is to achieve simplification of the concepts and awareness of body language and its role in the delivery of information and the building of social relations supporting of which helps to solve problems and create favorable social communication for pilgrims despite the different races, languages, cultural and social backgrounds. The researcher prepared a social communication scale in addition to counselling Program sessions, which include (12) guiding the sessions , distributed in (6) consecutive weeks, at rate of two days each week, and taking hour and a half. The researcher followed the quasi-experimental approach, which required the sample to be split into two groups, half Random officer and pilot, and the researcher used nonparametric statistical method (Man Whitney, and welcecson) to measure the study hypotheses and test their validity. The results of the study showed the positive effect of the group-counselling program which was on the experimental group of female Guides. This comes in favor of the need to train staff working in the service of pilgrims according to the need of their work. With the empowerment and rehabilitation of female

guides to provide the service in the institutions Participating in the awareness and social services for guidance and Rites.

Full text is available in Arabic section under title

فاعلية برنامج إرشادي لتنمية التواصل الاجتماعي لدى عينة من المطوفات بمدينة مكة المكرمة

The Role of Social Networking Sites in Shaping the Mental Image of University Youths Toward the Institutions Involved in the Pilgrimage A Field Study

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Abstract

The main issue that this study discusses is to identify the role of social networking sites in shaping the mental image of university youths toward the institutions involved in the pilgrimage. The study aims to: 1- identify the services on social networking sites (Facebook and Twitter) provided by institutions involved in Hajj (Saudi Ministry of Hajj) from the view point of a surveyed samples. 2- identify the influence of the diversity of services offered by institutions involved in Hajj (Saudi Ministry of Hajj) and advertised on social networks on the mental picture of those institutions left in the surveyed samples. 3- identify the ideas provided by the surveyed samples to improve the web pages of the institutions involved in Hajj (Saudi Ministry of Hajj) on social networking sites. This study belongs to the descriptive studies, which use only the survey methodology of field samples. This study has been applied intentionaly on young university students of Umm Al Qura University, located in Al-Zaher and Abedia areas, Makkah. The number of students were 400 both male and female, aged between 18-21 years. The results of the study indicated that: (1) The most important services provided by the institutions involved in Hajj (Saudi Ministry of Hajj) was as follows (arranged from top to bottom): alerting about the kind of mistakes the pilgrims might make during performing their rituals; developing and implementing plans aimed at sensitizing the pilgrims and guiding them to the correct methods in the pilgrimage showing a version of the indicative handouts that are printed out in different languages on their web pages; displaying multiple videos on their web pages to educate pilgrims in different languages and offer lectures, seminars, sermons and speeches which are usually givin in mosques and places of gathering of pilgrims as well as their homes; and displaying different connectivity methods for the awareness, orientation, and

guidance centres in the Holy Sites; (2) The impact of various services provided by institutions involved in Hajj (Saudi Ministry of Hajj) on the mental picture in the surveyed sample toward those institutions advertised on social media sites (Facebook and Twitter) was considered as “Average Impact” in the first place, “Strong Impact” in the second place, and “Weak Impact”, in third place; (3) Expansion of the institutions web pages on new social media networks, such as snap-chat, Instagram, and WhatsApp, came in the first place for the surveyed samples who proposed methods to improve the pages of the concerned institutions on the web, followed by precision in choosing of scholars and preachers who have the ability to use the social media networks to connect better with the audience, and finally allocating people for instant response to the pilgrims inquiries on those pages.

Full text is available in Arabic section under title

دور مواقع التواصل الاجتماعي في تشكيل الصورة الذهنية لدى الشباب الجامعي تجاه المؤسسات المعنية بالحج "دراسة ميدانية"

Media Efforts of Civil Defense and Their Role in Promoting Precautionary Awareness for the Visitors of the Two Holy Mosques

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Abstract

The aim of this study is to identify the means and resources, which contribute in promoting the precautionary awareness for the visitors of the Two Holy Mosques. This can help recognize the best awareness of means and resources from the recipients' viewpoints. Also, getting information about media and awareness efforts presented by the Civil Defense, and some statistically significant differences between the recipients. Samples are collected from the visitors of the Two Holy Mosques who speak different languages e.g. Arabic, English, Urdu, Turkish, Indonesian, French, and Pashto. The descriptive survey method was used in this study. The majority of study samples are males, ranging in age from 40 to 50, largest proportion speaking Arabic, followed by Urdu, English, and French. The majority of participants are nonresidents in the Kingdom of Saudi Arabia. They are mostly coming to visit the Two Holy Mosques for pilgrimage and Umrah. Largest proportion of the visitors come to Saudi Arabia by air, followed by those who come by land, then by those who arrived by sea. The majority of candidates believe that the most useful precautionary awareness for them is in their country, then during their stay in the Holy Sites. They believe that the level of precautionary awareness, presented by CIVIL Defense, is "GOOD". Also, they realize the importance of both traditional media and social media, as they complement each other. The most important means of awareness were those of the Saudi Embassy and Consulate and the Islamic centers at the countries where these visitors came from. The most important means of awareness in the holy places were signs, then direct awareness by officials of the security and safety individuals. Awareness during residency was offered through guidance signs, display monitors, the awareness centers of the Islamic communities and awareness presented by officials of the security and safety, respectively. The majority of awareness act has been performed mainly for safety in Jamarat area where there are risk of rowdiness and fire. The

significance in the statistical variations between the responses in the surveyed samples was mostly due to the difference in their spoken languages and their length of stay in the Holy Sites as well as the quality of traditional and new media. Results from this study indicated; (1) there is a need to prepare an awareness strategy plan starting from pilgrims in their countries by the Ministry of Hajj in coordination with the relevant authorities including; Ministry of the Interior, Ministry of Foreign Affairs, embassies and consulates, and Ministry of culture and information, (2) It is important to keep balance in the use of all media types, (3) create electronic display panels of suitable sizes for preventive education in a number of locations, such as the squares surrounding the Haram area, buildings, residential towers and squares surrounding the Jamarat area by the General Presidency for the Two Holy Mosques, (4) examine the experiences of some countries in raising awareness, (5) develop an awareness plan model to be applied to the means of transport by the General Civil Aviation Authority, Ministry of transport and ports, (6) the General Directorate of civil defense to take advantage of the Ministry of Hajj website in the field of preventive education, (7) benefit from the expertise of the Directorate General of civil defense in using social media, (8) establishing the principles of safety and security is everyone's responsibility, and (9) to work on the production of an awareness education documentary in several languages, involving all stakeholders.

Full text is available in Arabic section under title

الجهود الإعلامية لجهاز الدفاع المدني وإسهامها في تعزيز

الوعي الوقائي لضيوف وزوار الحرمين الشريفين

" دراسة ميدانية "

Awareness of Pilgrims about Middle East Respiratory Syndrome-Corona Virus During 2015 Hajj Season

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Abstract

Middle East Respiratory Syndrome Coronavirus (MERS-CoV) is becoming a global health concern with the majority of cases occurring in the Arabian Peninsula, and with higher risk of transmission during mass gatherings such as Hajj. The purpose of this study is to assess awareness of Pilgrims about this disease, and to determine important aspects for future pilgrims' education plans. During Hajj season 2015, a questionnaire on MERS-CoV that covers publicly important aspects of the disease was professionally prepared in 7 languages (Arabic, English, French, Urdu, Malayalam, Indonesian, and Turkish). The study was conducted as a collaborative project between Otolaryngology and Infection Control Departments at King Abdullah Medical City and Umm Al-Qura University. Questionnaires were distributed inside Makkah to 2350 pilgrims from 33 different countries with the help of 56 medical students organized into 8 groups. Exclusion criteria were illiterate pilgrims and those speaking non-included languages. Pilgrims' demographics and responses to different questions on presentation, complications, and prevention of MERS-CoV were then tabulated and analyzed. Results indicate that a total of 2302 pilgrims (97.9%) have responded to the questionnaire. Of the responders, only 1156 (50.2%) reported that they have heard about MERS-CoV. Out of these, 75.5% did not know about diarrhea as a presenting symptom, 33% believed that the disease had a vaccine, 43.9% thought they are not following the appropriate measures to avoid the infection, and 40.5% did not know what to do after exposure to a patient. TV was a valuable source of information for 62.8% of pilgrims, Internet for 38.3%, and teaching flyers for only 19.5% of them. There is a significant need for pilgrims' education about MERS-CoV. The lack of appropriate orientation of pilgrims about the disease highlights the

importance of awareness campaigns and teaching materials about MERS-CoV as well as other Hajj related health problems and catastrophes.

Full text is available in Arabic section under title

وعي الحجاج عن فيروس كورونا المسبب لمتلازمة الشرق الأوسط التنفسية خلال موسم الحج عام 1436هـ - 2015 م

The Development of E- Medical Interpreter during Hajj

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Abstract

The Government of the Custodian of the Two Holy Mosques presents services to pilgrims and visitors in all aspects. One of the aspects is to employ the use of technology for the development of services e.g. health care. Almalki et.al (2011) stated "The government of Saudi Arabia has given high priority to the development of health care services at all levels: primary, secondary and tertiary." Medical staff had communication difficulties with pilgrims of non-Arabic and English speakers, in getting accurate information of the patients' health history, diagnose of diseases, and the delivery of medications. Communication is considered a crucial element for patients' safety and quality healthcare, especially during Hajj season (Alabsi and Taha, 2014). Responding to the issue, and based on the previous research which has been done by (ibid, 2014), this research aims to provide a medical interpreter application supported with images and sounds of the most common languages among the pilgrims such as Arabic, English, French, Urdu, Hindi and Malay. The application will bridge the gap of communication regarding healthcare. A descriptive method and a rubric will be used as an instrument to collect data and evaluate the application in terms of its relevance, organization, usability, engagement, language, sound and images. The sample that the application was tested on were (50) doctors / nurses working in Makkah and Madinah hospitals.

Significance of the study:

The current study is significant for the following reasons:-

1. According to authors' knowledge, there has been no previous application concerning this issue.
2. Providing a medical mobile application to facilitate the communication with non- Arabic / English speakers of pilgrims, patients with special needs, and elderly patients.
3. Improving the patients' health care quality during Hajj and Umrah seasons. It also saves time and effort to present the best medical services.

Introduction

Since health is an important issue for all people, many health care applications, which are suitable to smart phones, have been produced during the last few years. Each application tries to help different healthcare such as Internal Medicine physicians, physician assistants, nurse practitioners, and other clinicians from different specializations.

Many of these applications are concerned with how to monitor patients' health remotely and keep a track on their medical history. Especially those who have chronic diseases and are required to be monitored continuously to provide their doctors with the most updated information.

Other applications focus on providing quick medical reference as a mini-textbook for disease pathologies such as Medscape (Medscape, 1994-2015)

(Satish Misra, 2015) classifies some of top applications based on different category such as best medical calculator, best medical literature applications and image challenges. Also, it updates their list regularly to select the application of the month.

