Journal of Occupational Safety and Health

Editor-in-chief
Ir. Haji Rosli bin Hussin
Executive Director
NIOSH, Malaysia

Editorial Board
Prof. Dr. Krishna Gopal Rampal
Universiti Kebangsaan Malaysia
Ir. Daud Sulaiman
NIOSH, Malaysia
Fadzil Osman
NIOSH, Malaysia
Raemy Md. Zein
NIOSH, Malaysia

Associate Editors
Prof. Dr. Ismail Bahri
Universiti Kebangsaan Malaysia
Dr. Jeffereli Shamsul Bahrain
BASF East Asia Regional Headquarters Ltd.
Dr. Abu Hasan Samad
Prince Court Medical Centre

Secretariat
Mohd Rashidi Rohmad
Roslina Md Husin
Nor Akmar Yussuf

The Journal
- Aims to serve as a forum for the sharing of research findings and information across broad areas in Occupational Safety and Health.
- Publishes original research reports, topical article reviews, book reviews, case reports, short communications, invited editorial and letters to editor.
- Welcomes articles in Occupational Safety and Health related fields.
## Contents

### Assessing Medical Emergency Preparedness in an office setting – The BASF Hong Kong Experience
Authors: Jefferelli S.B. 1, Bauder K. 2, Trauth B. 2
Address:  
1. Occupational Medicine and Health Protection, BASF East Asia Headquarters Limited, 45th Floor, Jardine House, No 1 Connaught Place, Central Hong Kong.  
2. Occupational Medicine and Health Protection, BASF Ag, GUA-H306, Carl Bosch Strasse 38, 67056 Ludwigshafen, Germany
Corresponding Author: Dr Jefferelli Shamsul Bahrin. E-mail: jeff.bahrin@basf.com

### Local Exhaust Ventilation: PAST, PRESNT, and FUTURE
Nor Halim Hasan1, a*, M.R. Said2, b and A.M. Leman3, c
1,2 Department of Structure and Material, Faculty of Mechanical Engineering, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia.  
aEmail: irnorhalim@student.utenm.edu.my
bEmail: radzai@utenm.edu.my
3Department of Plant and Automotive Engineering, Faculty of Mechanical and Manufacturing Engineering, Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor, Malaysia.
cEmail: mutalib@uthm.edu.my

### Effect of Noise and Pesticides Exposures among Foggers in Selangor
Anita AR1, Noor Hassim I2
1Department of Community Health, University Putra Malaysia, Faculty of Medicine and Health Sciences, University Putra Malaysia, 43400 UPM, Serdang Selangor. Handphone: +6012-3180272 Office: +602-89472409 Fax: +603-89450151
2Department of Community Health, UKM Medical Centre, Jln Ya’acob Latif, Bandar Tun Razak, 56000 Cheras, Kuala Lumpur.
Corresponding author: anitaar@medic.upm.edu.my

### Hearing impairment as occupational hazard in airport: a comparative cross sectional study in Malaysia
Ibrahimzubil A.R1, Nor Hassim I2, ThaherahNor3  
1 Department of Public Health Unikl RCMP, Ipoh, Perak  
2 Department of Community Health, UKM, Jalan Tun Razak, Cheras, Kuala Lumpur  
3 District health Office, Jalan Sekolah, Parit Buntar, Perak
Corresponding author: ibrahimzubil@rcmp.unikl.edu.my

### Respiratory Symptoms and Spirometry Findings among Pottery Makers in Perak
Ibrahim Zubil AR, 2Wan Adnan WA
1 Public Health Department, Unikl RCMP, 30450 Greentown Ipoh, Perak.  
2 Community Health Department, Mahsa College University, Kuala Lumpur.
Author correspondence: ibrahimzubil@rcmp.unikl.edu.my

### The Administration of Marine Spill Response of Malaysia
Ahmad Faizal AHMAD FUAD1, Mohd Sharifuddin AHMAD2 and Saharuddin ABDUL HAMID2  
1 Department of Nautical Science and Maritime Transportation, Faculty of Maritime Studies and Marine Science, University Malaysia Terengganu  
2 Department of Maritime Management, Faculty of Maritime Studies and Marine Science, University Malaysia Terengganu

---

**Journal of Occupational Safety and Health**  
June 2013                   Vol.10 No.1
Assessing Medical Emergency Preparedness in an office setting-The BASF Hong Kong experience

Authors: Jefferelli S.B. ¹, Bauder K. ², Trauth B. ²

Address:
1. Occupational Medicine and Health Protection, BASF East Asia Headquarters Limited, 45th Floor, Jardine House, No 1 Connaught Place, Central Hong Kong
2. Occupational Medicine and Health Protection, BASF AG, GUA-H306, Carl Bosch Strasse 38, 67056 Ludwigshafen, Germany

Corresponding Author: Dr Jefferelli Shamsul Bahrin. E-mail: jeff.bahrin@basf.com

Abstract

Medical Emergency Preparedness is important to ensure timely and correct response during medical incidents. In the past there was less focus on medical emergency preparedness of office sites compared to production sites. This paper shares our experience in conducting a medical drill and assessing medical emergency preparedness in a large office with 600 employees in Hong Kong. A project team was formed to plan the medical drill and assessment. The team developed an assessment tool and criteria. The focus of the assessment during this medical drill was first aider: availability, certification, response time and ability to recall important basic first aid actions. Among the important findings were: 68% of first aiders were at their desk, 15% of first aiders did not have a valid first aider certificate, 38% of first aiders were unable to confirm the need to get an Automated External Defibrillator (AED) on-site, 54% were unable to confirm the correct number of chest compressions and 77% were unable to confirm the correct number of rescue breaths to be given. The recommendations from this medical drill were: establish a system to ensure that first aiders have valid certification, ensure adequate first aiders on every floor, reemphasize the need to get an AED when victim is unresponsive, conduct regular first aider meetings and refresher training and develop pocket first aider checklist. This assessment has reminded first aiders of their role in medical emergencies and identified areas for improvement.

Key words: Medical Emergency Preparedness, Medical drill, First Aid, office.
Introduction

Medical emergency preparedness at workplaces is important. This is partly because of the high risk at some worksites such as construction or chemical production sites. Another important factor is that when the work force ages and people spend more time at their workplace, there is an increased likelihood that medical emergencies such acute myocardial infarction (heart attack) or cerebrovascular accident (stroke) will occur while they are at work. Government agencies responsible for workplaces have also produced guidance documents to improve First Aid provision at the workplace. Examples of such documents are Hints on First Aid in Hong Kong and Guidelines on First Aid in the Workplace in Malaysia.

BASF is a German chemical company with global operations employing around 110,000 employees. The BASF regional headquarters for Asia Pacific is in Hong Kong, with 600 employees. These employees occupy 5 consecutive floors (floor A-E) in Jardine House which is a 48 floor building located in Central Hong Kong. A total of 19 employees (at least 2 on each floor) are appointed as Safety Officers and First Aiders. Direction on Safety and Health matters for BASF Hong Kong office is provided by the Office Safety Committee whereas implementation is overseen by the Office Administration department. The Human Resource department coordinates the First Aid Training. The Hong Kong St. John’s Ambulance conducts certification training for the First Aiders. The BASF Asia Pacific Regional Head for Occupational Medicine and Health Protection, who is based in the same office, provides technical advice on Health matters including First Aid.

The BASF Occupational Medicine and Health Protection (OMHP) Directive defines the global Occupational Health requirements in the company. This directive covers goals, scope, definitions, responsibilities, performance standards, audits and communication. There are eight performance standards, one of which is Medical Emergency Preparedness. This standard states the need for sites to ensure that medical drills are carried out at least once a year, five percent of the office workers are trained in first aid and immediate medical attention is guaranteed at all times. Further guidance is

**Planning**

A project team which comprised the BASF Asia Pacific Regional Head for OMHP, two medical emergency specialists from the BASF headquarters and one BASF HK office administrator was formed. The team evaluated the resources available and potential life threatening incidents that may occur in the office. It decided that the specific objective of this medical drill would be to assess first aider response time, certification and ability to recall important action. The plan was to inform first aiders, over the phone that a medical drill was being conducted and request them to come immediately to a room on floor D. When they arrive they would be asked what they needed to do for an unresponsive and non-breathing victim. A questionnaire was developed to document: name of first aider who answered call, time of call and time of response, possession of valid first aid certification and ability to recall 10 important actions. The 10 important actions were: obtain First Aid Box, check responsiveness, open airway and check breathing, call for help, get help from other First Aiders, Get help to call ambulance, Get help to bring Automated External Defibrillator (AED), start cardiopulmonary resuscitation (CPR), give thirty chest compressions and two rescue breaths. Levels of response were categorized into: ‘spontaneous’, ‘reminded’ and ‘unaware’. If person was able to offer answer spontaneously or recall when asked have you forgotten any action, their response was categorized as ‘spontaneous’. If after a reminder of correct action, the person is able to confirm it is correct, their response was categorized as ‘reminded’. If after a reminder of correct action, person is unable to confirm it is correct, their response was categorized as ‘unaware’.
**Findings**

Thirteen (68%) out of the 19 company appointed First Aiders, were at their desk and able to participate in this medical drill. One (50%) out of 2 company appointed First Aiders at level E, were at their desk and able to participate in medical drill. Two (15%) of the First Aiders who responded did not have a valid First Aid certificate. The response time was between 1-4 minutes (Table 1).

**Table 1: Response and time**

<table>
<thead>
<tr>
<th>Floor</th>
<th>Number of First Aiders</th>
<th>Responded</th>
<th>Valid First Aider Certification</th>
<th>Response Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>2-4mins</td>
</tr>
<tr>
<td>B</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>3mins</td>
</tr>
<tr>
<td>C</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>1-3mins</td>
</tr>
<tr>
<td>D</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1-2mins</td>
</tr>
<tr>
<td>E</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2mins</td>
</tr>
<tr>
<td>Overall</td>
<td>19</td>
<td>13</td>
<td>11</td>
<td>1-4mins</td>
</tr>
</tbody>
</table>

Five (38%) first aiders were unable to confirm that they needed to get an AED as part of their response to an unconscious victim. Seven (54%) first aiders were unable to confirm the correct number of compressions required during CPR. Ten (77%) first aiders were unable to confirm correct number of rescue breaths to be given during CPR (Table2).
Table 2: Recall of appropriate action

<table>
<thead>
<tr>
<th>Action</th>
<th>Spontaneous</th>
<th>Reminder</th>
<th>Unaware</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arrive with First Aid Box</td>
<td>9</td>
<td>4</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>Check responsiveness</td>
<td>12</td>
<td>1</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>Open Airway &amp; check breathing</td>
<td>12</td>
<td>1</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>Call for help</td>
<td>12</td>
<td>1</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>Get help from other First Aider</td>
<td>6</td>
<td>6</td>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td>Get help to call ambulance</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>Get help to get AED</td>
<td>0</td>
<td>8</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>Start CPR</td>
<td>12</td>
<td>1</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>Thirty compressions</td>
<td>6</td>
<td>0</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>Two rescue breaths</td>
<td>2</td>
<td>1</td>
<td>10</td>
<td>13</td>
</tr>
</tbody>
</table>

Recommendations and Discussion

Based on the findings from this medical drill, six recommendations were developed. The first recommendation was to develop a system to ensure that all first aiders possess a valid certification. Prior to appointment as a First Aider, the nominated individual must complete the First Aid certification training and pass the assessment. Those who were already certified, needed to undergo refresher training within three years, before expiry of certificate. An effective system is important because there is bound to be staff movement and changes in first aider appointment. The first aider
certificate is also time-bound and needs to be periodically renewed. The second recommendation is that there should be adequate first aiders appointed at each floor. In this drill, on floor E, only one out of the two appointed first aiders were available. We recommend that at least three first aiders are nominated reducing the likelihood of a situation where all first aiders on a floor are unavailable when assistance is required. The third recommendation is to reemphasize the need to get an AED when a victim is unresponsive. The AED is a life saving device and plays a key role in resuscitation. The fourth recommendation is to enhance current meetings with first aiders. Meeting should be held more frequently, for example on a 4-monthly basis. Items to be discussed at such meetings would include the findings of previous medical drills, status of enhancements, review of key first aider action and first aider training status. It would also offer an opportunity for first aiders to get to know each other better and clarify any related doubt. The fifth recommendation is that the first aiders undergo refresher CPR training once a year. Most of the participants in this drill had undergone first aider certification training 1 year prior to assessment and yet were not confident of key CPR actions. The sixth recommendation is to develop pocket checklist to assist the first aider recall appropriate action in a medical emergency including CPR. It could be used as a revision tool and also be referred to during actual response.

**Conclusion**

Medical emergencies in the office maybe rare, but when it occurs, rapid and correct action are required to save lives. Conducting medical drills is important because it tests preparedness and lessons learnt will help enhance arrangements. It also gives first aiders a feeling how it is to respond to an emergency and should motivate them to maintain their knowledge and skills. Future medical drills can test other aspects of medical emergency preparedness and the findings used to strengthen such areas. Good medical emergency preparedness is not only about having a plan but having it continuously tested and enhanced.
References

Hints on First Aid. Occupational Safety and Health Branch, Labour Department, Hong Kong.

Guidelines on First Aid in the Workplace. Department of Occupational Safety and Health, Ministry of Human Resources, Malaysia. 2004


BASF First Aid Manual.