However, there are very limited applications that pay attention to electronic medical interpreter although the interpreter has an important impact on the quality of health care (Flores, 2005), especially if the patients are more satisfied if treated by bilingual staff member.

The most related applications to this study are Xprompt (Blue Owl, 2011), Medical Spanish (Marvo, 2011), MediBabble (NiteFloat, 2013) and Canopy (Canopy Innovations, 2015). Most of their applications translate around 800-1,500 common medical phrases from around nine specialties, which are created by professionals to one or more (up to ten) languages, in order to have a quick communication with the patients. Even though, the application depends only on the text and voice for some languages. Some of these applications require to be paid while others are free.

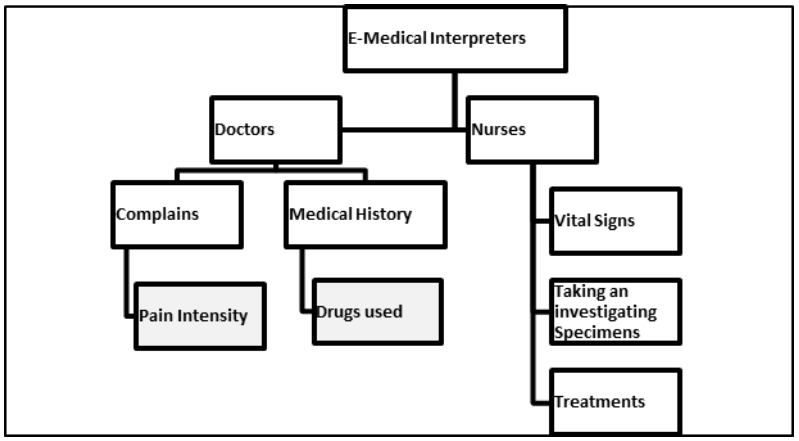
To the best of the authors' knowledge, there is no medical interpreter application concerned with using images or drawings to facilitate communication. This paper introduces images with more details on the design and implementation of the E-medical interpreter.

Methodology

The descriptive method has been chosen to assess the medical staff thoughts in using the suggested App "E-medical interpreter app" to facilitate communication. The application is built based on Android platform since Android is "the platform of the future" as stated by Paras Lakhani (George Shih, 2010). The Android, which is developed by Google is approved as the operating system by consortium of 48 major

companies in mobile phone industry including Samsung, Motorola, Sony Ericson and HTC.

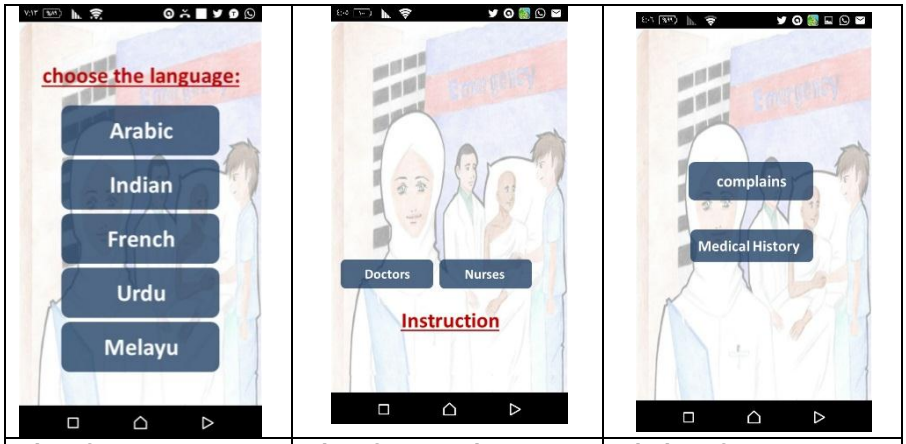
Figure 6: Content of the E-Medical Interpreter Application



E-Medical Interpreter provides an application for the most common languages among the pilgrims' patients such as Arabic, English, French, Urdu, Hindi and Malay. Patients on a Yes, No format answer the questions in order to bridge the gap of communication regarding healthcare.

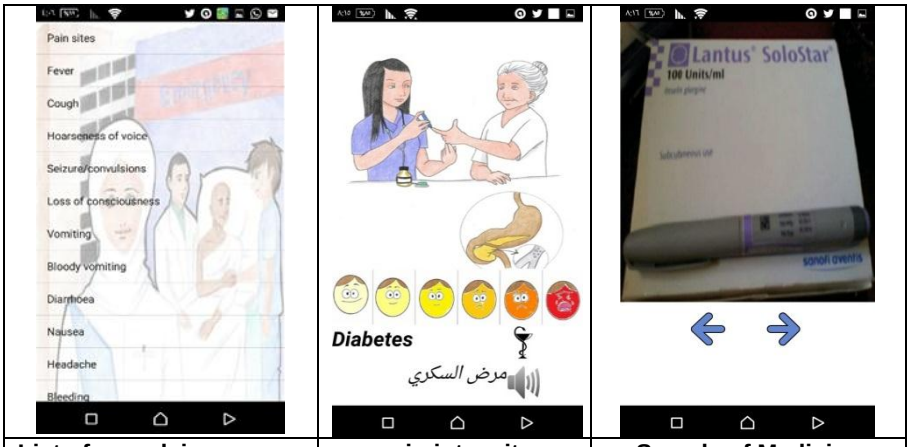
Accuracy and simplicity are put in mind throughout all stages of designing the application to deal with time issue during Hajj.

Figure 7: Main Interfaces of the application



List of Languages	List of targeted users	Choices for Doctors

Figure 8: Some features of the App

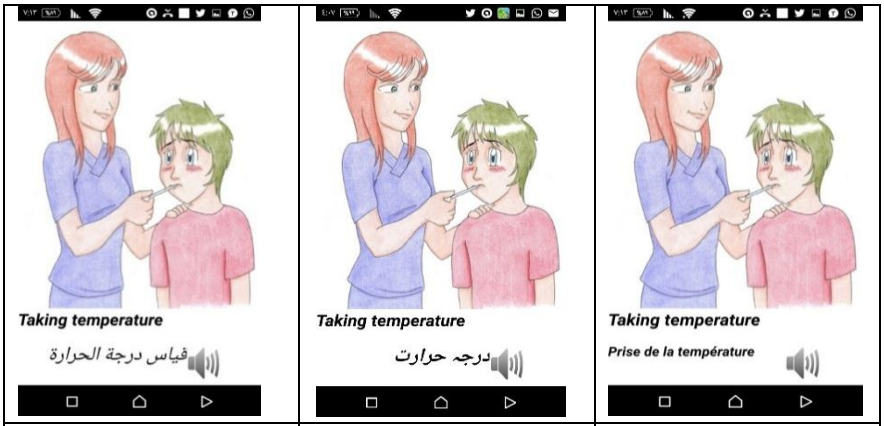


List of complains	pain intensity	Sample of Medicine

The App consists of two main sections for medical staff (doctors - nurses) as shown in Figures 1 and 2. The doctors can gain the patients' main 16 complains including pain sites, fever, cough, vomiting and bleeding.

Each symptom is described as an image supported with standard pain intensity measure to gain accurate information of the patients' health history, diagnose of diseases, and the delivery of medications and treatments. Voice icon is associated with every image to interpret the symptom to the patient. Figure 3 and Figure 4 present some of the features and examples of the application.

Figure 9: An example of vital sign in 3 languages



Arabic	Urdu	French

The Instrument

This current study uses a rubric as an evaluation sheet. (Mertler, 2001) defines a rubric as a rating scale as opposed to checklists or form of scoring instrument used when evaluating products resulting from a performance task.

The rubric consists of ten dimensions to evaluate the application as follows:

- Connected to the purpose,
- appropriate for the pilgrims,
- organization,
- navigation of the slides' flow,
- usability
- errors occurred,
- voice
- image
- satisfaction
- time required

Each dimension includes a statement that is rated on a five-point scale: 1= Strongly disagree 2= Disagree 3= Neither agree nor disagree 4= Agree 5= Strongly agree.

Validity of Rubric :

Rubric was shown to a group of professors from College of Computer Science and Engineering. They agreed on the appropriateness of the statements, and that all questions measure points of view about using App in the Hajj season. They agreed that it was suitable for the research sample as it was easy to understand. A few minor modifications were suggested and implemented.

The Sample

The sample was 50 doctors and nurses working in Makkah and Madinah hospitals. Out of 50 there were 14 doctors and 36 nurses. (Wang, 1998) states that selecting a sample randomly is easy to understand and the equations for determining sample size are relatively straightforward. The study was conducted in 1437 H (2015).

Result

Most of the samples (54%) had Android smart phone (Samsung, LG, Sony, HTC), while 46 % of them owned iPhone mobiles. More than half of the participants owned Android, which is considered a good indication for using the app. More details of mobile ownership are shown in Table 1.

Table 4: The type of mobile owned by the participants

Mobile	Doctors and nurses	
	Frequency	Percent
iPhone	23	46%
Android (Samsung, LG, Sony, HTC)	27	54%
Total	50	100%

Furthermore, most of the participants (64.6%) found according to their experience that Urdu was the most common language among patients, while (18%) found Malaya. A few revealed that Turkish pilgrims found difficulty in communication.

Regarding the use of E-Medical Interpreter Application (96%) medical staff found the content connected to its purpose and supported the idea of using the application especially in ER. Moreover, the majority of participants felt that using the application would be appropriate and facilitate communication with pilgrims. Regarding the organization and navigation of the slides' flow, the majority of participants (86%) believed that the application is clear and logically ordered.

While (92%) of participants revealed that the interface of the application was very easy to use and remember and can be launched within the app independently, (94%) of the sample found itwas easy to learn and understand. On the other hand, (20%) of medical staff indicated few errors occurred while they were using the application, as shown in Table 2.

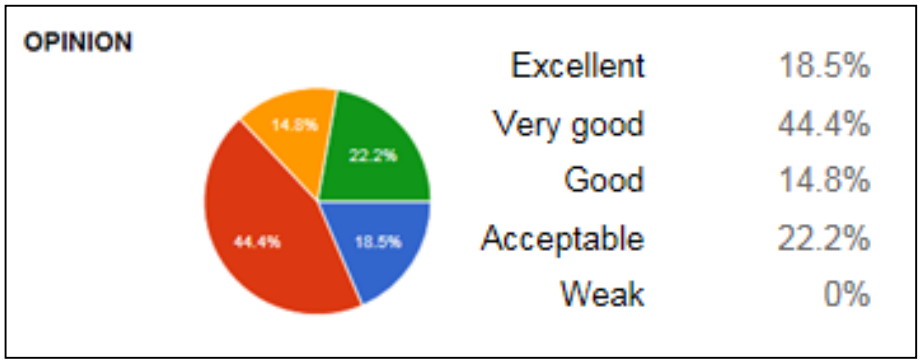
(70%) of participants indicated that the voice was clear and the images enhanced the content and created interest. The majority of participants (86%) were satisfied to use the application. According to the time, (94%) found the time to accomplish the tasks of the application was reasonably suitable and fast.

Table 5 Participants' point of view of using E-Medical interpreter

Statements	1	2	3	4	5
	Strongly disagree	**Disagree**	**Neither**	**Agree**	**rongly agree**
Connection to the purpose of App	1	1	0	24	24
Appropriate for pilgrims	1	0	3	26	20
slides' **organization** and navigation	0	2	5	22	21
Usability interface of the App	1	0	3	26	20
Understanding of the App	0	0	3	22	25
Errors occurred in using the App	3	5	2	30	10
Voice of the App	1	3	1	25	10
Images of the App	1	3	1	9	26
Satisfaction to use the App	0	3	4	21	22
The **time** to accomplish the tasks	1	1	1	26	21

In addition, doctors and nurses were asked to give their general opinion of the application. Figure 5 shows that participants liked using the application to facilitate the communication with pilgrims.

Figure 10: Overall opinion of the application



Conclusion and Recommendations

This descriptive study provides empirical evidence of how E-medical interpreter can be used to develop and facilitate communication during Hajj season, with practical suggestions for decision makers in the Hajj community to use the application. A rubric explores doctors and nurses perceptions about using the application. As the results show, both of them are encouraged to use the application and supported the idea especially in the ER. The power of E-medical interpreter relies on its simplicity through using the images and sounds in addition to its free cost.

Furthermore, the results emphasize that just over half of medical staff owned android, while the other half were using iPhone mobile. It is recommended to extend the app to involve iPhone devices since 46% of the users owned iPhone mobiles. It is recommended by participants to include the Turkish language in the application. Lack of the supported sounds for some languages are considered limitations, as indicated by errors occurred.

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Fifth Theme:

Technology & its Applications

Improving Hajj and Umrah Services Utilizing Exploratory Data Visualization Techniques

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Abstract

This paper proposes improving Hajj and Umrah services by benefiting from the development of the exploratory data visualization technology. We will describe the updated idea of data visualization, its difference from the normal explanoretory figures and how it is needed as a current effective exploration decision making solution using the huge amount of data (big data) gathered from all agencies serving Hajj and Umrah. The data visualization approach proves the concept by presenting some real exploratory global practical examples. We apply the technique to visualize some real data from 2015 Hajj season representing the numbers of people and services as well as accommodation of pilgrims in Makkah during the peak Hajj days. We also give a simplified theoretical example to illustrate the concept linking between pilgrims of different nationalities and their residence in Makkah beside the grand mosque (Al-Masjid Al-Haram). We show another exploratory data visualization example relating a virtual map of Mina (a 4-days Hajj living area) to improve civil defense system services providing the various civil defense stations with its specialized most probable needed equipments and number of employees.

Full text is available in Arabic section under title

الاستفادة من التمثيل المرئي للبيانات لتحسين خدمات الحج والعمرة

Health centers decision support system for disaster management in the Holy City

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Abstract

Potential safety and security risks of pilgrims during Hajj and Umrah seasons pose challenges to Saudi Arabia authorities. Medical centers in the Holy City of Makkah are ordered to provide all the required medical services needed to pilgrims during emergency. Therefore, disaster management planning is an important task to accomplish for the sustainability of these services by allocating the available resources (electricity and water). In this paper, we propose a decision support system that consists of an infrastructure interdependency simulator and a machine learning technique known as Reinforcement Learning. This system once implemented is capable to give the proper assistance to the concerned people in the medical centers. Similar work elsewhere has shown that medical services were boosted up because of the intelligent reallocation operation of the available resources. This approach can be adapted in the Holy City of Makkah to optimize the allocation of these resources during natural or man-made force majeure.

Full text is available in Arabic section under title

نظام دعم القرار للمراكز الصحية في إدارة الكوارث في العاصمة المقدسة

The Influence of the Modern Technologies on the Employment of Emergency Resources Management in Saudi Red Crescent Authority During Hajj 1436H

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Abstract

The study aims to reveal the impact of some modern technologies employment on the ambulance resources management through a way to acknowledge the informatics systems which contribute to expedite and facilitate the emergent response of medical services by the utilization of the caller location program and Call Canter technologies.

The study is meant to target some of the Communications and Information Technology group and the devoted effort at the operation room team.

The study methodology is specific using some of the analytical methods and designed as a descriptive survey, the main tool was an interviews and a questionnaire of the researcher's team which has been chosen randomly.

Results has been estimated depending on the direct interviews with supervisors of the information technology and operation room teams during the hajj season to point at the prepared questionnaire track which targets the workers at the operation room to devote these technologies. The research has debated two technologies which are the call system and the center caller location point out which considered to be the addend technologies to the task of the operation room.

The call center technologies attained a basic role at reducing the waiting time on phone so that the average of the response time recorded 5 seconds.

The questionnaires showed to the team working at the operation room some results about the user's impression dealing with these technologies who reached to 50 participants of the deported and the recipients. The technology event efficiency proponents rate was 92 % while 8 % are proponents to the non- efficiency of that technology.

The questionnaire findings of the impression to the caller location program users revealed that 75 % of the participants are using the program as a secondary step of report making and that's when they have a difficulty finding the location of the reporter. 21 % are non-users of the program 4 % are using the program firstly for all the reports, the efficiency of the program as the participant's opinion to that the program is barely valid while 16 % said its very good working while 14 % still can't realize the program efficiency.

The reasons revealed that the results which restrict the participants of using the program that 64 of them still with the idea of non-attachment of the program directly with the basic operations program is considered to be a main reason, also 47 of them have a connection problem, 41 % says it is a technical problem and 13% still don't know how to use it.

Constitute of the researcher overall impression that utilize of the technology need to train and definition and qualification to increase effectiveness, also how to adapt with those technologies and linked them programmatically by CAD system to contribute in improving the ambulance service by reduces the obstacles that may result from its use them.

The researcher recommends the necessity to develop a clear methodology for utilize those technologies in accordance with the training programs, with activation of the fact that the performance indicators able to measure the effectiveness of the product and employment.

Full text is available in Arabic section under title

أثر توظيف التقنية الحديثة في ادارة الموارد الاسعافية خلال موسم الحج 1436هـ

Regulating Access to El-Salam Gate in the Prophet's Mosque at Peak Times During Holidays using Simulation

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Abstract

Crowd simulations have been always essential tools that help in developing and understanding of crowd risks and safety for many of the world's largest events. Regulating the access to El-Salam gate in the Prophet's Mosque at peak times during holidays is a complex crowd dynamics analysis problem that requires special attention. Every day, thousands of visitors are keen to visit the Prophet and, consequently, need access to the El-Salam gate in order to start their visit. Computer simulation can be utilized as an important research tool in understanding the complexity of crowd dynamics across such a wide space. Simulating crowds' behavior in such a large-scale and in a complex environment presents a variety of challenges in representing the interrelated processes that characterize real-world interaction. This paper focuses specifically on the problem of simulating the dynamics of large, dense crowds in the area of El-Salam gate. Such crowds exhibit a low interpersonal distance and a corresponding loss of individual freedom of motion. Three different 3D simulating models are presented where concurrent groups of simulated agents interact in a modeled environment of El-Salam gate area with potential to enable direct acquisition of statistics and indications at levels of detail and accuracy. A series of simulation results are carried out for each scenario, in order to reflect the behavior of each model and to assess its effectiveness in improving the gate accessing process.

Keywords: crowd simulation, environment representation

Introduction

Over the past decades, a wide range of crowd simulation systems have been developed and applied to crowd safety for many of the world's largest events. Crowd simulations have been always essential tools that help in developing and understanding of crowd risks [1,2,3,4]. Methods of assessing crowd density and understanding of the rates at which spaces can fill is vital in order to understand and

avoid dangerous overcrowding. To do that, some basic information about the space a moving crowd occupies, the rates at which crowds can move, and the rates at which spaces can fill are needed. One solution has been to use crowd simulations. Moreover, they enabled us to experiment with a wide range of behavioral assumptions. Experimentations with crowds using a computer-generated environment can be conducted in a way that is not possible in real time, to get understanding of the interactions between crowds and their environment [2]. Using crowd simulations enable us to understand how risks develop into incidents and how incidents can escalate into disasters. However, simulation techniques have been expensive and time consuming.

Computer simulation utilizes mathematical models, which describe the crowd dynamics in addition to the way individuals behave in a range of situations [3]. The crowd simulation is limited by the assumptions of the mathematical model. A simulation process would not behave properly if built in an incorrect or unsuitable set of assumptions.

An important feature of crowd density and risk assessment is to determine which areas within the space will be of high density and which areas will be of lower density, and also to determine which areas are going to be standing and static, and which areas are going to be dynamic. For example, entry and exit gates would be predominately of higher density during ingress and egress, but low density at other times. Occasionally, there may not be time to react between the crowd entering the space and the space becoming too crowded. Therefore, real time monitoring and managing crowd flow and crowd density is essential for crowd safety.

Reviewing crowd accidents from around the world, as an example the accidents in [5], shows that deficient planning before events and unsatisfactory risk management during events are the common causes to major incidents and are the key points of failure.

Many research have been conducted to study the services presented in Al-Masjed Al-Nabawi [6,7]. Regulating the access to El-Salam gate in the Prophet's Mosque at peak times during holidays is a complex crowd dynamics analysis problem that requires special attention. Every day, many hundred thousands of visitors are keen to visit the Prophet and, consequently, need to access the El-Salam gate in order to start their visit. Computer simulation can be utilized as an important research tool in understanding the complexity of crowd dynamics across such a wide space. Simulating crowds' behavior in such large-scale and complex environment presents a variety of challenges in representing the interrelated processes that characterize real-world interaction.

A Major event, like visiting the Prophet's mosque at peak times during holidays, require a significant amount of planning. This process engage a wide range of organizers,

such as the emergency services, local authorities, and security authorities. During such special events, careful review of the risk analysis is critical; any risks missed during the planning process must be identified. If planning phase neglects risk assessment, risks may be realized during the operational phase of the event.

Crowd risk analysis should include the necessary examination of spaces for both static (standing) and dynamic (moving) crowds. These are spaces such as queuing systems, entry points, exit points, emergency access, etc. There is also a need for crowd monitoring and continual risk assessment during the operational phase of the event, for example, assessment of crowd flow rates for congestion during queuing, at entry points, congestion in critical locations, and whether the system is performing as planned.

This paper focuses specifically on the problem of simulating the inter-agent dynamics of large, dense crowds in the area of El-Salam gate. Such crowds exhibit a low interpersonal distance and a corresponding loss of individual freedom of motion. Three different 3D simulating models are presented where concurrent groups of simulated agents interact in a modeled environment of El-Salam gate area with potential to enable direct acquisition of statistics and indications at levels of detail and accuracy. A series of simulations are carried out, for each scenario, in order to reflect the behavior of each model and to assess its effectiveness in improving the gate accessing process.