Acknowledgements

We would like to thank the BASF Hong Kong Safety Officers and First Aiders for participating in this medical drill, Ms. Calina Kwok for assisting in the assessment and Mr. Anthony Clymo for his support.
This page has been intentionally left blank
Local Exhaust Ventilation: PAST, PRESENT, and FUTURE

Nor Halim Hasan¹, a*, M.R. Said², b and A.M. Leman³, c

¹, ²Department of Structure and Material, Faculty of Mechanical Engineering, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia.
³Department of Plant and Automotive Engineering, Faculty of Mechanical and Manufacturing Engineering, Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor, Malaysia.

a*Email: irnorhalim@student.utem.edu.my, bEmail: radzai@utem.edu.my, cEmail: mutalib@uthm.edu.my

Abstract

Engineering control is a method of controlling the risk of exposure to contaminants. Health effects to industrial workers are more severe whilst high exposure and time exposed to contaminants at workplace. Installation of industrial ventilation or local exhaust ventilation (LEV) system is the proposed method to reduce the risk. This paper discusses the past, present and future relating to LEV system in Malaysia. Current issues related to monitoring reported by Hygiene Technician in compliance with Occupational Safety and Health (Use of Standard Chemical Hazardous to Health Regulation 2000) carried out in several states in Malaysia as a sample. The nanotechnology is a new area at present and future. The involvement of government, employers and employees need to be justified due to the attention to prevent and control of any exposure. It is suggested that using the Computational Fluid Dynamic (CFD) simulation, a new design of LEV system can be upgraded and predicted.

Keywords - Volatile Organic Compounds, Occupational Safety and Health, Local Exhaust Ventilation, Computational Fluid Dynamic, Green Technology.
1. Introduction

Industrial ventilation is a system of controlling airborne toxic chemicals or flammable vapors by exhausting contaminated air away from the work area and replacing it with clean air. It is an alternative to control the employee’s exposure to air contaminants in the workplace. Other alternatives include process changes, work practice changes, substitution of toxic substances with less toxic or total elimination. Industrial ventilation is typically used to remove welding fumes, solvent vapors, oil mists or dusts from a work location and exhaust these contaminants outdoors.

The objective of a local exhaust ventilation system is to remove the contaminant that being generated at a source. Industrial which involved and used with ventilation systems are required to comply with Malaysian Legislation such as Occupational Safety and Health Act 1994, Use of Standard Exposure Chemical Hazardous to Health Regulation and Factory and Machinery Act 1967 and Regulations under this Act.

1.1 Local Exhaust Ventilation (LEV)

The initial opening through which contaminated air enters a local exhaust system is called the hood. The term hood is used generically for any opening whether it is specifically designed or consists of simply the open end of a round or rectangular duct section. Hoods are specifically designed and located to meet the requirements of the operation and the contaminant being generated. After the contaminated air has entered the hood, it flows through a duct system that directs the flow of contaminated air and prevents the mixing of this air with the workroom atmosphere. Branches may exist within the duct to join separate local systems into one single exhaust system. The third component of a local exhaust system is filter or air cleaner. It is often necessary to remove the contaminant from the air before exhausting the air into the atmosphere to prevent hazardous materials from entering the breathing [1].
1.2 Why do we need LEV?

To comply with the local legislation, Industries need to install the LEV system to remove the contaminants in a workplace will involves a cost. Estimating cost must consider in system design before install. Buy and Mathews (2005) in their investigation using QUICKcontrol simulation for initial cost model found that without a fairly detail design and costing model, no accurate cost estimation can be made[2].

1.3 LEV related with to VOC

Volatile Organic Compounds (VOC) has an impact on health. A study by Yu & Crump[3] found that release of VOC comes from polymeric materials used in buildings. Information obtained from European standards based on the chamber test of VOC emissions from building materials and the wet solid, the level of emissions and materials used in a building need further testing. They concluded polymeric materials such as vinyl flooring; carpets and so major sources of VOC. VOCs also cause Sick Building Syndrome. European has European standards for VOC emissions testing for product certification. Yu and Crump (1998), proposed in their study of labeling Schemes for Develop and material of emission databases in a market to meet the needs of products with low VOC emission rates for less risk to the occupier.

Other study by Hasan, Said, and Leman[4] related with painting activities and impact to workers health. They found that workers in interior construction and office are highly exposed. To control exposed to VOCs are to install good ventilation system and good filters to absorbed and performances of activated carbon fiber to absorb the VOCs.
2. Past Histories

2.1 History on Occupational Safety and Health

OSH started 2,000 years ago. Early Historical of OSH is based on Ancient Greek and Roman Physicians [5][6][7]. Figure 2 below illustrates evolution on OSH. The Field of OSH has undergone significant change over the past two decades. Some of the reason include the following: technological changes that have introduced new hazards in the workplace; proliferation of safety and health legislation and corresponding regulation; increase pressure from regulatory body, realization by executives that workers in a safe and healthy workplace are typically more productive; increase pressure from environmental groups; corporate social responsibility and increased pressure from labor organizations and employees in general.[5][6]

![Figure 2: The Evolution on OSH (Goetsch, 2010)](image)

2.2 Occupational Health status

DOSH is the government body responsible for administrating, managing and enforcing legislation pertaining to in Malaysia. From DOSH annual report, the industrial accident statistic was tabulated in table 1. The data describes the number of industrial accidents occurred by sector from year 2008 to 2009. It shows that the number of industrial accident is quite high especially for manufacturing sector.
### Table 1: Accident Data year 2008 to 2009 base on Sector in Malaysia

<table>
<thead>
<tr>
<th>Sector/Year</th>
<th>YEAR 2008</th>
<th></th>
<th></th>
<th>YEAR 2009</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D</td>
<td>PD</td>
<td>NPD</td>
<td>D</td>
<td>PD</td>
<td>NPD</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>76</td>
<td>134</td>
<td>1564</td>
<td>63</td>
<td>90</td>
<td>1419</td>
</tr>
<tr>
<td>Mining and Quarrying</td>
<td>6</td>
<td>0</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Construction</td>
<td>72</td>
<td>2</td>
<td>55</td>
<td>71</td>
<td>6</td>
<td>38</td>
</tr>
<tr>
<td>Agriculture and Forestry</td>
<td>42</td>
<td>7</td>
<td>365</td>
<td>44</td>
<td>8</td>
<td>440</td>
</tr>
<tr>
<td>Utility</td>
<td>19</td>
<td>12</td>
<td>82</td>
<td>23</td>
<td>3</td>
<td>116</td>
</tr>
<tr>
<td>Transport &amp; Communication</td>
<td>8</td>
<td>1</td>
<td>18</td>
<td>18</td>
<td>0</td>
<td>21</td>
</tr>
<tr>
<td>Wholesale and retail</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hotel and restaurant</td>
<td>1</td>
<td>1</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>Financial &amp; Real Estate</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Public Services</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>230</td>
<td>159</td>
<td>2109</td>
<td>224</td>
<td>108</td>
<td>2054</td>
</tr>
</tbody>
</table>

LEGEND: D = Death. PD = Permanent Disability. NPD = Non Permanent Disability.

### Table 2: Total Number of Investigation Cases of Occupational Diseases and Poisoning from 2008 - 2009

<table>
<thead>
<tr>
<th>No.</th>
<th>Types of Disease</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Occupational Lung disease (OLD)</td>
<td>56</td>
<td>57</td>
</tr>
<tr>
<td>2.</td>
<td>Occupational Skin Disease (OSD)</td>
<td>70</td>
<td>53</td>
</tr>
<tr>
<td>3.</td>
<td>Occupational Noise Hearing Loss (NIHL)</td>
<td>169</td>
<td>427</td>
</tr>
</tbody>
</table>
Table 2 present a total number of investigation cases of Occupational diseases and poisoning. For the occupational diseases, The Occupational health Division of DOSH monitors and analyses the data received. For each case of occupational diseases and poisoning that is investigated, the Department will advises to the industries to take corrective measure to prevent from recurrences.

3. Current Implementation

3.1 Method and references

American Conference of Governmental Industrial Hygienists (ACGIH) and DOSH Guideline is used as reference, in order to design, build and install LEV. Figure 3 shows the life cycle of An Industrial Ventilation System. In ACGIH\(^{(1)}\) are suggested as in figure 3 to have an Industrial Ventilation System. Start from early stage in assessment of exposure, preliminary design, detail design, installation and operation and maintenance. A guideline is recommended by the ACGIH, there are 6 parts in compliance and LEV installation in the industry. Assessment the workplace of exposure to the risk analysis must be carried out in initial stage. The next stage is the preliminary design; taking into account several factors, design concepts, cost evaluation, energy issues and the replacement of air and followed by detail design. Manufacturing, installation and commissioning after being satisfied with LEV design to be made. Last part of the cycle is operation and maintenance where the LEV must carry out monitoring, troubleshooting, change of management and training.
3.2 Compliance Analysis

Using a form provided by the Division of Industrial Hygiene and Ergonomics of DOSH for analyzing report submitted by industrial in compliance of Regulation of USECHH 2000. The elements observed are Hood, Ducting, and Air Cleaning, Fan/Motor and Comparison design value and tested value for fan/motor. Data collected and analyzed using Statistical Package for Social Science (SPSS Version 12.0).

Figure 4: Type of Industry

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palm Oil Mill/Plantation</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Electronic/Electrical</td>
<td>38</td>
<td>43.7</td>
</tr>
<tr>
<td>Manufacturing Polymer</td>
<td>1</td>
<td>1.1</td>
</tr>
<tr>
<td>Manufacturing Plastic</td>
<td>3</td>
<td>3.4</td>
</tr>
<tr>
<td>Industry</td>
<td>No.</td>
<td>Percentage</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----</td>
<td>------------</td>
</tr>
<tr>
<td>Manufacturing Rubber</td>
<td>3</td>
<td>3.4</td>
</tr>
<tr>
<td>Manufacturing Wood</td>
<td>5</td>
<td>5.7</td>
</tr>
<tr>
<td>Manufacturing Chemical</td>
<td>16</td>
<td>18.4</td>
</tr>
<tr>
<td>Chemical Storage</td>
<td>1</td>
<td>1.1</td>
</tr>
<tr>
<td>Manufacturing Metal</td>
<td>7</td>
<td>8.0</td>
</tr>
<tr>
<td>Government Agency</td>
<td>2</td>
<td>2.3</td>
</tr>
<tr>
<td>Manufacturing Food</td>
<td>4</td>
<td>4.6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>87</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Three states involved in taking the data of 87 data, which is Johor, Malacca and Negeri Sembilan with 33 companies, or consultant/competent persons were involved. 10 types of industries were identified as a result of observations on the report and found Industry Electrical/Electrical is the highest at 38, while the percentage was 43.7%. Followed by chemical manufacturers (18.4%) and metal manufacturers (8%), and the other industries are less than 5%. (Figure 4)
Table 3 shown that Cross Tab Data Related with type of Industries, type of LEV against result of Design value/Test Value in reported monitoring of compliance data analysis. Design type of LEV involve in a study are fume Hood (27), System of LEV (49) and Spray Booth (11). Three categories of analysis of result finding are OK, Not OK and only provided BHP data. OK means all data shown in table 5 are complete and not OK means no data provided. Another category is the measurement only provided BHP data.

<table>
<thead>
<tr>
<th>Type of Industry</th>
<th>Type of LEV</th>
<th>Design value vs Test value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fume Hood</td>
<td>Systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Design value vs Test value</td>
</tr>
<tr>
<td></td>
<td>OK</td>
<td>Not OK</td>
</tr>
<tr>
<td>Type of Industry</td>
<td>Type of Industry</td>
<td>Type of Industry</td>
</tr>
<tr>
<td>Count</td>
<td>%</td>
<td>Count</td>
</tr>
<tr>
<td>Palm Oil Mill/Plantation</td>
<td>18.7</td>
<td>44.4</td>
</tr>
<tr>
<td>Electronic/Electrical</td>
<td>31.2</td>
<td>11.1</td>
</tr>
<tr>
<td>Manufacturing Polymer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing Plastic</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Type of Industry * Type of LEV * Design Value vs. Test Value
### Table 4: Example data measurement and calculation

<table>
<thead>
<tr>
<th>Point</th>
<th>Static Pressure, SP (in wg)</th>
<th>Velocity, V (fpm)</th>
<th>Flow rate, Q (cfm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fan Inlet</td>
<td>-5.328</td>
<td>2,617</td>
<td>2,795</td>
</tr>
<tr>
<td>Fan Outlet</td>
<td>0.079</td>
<td>2,935</td>
<td>3,135</td>
</tr>
</tbody>
</table>

| Manufacturing  | Rubber | 1 | 11.1 | 1 | 14.2 | 1 | 3.85 | 1 | 6.25 | 2 | 18.18 |
|----------------|--------|--|--|-----|----|-----|----|-----|----|-----|----|-------|
| Manufacturing  | Wood   | 1 | 6.25 | 1 | 3.85 | 1 | 6.25 | 2 | 18.18 |
| Manufacturing  | Chemical | 2 | 100 | 5 | 5 | 14.2 | 2 | 7.69 | 5 | 5 | 1 | 9.09 |
| Manufacturing  | Chemical Storage | 1 | 6.25 | 14.2 | 2 | 11.5 | 1 | 9 |
| Manufacturing  | Metal | 1 | 9 | 3 | 4 | 14.2 | 3 | 27.27 |
| Government Agency | 1 | 6.25 | 14.2 | 1 | 9 |
| Manufacturing  | Food | 1 | 6.25 | 3 | 3 | 33.3 | 26 | 100 | 16 | 100 | 11 | 100 |
| **Total**      | 2 | 100 | 16 | 100 | 9 | 100 | 7 | 100 | 26 | 100 | 16 | 100 | 11 | 100 |
Example of calculation of Fan Static Pressure (FSP) and Total Pressure (FTP) for design value vs. test value is shown in Table 4 and 5. Data available for the design and measurement data can be implemented for comparison purposes. However, results from the calculations are the value of BHP's 50% less than the design value.