The paper is organized as follows. Section 2 discusses problem description and crowd risk analysis. Section 3 describes the proposed scenarios. In Section 4, simulation results are presented. Finally, conclusions are drawn in Section 5.

Problem Description

To control entry to a gate, some sort of barrier or fence should be put around the site. The crowd needs to access the gates and leave the masjid area by another gate after the visit has finished. The entry and exit points will be of limited throughput, and they need to be of sufficient capacity to minimize the risk of crushing on entry or exit. These entry/exit points affect the rate of fill, and if the high-density areas fill too quickly the situation becomes of high risk.

Crowd Risk Analysis

For the crowd risk analysis, there are several considerations: site capacity, movement pathways, entry and exit systems, and facilities management during normal and emergency situations.

Site capacity: is typically calculated based on the available area, the suitability of that area, and the rates of evacuation in an emergency. Site capacity is also based on physical and safety considerations for a site. International guidance recommends

assessment of entry rates as an important safety factor that may reduce the overall site capacity if not sufficient to meet the arrival profile of the crowds.

Movement pathways: Arrangements that result in unbalanced use of entry or exit routes, dead ends, or similar confusing pathway choices, are not acceptable. Equally balanced entry and exit points are preferred over a single centralized location.

Entry and exit points: If the arrival flow rate exceeds the entry system capacity, then a queue will develop. In other words, people arriving at the back of the queue arrive more quickly than the people enter at the front of the queue (the people nearest the entry system). This results in a gradual build-up of crowd density (people per square meter) over time. As the crowd/queue size grows, the density at the front part of the queue will be compressed. This increases the crowd density (people per square meter) and exposes the crowd to risk of crushing. As crowd density increases to above six or seven people per square meter, the crowd reaches a point at which individuals experience physical contact and pressure. Continuous exposure to this pressure affects the crowd behavior, and there is an inherent risk to life. Those individuals at the front of an entry system queue can become trapped. They cannot remove themselves from the system, as the back of the queue is moving towards the entry point.

Crowd Flow to El-Salam Gate

During holidays, at peak times, regulating the access to El-Salam gate requires special attention. In order to control entry to that gate, some sort of barrier or fence is put around the site. The entry and exit points will be of limited throughput, and they need to be of sufficient capacity to minimize the risk of crushing on the entry point. The usual setup of fence that is used for controlling crowd flow is shown in Fig. 1.

Fig. 1: The fence that is put around El-Salam gate site for controlling crowd flow.

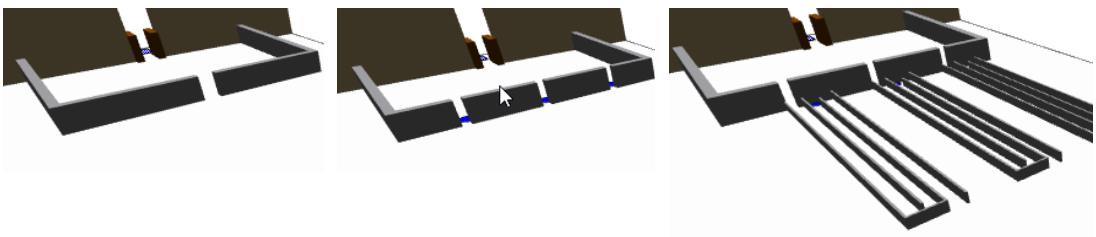
Proposed Scenarios

As mentioned earlier, in order to control entry to El-Salam gate, some sort of barrier or fence is put around the site. Accessing the closed fence (shown in Fig. 1) is controlled through a doorway (or more) in the front side of the fence.

Three different 3D simulating models are presented, where concurrent groups of simulated agents interact in a modeled environment of El-Salam gate area with potential to enable direct acquisition of statistics and indications at levels of detail and accuracy. The three scenario are as follows:

- Scenario 1: the front side of the fence has one doorway of width 2 m., as shown in Fig. 2-a; this is the usual scenario that is already used.
- Scenario 2: the front side of the fence has three doorways, each of width 1 m, as shown in Fig. 2-b.
- Scenario 3: the front side of the fence has three doorways, each of width 1 m and are accessed through a zigzag-shaped track (3 sides) of length 30 m and width 1.5 m, as shown in Fig. 2-c.

The behaviors of these scenarios are examined in the next section.



(a) Scenario 1 (b) Scenario 2 (c) Scenario 3

Fig. 2: Three different scenarios for controlling crowd flow to El-Salam gate.

Simulation Results

A series of simulations are carried out, for each scenario, in order to reflect the behavior of each model and to assess its effectiveness in improving the gate accessing process. Experiment time, for each simulation is 16:40 min, while the total number of agents that entered the simulation session is 10000 persons (i. e., 600 person/min).These 10000 persons are uniformly distributed on the available doorways. Some simulations results of the three aforementioned scenarios are calculated; these results include:

- Crowds' distributions after several time intervals (2 min, 4 min, and 6 min), in 2D and 3D,

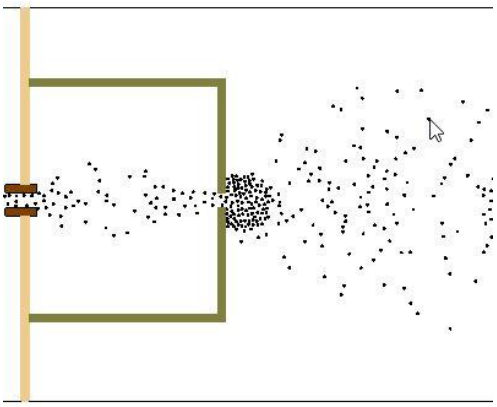
- Average density per time interval,
- Travel time statistics.

Results of Scenario 1:

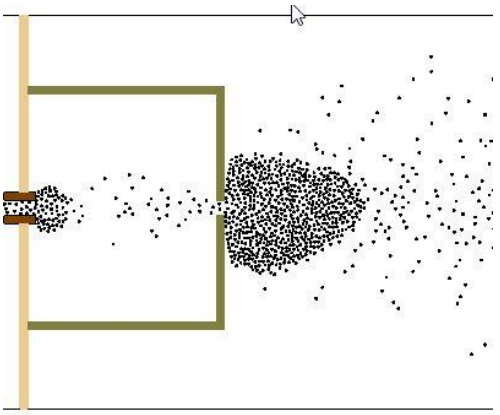
The calculated statistics are listed in Table 1, while simulation results are shown in Fig. 3.

Table 1: The calculated statistics of Scenario 1

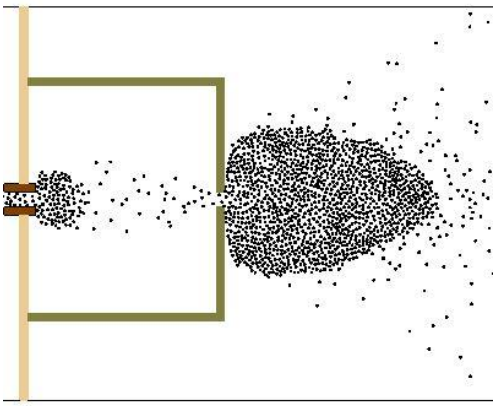
Experiment time	00:16:40
Total number of agents	10000
Number of agents reached the destination	2135
Average travel time	00:07:13
Maximum travel time	00:14:35
Minimum travel time	00:01:31



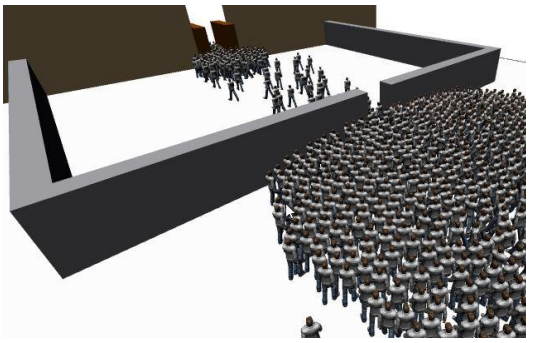
(a) Crowds distribution after 2 mins.



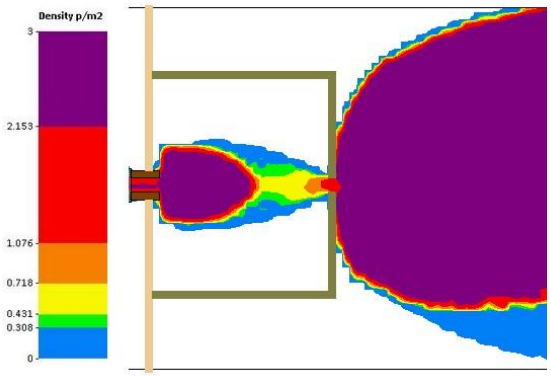
(b) Crowds distribution after 4 mins.

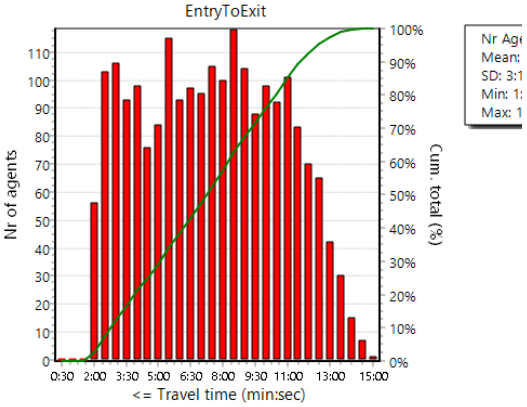


(c) Crowds distribution after 6 mins.



(d) Crowds distribution after 6 mins, in 3D.





(e) Average density per time interval **(f) Travel time statistics**

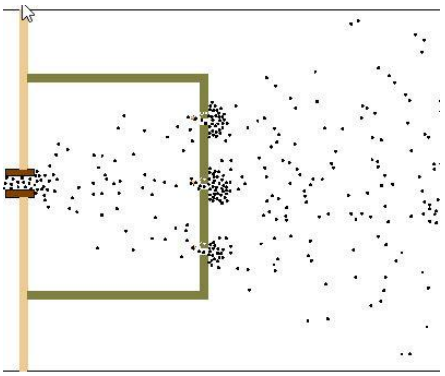
Fig. 3: Simulation results of Scenario 1

Results of Scenario 2:

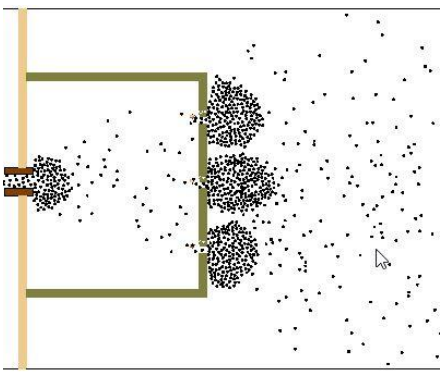
The calculated statistics are listed in Table 2, while simulation results are shown in Fig. 4.