Data for the design value cannot be found and also the measurement data cannot be implemented. This is because the area is difficult to carry out the measurements entered. Table 3 shows the three types of LEV is most do not show any data that can be measured for comparison with the design so that the motor performance can be determined. Number of studies have shown 53 of 87 (61%) were indeterminate LEV performance. For which there is only the value of BHP in the design data of 25 (29%). This value cannot reflect the actual performance of the LEV motor. While the number of LEV that is perhaps more to comply with legal requirements is of 9 (10%).

This can be expressed in a preliminary study only 10% of the industry has monitored the design and measurement data. Nevertheless, the ability of the test is part of the design value. Further study and a standard should be recommended to further improve this performance.
3.3 National Legal Requirement

Compliance to the regulation is an approach to reduce and maintain the exposure level of employees to chemicals hazardous to health. The requirements are to the lowest practicable level or below permissible exposure limits.

Engineering Control Equipment (Regulations 2) means any equipment, which is used to control exposure of employees to chemicals hazardous to health and includes local exhaust ventilation equipment, water spray or any other airborne chemical removal and containment equipment? The equipment shall be maintained and operated at all times while any machinery or plant is in operation, and for such time. (Regulation 17)[8].

Regulation 25 (1): Requirement of ventilation in a industry and the required of natural ventilation or mechanical ventilation or both shall be provided.[9] Dilute the concentration of the airborne contaminant before it reaches the worker ventilation, to cool the air, to create adequate air move. Adequate ventilation mention in Regulation 25 (2)[9]: where the number of air changes every hour is not less than ten (10) in the case of processes, which generate little or no heat, smoke or fume, or not less than twenty (20) in the case of processes, which generate heat, smoke or fume, not less than thirty (30) if any fume generated is likely to cause bodily injury.

Mechanical Ventilation Design: Regulation 25 (3): The total free area of any ventilation air inlets shall be at least 50% greater than the total free area of the air outlets. Air inlets shall, so far as practicable, be located at floor level, and air outlets shall be located as high as practicable.[9] Air Cleanliness: Regulation 26 (1): where any process given off any offensive fume or dust which is or is likely to be offensive or injurious to any person or being accumulated, measures shall be taken to protect such persons against inhalation and to prevent it accumulating.[9]
Removal dust laden air: Regulation 26 (2): Dust laden air shall be removed by a settling chamber, water spray, cyclone, filter or any combination of these or other suitable appliance[9]. Hood and Ducting: Regulation 26 (3): Any hood, enclosure, canopy or shall be constructed so as to envelop, as far as practicable, the point of origin of the fume or dust so that a smooth and uninterrupted flow is maintained. In addition to this requirement the hood, enclosure, canopy, or ducting for the extraction of fume shall be constructed so as to maintain the air velocity at the surface thereof at a rate not less than one hundred and fifty (150) feet per minute.[9]

Design, construction and commissioning of local exhaust ventilation equipment. Regulation 18: any local exhaust ventilation equipment installed shall be designed according to an approved standard by a registered professional engineer and constructed according to the design specifications; and tested by a registered professional engineer after construction and installation to demonstrate that the equipment meets the design specifications.[8]

4.0 Future Technology

4.1 Nanotechnology

A number of consumer nano-based products are already available on the market. Not much is known of the risks of Engineered Nanomaterials (ENM) to occupational safety and health. The level of exposure for these materials is usually higher at workplaces than in other environments and workers are likely to be at extra risk. Several issues related to ENM in the workplaces require marked attention. The most topical issues include: (1) improved understanding of ENM metrics associated with ENM toxicity; (2) development of monitoring devices for ENM exposure assessment; (3) understanding the changes of ENM structure and state of agglomeration at different concentrations in aerosols; (4) understanding translocation of ENM in the human body; (5) identifying the key health effects of ENM including pulmonary toxicity, genotoxicity, carcinogenic effects, and effects on circulation; (6) development of tiered approaches for testing of safety of ENM; and (7) utilising these data for health risk assessment, with a special emphasis on occupational environment. [10]
4.2 Computational Fluid Dynamic (CFD)

For control the VOCs exposure to the workers, LEV systems are design and fabricate to remove contaminants. CFD is the solution on preventive method in designing LEV system and before the LEV systems are fabricate.

Flynn & Sills \cite{11} conducted study to simulate breathing-zone concentration for a simple representation of spray-painting a flat plate. The results demonstrate the capability of CFD to track correctly changes in breathing-zone concentration associated with work practices shown previously to be significant in determining exposure.

CFD is the way to determine the efficiency of ventilation systems. Kassomenos et. al.\cite{12} use CFD model PHOENICS to investigate VCM concentration at workplaces. The results showed that the use of a CFD is a promising technique to study the occupational exposure in the known carcinogen VCM and to design the proper ventilation system to reduce the consequences of an accidental release of VCM in a workplace. Measurement also made and found that the computational results are realistic and in good agreement with the experimental measurements.

More efficient in remove contaminant from workplace is using push pull method. A study in Occupational Exposure to VOCs and Mitigation by Push-Pull Local Exhaust Ventilation in Printing Plants conducted by Leung et al.\cite{13} evaluate the Occupational VOC exposure, quantitatively, by detailed field measurement and parametric analysis on a proposed mitigation measure; push pull local exhaust ventilation (LEV) was conducted. None was found close to individual 8-h time weighted average (TWA) and push-pull effective identified by CFD.

Kyoungbin & Changhee,\cite{14} using FLUENT V.6 in order to investigate flow characteristic of kitchen hood system with using 3D numerical analysis method and improving the system to expel pollutes more efficiently. The work are divided to 4 different types of separation plates (Case 1 - Case 4) were
modeled using Gambit Ver. 2.1.X and Case 3 showed the lowest value of the temperature and CO2 concentration distribution.

CFD simulation is using as study of the effectiveness of mechanical ventilation systems of a hawker center in Singapore using conducted by Wong et al.\cite{15} The objective is to investigate the effectiveness of the different types of mechanical ventilation systems to alleviate the thermal discomfort in a hawker center using Phoenics v3.5.

In wood processing industry, workers are commonly exposed to mechanical hazard. Inthavong et al.\cite{16} conducted study of effect of ventilation design on remove of particles in woodturning workstations. Using five different ventilation designs were considered with the aim of reducing the particle suspension within the breathing zone. The result stated that ventilation R3, where the local outlet emanated from the roof and had an angled outlet, provided greatest total particle clearance and low particles in the breathing plane.

5.0 Conclusions and recommendation

Analysis done in early stage show that most of the current Local Exhaust Ventilation is not complying with the standard and design proposed. Based on 87 data collected in southern region of Malaysia most of the LEV reported are not comply with the requirement with fan and motor measurement data are ignoring and only 10% out of measured data are provided. The future contaminants such as from Nanotechnology are seriously to look on consideration to prevent effect on workers health. The issues are the performances of the ventilation to ensure of workers are preventing from exposure contaminant at their workplace. To improve the performance of industrial ventilation, the CFD are recommendation in design stage to ensure the systems are effective and work as per design. CFD recommendation also will cost effectives plan before fabricate and install the LEV.
Responsible for manufacturer and designer under OSHA 1994 described that in Part V, to provide general duties of person who design, manufacturers imports and supplies any plant in section 20. This section states: “It shall be the duty of a person who designs, manufactures, imports or supplies any plant for use at work “ – to ensure, so far as is practicable, that the plant is so designed and constructed as to be safe and without risks to health when properly used;

This subsection required to the designers (engineers) to ensure that a plant for use at work is designed and constructed to be safe and without risk to safety and health. Hence, properly used means that the designer must having being given instructions, employers as well as employees must follow the instructions.

Other is “to carry out or arrange for the carrying out of such testing and examination as may be necessary for the performance of the duty imposed on him by paragraph (a)”. The designers are required to carry out testing and examination of the plan and running test before the employees use it. “It shall be the duty of a person who undertakes the design or manufacture of any plant for use at work to carry out or arrange for the carrying out any necessary research with a view to the discovery and, so far as is practicable, the elimination or minimization of any risk to safety or health to which
the design or plant may give rise.” Designers have a duty to carry out the necessary research to discover and eliminate or minimize any risk to safety or health that there design or plant might cause.

Acknowledgements

The authors like to acknowledge the following organizations and individual for their contributions and supports: Government of Malaysia, Department of Public Services, Department of Occupational Safety and Health Malaysia. Faculty of Mechanical Engineering, University of Technical Malaysia, Melaka. University Tun Hussien Onn, Malaysia.

References


Effect of Noise and Pesticide Exposures among Foggers in Selangor Health District Offices

Anita AR¹, Noor Hassim I²

¹Department of Community Health, University Putra Malaysia. Faculty of Medicine and Health Sciences, University Putra Malaysia, 43400 UPM, Serdang Selangor.

Handphone: +6012 – 3180272  Office: +602 – 89472409  Fax: +603 – 89450151

²Department of Community Health, UKM Medical Centre, Jln Ya’acob Latif, Bandar Tun Razak, 56000 Cheras, Kuala Lumpur.

Corresponding Author: anitaar@medic.upm.edu.my

ABSTRACT

Fogging activity has become one of the important methods in tackling dengue outbreaks nowadays. Despite this, it is an occupation that has known hazards namely noise and pesticides which can affect the body organs. Based on this knowledge, a cross sectional study was conducted to determine the association between hearing impairment and serum cholinesterase level among foggers from five randomly selected Health District Offices in Selangor. A total of 200 workers comprising of 100 workers exposed to fogging activity and another 100 workers not exposed were randomly selected for this study. Data was obtained through self administered questionnaire, audiometric testing and serum cholinesterase level measurement. The overall prevalence of hearing impairment was 16% with foggers having significant higher prevalence (24%) compared to the non foggers (8%) ($\chi^2=9.52$, $p=0.002$). Measurement of serum cholinesterase showed that exposed workers had lower level compared to the non exposed group. Similarly, those who have hearing impairment had also lower serum cholinesterase level although it was not statistically different. Among all studied factors, age and duration of exposure to fogging activities were statistically different with hearing impairment ($p<0.05$). With regression analysis, the age (adjusted OR=5.15; 95% CI: 1.06–5.77) and duration of exposure (adjusted OR= 2.47; 95% CI: 2.01-13.24) were found to have consistent association with hearing impairment. It was concluded that the hearing impairment among foggers were prevalent. Therefore steps in conducting hearing conservation program need to be done adequately to ensure the health of the workers is not compromised by such activities.

Keywords : Hearing impairment, foggers, pesticide, serum cholinesterase
INTRODUCTION

Many factors have been identified in contributing to hearing impairment. Some factors can be prevented while others are not. The relation between hearing impairment and occupation has been known way back to Ramazzini’s era. Previous studies have looked into the effect of hearing impairment due to exposure in various industrial sectors such as manufacturing of metals and pesticide exposure among agricultural workers (Teixeira et al. 2003). Other risk factors for hearing impairment have also been observed such as chemical exposure (Morata et al. 199, Kowalska et al. 2003) and association to certain medical drugs such as salicylate (Douek et al. 1983), quinine and aminoglycosides which are known to have ototoxic effects. In addition, noise is one of the more widely and frequently experienced problem of the working environment that can occur independently or in combination with other hazards. Long term exposure to occupational noise exceeding the permissible level carries an increased risk of hearing related problem and in the United States; hearing impairment due to noise exposure at workplace is ranked among the top 10 common occupational related diseases (NIOSH, US 2000). Although counter measures have successfully reduced noise level in many industries, noise is still a common occupational hazard. As for this study, those working as foggers in the District Health Office under the Vector Disease Control Program are also exposed to noise that can affect many organs of the body and in particular, the ear. Previous study have measured the sound level that was emitted from the Fogging machine (model Agrofog) used was between 85-98 db (A) which exceeded the permissible level Zaidi & Noor Hassim 1994). Till now, not many studies have been conducted in Malaysia to look at the association of the factors involved. Therefore, this study aims to identify and determine the prevalence and factors involved in hearing impairment and serum cholinesterase level among the workers of 5 District Health Offices in the state of Selangor who were exposed to such activity.

METHODOLOGY

A cross sectional study was conducted where out of 9 districts in Selangor, 5 districts were randomly sampled. Through cluster sampling method, those workers who were exposed to fogging activities and compared to those who were not exposed to such activity in each district were the sample population. Sample size was determined based on the prevalence of hearing impairment by previous study (Noor Hassim & Rampal 1994) was 20% with alpha (α) as 95% and power of the study (1- β) as 80% using Epi Info 2000. A total of 210 respondents comprising of 105 subjects each
for the exposed and the non exposed groups participated. The study was carried out with the approval of Ministry of Health Malaysia and the Medical & Ethics Research Committee of the UKM Medical Centre.

**Inclusion and Exclusion criteria**

Respondents were among male workers from each selected each district. Those eligible were further selected using the inclusion and exclusion criteria. Respondents were excluded if they have hearing loss as a result of non-occupational condition such as ear infection – Chronic Suppurative Otitis Media (CSOM), Perforated Tympanic Membrane, hepatic diseases, renal diseases, certain cancer such as Leukemia, Multiple Myeloma, those workers on certain drugs for example anti-cholinergic (atropine), codeine, aminoglycosides, aspirin and/or diuretics, female workers and those working on part-time basis. Participation of respondents was on voluntary basis.

**Data collection**

Data was obtained using several tools after obtaining a written consent from each subject. An 8 pages questionnaire was given to obtain the sociodemographic data of respondent, occupational history, medical history, drug history, personal protective equipment usage, hobbies and smoking history. Respondents were then subjected to autoscopic examination to exclude any outer ear abnormalities followed by a pure tone audiometry testing. All audiometric instruments has been calibrated and certified by the Department of Occupational Safety and Health (DOSH) Malaysia. Tests procedure was done according to NIOSH, Malaysia standards. To study serum cholinesterase level due to pesticide exposure, blood serum were collected and sent to the Public Health National Laboratory for color kinetic analysis as suggested by the German Society for Clinical Chemistry, using the Olympus AU400 Chemistry Analyzer. This test complies with the USECHH regulations for workers exposed to organophosphate (USECHH 2000). For workplace noise monitoring, Quest Precision Sound Level Meter (SLM) was used to determine the noise mapping during fogging activities.

**Data analysis**

All statistical tests were done using SPSS software. Student t-test was used to compare the hearing threshold level and serum cholinesterase level between the two groups. Chi-square test was done to compare factors studied and hearing impairment. Multivariate and logistic regression analyses
were also performed to determine between risk factors and hearing impairment. A p value of less than 0.05 was accepted as significant.

RESULTS

A total of 110 workers exposed to fogging activities and 117 workers not exposed were identified for the study. However during autoscopic examination, 6 workers of the exposed group and 5 workers from the non exposed group were found to have ear abnormalities (perforated tympanic membrane, impacted wax and ear discharge) and were excluded from the study. Another 10 workers (4 exposed workers and 6 non exposed workers) did not attend for the audiometric testing despite follow up given and 6 workers did not give consents. At the end of the study a total of 200 workers participated with 100 workers in the exposed group and 100 workers in the non exposed group, giving an overall response rate of 88.1%. Sociodemographically, the majority of workers were of Malay ethnicity (87.5%), married (70.5%) and has obtained education up to secondary school level (46.5%). In general 29% of workers were between 30 – 39 years of age with the median age of 35.00 year (IQR 18.75). There was no difference between age of the exposed and non exposed group statistically.

The overall prevalence of hearing impairment was 16%, with higher prevalence among the exposed group (24%) than the non exposed group (8%) and the difference was statistically significant. (Insert Table 1). In relation to the factors studied, only age (p<0.001), education level (p=0.021) and duration of exposure (p<0.001) showed a significant difference with hearing impairment. (Insert Table 2)

Noise mapping done showed that noise zone of more or at 90 dB (A) was at a distance of 1 – 2 meters and between 85 to 90 dB (A) was 2 to 4 meters. The comparison of the mean threshold level in both ear showed that the mean of the exposed group was higher significantly (p<0.05) than the non exposed group, involving the high frequencies: 2000Hz, 3000Hz, and 4000Hz. (Insert Graph 1 & 2). As for the serum cholinesterase, the level was found to be lower in the exposed group but when compared to hearing impairment the difference was not significance. (Insert Table 3). With logistic regression analysis, the age (adjusted OR 5.15; 95% CI: 1.06– 5.77) and duration of exposure (adjusted OR 2.47; 95% CI: 2.01-13.24) was also found to have significant association with hearing impairment. (insert Table 4).
DISCUSSION

Many factors have been known to affect the normal functions of the ear either physiologically or otherwise. Occupational related hearing impairment is still considered as one of the common problems among workforce even though they are preventable. This study showed that hearing impairment due to noise exposure among foggers is still a common occupational disease. Previous studies have also showed similar findings (Noor Hassim & Rampal 1994, Noriyuki et al. 2000, Teixeira et al. 2003). Based on noise mapping it showed that noise emitted from the fogging machine itself was noisy. Therefore steps in conducting exposure monitoring should be done properly according the Factory and Machinery Act (Noise Exposure) Regulations 1989 so as to ensure that the health of the workers is not affected by the fogging activities. The overall mean threshold level was also found to be higher in the exposed group than the non exposed group especially at high frequencies indicating high frequencies hearing involvement. Among all the studied factors, the variable that gave consistent significant result with hearing impairment were age (those of 41 years and above), duration of exposure (> 3 years) and lower education level. Earlier studies have also shown significant relations between hearing impairment with duration of work (Douek et al. 1983) and age (Noriyuki et al. 2000, Teixeira et al. 2003). This shows that workers who are older and/or works longer have a higher risk of developing hearing impairment. As for smoking, this study did not give similar result as other study noted (Noor Hassim & Rampal 1994). This might be due to the fact that majority of the workers involves in this study smokes. However there was a study that found no association between smoking and hearing impairment (William et al. 2000). Another important aspect that was looked into was the relation between pesticide exposures with hearing impairment. Results found that workers who were involved with fogging activity did have a lower cholinesterase serum level than the non exposed group even though the difference were not significant statistically. This may be due to inhibition of cholinesterase in serum only occur for a short while and returns back to normal when there is no exposure. According to Department of Health and Human Resource, USA, the best measurement to see and study cholinesterase inhibition due to pesticide exposure is to get red blood cell (RBC) cholinesterase rather than serum. This test is better when looking for chronic effect of pesticide exposure because RBC’s has a longer life time (120 days) (Manninen 1989). Further analysis did show the contribution of age and duration where age had the odds of five times and duration of exposure had the odds of two times to the probability of hearing impairment. However the study also showed that other factors that were not studied could have contributed towards hearing impairment (Nor Wati et al. 1997).
## TABLES

### Table 1. Prevalence of hearing impairment among respondents.

<table>
<thead>
<tr>
<th>Group category</th>
<th>Hearing impairment</th>
<th>$\chi^2$ test</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>N (%)</td>
<td>N (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall workers (n=200)</td>
<td>32 (16)</td>
<td>168 (84)</td>
<td>9.524</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exposed group (n = 100)</td>
<td>24 (24.0)</td>
<td>76 (76.0)</td>
<td>9.524</td>
</tr>
<tr>
<td>Non exposed group (n = 100)</td>
<td>8 (8.0)</td>
<td>92 (92.0)</td>
<td></td>
</tr>
</tbody>
</table>

*p<0.05

### Table 2. Association between the studied factors and hearing impairment

<table>
<thead>
<tr>
<th>Factors</th>
<th>Hearing impairment</th>
<th>$\chi^2$</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td>test</td>
</tr>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malay</td>
<td>28 (16.0)</td>
<td>147 (84.0)</td>
<td>1.000</td>
</tr>
<tr>
<td>Indian</td>
<td>4 (16.0)</td>
<td>21 (84.0)</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 41 years</td>
<td>7 (5.9)</td>
<td>111 (94.1)</td>
<td>21.705</td>
</tr>
</tbody>
</table>

*<p<0.05
| ≥ 41 years | 25 (30.5) | 57 (69.5) |

**Education level**

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard 6</td>
<td>2 (25.0)</td>
<td>6 (75.0)</td>
<td></td>
</tr>
<tr>
<td>Form 3</td>
<td>11 (27.5)</td>
<td>29 (72.5)</td>
<td>9.475</td>
</tr>
<tr>
<td>Form 5</td>
<td>16 (17.2)</td>
<td>77 (82.8)</td>
<td></td>
</tr>
<tr>
<td>Diploma &amp; Degree</td>
<td>3 (5.0)</td>
<td>56 (95.0)</td>
<td></td>
</tr>
</tbody>
</table>

**Income**

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1000</td>
<td>16 (16.2)</td>
<td>83 (83.8)</td>
<td></td>
</tr>
<tr>
<td>1000 – 1999</td>
<td>14 (15.4)</td>
<td>77 (84.6)</td>
<td>0.891</td>
</tr>
<tr>
<td>≥ 2000</td>
<td>2 (20.0)</td>
<td>8 (80.0)</td>
<td></td>
</tr>
</tbody>
</table>

**Duration of exposure**

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 3 years</td>
<td>14 (9.7)</td>
<td>129 (90.3)</td>
<td>14.396</td>
</tr>
<tr>
<td>≥ 3 years</td>
<td>18 (31.6)</td>
<td>39 (68.4)</td>
<td></td>
</tr>
</tbody>
</table>

**Smoking**

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>23 (18.5)</td>
<td>101 (81.5)</td>
<td>1.577</td>
</tr>
<tr>
<td>No</td>
<td>9 (11.8)</td>
<td>67 (88.2)</td>
<td></td>
</tr>
</tbody>
</table>

**Hearing protective device**
Yes          13 (20.0)  52 (80.0)  0.021  0.884
No           11 (31.4)  24 (68.6)

*p < 0.05

**Table 3.** Comparison of the serum cholinesterase level among the exposed and non exposed group.

<table>
<thead>
<tr>
<th>Group</th>
<th>Exposed</th>
<th>Non exposed</th>
<th>Independent t test</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(kU/I )</td>
<td>(kU/I )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cholinesterase level</td>
<td>8.176 ± 1.58</td>
<td>8.367 ± 1.42</td>
<td>- 0.897</td>
<td>0.371</td>
</tr>
</tbody>
</table>

* p < 0.05

**Table 4.** Prediction of hearing impairment based on logistic regression model.

<table>
<thead>
<tr>
<th>Variables</th>
<th>β</th>
<th>S.E</th>
<th>Adjusted odds</th>
<th>95% CI</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age category</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 40 years</td>
<td>1.640</td>
<td>11.613</td>
<td>5.154</td>
<td>2.007 – 13.236</td>
<td>0.001*</td>
</tr>
<tr>
<td>&gt; 40 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Duration of exposure

<table>
<thead>
<tr>
<th>Duration of exposure</th>
<th>0.905</th>
<th>0.433</th>
<th>2.472</th>
<th>1.058 – 5.774</th>
<th>0.037 *</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 3 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥ 3 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-5.490</td>
<td>0.918</td>
<td>0.004</td>
<td></td>
<td>&lt;0.001*</td>
</tr>
</tbody>
</table>

- * Nilai p < 0.05

- $r^2$ Cox & Snell = 0.123; Nagelkerke = 0.210

**GRAPHS**

**Graph 1:** Comparison between the mean threshold level of the right and left ear at each frequency.

*Student-t test - p < 0.05.*
CONCLUSION

Hearing impairment is still prevalent among foggers. Therefore efforts need to be done so that these workers are not neglected and further actions taken will be able to reduce the prevalence. One must remember that hearing impairment due to noise at workplace is a preventable disease. Further identification of other factors involved in hearing impairment among workers will be able to ensure safety and health at workplace as a whole. Lastly, hazards control action/program and hearing protection program should be given priority to workers so that while they provide health services to the community, their own health is not affected by the fogging activities.

Acknowledgement: This study was supported by a grant from the UKM Medical Centre (FF-103-2004).

REFERENCES


Hearing impairment as occupational hazard in airport: a comparative cross sectional study in Malaysia

Ibrahimzubil A.R1, Nor Hassim I2, ThaherahNor3

1Department of Public Health Unikl RCMP, Ipoh. Perak
2Department of Community Health, UKM, Jalan Tun Razak, Cheras, Kuala Lumpur
3District health Office, Jalan Sekolah, Parit Buntar, Perak

* Corresponding author: ibrahimzubil@rcmp.unikl.edu.my

ABSTRACT

Comparative cross sectional study was conducted to determine the prevalence of hearing impairment among workers in one of the airport in Malaysia and the factors associated with it. A total of 248 subjects comprising 175 from the exposed group and the remaining control group were sampled. The main tools used in this study were validated questionnaire on hearing assessment and pure tone audiometric test. Response rate was 94%. Both area and personal exposure monitoring have exceeded action level for 8 Hrs TWA in the exposed group but within normal limit in the control group. The prevalence of hearing impairment was 88% among the noise exposed group and 11% in the control group with prevalence odds ratio (POR) 3.569 (95%CI 1.210-10.53, p<0.05). There was a significant association between gender, duration of noise exposure, and smoking with hearing impairment. Logistic regression analysis revealed that the factors significantly contributed to hearing impairment were age of the subjects and smoking duration. The adjusted odds ratio for age was 1.110 (95%CI 1.040-1.18, p<0.05) and 1.077 (95%CI 1.016-1.142, p<0.05) for smoking duration. Ethnicity, education and noisy were not found significantly associated with hearing impairment. This study emphasized that age and smoking were important factors in hearing impairment. Exposure to excessive noise is still the major cause of hearing impairment

Key: Hearing impairment, audiometric test, airport workers

Introduction.