Table 2: The calculated statistics of Scenario 2

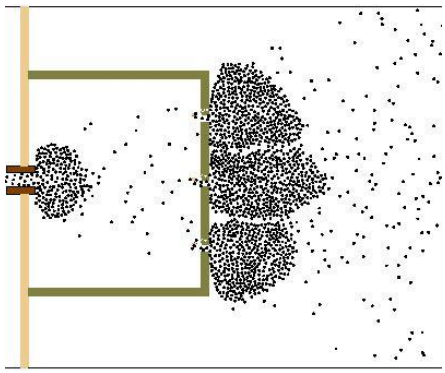
Experiment time	00:16:40
Total number of agents	10000
Number of agents reached the destination	2159
Average travel time	7:13
Maximum travel time	15:00
Minimum travel time	1:30



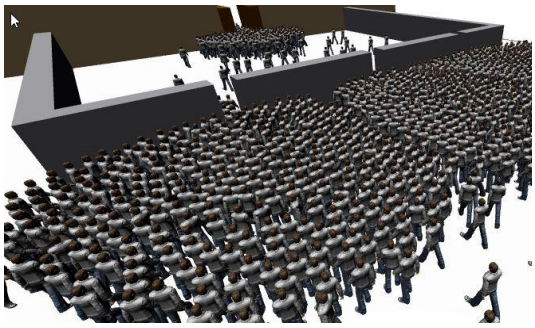
(a) Crowds distribution after 2 mins.



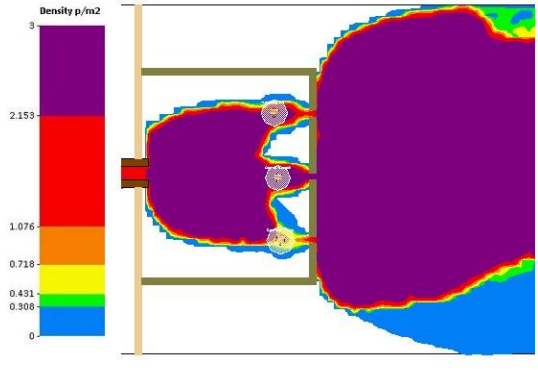
(b) Crowds distribution after 4 mins.



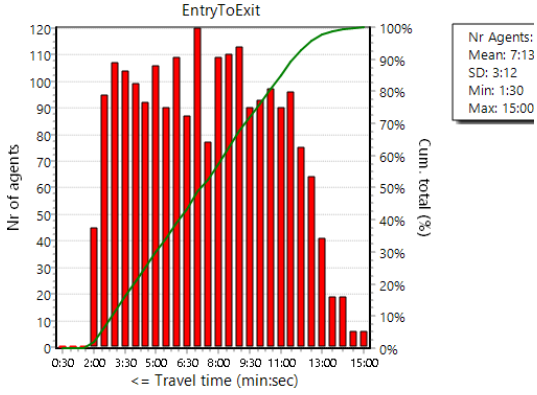
(c) Crowds distribution after 6 mins.



(d) Crowds distribution after 6 mins, in 3D.



(e) Average density per time interval



(f) Travel time statistics

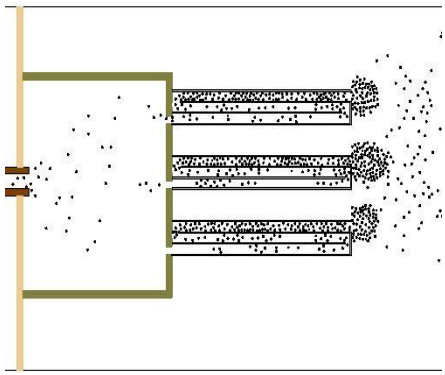
Fig. 4: Simulation results of Scenario 2

Results of Scenario 3:

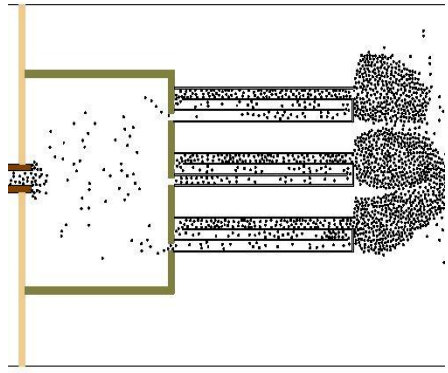
The calculated statistics are listed in Table 3, while simulation results are shown in Fig. 5.

Table 3: The calculated statistics of Scenario 3

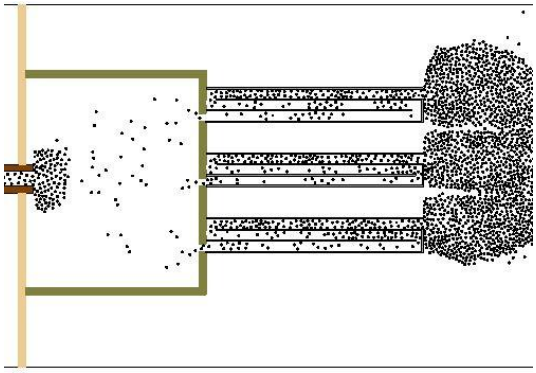
Experiment time	00:16:40
Total number of agents	10000
Number of agents reached the destination	2005
Average travel time	00:07:48
Maximum travel time	00:14:58
Minimum travel time	00:02:19



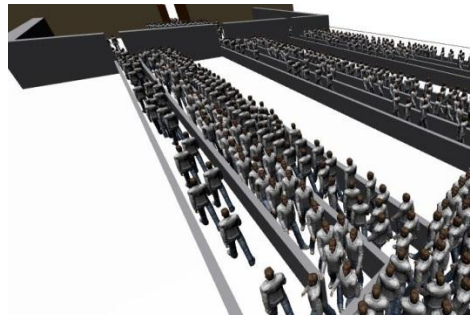
(a) Crowds distribution after 2 mins.



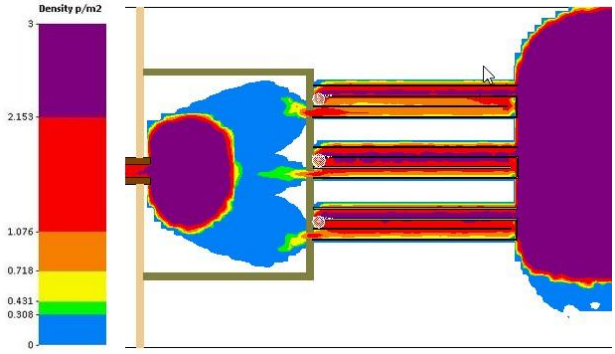
(b) Crowds distribution after 4 mins.



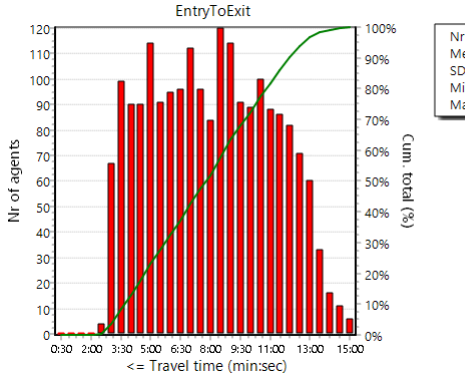
(c) Crowds distribution after 6 mins.



(d) Crowds distribution after 2 mins, in 3D.



(e) Average density per time interval



(f) Travel time statistics

Fig. 5: Simulation results of Scenario 3

As crowd density increases, the crowd reaches a point at which individuals experience physical contact and pressure. Continuous exposure to this pressure increases risk to life. Those individuals at the front of the doorways can become trapped. They cannot remove themselves from the system, as the crowds are moving towards the entry point.

It can be seen from the aforementioned results that, in order to keep the queue (crowd density) small at the entrance of El-Salam gate, the crowd flow rate to the closed fence in its area should be controlled. This can be achieved by using the arrangement of Scenario 3, which can keep the high density of crowds away from the front of the doorways area. This can also provide a certain degree of safety when the arrival flow rate exceeds the capacity of the entry system at entrances of the zigzag-shaped tracks.

Conclusions

In this paper a simulation of the problem of the dynamics of dense crowds in the area of El-Salam gate has been presented. Three different 3D simulating models have been discussed where concurrent groups of simulated agents interact in a modeled environment of El-Salam gate area with potential to enable direct acquisition of statistics and indications at levels of detail and accuracy. A series of simulation results are carried out, for each scenario, in order to reflect the behavior of each model and to assess its effectiveness in improving the gate accessing process. The simulation results showed that Scenario 3 can keep the crowd density low at the entrance of El-Salam gate, while providing a certain degree of safety at entrances of the zigzag-shaped tracks.

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Modelling PM10 emissions from Fossil Fuels Combustion Using ADMS-Urban in the Holy City of Makkah – A Focus on Hajj and Umrah Seasons

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Abstract

Makkah experiences high levels of atmospheric Particulate Matter (PM) emitted by various sources including re-suspension, construction-and-demolition activities, windblown particles and combustion of fossil fuels. During Hajj and Ramadhan seasons millions of Muslims from around the world visit the Holy City of Makkah to perform Hajj and Umrah, which put extra burden on the available resources. Energy consumptions and the number of road vehicles are increased by several folds, resulting in a large amount of pollutant emissions in the city, which requires effective monitoring and modelling programmes. In this paper the emissions of PM with aerodynamic diameter up to 10 µm (PM10) from the burning of natural gas, petrol, and diesel consumed in residential houses, road traffic and electricity generation are modelled in Makkah for year 2015, applying Urban Atmospheric Dispersion Modelling System (ADMS-Urban). Natural gas is mostly consumed in residential houses and restaurants, whereas petrol and diesel are predominantly used for road traffic and electricity generation. The highest amount of PM10 (tons) was emitted from the combustion of diesel used for electricity generation (330174), followed by diesel used in heavy duty vehicles (171), petrol used in light duty vehicles (48) and natural gas (< 1). Road traffic counts, fleet composition and vehicle speed data were not available in Makkah, therefore emissions were input as grid sources into ADMS-Urban. The outputs of ADMS-Urban are presented as contour maps for various emissions and meteorological scenarios. Modelled and observed PM10 concentrations are compared and discussed. ADMS-Urban model is run for the first time to model the levels of PM10 in Makkah, which will help in determining the emission sources and lead to better air quality management in Makkah, especially during Hajj and Umrah seasons.

Key words: ADSM-Urban, PM10, Air Quality Modelling, Makkah, Air Pollutant Emission, Hajj and Umrah.

Introduction

Particulate Matter (PM) is considered one of the most vital atmospheric pollutants in terms of its detrimental biological and non-biological impacts, including human health, vegetation, visibility, and ecosystem (AQEG, 2005). Atmospheric particles are found in different sizes and have different physical and chemical nature. The effect of PM on human health depends on the particles size, their atmospheric concentrations and chemical composition. The fine PM can penetrate deeply into the lungs, where they may remain embedded for long periods of time or might be absorbed into the bloodstream (AQEG, 2012; COMEAP, 2010). Prolonged exposure to fine PM can be linked to a variety of health problems including irregular heartbeat, aggravated asthma, decreased lung function, increased respiratory symptoms, such as irritation of the airways, coughing or difficulty in breathing, nonfatal heart attacks, and premature death in people with heart or lung disease (TCEQ, 2015; COMEAP, 2010). Furthermore, atmospheric PM can deposit on water bodies and on vegetation harming ecosystems and crops (Harrison, 2001). PM can also stain and damage stone and building materials, including culturally important objects such as statues and monuments (Harrison, 2001).

Recently several investigations have been made in Makkah and other cities of Saudi Arabia to investigate spatial and temporal variability of PM, quantify its emission sources, and determine various factors affecting its concentrations (e.g., Mohammed et al., 2015; Munir et al., 2013 a & b; Khodeir et al 2012). Makkah is one of the busiest cities in the world. Every year millions of people visit the city to perform Hajj and Umrah. This puts extra burden on the resources of Makkah, including energy consumption and road traffic. High fuel consumption for power generation and in road traffic result in large amount of air pollutant emissions during Hajj and Ramadhan seasons (Al-Jeelani 2009; Othman et al. 2010; Seroji 2011; Munir et al. 2013a; Munir et al. 2013b; Habeebullah 2013a; Habeebullah 2013b). PM10 concentrations in Makkah exceed air quality standards set for the protection of human health. The reasons for the high PM concentrations are most probably high volume of road traffic, construction-and-demolition work, resuspension of particles, windblown dust and sand particles, and geographical conditions (arid region) with hot temperature and low rainfall (Khodeir et al. 2012; Munir et al 2013b). Furthermore, it is reported that the concentrations of PM10 in Makkah have increased during the last 15 years or so (Munir et al., 2013b).

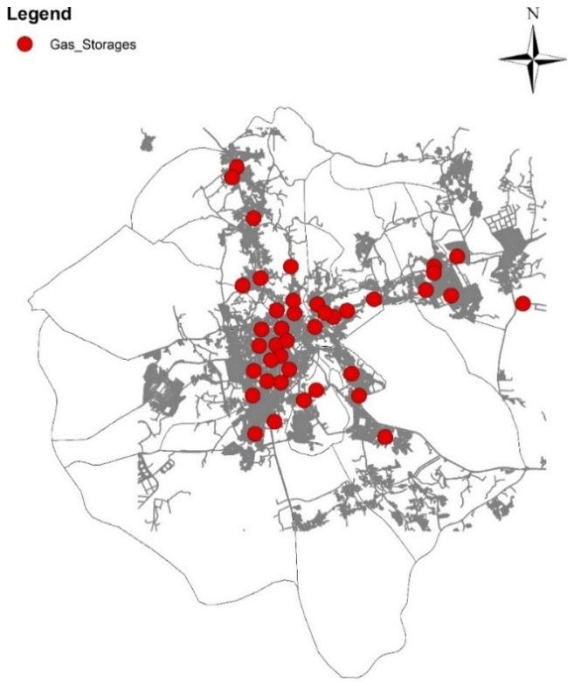
Previously several authors (Munir et al., 2013a; Sayegh et al., 2014) have modelled PM_{10} concentrations in Makkah applying statistical modelling techniques, including Generalised Additive Model, Quantile Regression Model, Multiple Linear Regression Models and Boosted Regression Trees. Further investigations are required to analyse the health impacts of PM_{10} and model its emission sources applying dispersion modelling techniques. In this study Urban Atmospheric Dispersion Modelling System

(ADMS-Urban) has been applied for the first time in Makkah to model PM_{10} emissions from the combustion of fossil fuels, such as natural gas, petrol and diesel consumed in residential houses, road traffic, and electricity generation.

Methodology

Fuel Data

In this paper PM_{10} emissions from combustion sources, including road traffic, electricity generation and residential combustion of natural gas, petrol, and diesel are modelled applying ADMS-Urban. The data of petrol, diesel and natural gas consumed in Makkah during 2015 are collected. Fuel stations (both diesel and petrol) and natural gas storages, where natural gas cylinders are filled (exchanged) are shown in Figure 1. In Makkah there are 137 fuel stations and 40 natural gas storages. Total amount of natural gas, petrol and diesel are determined and the amount of PM_{10} emission was estimated using emission factors. Emission factors were downloaded from the United Kingdom National Atmospheric Emission Inventory (NAEI, 2013) website. Emission are formatted as required by ADSM-Urban model. Road traffic characteristics, such as fleet composition, traffic counts and vehicle speed are not available in Makkah, therefore emissions are modelled as grid sources. Emissions from power plant are firstly entered and modelled as grid sources. However, power plant is also modelled as a point source separately in the second run.



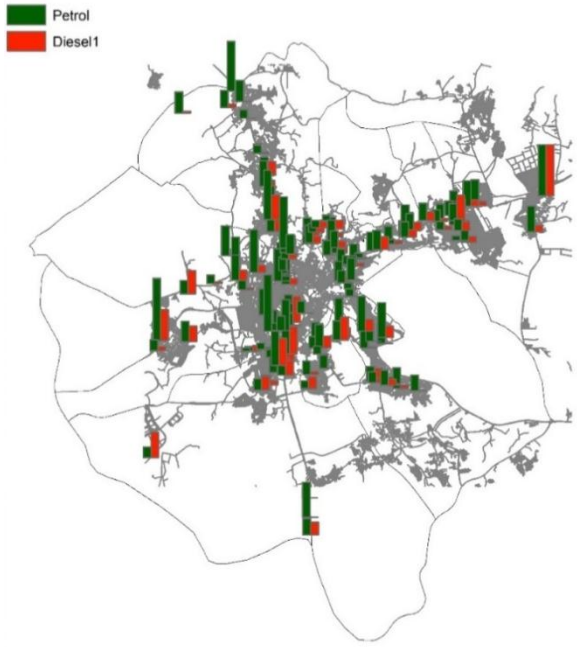


Figure 1. Gas storage sites (upper-panel), petrol and diesel stations (lower-panel) in Makkah

ADMS-Urban

ADMS-Urban has been developed commercially by Cambridge Environmental Research Consultants (CERC) and has been updated regularly since the early 1990s. The most recent version (Version 3.4) has been used throughout this paper. ADMS-Urban models the atmospheric dispersion of pollutants released from industrial, domestic and road traffic sources in urban areas. ADMS-Urban is designed to model dispersion from a single isolated point source or a single road as well as dispersion from a complex urban scenarios having multiple industrial, domestic and road traffic emissions over a large urban area. The ADMS-Urban can be applied in the following cases: (a) Developing and testing policy on air quality; (b) Development of air quality action plans; (c) Investigation of air quality management and planning options for a wide range of sources including transport sources; (d) Source apportionment studies; (e) Air quality and health impact assessments of proposed developments and use of the model for the provision of detailed street-level air quality forecasts (CERC, 2014). To predict the concentrations of pollutants, ADMS-Urban uses: (i) Relevant meteorological parameters, such as wind speed and direction, temperature, relative humidity, cloud cover, boundary layer height and temperature; (ii) Emissions and activity data e.g., traffic, industrial, area and grid sources; (iii) background air pollutants data (optional, unless modelling chemistry); and (iv) Grid or specified points where the model outputs are to be presented.

Emission data from natural gas, petrol and diesel combustion are calculated for the whole Makkah city (see Table 1). Natural gas is mostly consumed in residential house, petrol in light duty vehicles and diesel in heavy duty vehicles and power plants. PM_{10} emissions were calculated (Table 1) and imported to ADMS-Urban as emission inventory. Meteorological data were available in Makkah from several monitoring stations run by the Custodian of the Two Holy Mosques Institute for Hajj and Umrah Research, Umm Al-Qura University Makkah. Several emissions and wind direction scenarios are tested to model their effect on PM_{10} concentrations.

Results and Discussions

The fuel consumption data were collected from various petrol and diesel filling stations in Makkah. Natural gas is mainly used in residential houses and restaurants, petrol in light duty vehicles and diesel in heavy duty vehicles. Diesel is also used for electricity generation in the power plants in Makkah. Makkah has 1.7 million population using annually 7800 kwh electricity per person (Statistical Year Book, 2014), resulting in total of 13260000000 kwh electricity usage per year.

Emissions of PM_{10} from various fuel types are presented in Table 1, which shows that in 2015 PM_{10} emission was 47.52 tons from petrol, 171 tons from diesel, < 1 ton from natural gas, and 330174 tons from power plants using diesel as fuels for electricity generation. It shows that most of the PM_{10} emission come from electricity generations. Total emissions and emission rates are also given in Table 1. Emissions were input as grid sources (0.0000087306 $g/m^2/s$) into the ADMS-Urban model.

Table 1. Emissions of PM_{10} from various sources in Makkah for 2015.

Pollutant	Emission Factor (EF) (Kton/megaton)	Fuel consumption (Mton)	Emission (Kton)	Emission (ton)
PM_{10} from Petrol	0.021	2.254	0.047	47.52
PM_{10} from Diesel	0.249	0.688	0.171	171.04
PM_{10} from Natural Gas	0.00005	0.23998	0.00001	0.01
PM_{10} from Power Generations	0.249	1326	330.174	330174.00
Total Emissions (in tons)				330392.57
Emission Rate ($g/m^2/s$)				0.0000087306

Figure 2 shows the output of ADMS-Urban model, using emissions from natural gas, petrol and diesel, which were input as grid source (scenario 1). Annual average PM_{10}

estimated concentrations (µg/m^3) ranged from 11.08 to 12.10. Wind direction 211^o and wind speed (1 m/s) was used in the model as input, which are average values for 2015. Other parameters are shown in the captions of Figure 2. Figure 2, shows the pattern as to how PM_{10} particles are dispersed, affecting the downwind areas of Makah the most, mainly the north-eastern parts of the city. These values are much lower than the European Union (EU, 40 µg/m^3) and Saudi Arabia (80 µg/m^3) annual air quality limits and, therefore are unlikely to have negative impacts on human health. The values are lower because in this model run we modelled only emission from traffic and residential houses, excluding emission from power generation.

Figure 3 shows a contour map as an output of ADSM-Urban model run, using a different emissions scenario (scenario 2). In scenario 2 in addition to scenario 1, emissions from power plant using diesel as fuels are included in the model. Again all emissions are input as a grid source. Meteorological parameters are kept the same as in Figure 2. Here the maximum level of PM10 concentration (µg/m3) has increased up to 350. Because the model uses the same meteorological parameters as earlier, the PM10 spatial trend seems the same, however the levels are much higher. Maximum levels exceed both EU and Saudi Arabia air quality standards. This should be noted the power plants is situated toward the north, outside of the main Makkah city. In real world situation, the emissions from the power plants should be modelled as point source, which will have a different dispersion pattern than using the emissions as a grid source. This is, therefore, over estimating PM10 concentrations in Makkah.