The prevalence of noise induced hearing loss (NIHL) among airport workers has been increased (Imtiaz and Riaz 2008, Hong et al.1998 and Chen et al.1992) but yet none has been reported in Malaysia. NIHL is a disabling irreversible condition that may adversely affect the health and survival of the workers (Agawal et al. 2008). About half of all industrial workers including aviation sector are
exposed to 85 decibels sound intensity or more for eight hours a day throughout their working life (Flak 1997) and this exposure can lead to NIHL in the long term. Air traffic is steadily increasing in many industrialized countries with no exception in Malaysia and doubling of air traffic is predicted by 2015 (ACI 2003). Therefore there is a need to study the prevalence of noise induced hearing impairment among the airport workers in Malaysia and its associated factors with the intention to prevent or minimize NIHL.

Methodology
A cross sectional comparative study conducted among noise exposed and control group not exposed to noise. The exposed subjects were the maintenance, security and fire fighter whereas the administration and corporate personnel represented the control group. Using the PS software (Dupont & Plummer 1997), the targeted sample size was 282 with a ratio two to one between the exposed and the control. The exposed group was identified by the airport management based on their periodic audiometric testing programme, stratified into 3 groups and convenience sampling applied. For the control group simple random sampling was used based on the name list provided by the management. Guided interview using standardized questionnaire on noise exposure in Bahasa Melayu asking for personal biodata, general medical history and noise exposure history was taken. Pure tone audiometric test using approved and calibrated audiometer was conducted in the mobile audiometric van which complied to Schedule 2 Noise Exposure Regulation 1989. This was done after external ear examination and otoscopy. Hearing impairment was defined based on Noise Exposure Regulation as average hearing threshold at frequencies 0.5 kHz, 1 kHz, 2 kHz and 3 kHz equal or more than 25 dB (A) in one or both ears.

Participation was on voluntary basis with prior written consent obtained and the study was approved by the post graduate ethical committee of UKM. The airport identity was not revealed to maintain confidentiality. Personal dose for 8hrs TWA and area monitoring were determined on the control subjects, fire fighters and security personnel. The mean for both measurements was computed. The inclusion criteria was age at 20 years and above and had been working for more than one year. Workers with evidence of ear discharge, perforated ear drum, metabolic disorders, on medication with diuretic, salicylates, aspirin, aminoglycosides and foreign workers were excluded.

The data obtained were analyzed using software program ‘Statistical Package for Social Science’ (SPSS) version 13. Descriptive statistic chi square test for categorical data and t test were used. Risk
Factors associated with hearing impairment i.e age, race, duration of work, type of work were determined by bivariate and multivariate analysis

**Result**

The actual number of subjects recruited was 263 and 248 were accepted meeting the inclusion criteria giving response rate 94%. The distribution of the exposed group was security personnel 68 (38.9%), maintenance 52 (29 %) and fire fighter 55 (31.4 %). About half of the security personnel were ex servicemen from the military or police.

The overall comparison of the sociodemographic characteristics, education, noise exposure duration, smoking and noisy hobby is shown in (table 1). The majority of the subjects were Malays, amounting to 92% of the respondents and the remaining were non Malays. The age ranged from 21 to 54 years old. There was a significant difference in level of education and duration of exposure to noise between the subjects in which the exposed groups have slightly longer period of noise exposure because about half of them were ex- security who had previous exposures to firearms. There was no significant difference among both groups with respect to gender, smoking history and noisy hobby.

The mean hearing threshold at 0.5-3KHz among subjects and gender showed a significant difference as in table 2. The noise exposed group have slightly higher mean hearing threshold as compared to control group and male gender have higher mean hearing threshold at 0.5-3KHz. There was no significant difference in the median hearing threshold at 0.5-3KHz among job types in the exposed group. Mean noise exposure duration was found to be significantly associated with hearing impairment. (insert table 3). Majority of the exposed group had significant positive evidence of notch 4-6 in the audiogram, the cardinal sign of NIHL as compared with control group.

For the association between smoking and hearing impairment, cross tabulation showed a significant association between smoking and hearing impairment with $P= 0.002$ (insert table 4).

The prevalence of hearing impairment among the noise exposed group was 88.24% as compared to 11.76 % among the control ($X^2 = 5.92$, $p<0.05$) (insert tab. 5). The highest recorded result of area monitoring in work area of security and fire fighting unit were 87 dB and 88 dB respectively as compared to 80 dB in administration office.
In determining the significant factors associated with hearing impairment among the noise exposed group, all variables associated with hearing impairment were regressed with binary logistic regression. The factors were age, duration of exposure to noise, ethnic, gender, education level, smoking duration, and noisy hobbies. After multivariate analysis, 2 significant dependent variables were identified associated with hearing impairment in the noise exposed subjects, namely age and smoking duration (insert table 6)

Nagelkerke R² value was 0.443 which indicated that 44.3% variation in hearing impairment can be explained or predicted by this logistic regression model. From the above result, the equation for logistic regression model was derived as follows:

\[
\text{Hearing impairment} = -6.668 + 0.105 \times \text{(Age)} + 0.074 \times \text{(Smoking duration)}
\]

### Table 1 Sociodemographic characteristic of the subjects

<table>
<thead>
<tr>
<th>Variables</th>
<th>Exposed group</th>
<th>Non exposed group</th>
<th>$\chi^2$ value</th>
<th>t- value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N= 175 (%)</td>
<td>N= 73 (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (years) mean ± SD</td>
<td>34.05 ± 10.46</td>
<td>31.31 ± (9.96)</td>
<td>1.907</td>
<td></td>
<td>0.058</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malay</td>
<td>165 (94.28)</td>
<td>63 (86.3)</td>
<td>4.42</td>
<td></td>
<td>0.035*</td>
</tr>
<tr>
<td>Non Malay</td>
<td>10 (5.72)</td>
<td>10 (13.7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>137 (78.28)</td>
<td>49 (67.12)</td>
<td>3.42</td>
<td></td>
<td>0.064</td>
</tr>
<tr>
<td>Female</td>
<td>38 (21.72)</td>
<td>24 (32.88)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 years</td>
<td>155 (88.6)</td>
<td>44 (60.27)</td>
<td>23.93</td>
<td></td>
<td>0.001*</td>
</tr>
<tr>
<td>&gt;12 years</td>
<td>20 (11.4)</td>
<td>28 (38.73)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noise Exposure duration (yrs) Mean ± SD</td>
<td>10.06 ± 9.272</td>
<td>7.47 ± 6.503</td>
<td>2.046</td>
<td>0.042*</td>
<td></td>
</tr>
<tr>
<td>Smoking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>55 (31.43)</td>
<td>32 (43.84)</td>
<td>3.48</td>
<td></td>
<td>0.064</td>
</tr>
<tr>
<td>Yes</td>
<td>120 (68.57)</td>
<td>41 (56.16)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2. Mean hearing threshold 0.5-3KHz among the subjects and gender

<table>
<thead>
<tr>
<th>Variable</th>
<th>Hearing threshold 0.5-3KHz</th>
<th>Z stat</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ( SD)</td>
<td>Z stat</td>
<td>P value</td>
</tr>
<tr>
<td>Exposed (n=125)</td>
<td>14.35 ± 7.49</td>
<td>-2.114</td>
<td>0.034</td>
</tr>
<tr>
<td>Non exposed (n=73)</td>
<td>11.4 ± 4.98</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (n=196)</td>
<td>14.26 ± 7.99</td>
<td>-2.854</td>
<td>0.004</td>
</tr>
<tr>
<td>Female (n=52)</td>
<td>12.36 ± 5.05</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mann-Whitney U test. Significant at P- value <0.05

Table 3. Mean noise exposure duration and hearing impairment among the subjects

<table>
<thead>
<tr>
<th>Variable</th>
<th>Hearing impairment</th>
<th>Z- stat</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes n= 34</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No n= 214</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exposure Duration (yr)</td>
<td>mean ± SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>19.352 ± 10.45</td>
<td>-5.379</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td></td>
<td>7.703 ± 7.787</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mann-Whitney U test. Significant at P- value <0.05
### Table 4. Association between smoking and hearing impairment

<table>
<thead>
<tr>
<th>Variable</th>
<th>Hearing impairment frequency (%)</th>
<th>( \chi^2 ) value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoking</td>
<td>Yes (N=34)</td>
<td>30 (88.24)</td>
<td>9.405</td>
</tr>
<tr>
<td></td>
<td>No (N=214)</td>
<td>131 (61.21)</td>
<td>0.002</td>
</tr>
<tr>
<td>No smoking</td>
<td>Yes (N=34)</td>
<td>4 (11.76)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No (N=214)</td>
<td>83 (38.79)</td>
<td></td>
</tr>
</tbody>
</table>

Chi square test, significant at p value < 0.05

### Table 5. Prevalence of hearing impairment among the subjects

<table>
<thead>
<tr>
<th>Subject</th>
<th>Hearing impairment frequency (%)</th>
<th>( \chi^2 )</th>
<th>Prev OR (95%CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposed workers</td>
<td>Yes (N=34)</td>
<td>30 (88.24)</td>
<td>5.923</td>
<td>3.569</td>
</tr>
<tr>
<td></td>
<td>No (N=214)</td>
<td>145 (67.76)</td>
<td></td>
<td>0.015</td>
</tr>
<tr>
<td>Non exposed</td>
<td>Yes (N=34)</td>
<td>4 (11.76)</td>
<td>69 (32.24)</td>
<td>(1.210-10.53)</td>
</tr>
<tr>
<td></td>
<td>No (N=214)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Chi square test with Yates correction, significant at P-value < 0.05

### Table 6. Logistic regression model on factors associated with hearing impairment among the exposed subjects (significant variables only)

<table>
<thead>
<tr>
<th>Variable</th>
<th>( \beta ) value</th>
<th>Wald</th>
<th>Adj OR</th>
<th>95% CI</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>- 6.668</td>
<td>27.634</td>
<td>0.00</td>
<td>-</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Age</td>
<td>0.105</td>
<td>9.939</td>
<td>1.110</td>
<td>1.040 - 1.185</td>
<td>0.002</td>
</tr>
<tr>
<td>Smoking duration</td>
<td>0.074</td>
<td>6.288</td>
<td>1.077</td>
<td>1.016 - 1.142</td>
<td>0.012</td>
</tr>
</tbody>
</table>

\[ R^2 = 0.443 \]
Discussion

The overall response rate 94% was very good for an epidemiology study. Malay ethnic was the majority of the respondents in both groups. This is a common phenomenon in Malaysian civil service. With respect to the education level, there was a significant difference in education among the exposed and non exposed respondents. This phenomenon of disparity in education level among Malaysian worker has been reported by local researchers (Firdaus 2000, Yusrina 2005).

When comparing the mean hearing threshold at 0.5-3KHz among the subjects and gender the difference was statistically significant (P=0.034) and (P=0.038) respectively. The exposed group and male gender have higher mean hearing threshold than the control group and female.

Duration of exposure to noise is one of the several factors that may lead to hearing impairment, and the effect follows dose response manner. There was significant association between hearing impairment and mean noise exposure duration found in this study like has been quoted earlier (Khiew and Nizam 2006 and Palmer et al. 2002). The longer the exposure duration to noise the severe the effect on hearing loss.

In this study, there was a statistical significant association between smoking and hearing impairment at the bivariate analysis. This was further shown in multiple regression analysis of factors associated with hearing impairment among the exposed group, where smoking duration was found to be a significant predictor for hearing impairment.

The prevalence of hearing impairment was around 30 (88.24%) in the exposed group and 4 (11.76 %) in control group with prevalence odds ratio 3.569 (95%CI 1.210 -10.53). Among Karachi airport worker the prevalence of NIHL was 84% (Imtiaz and Riaz 2008). In a similar study at Seoul Airport the estimated prevalence was around 42% (Hong et al. 1998). The reason for high prevalence of hearing impairment in the exposed group could be due to relatively longer duration of exposure to noise as in table 3, having exposed to noise in the previous job among the ex policemen and arm forces who constituted about half of the security personnel, smoking and other confounders. This result was in line and reflected the exposure monitoring result which showed the exposed group have higher personal dose and exposed to higher ambient noise compared to control.

In this study, it was found that male subjects have higher prevalence of hearing impairment as compared to female subjects with prevalence odds ratio 8.755. This finding was similar with the study...
by Agawal et al. (2008) who found that men generally had higher prevalence of bilateral, unilateral, and high-frequency hearing loss across the age range compared with women.

After adjusting confounders that may have effect on hearing impairment on noise exposed group, multivariate logistic regression identified significant factors associated with hearing impairment among the noise exposed group were age and smoking duration. The adjusted odds ratio following multiple logistic regression analysis for age was 1.110 (95% CI 1.040-1.185, p< 0.05) and 1.077 (95% CI 1.016 - 1.142, p<0.05) for smoking duration. Therefore this study showed that for every one year increase in age, the odds of developing hearing impairment would increase by 1% (95% CI 4.0 to 8.5, p < 0.05) when adjusted for duration of smoking, and a person with an increase in one year of smoking has a 1.077 times the odds of having hearing impairment (95% CI 1.016 to 1.142, p< 0.05) when adjusted for age.

The aging process is known to have impact on the capacity of human hearing. (Ferrite & Santana 2005, Royster & Thomas 1979 and Rylander 2004). Most of the occupational noise burden is attributable to unprotected exposures above 95 dB(A), and becomes apparent in middle age, when occupational noise exposure has ceased but age-related threshold shifts are added to prior noise-induced shifts, resulting in clinically significant impairment (Dobie 2008).

Smoking duration is also a significant factor for the development of hearing impairment (Noor Hassim & Rampal 1998, Mizoue et al. 2003 and Noriyukic et al. 2000). Smoking is associated with increased odds of having high frequency hearing loss in a dose-response manner.