Figure 4, presents the outputs of the ADMS-Urban model using power plant as a point source, and emissions from other sources as grid sources (scenario 3). Here we modelled 2 wind directions: (a) using wind direction 211^o i.e. actual data for 2015 and (b) wind direction 0^o or 360^o i.e. assumed northerly wind. Using wind direction 211^o, the emissions from the power plant are disperse away from the city and most of the city is not affected by the emissions. In this scenario the predicted PM_{10} concentrations (µg/m^3) are below the EU and Saudi Arabia air quality standards. However, when the wind was assumed to be blowing from the north (0^o), the emission are dispersed toward the Makkah city. In this case the main Makkah city is experiencing a high levels of PM_{10} pollution, reaching as high as 960 (µg/m^3).

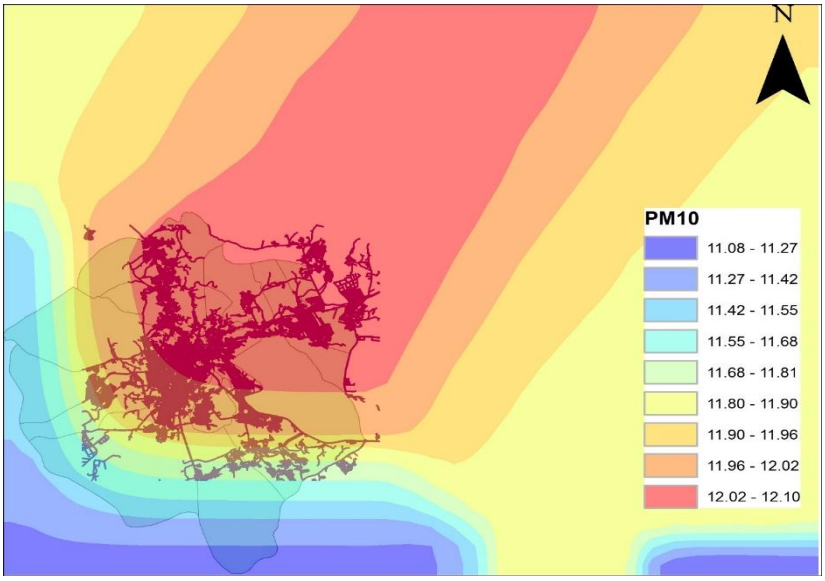


Figure 2. Contour map of modelled PM_{10} ($\mu g/m^3$) in Makkah 2015 presenting ADMS-Urban outputs using petrol, diesel, and natural gas emissions and meteorological parameters (WS = 1 m/s, WD = 211°, Temp = 32°C, Relative Humidity = 51 %, Cloud Cover = 0, and Boundary Layer Height (BLH) = 800 m).

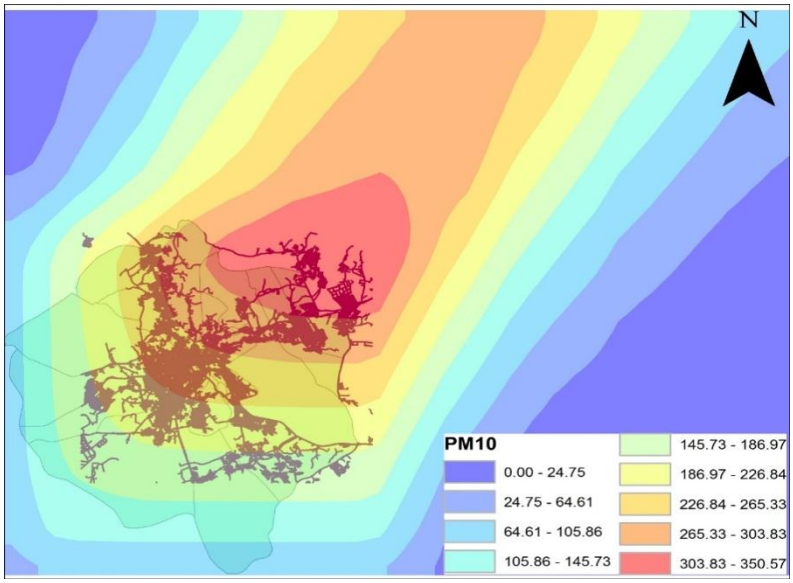


Figure 3. Contour map of modelled PM10 (µg/m3) in Makkah 2015 presenting ADMS-Urban outputs using petrol, diesel, natural gas, electric generation emissions and meteorological parameters (WS = 1 m/s, WD = 211o, Temp = 32oC, Relative Humidity = 51 %, Cloud Cover = 0, and Boundary Layer Height (BLH) = 800 m).

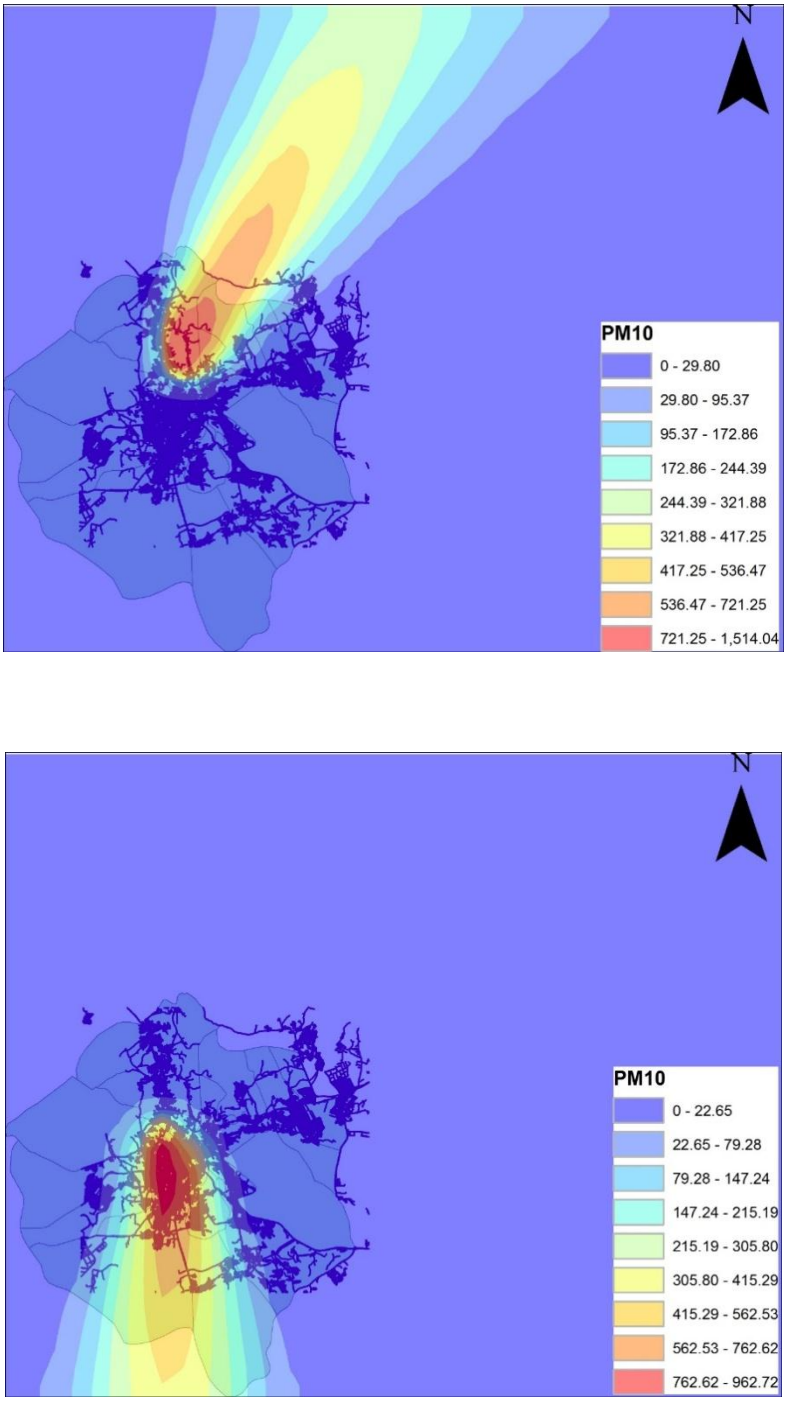


Figure 4. Contour map of modelled PM10 (µg/m3) in Makkah 2015 presenting ADMS-Urban outputs using petrol, diesel and natural gas as grid source and electric generation emissions as point source along with meteorological parameters (WS = 1 m/s, Temp = 32oC, Relative Humidity = 51 %, Cloud Cover = 0 and BLH = 800 m): (a) upper panel - wind direction 211o; lower panel -wind direction 0 or 360o.

The modelled (scenario 2) and observed PM_{10} concentrations ($\mu g/m^3$) are compared. The observed data were used from PME (Presidency of Meteorology and Environment) monitoring stations, except for 2015. Data for 2015 came from a background monitoring stations, situated in a rural background location away from the main city of Makkah. PME sites is situated next to the Holy Mosque (Al-Haram) in the centre of Makkah, data for 2015 are not available from this site. Therefore, PM_{10} concentrations are obtained from the background site, where understandably PM_{10} levels are much lower. PM_{10} concentrations for other years (2012 – 2014) are greater than the modelled level, which is expected because the model does not include background concentrations, which come from construction-and-demolition activities, windblown dust particles and resuspensions. Mean and maximum modelled PM_{10} values were 136 and 351, respectively. Observed PM_{10} values varied during different years, where mean value ranged from 27 to 185 and maximum value ranged from 231 to 821 (Table 2).

Table 2. Comparison of modelled (scenario 2) and observed PM_{10} concentrations ($\mu g/m^3$).

Year	Min	Mean	Max
2012	3	165	821
2013	8	185	480
2014	6	169	513
2015	0	27	231
Modelled	0	136	351

During the Hajj season the population of Makkah is more than doubled. From 2012 to 2015 the number of pilgrims (in millions) were 3.16, 1.98, 2.08, and 1.95, respectively. The average number of pilgrims during the last 4 years is just over 2 million, which is more than the Makkah population (1.7 million). This is not difficult to comprehend how this would affect the energy, food and transport requirements in Makkah during the Hajj season. Increasing demand for these resources would simply increase the pollutant emissions by a factor of 2, which will double the atmospheric concentrations of PM_{10} in Makkah. Similar situation occurs in Ramadhan. However, further detailed work is required to quantify emission from every individual source, including road traffic, restaurants, construction-and-demolition activities, windblown dust, power plants and other major and minor point, line and area sources.

Conclusions

In this paper the emissions of PM10 have been modelled from combustion of major fossil fuels, such as petrol, diesel and natural gas. Natural gas and petrol are mostly burnt in residential houses and light duty vehicles, respectively, whereas diesel is used in heavy duty vehicles and power plants. Employing ADMS-Urban model the emission of PM10 are modelled to estimate PM10 concentrations under various emission and wind direction scenarios. Makkah experiences highest PM10 concentrations when wind is blowing from the north and emissions from the power plant are treated as point source. In contrast, when the wind direction is changed to south, keeping power plant emission as point source, the levels of PM10 decrease drastically. PM10 concentrations are estimated to be more than doubled during the season of Hajj and Umrah as about 2 million people visit Makkah during the season of Hajj, which more than doubles the requirements of road traffic, energy and food consumptions.