Conclusion

There are many factors that can contribute to hearing impairment apart from noise. Maintenance workers may also expose to solvent while fueling the aircraft and this was found to have much more pronounced sensori-neural hearing loss than would be expected from noise exposure only (Barregard & Axelsson 1984). As hearing loss may develop at an earlier age with noise exposure, smoking and cardiovascular disease, a healthy life style may delay the onset. High BMI and hypertension which are also predictors for hearing loss need also to be considered in any study on hearing loss among workers.
Acknowledgement

We thank to Niosh especially Nurhidayah, Aris and Norida for assisting us in the interview and audiometric testing. We also express our gratitude to Dr. Rozhan Shariff for helping us in the statistical method and Mr. Malik Yunus of the airport HSE department in facilitating data collection.

REFERENCES


Respiratory Symptoms and Spirometry Findings among Pottery Makers in Perak

Ibrahim Zubil AR, Wan Adnan WA

Public Health Department, Unikl RCMP, 30450 Greentown Ipoh, Perak.
Community Health Department, Mahsa College University, Kuala Lumpur

Author correspondence: ibrahimzubil@rcmp.unikl.edu.my

Abstract

Occupational health hazards as a result to exposure to mineral dust containing silica has been established long time ago in occupational health history. Its effects on lung function and symptom was evaluated in a cross sectional studied among 49 small enterprise pottery workers in the county of Sayong clustered in 3 villages. Respiratory symptoms and lung function was evaluated using MRC respiratory questionnaire 86 and standard spirometry performed. The prevalence of chronic cough, phlegm and chest tightness was 24.5%, 16% and 16% respectively. There was no significant decrement in lung function parameters from the predicted normal value with the mean predicted FVC; FEV1 and FEV1/FVC ratio was 85.32%, 83.87% and 99.22 respectively. The relationship between lung symptoms and lung function parameters was evaluated and the result was not significant.

Keywords: Respiratory symptom, lung function, pottery makers

INTRODUCTION

Workers exposed to various mineral dusts such as quartz, silicon dioxide (silica), kaolin which present in clay to make ceramic materials are at risk of developing silicosis and lung cancer, pulmonary tuberculosis and airways diseases.1-3 the risk is directly related to the amount of cumulative dust inhalation. Silicosis is a fibrotic lung disease due to accumulation of respirable dust in the lung parenchyma and the tissue reaction to its presence4, resulting in reduced lung compliance and restrictive lung disease. Depending on the type and severity, the disease may presents with no
symptom or mild cough to disabling respiratory failure. All forms of silicosis can progress in the absence of continued exposure and chronic silicosis can appear after exposure ceases.\textsuperscript{5}

Small scale family based ceramic pottery makers using traditional technique are scattered in the district of Kuala Kangsar and yet no study has been done on their respiratory health. Cognizant of the health effects of silica dust expose on them, this study is aimed at estimating the prevalence of respiratory symptoms and lung function among them as base line data for future reference.

**MATERIAL AND METHOD**

This was a cross sectional study on cottage and small and medium enterprise pottery makers in Kuala Kangsar district of Perak undertaken in January to February 2010. Majority of the entrepreneurs estimated to be around 200 which formed the sample unit were scattered in one of the county (mukim) known as Sayong in the district. Samples were clustered in 3 villages in the county where a larger number of small enterprise cottage ceramic workshops located and purposive sampling method was undertaken with equal proportion of sample in each cluster.

Respiratory symptoms was evaluated using validated Malay translated MRC respiratory questionnaire 1986. Information on demographics, occupational history, chronic respiratory symptoms, smoking habits, and use of respiratory protection equipment was collected and guided by trained assistants. Anthropometric and personal data were obtained prior to spirometry. Calibrated spirometers model Trend Micro used for evaluating lung function and performed by trained technicians. Data were uploaded and analyzed using American Thoracic Society (ATS) criteria for acceptability and reproducibility.

**RESULTS**

Due to logistic and time constraint as the majority of the subjects being sole proprietor, worked on odd day and time only 53 subjects voluntarily agreed to participate. Finally 49 were eligible for analysis because, two of them were rejected due to known active asthma and one refused lung function test. The demographic characteristics of the subject is shown in table 1. All the subjects were Malay ethnic with mean age 39.35±11.62 and 75% of them were male. Nearly two third of them have education up to secondary level. Of the total 37 males, 15(40.5%) of them were smokers and none of the female was smoker. The mean exposure duration was 14.67 years and the mean of predicted FVC, FEV\textsubscript{1} and
FEV1/FVC ratio median were 85.32±13.32, 83.87±12.98 and 99.22 respectively. The most prevalent respiratory symptoms was chronic cough accounted for 25% followed by phlegm and chest tightness with equal percentage of 16% (table 2). Wheezing was the least complained symptom accounted for 2%. There was no significant difference in symptoms prevalence among gender (table 3). The proportion of subjects with normal predicted FCV, FEV1 and FEV1/FVC ratio were 61.22%, 65.3% and 97.9% respectively (diagram 1). As shown in table 1, there was no depreciation in the mean predicted lung function parameters from the expected value and no statistically significant difference in these parameters between gender. The association between respiratory symptoms and lung function parameters was not significant with P value > 0.05 (table 4).

**DISCUSSION**

**Respiratory symptoms**

A higher prevalence of dyspnoea and chronic cough with a significantly poorer pulmonary function were observed in workers with pneumoconiosis than those without, irrespective of dust type. In this study only chronic cough was found at higher percentage than other symptoms with a prevalence of 24.5% followed by phlegm and chest tightness in about equal percentage 16%. These figures were not much different as compared to the result of other study on brick manufacturing workers (also exposure to silica dust) which found the prevalence of cough was 31%, phlegm 26% and chest tightness 24%.

A number of studies have shown that in population exposed to mineral dust there is greater prevalence of chronic bronchitis, even in the absence of radiological evidence of pneumoconiosis. Cough and phlegm are the main symptoms and prerequisite for chronic bronchitis. As 30% of the subjects were smokers, confounding effect of smoking on lung symptom cannot be totally neglected as the effect is additive. Overall the prevalence of positive respiratory symptoms was low in this study as well as neither obstructive or restrictive pattern was observed. This is consistent with the finding of another study among European ceramic fiber workers where low respiratory prevalence but mild restrictive pattern were noted. Further more in a few individuals, lung diseases may be symptomless and yet lung function is severely impaired.
Lung function parameters

In this study there were no changes in the average lung function parameters among the majority of the subjects. The reason may be due to low concentration and degree of exposure to silica dust. During mixing of the raw materials clay, silica, sand and water to make dough before pouring into the mould, dust could have been trapped by water preventing them from becoming airborne.

The similar finding was also noted in a study of silicosis among coal miners and unexposed control group that found no lung function difference among them despite more frequent respiratory symptoms in the exposed group. Even the predicted FVC and FEV1 value lower in silica exposed group but there was no statistically significant difference between the non exposed group.12,13

In a study of relationship between silicosis and lung function, Gamble et al. noted that even those in profusion category 2, they only had small reduction in lung function relative to those with category 0. Comparison of the lung function between genders in this study showed that women had slightly lower FVC and FEV1 but the difference is not significant. This means that man and women shared similar risk and the long–held view of silicosis risk is greater in men is refuted.15

Despite many studies have showed lower lung function in ceramic worker having lung symptoms as compared to those without symptom, but this present study did not find significant association between respiratory symptom and lung function parameters. The difference could be caused by limited sample size and method of making ceramic products. As Burge noted earlier sometimes there is no correlation between lung function and symptom in respiratory diseases. The other reason could be minimal dust exposure.

Conclusion

Although majority of the subjects have negative lung symptom and normal lung function further study such as standard ILO chest X-ray and sputum test would be required to determine the clinical impact of exposure like silicosis and pulmonary tuberculosis. Airborne dust exposure monitoring of and personal exposure estimation is highly recommended to be done in order to correlate symptoms and lung function more precisely.
List of table

Table 1. Socoidemo character and lung function parameters

<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>%</th>
<th>Mean (SD)</th>
<th>Median</th>
<th>Qtr</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td>39.35 ± 11.62</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 - 29</td>
<td>13</td>
<td>26.30</td>
<td>13</td>
<td>26.30</td>
<td></td>
</tr>
<tr>
<td>30 - 39</td>
<td>8</td>
<td>16.33</td>
<td>8</td>
<td>16.33</td>
<td></td>
</tr>
<tr>
<td>40 - 49</td>
<td>18</td>
<td>36.73</td>
<td>18</td>
<td>36.73</td>
<td></td>
</tr>
<tr>
<td>50 - 59</td>
<td>8</td>
<td>16.33</td>
<td>8</td>
<td>16.33</td>
<td></td>
</tr>
<tr>
<td>&gt; 60</td>
<td>2</td>
<td>4.08</td>
<td>2</td>
<td>4.08</td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>12</td>
<td>24.5</td>
<td>12</td>
<td>24.5</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>37</td>
<td>75.5</td>
<td>37</td>
<td>75.5</td>
<td></td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malay</td>
<td>49</td>
<td>100</td>
<td>49</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>6</td>
<td>12.24</td>
<td>6</td>
<td>12.24</td>
<td></td>
</tr>
<tr>
<td>Secondary</td>
<td>30</td>
<td>61.23</td>
<td>30</td>
<td>61.23</td>
<td></td>
</tr>
<tr>
<td>Tertiary</td>
<td>13</td>
<td>26.53</td>
<td>13</td>
<td>26.53</td>
<td></td>
</tr>
<tr>
<td><strong>Smoking</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>34</td>
<td>69.4</td>
<td>34</td>
<td>69.4</td>
<td></td>
</tr>
</tbody>
</table>
Yes                              15         30.6
Duration of work            14.67 ± 1.31
Income*
<2000                          25         51
2000-4000                   12         24.5
>4000                           6          12.2
FVC                                                                   85.32 ± 13.32
FEV$_1$                                                                  83.82 ± 12.98
FVC/FEV$_1$ ratio                                                                                100                 15
__________________________________________________________________________
*missing data 6

Table 2. Prevalence of symptoms N=49

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Yes</th>
<th>%</th>
<th>No</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic cough</td>
<td>12</td>
<td>24.5</td>
<td>37</td>
<td>75.5</td>
</tr>
<tr>
<td>Phlegm</td>
<td>8</td>
<td>16.3</td>
<td>41</td>
<td>83.7</td>
</tr>
<tr>
<td>Shortness of breath</td>
<td>4</td>
<td>8.2</td>
<td>45</td>
<td>91.8</td>
</tr>
<tr>
<td>Wheezing</td>
<td>2</td>
<td>4.1</td>
<td>47</td>
<td>95.9</td>
</tr>
<tr>
<td>Chest tightness</td>
<td>8</td>
<td>16.3</td>
<td>41</td>
<td>83.7</td>
</tr>
</tbody>
</table>
Table 3. Prevalence of symptoms among gender

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Female</th>
<th>Male</th>
<th>(X^2)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chronic cough</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>10 (27.1)</td>
<td>27(72.9)</td>
<td>0.115*</td>
<td>0.735</td>
</tr>
<tr>
<td>Yes</td>
<td>2 (16.7)</td>
<td></td>
<td></td>
<td>10(83.3)</td>
</tr>
<tr>
<td>Phlegm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>11(26.8)</td>
<td>30(73.2)</td>
<td>0.17*</td>
<td>0.680</td>
</tr>
<tr>
<td>Yes</td>
<td>1(12.5)</td>
<td></td>
<td></td>
<td>7(87.5)</td>
</tr>
<tr>
<td>Shortness of breath</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>12(26.7)</td>
<td>33(73.3)</td>
<td>0.339*</td>
<td>0.561</td>
</tr>
<tr>
<td>yes</td>
<td>0(0)</td>
<td>4 (100)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheezing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>12(25.5)</td>
<td>35(74.5)</td>
<td>0.00*</td>
<td>1.0</td>
</tr>
<tr>
<td>Yes</td>
<td>0(0)</td>
<td>8(100)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chest tightness</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>no</td>
<td>12(29.2)</td>
<td>29(70.7)</td>
<td>1.72*</td>
<td>0.19</td>
</tr>
<tr>
<td>Yes</td>
<td>0(0)</td>
<td>8(100)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Chi square test with Yates correction, significant value at p < 0.05
% Predicted value

Diagram 1. Spirometry parameters among subjects, N = 49

Table 4. Association between mean spirometry results and respiratory symptoms

<table>
<thead>
<tr>
<th>Variable</th>
<th>with symptom</th>
<th>no symptom</th>
<th>t-stat (df)</th>
<th>Z-stat^</th>
<th>P</th>
<th>95%CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC</td>
<td>87.79</td>
<td>83.77</td>
<td>-1.031(47)</td>
<td>0.308</td>
<td>-11.87 –</td>
<td></td>
</tr>
<tr>
<td>FEV1</td>
<td>87.00</td>
<td>81.80</td>
<td>-1.382(47)</td>
<td>0.174</td>
<td>-12.40 –</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td>26.63*</td>
<td>23.97*</td>
<td>-0.64</td>
<td>0.524</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Independent t-test significant at P < 0.05

^ Mann Whitney test significant at P < 0.05

* Mean rank

Reference

1. DHSS (Niosh) publication No.2002-129. Health effect of occupational exposure to respirable crystalline silica. 2002


The Administration of Marine Spill Response of Malaysia

Ahmad Faizal AHMAD FUAD¹, Mohd Sharifuddin AHMAD² and Saharuddin ABDUL HAMID²

¹ Department of Nautical Science and Maritime Transportation, Faculty of Maritime Studies and Marine Science, University Malaysia Terengganu
²Department of Maritime Management, Faculty of Maritime Studies and Marine Science, University Malaysia Terengganu

Abstract

Maritime transportation is very important for coastal state country like Malaysia. However, as having the busiest straits in the world, Malaysia is continuously exposed to the risk of marine spill. The nation had experienced around 30 marine spill incidents since 1976 to the present. The main contributor of marine spill is ship’s accident and in term of category of accident, collision had contributed the most. In term of type of substance that mostly spilled by ships is highly persistence crude oil. The management of marine spill response of Malaysia is applying the three tiers system which is base on the area and scale of the spill. The basis of establishing the marine response service is in accordance with OPRC, which incorporated into the national environmental law. With the three tiers of response system, Malaysia is equipped with arsenal of marine spill response and control equipments. However, with the present magnitude of threat, the current capacities of equipments are insufficient. Nevertheless, the possibility of full magnitude of marine spill is unlikely due to the safety features incorporated into the design of the ships and FSO/FPSO. In term of claim and compensation for marine spill incident, Malaysia is applying the two layers of compensation under the CLC 1992 Protocol and FUND 1992 Protocol. Therefore, Malaysia is ready in various aspects of marine spill response and control.

Keywords: Marine, Oil Spill, Response

1.0 Introduction

Maritime transportation is consider as the world most internationally industry as 90% of the global trade goods are carried by sea (International Maritime Organisation, 2010). Maritime transportation is also deems as the most environmentally friendly in term of using the least energy to transport the same amount of cargo compare with other means of transportation. However, accidents involving ships had caused severe pollution to the marine environment. Marine spill incidents such as the famous Exxon
Valdez\(^1\) in year 1989 and Prestige in year 2002 had shown to world on the negative impact of shipping. However, the frequency of marine spill incident worldwide had reduced significantly since the 1980’s (White, 2000). This development may due to improvement in safety of navigation and the introduction of stricter regulations that had reduced the risk of marine spill. In addition to reducing the risk, most of the coastal state had established the management of marine spill response and had acquired the necessary equipments for the purpose. As one of the coastal state that manages the busiest straits in the world and conduct oil exploration within the state water, Malaysia is exposed to the threat of marine spill. This paper is discussing on the management of marine spill response in Malaysia.

2.0 The Marine Spill Incidents Occurred in Malaysian Waters

The Exxon Valdez incident is one of the classic examples of marine spill incident that involved crude oil and had contributed to the review and improvement of the management of marine spill response to the world. The Exxon Valdez (Figure 1), a 300 meter tanker ran aground Bligh Reef of Prince William Sound Alaska on March 1989 had spilled over 240,000 barrels of crude oil. This was the largest oil spill incident in United States of America after the recent 2010 spill in Gulf of Mexico (The Mariner Group, 2008). The oil slick had scattered over 3,000 square miles and spread to more than 350 miles of coastline (NRT, 1989). The incidents had cause severe effect to the environment such as fatalities of marine lives and had destroyed the ecology system. On the economic impact, the tourism industry had suffered lost of more than USD 630 million from 1989 to 1990 (The Mariner Group, 2008). This lost however did not include the lost from the commercial fishing activities. The ship owner, Exxon Mobil had paid USD 2.2 billion for the cleanup operations in addition to USD 250 million of fined for the criminal settlement (Cleveland, 2008).

\(^1\)Tanker Exxon Valdez grounded in Prince William Sound Alaska on March 24 1989 and spilled 10 million gallons of crude oil (NRT, 1989)
The history of marine spill in Malaysia began with MT Showa Maru incident on January 1975 where 54,000 barrels of crude oil was spilled to the Malacca and Singapore Straits (Department of Environment, 2005c; Lamri, 2005). Learnt from the incident, Malaysian government had set up the National Oil Spill Control Committee (NOSC) in accordance with Malaysia Cabinet decision on June 1976 (Department of Environment, 2005d). With the setup of NOSC, the National Contingency Plan was established. The plan has been continuously review and improve from time to time according to experience gathered from oil spill incidents, exercises and the advent of new technologies (Department of Environment, 2005e).

The record of marine spill incidents in chronological order is show in Appendix A. There are 28 recorded cases of marine spill and the recent one was occurred on 25th May 2010. The oil spill was due to collision between Malaysian registered double hull oil tanker MT Bunga Kelana 3 with bulk carrier MV Wailey under Saint Vincent and Grenadines flag which had spilled 2,000 metric ton (14,600 barrels) of crude oil to the Singapore Straits (Bernama, 2010a). The tanker was carrying 61,858 tonnes of light crude oil from Bintulu to Melaka during the incident (Bernama, 2010b). Around 1,400 fishermen of the Malaysian coast were affected by the spill.
The worst oil spill occurred in Malaysian waters was at Singapore Straits in 2005 due to collision between MV Evoikos with an empty VLCC Orapin Global at Singapore port. The collision had caused MV Evoikos to spilled around 28,500 tons of heavy marine fuel. It took three weeks for the relevant authorities from Malaysia and Singapore to clean up the spill.

2.1 Analysis on Type of Incident that Cause the Marine Spill Incident

According to Annex I, there are six categories of accident that caused the marine spill. Figure 1 is showing the percentage of incident that contributed to the marine spill. Collision is the most frequent category of incident recorded since 1976 that had caused the marine spill. This is follow by other category of accident which is grounded, human error, leaked pipeline, material fatigue and capsized. Many reasons were associated with the accident which among are the human factor, weather conditions and faulty of equipments. In order to determine the cause, more research should be conducted.

![Percentage Type of Accident that Caused Marine Spills 1976 to 2010](image-url)

**Figure 2:** Type of Incident that Causes the Marine Spill
2.2 Analysis on Contribution of Each Category Accident to Marine Spill

Figure 3 is showing the amount and substance of each type of accident. Collision is the highest contributor to marine spill by 32,200 tons crude oil, 28500 tons of heavy marine fuel, 808 tons of fuel oil and 1500 tons of bitumen. This shows that collision is not only the most frequent in term of accident category; it also caused the highest volume of spill compare with other category. This followed by grounded, sunk, human factor, capsized and material fatigue.

![Chart showing the amount and type of substance spilled according to incident type from 1976 to 2010.](image)

**Figure 3:** Amount and Type of Substance Spilled According to Incident Type from 1976 to 2010

2.3 Analysis on the Type of Substance Spilled in Malaysia’s Waters

The substances of the marine spill are from the cargo or fuel use by the ship. Figure 4 shows the type of substances that spilled in Malaysia’s waters by percentage from 1976 to 2010. Most of the substance spilled is Crude Oils follow by Heavy Marine Fuel Oil, Fuel Oil, Bitumen and Phenol (Highly Toxic Substance or HNS).
Figure 4: The Percentage of Substance of Marine Spill in Malaysia from 1976 to 2010

Crude Oils are complex mixtures of hydrocarbons of varying molecular weight and structure comprising the three main chemical groups, paraffinic, naphtenic and aromatic (International Maritime Organization, 1988). While for the petroleum products such as Heavy Marine Fuel Oil, Fuel Oil of light and medium, and Bitumen, are derived from refining of crude oil.

3.0 The Management of Marine Spill Response of Malaysia

The leading agency for marine pollution control in Malaysia is Department of Environment Malaysia as conferred by the Environmental Quality Act 1974 (amendment 1996) and Exclusive Economic Zone Act 1984 (Department of Environment, 2005f; Government of Malaysia, 2001a). However,
Malaysia Marine Department Malaysia is the designated agency for marine pollution control operation and maintain pollution control equipments.

Other national regulations that relating with protection of marine environment are as the following (Department of Environment, 2005f):

- Merchant Shipping Ordinance 1952, Amendment 1994, Chapter VA (Peninsular Malaysia) and 1960 (Sabah & Sarawak)
- Continental Shelf Act No. 83
- Petroleum Exploration Act, 1966
- Emergency Ordinance No. 7 1969

Malaysia is also party to international conventions pertaining to protection of marine environment as the following (Department of Environment, 2005f; International Maritime Organisation, 2008):

- The International Convention for The Prevention of Pollution from Ships 1973 as modified by the Protocol of 1978 (MARPOL 73/78)
- International Convention on Oil Pollution Prevention Preparedness, Response and Cooperation (OPRC)\(^2\) 1990
- International Convention on Civil Liability for Oil Pollution Damage (CLC) 1969, Protocol 1992

### 3.1 The National Contingency Plan

The National Contingency Plan of Malaysia is applying three tiers approach according to the severity of the oil spill incident (Department of Environment, 2005d, 2005e; International Maritime Organisation, 1990). Since the establishment of the National Oil Spill Control Committee (NOSCC) and the national contingency plan in 1976, the plan had been reviewed and improved from time to time in accordance with lesson learnt from the real incident and exercises conducted (IPIECA, 2008).

### 3.1.1 The Three Tiers Approach

\(^2\) Malaysia had ratified OPRC Convention on 30\(^\text{th}\) October 1997
The three tier approach is a structured approach in establishing the oil spill preparedness and level of response where it allows the potential oil spill incidents to be categorized in terms of their potential severity and the capabilities that need to be in place to respond (IPIECA, 2007).

The three tiers approach starts with the lowest scale of oil spill which is the Tier 1. The example of Tier 1 incident is oil spill at port due to bunker or ships transfer operation. For this scenario, the port operator is responsible for controlling the spill by mobilising all their resource available such as marine spill equipments and personnel as in Appendix II (Department of Environment, 2005e; IPIECA, 2007). If their resource is inadequate, an additional equipments and support would be provided by a specialist company that has an agreement with them such as Petroleum Industry Malaysia Mutual Aid Group (PIMMAG). The operation would then be supervised by the Department of Environment (DOE).

If the situation of the spill deteriorates and spread beyond the area of port’s geographical responsibility, it becomes Tier 2. In this stage, the DOE State Director has to perform the duty as the State Oil Spill Control Committee (SOSCC) Chairperson as confer by the National Contingency Plan in Appendix IV (Department of Environment, 2005a).

If the spread of the spill reach the nearby beach, the DOE State Director would request the District Officer to set up the District Oil Spill Control Committee (Appendix III) for the beach or riverbank clean-up operation (Department of Environment, 2003). Equipments for the clean-up operation would be provided by the Malaysia Marine Department through its nearest stockpile to the location of spill in addition to equipments from PIMMAG. This had been practiced during the Lutong River Spill incident in May 2005 where Marine Department’s stockpile in Miri had reinforced PIMMAG with the necessary equipments (Lamri, 2005). However, PIMMAG had to reimburse the relevant cost of the equipment use during the operation to the government.

For the occurrence of oil spill at sea, the DOE State Director would perform his/her duty as the chairperson of the SOSCC. While for the On-Scene Commander, the task is given to commanding officer of the first government vessel that arrives at the scene as conferred by the law. Although the current leading agency for maritime search and rescue in Malaysia is Malaysia Maritime Enforcement Agency (MMEA), the task of marine spill control is still performed by Malaysia Marine Department; therefore the On-Scene Commander is personnel of the Marine Department. If the oil spill had reach

---

3 Port Authorities, Port Operators, and Local Oil Companies which operate the Oil Terminal or Oil platform offshore

4 In Malaysia, district is the areas within a state and have its own administration
the beach or riverbank, the DOE State Director has to request the State Secretary to establish and chair the State Beach Clean up Committee as in Appendix V (Department of Environment, 2003, 2005e).

The Tier 3 contingency plan (Appendix VI) is the highest level to cater for major oil spill that directs by the National Oil Spill Control Committee at headquarters of Department of Environment in Putrajaya\(^5\) (Department of Environment, 2005b). The chairperson of NOSCC is DOE Director General and the committee members are consist of representative from various agencies with specific role as shown in Appendix VII (Department of Environment, 2005b). The working concept of NOSCC is similar with the smaller committee of State Oil Spill Control Committee but with more committee’s member. In accordance with the contingency plan, the NOSCC issue directives to the On Scene Commander through DOE State Director in controlling spill at sea, however the role of NOSCC is change as advisor to the State Beach Clean up Committee when the oil spill had reached the beach. This is due to the responsibility of clean-up at land is under the state government and the federal agency such as DOE act as advisor and the overall coordinator.