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Sixth Theme:

Working Papers: The Efforts & Experience in Service Development

Working Paper: Sectors Collaboration to Organize Pilgrims Shuttles for Performing Prayers

Esam Tunisi

The High Commission for Monitoring Transportation of Pilgrims

Abstract

The paper aims to shed light on the experience of the high authority for monitoring pilgrims transport in improving the performance of public transport services to and from the Holy Mosque during pilgrimage season in 1436 H. The study illustrates the operational integration of the functions and responsibilities of both partners and operators to achieve their target and to explain the elements of operational management as well as geographically map the distribution of the public transport routes and standard tours. In addition, it illustrates the benchmarking of service implementation and completion percentage. Results showed the executive summaries and statistics regarding the number of pilgrims, the impact of improved transportation standard rates for certain tracks to speed up evacuation of the transport terminals after prayers, high transfer rates and high numbers of some groups of pilgrims are covered by public transport compared to the pilgrimage season in 1435, and increased demand for certain public transport stations around the Haram area. The paper recommends utilizing the mechanisms and consequence of applying the service as a field experiment on Makkah for permanent public transport and integrated bus and train services.

Full text is available in Arabic section under title

تكاملية القطاعات لتنظيم خدمة نقل الحجاج لأداء الصلوات

Working Paper: The Means Used to Communicate with the Visitors and Prayers at Al-Masjid An-Nabawi

Ali Solieman Alobied

Deputy of presidency of al-Masjid an-Nabawi affairs, The General Presidency for Al-Masjid Al-Haram and Al-Masjid al-Nabawi Affair

Abstract

The researcher tried to demonstrate the most common means of communications that is used by the deputy of al-Masjid an-Nabawi (The Prophet's Mosque) affairs under supervision of presidency for the affairs of the two holy mosques. He started with a brief introduction of Medina's importance as a religious site due to the presence of al-Masjid an-Nabawi. A great consideration is given to al-Masjid an-Nabawi and to the prayers and visitors. They are categorized into four means: the first one is learning (knowledge), which is concerned with khutbahs, lessons, quran memorizing symposium, books symposium, questions answering, al-Masjid an-Nabawi institute/college, khutbahs translations, al-Masjid an-Nabawi library and al-Masjid an-Nabawi Academy. The Second one is the Information technology, which is concerned with electronic screens, SMS, electronic gate, E mails, smart applications, electronic services and social channels. Third one is the general services, which include receiving and bidding farewell to the visitors, Books giving, pamphlets giving, visitors transportation, visitors guiding, advisors appointments, and crowd management. The fourth one is media, which is concerned with the broadcast news, regular message named "the massage of two holy mosques", regular peer reviewed journal named "journal of the two holy mosques", permanent exhibition for building and expansion of al-Masjid an-Nabawi, always keeping the slogan (serving pilgrims and visitors is an honor for us).

Full text is available in Arabic section under title

وسائل الاتصال بالزائرين والمصلين

بالمسجد النبوي

Working Paper: Pairing Al-Mashaer Hospitals with Makkah Hospitals and King Abdullah Medical City

Hasn Alwtishi, Abdullah Khan

Medical Engineering Department, King Abdullah Medical City

Abstract

The seasonal work in the Holy Makkah hospitals during the Hajj season requires concerted efforts and enormous expenditures of money for equipping and maintaining the hospitals with the required devices so the pilgrims can be served at full capacity and to provide them with the required care. In this sense, the engineering research efforts should focus on improving services and balancing the human resources. As a result, the idea of pairing the hospital services in Makkah can be provided in; Pairing general maintenance work, Pairing of biomedical engineering management, and Pairing supply. First, pairing the general maintenance work, which can be accomplished by referring maintenance contracts of Holy Site's hospital to a referenced hospital within the area. For instance, the referenced hospital shall prepare the action plan for the targeted hospital in the Holy Sites (Al-Mashaer) and supervise its implementation according to a specific timetable, such as; scheduling and performing of preventive periodic maintenance (ppm), follow-up corrective maintenance, assuring the functionality of the devices; and supplying spare parts. Second, pairing the biomedical engineering sector, which can be accomplished by letting the biomedical engineering department of the referenced hospital, to be fully responsible for medical equipment of the Al-Mashaeer hospital from preparation, installation, and operation of the equipment to packaging and storage at the end of the season. The responsibility shall include performing the needed preventive maintenance as well as following up with the spare parts and closing the corrective work orders and preparing the sites in accordance with close supervision throughout the year. Finally, pairing the medical supply sector, that applies to the medical supply and all of its branches. It can be accomplished by estimating the actual need as well as the reserve by calculating the actual cost of the expense for each patient with the expected cases according to the previous statistics of past seasons. Doing so will minimize the cost and wastage of public resources. It is already clear that Pairing departments process all of which is intended to develop action plans and implement strictly according to business needs and take advantage of scientific expertise in the facilities of a continuous work which requires the development of an ongoing plans for

each hospital in the holy sites before seasonal operation, after seasonal operating and during seasonal operation.

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توأمة مستشفيات المشاعر المقدسة مع مستشفيات العاصمة المقدسة ومدينة الملك عبد اللّه الطبية

Working Paper: Contemporary Challenges for the Promotion of Virtue and Prevention of Vice - A Field Study During the Pilgrimage Season of 1436 AH

Nasser Bin Othman Al-Zahrani

General Supervisor of the Promotion of Virtue and Prevention of Vice in the Grand Mosque, Director of The Holy Mosque Academy

Abstract

This paper addresses the task of the propagation of virtue and the prevention of vice, as one of the main of guidance messages in the Holy Mosque, which is built on the contribution of all those interested in the affairs of the Two Holy Mosques in the achievement of this message to the convenience and benefit to the Attendees. This article discussed three of the main issues, namely; (1) not to kiss the black stone because of the crowd, with a description of the current situation, the pros and cons, and the proposal for adding a plastic barrier, which starts from the half distance of the western end until the black stone, with a description of its expected negative impacts, (2) photographing in Mataf area and how it affects the pilgrims, and the proposition to prevent it through posting guidance signs outside the Mataf area, and (3) Continuity of reformer person in the advising, directing and guiding processes without delay. In addition to clear the solutions through discussion and sharing the ideas to find best solutions that concluded with the suggestions and recommendations. Then at last, God's blessings and peace upon the Prophet Muhammad.

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تحديات معاصرة لهيئة الأمر بالمعروف والنهي عن المنكر دراسة ميدانية خلال حج عام 1436هـ

Working Paper: The Committee for the Promotion of Virtue and the Prevention of Vices' Evaluation of the Establishment of Small Exhibitions in the Holy Mosque for Pilgrim's Education During 1436 H

Ibrahem M. Shebah

Presidency for Al-Masjid Al-Haram and Al-Masjid al-Nabawi Affair

Abstract

The government of Saudi Arabia is working hard towards hosting, serving and educating pilgrims during every month of the year. The amount of pilgrims varies from month to month and season to season. Their number increases mainly during the month of Ramadan and Hajj and sometimes during the mid-term holidays. In the year 1436 H, the Committee for the Promotion of Virtue and the Prevention of Vice of the Holy Mosque has started serving the guests through giving them information about the correct performance of umrah through some small exhibitions taking place inside the Holy Mosque, where the number of pilgrims per day (except for Ramadan) may reach up to 25,128. The goal of this study is to identify the aims of such exhibitions and identify the programs presented to establish the methods of these exhibitions to achieve their goals.

Full text is available in Arabic section under title

تقويم تجربة هيئة الأمر بالمعروف والنهي عن المنكر بالمسجد الحرام لإقامة المعارض المصغرة لتوعية المعتمرين لعام 1436هـ

Working Paper: Development of an Integrated Information System Software to Support Decision-Makers in the Field of Hajj, Umrah and Visit

Mohammad S. O. Nojoum

The Custodian of the Two Holy Mosques Institute of Hajj and Umrah Research, Umm Al-Qura University

Abstract

The most important objective of the Custodian of the Two Holy Mosques Institute for Hajj and Umrah Research is the establishment of an Information bank on the pilgrimage to be a reference to a comprehensive scientific various types of statistics and facts, and thus help to build computer models for various Hajj operations, which can be helpful for future Hajj planning. In addition to working on building an integrated historical record of the studies, documents, photos, films, maps and historical manuscripts about Hajj, Makkah, and Medina, which can be used as a scientific reference and can help greatly in planning and serving the pilgrims and visitors of the Two Holy Mosques.

This program is designed to: (a) enrich the data bank at the Institute of the Custodian of the Two Holy Mosques for Hajj and Umrah Research ; (b) provide researchers, consultants and decision-makers at all levels (locally and globally) with respect to the affairs of Hajj and Umrah, correct and accurate information. The information will be provided in an appropriate and proper way, on time, and with less effort and cost. The program will lead to the integration and collaboration of information and pave the way for future linked to a broader network information with the relevant authorities in Saudi Arabia and abroad.

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برنامج تطوير منظومة معلوماتية متكاملة لدعم متخذي القرار

في مجال الحج والعمرة والزيارة

Working Paper: The Importance of Safety Measures Accompanying the Convoy of Pilgrims Patients

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Abstract

The Saudi Government is making great efforts and valuable services for pilgrims performing the hajj rituals. One of these services is the convoy for patients in hospitals, this gesture reflects the interest of the custodian of the tow holy mosques in serving the guests of Allah. Previously, King Abdullah city handled this type of service through its sponsors convoy each year. All hospitalized patient are ascended by convoy to Arafat, and receive much attention from the medical staff assigned to this task. This service has a positive reflection on the morale of the patients. When a patient is admitted to a hospital during the Hajj season, he/she suffers from psychological trauma thinking that he/she will miss the Hajj, for which he paid a significant amount of money to perform. When pilgrims are being told that there is a medical convoy responsible in taking them to Arafat, some of them belive it and others think that it is only a way to release their tension but they become delighted when watching it on the ground. The safety procedures accompanying the Caravan is very important and must be guaranteed to achieve its targetted mission. The King Abdullah medical city working through the medical plan of the Ministry of health has been escalating annually through medically equipped convoy those pilgrims patients who are unable to perform their rituals in Arafat. The convoy is usually equipped with an integrated medical team and ambulatory binding including heart monitors and resuscitation equipment, oxygen cylinders as well as a dietary and processing site where the pilgrims reside at Arafat and protect them from direct sunshine and increased temperature, for all the existing medical conditions within the convoy. In addition, there are equipped vehicles, security personnel and volunteers. The convoy is also accompanied by ambulances equipped for transporting any patient if his condition required an instant return to the hospital.

Full text is available in Arabic section under title

أهمية إجراءات السلامة المصاحبة لقافلة الحجاج المرضى