Malaysia has several regional agreements with its neighbouring countries for the cooperation of marine spill response in the South East Asia Region. These agreements enable Malaysia to cooperate with its neighbouring countries for marine spill beyond its boundaries. The regional agreements of oil spill are mention below (Chin, 2006):

- SOP\(^6\) for Oil Spill Combat for Straits of Malacca and Singapore in 1981 (Malaysia, Indonesia and Singapore)
- Lombok-Makasar Oil Spill Network Response Plan in 1987 (Malaysia, Indonesia and Philippines)
- SOP for Malaysia and Brunei Darussalam in 1993 (Malaysia and Brunei)
- ASEAN\(^7\)-OSRAP\(^8\)-1994 (ASEAN Countries)

4.0 The Capacity of Marine Spill Control Equipments in Malaysia

\(^5\) Putrajaya is the town of federal government administrative centre situated near to Kuala Lumpur.  
\(^6\) Standard Operation Procedure  
\(^7\) Association of South East Asian Countries (Singapore, Malaysia, Indonesia, Brunei, Thailand, Myanmar, Vietnam, Cambodia, Philippines and Laos)  
\(^8\) Oil Spill Response Action Plan
According to PIMMAG, the total capacity of Malaysia’s marine spill control equipments in 2005 is 256,000 thousand barrels as shown by Figure 5 (Lamri, 2005). Most of these equipments are stored in stockpiles such as the Figure 6. However, this total capacity is not including the compulsory Tier 1 equipments in all port and oil terminal. Therefore, the capacity should be more. However most of the tier 1 control equipments (Figure 7) are limited for shore use only. In term of the ownership of the equipments, the industry’s stockpile is 71.5% compare with government’s stockpile (Marine Department and DOE) which is 28.5%. This is showing that the industry is proactive and serious in the protection of marine environment by investing significantly in the spill control equipment and training. The well established environmental law and strong enforcement by the government may also contribute to the preparedness of the industry.

Figure 5: The Location and Capacity of Marine Spill Control Equipments in Malaysia (Source: DOE, Malaysia Marine Department & Lamri, 2005)
In term of expenditure for pollution control until 1997, the Marine Department had spent a total of RM34 million for the procurement of oil spill control equipments together with pollution control vessels (Ahmad, 1997). The recent procurement of oil spill control equipment for Sabah and Sarawak
in 2002 was around RM9 million for 40,000 barrel capacity while additional 16 marine control vessels\(^9\) ranging from 14-50 meter length were built from 1999 to 2005. Overall, the government oil spill control equipment capacity is 73,000 barrel and the number of oil spill control vessels\(^10\) is around 30 units.

In a glimpse, the overall oil spill equipment capacity of Malaysia (256,000 barrel) is not in parallel with the magnitude of the threat or risk. This can be determined by calculating the risk of spill according to four geographical marine area of Malaysia which is the west cost Peninsular Malaysia, east cost Peninsular Malaysia, Sarawak and Sabah.

5.0 The Magnitude of the Marine Spill

In order to determine the magnitude of marine spill especially crude oil in west cost Peninsular Malaysia that covers the Straits of Malacca, the authority should know the recent average size of tankers and its capacity. Figure 8 is showing the trend of tanker’s size. The average size of tankers in period of 2000’s\(^11\) is around 170,000 Dwt (Suezmax Tankers) with the estimate\(^12\) capacity of 1.2 million barrel. Therefore, the required oil spill control capacity for the area would be around 1.2 million barrel. However, the capacity of current oil spill control equipments in the west coast peninsular is limited to 101,000 barrel (13,780 tons). Nevertheless, from the previous records of incident especially involving collision, not all volume of cargo carried would be spilled. Instead, the loss of cargo was limited by the incorporation of limitation of size and arrangement of cargo tanks in accordance with Regulation 26 of MARPOL (International Maritime Organization, 2006). For example, around 18,000 barrels (2,500 tons) of crude oil was spilled of 454,000 barrel (62,000 tons) the total cargo carried from the recent 2010 incident of MT Bunga Kelana 3 (Figure 9). The magnitude of spill is limited due to distribution of cargo into several divisional tanks of the ship. Another example is the MT Evoikos collision incident in 1997 where 28,500 tons (209,000 barrels) of fuel oil cargo was spilled and the remaining was not affected. Therefore, the magnitude of the spill may not reach the total volume of the cargo due to safety features incorporated into the design of the ship.

\(^9\) 7 vessels of Peninsular Marine Department, 8 vessels of Sabah Marine Department and 1 vessels of Sarawak Marine Department
\(^10\) 30 vessels consists of 16 vessels in Peninsular, 9 vessels in Sabah and 5 vessels in Sarawak
\(^11\) Data from 2000 to May 2008
\(^12\) Author’s estimated derived from 150,000 Dwt tanker
In order to determine the magnitude of spill for east cost Peninsular Malaysia, offshore of Sarawak and Sabah, the approach is to know the number and the capacity of each Floating Production Storage and Offloading Facility (FPSO) or Floating Storage and Offloading Facility (FSO) that operating in that area. Location and capacity of FPSO/FSO in Malaysian waters shows by Table 1 below.
According to FPSO/FSO capacity in east coast Peninsular Malaysia, the maximum magnitude of spill according to capacity of FSO/FPSO is around 1.2 million barrels that refers to FSO Puteri Dulang which having the highest capacity. However, the capacity of oil spill control equipment is only 44,000 barrel. Nevertheless, by chances of FSO involve in collision in the east coast is unlikely due to less of traffic density compare with the Straits of Malacca of the west coast. The incident that would spill of the whole volume of cargo is unlikely as the crude oil in FSO is distributed into several divisions of cargo tanks.

For East Malaysia in Borneo, the maximum magnitude of the spill in Sarawak and Sabah is 750,000 barrel and 2 million barrels respectively. The capacity of the marine spill control equipment in Sarawak is 60,000 barrels and Sabah is 51,000 barrels. The risk of each FSO to spill the whole volume

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Location</th>
<th>Capacity (barrels)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FPSO Bunga</td>
<td>East Coast, Peninsular Malaysia</td>
<td>616,714</td>
</tr>
<tr>
<td>2</td>
<td>FPSO Abu</td>
<td>East Coast, Peninsular (Terengganu)</td>
<td>602,518</td>
</tr>
<tr>
<td>3</td>
<td>FSO Cendor</td>
<td>East Coast, Peninsular (Terengganu)</td>
<td>471,750</td>
</tr>
<tr>
<td>4</td>
<td>FSO South Angsi</td>
<td>East Coast, Peninsular (Terengganu)</td>
<td>471,750</td>
</tr>
<tr>
<td>5</td>
<td>FSO Puteri Dulang</td>
<td>East Coast Peninsular (Terengganu)</td>
<td>1,200,000</td>
</tr>
<tr>
<td>6</td>
<td>FSO PM3CAA</td>
<td>East Coast Peninsular (Kelantan)</td>
<td>840,000</td>
</tr>
<tr>
<td>7</td>
<td>FSO Caspian Sea</td>
<td>East Malaysia (Sarawak)</td>
<td>750,000</td>
</tr>
<tr>
<td>8</td>
<td>FSO Kikeh</td>
<td>East Malaysia (Sabah)</td>
<td>2,000,000</td>
</tr>
</tbody>
</table>

Table 1: FPSO and FSO in Malaysian waters (Sources: FPSO Ventures, Murphy Oil and FPSO Tech Sdn Bhd)
is unlikely as the number of traffic is relatively low compare with the west coast peninsular and the application of divisional cargo tanks.

6.0 Claim and Compensation for Marine Spill

Marine spill and pollution in all aspect is co-related with International environmental law which is mostly treaty-based. As the prevention of marine pollution and protection of marine environment is concerned, international conventions on marine pollution that are legally binding on Malaysia via rectification are (Hamid, 2007):-


2) International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78);

3) International Convention on Oil Pollution Preparedness, Response and Cooperation (OPRC), 1990;

4) International Convention on Civil Liability for Oil Pollution Damage, 1992 (the 1992 CLC);

and


Regarding to the claim and compensation for Marine Spill, currently there are three layers for compensation under the current relevant conventions (IPIECA and ITOPF, 2007). The first layer of compensation is through the application of CLC 1969, Protocol 1992. This is where the tanker owner and his/her Protection and Indemnity Association are liable for the compensation. The compensation provide by this fund is according to the gross tonnage of the ship. However, the compensation is limited to SDR 89.77 million (approximately US$ 135 million). The second layer of compensation is through the application of FUND 1971, Protocol 1992 where it constitute the establishment of the international oil pollution compensation fund 1992. The source of this fund comes from the contribution from the cargo owner or countries that import the oil. The function of this fund is to compliment the compensation beyond the limit of CLC 1969, Protocol 1992. The limit of

With regards to the claim and compensation on marine spill, the relevant convention which Malaysia is the party are as the following (International Maritime Organization, 2010):

i. International Convention on Civil Liability for Oil Pollution Damage (CLC) 1969, Protocol 1992


However, Malaysia has yet rectifies the Protocol 2003 FUND 1971 which apply the third layer compensation of Supplementary Fund. Therefore, only two layers of compensation that currently applies with the current limit of SDR 203 million (approximately US$ 305 million or MYR 374 million) which include both CLC Protocol and FUND Protocol 1992.

It is the matter of law that the rectification is the key towards the implementation of law via domestic law. Malaysia by rectifying the conventions has implemented it through the enactment of statues by the parliament i.e. Environmental Quality Act 1974. Reflecting to the Malaysian practice, the legislative power on Parliament requires the statues to be passed by parliament before the treaties become part of the law of Malaysia and render their legal effect.

In the other hand, the rectification of treaties will bind the party to perform accordingly. ‘Pacta sunt servanda’ or the rule that treaties are binding on the parties and must be performed in good faith is the fundamental principle of customary international law. Article 26 of the Vienna Convention on the law of Treaties 1969 has reaffirm the principle

“Every treaty in force is binding upon the parties to it and must be performed in good faith.”

Therefore, the commitment to the treaty by abiding all the agreed contains and intention is compulsory and subject to reparation for the breach.

6.1 Malaysia’s Law regulating the protection of the marine environment.

Relevant and specific laws regarding to the protection of the marine environment in Malaysia are The Environmental Quality Act 1974, Merchant Shipping Ordinance 1952, Merchant Shipping (Oil

1. **The Environmental Quality Act 1974**

It is the main legislation in Malaysia which relate to the prevention, abatement, control of pollution and enhancement of the environment (Government of Malaysia, 1974). For instance, according to section 29, The Environmental Quality Act 1974 provide on the prohibition of discharge of waste into Malaysian water.

However, there are two (2) limitations on the application which abate the effectiveness of the Act (Hamid, 2007). Firstly, the limitation on the territorial application which limit the scope of the territorial application of the Act only to the “Malaysian waters” According to section 2 of the Act has interpret "Malaysian waters" means the territorial waters of Malaysia as determined in accordance with the Emergency (Essential Powers) Ordinance, No. 7 1969 [P.U.(A) 307A/69]

The second limitation is on the subject-matter of the Act. The provision on marine pollution is small in number. It is due to the awareness and concern of drafting of the Act is to cater more on the land – based pollution. For instance, on 2 section in the Act reserve the provision on preventing of marine pollution i.e s. 27 (prohibition of discharge of oil into Malaysian waters) and s.29 (prohibition of discharge of wastes into Malaysian waters)(Hamid, 2007)

2. **Merchant Shipping Ordinance 1952**

Merchant Shipping Ordinance 1952 is adopted on the basis of the British Merchant Shipping Act. The one that relates to marine pollution is the Merchant Shipping (Amendment) Act 1991, which inserted a new Part VA, entitled “Pollution from Ships” (Federation of Malaya, 1952).

3. **Merchant Shipping (Oil Pollution) Act 1994 (as amended in 2005)**

It is an Act to make provisions with respect to civil liability for oil pollution by merchant ships and for matters inter related to oil pollution. The Act deliberately provide the regulation on civil liability on oil pollution, the international oil pollution compensational fund, the jurisdiction of the court concern on conducting the oil pollution cases and the enforcement of the Act such as the power of arrest, detention and prosecution of the ship (s.26) (Government of Malaysia, 2006).
The Act also has embedded the overall limit on liability of fund and has listed down the name of state parties to the civil liability convention and the list of state parties to the fund convention (Government of Malaysia, 2006).

4. **Exclusive Economic Zone Act 1984**

The Exclusive Economic Zone Act 1984 is a link to the implementation of certain aspects of the UNCLOS 1982. Section 3 (1) of the EEZ Act which is in line with UNCLOS 1982, provide that:-

“The exclusive economic zone of Malaysia, as proclaimed by the Yang di-Pertuan Agong vide P.U.(A) 115/80, is an area beyond and adjacent to the territorial sea of Malaysia and, subject to subsections (2) and (4), extends to a distance of two hundred nautical miles from the baselines from which the breadth of the territorial sea is measured.” (Government of Malaysia, 2001b)

The relevant provision is Part 4 on the protection and preservation of the marine environment. It leads to the offence in respect of discharge or escape of certain substances (s.10), and the civil liability for causing damage to any person or property or to environment in exclusive economic zone or continental shelf (Government of Malaysia, 2001b).

5. **Malaysian Maritime Enforcement Agency Act 2004**

MMEA 2004 deals with the maintenance of law and order and the preservation of the peace, safety and security in the Malaysian Maritime Zone. MMEA has power to stop, enter, board, inspect and search any places and structure, vessel or aircraft to undergo the enforcement operation (Hamid, 2007).

The function of the MMEA differs depending on the maritime zone in which the agency is operating. S 6(1)(a) to s 6(1)(h) are the functions to be performed within the Malaysian Maritime Zone. The function are s 6(1)(a) the function to enforce law and order under any federal law, s6(1)(b) the function to perform maritime search and rescue, s6(1)(c) the function to prevent and suppress the commission of an offence, s6(1)(d) the function to lend assistance in any criminal matters on a request by a foreign State as provided under the Mutual Assistance in Criminal Matters Act 2002 [Act 621],


s6(1)(e) the function to carry out air and coastal surveillance, s6(1)(f) the function to provide platform and support services to any relevant agency, s6(1)(g) the function to establish and manage maritime institutions for the training of officers of the Agency and s6(1)(h) the function generally to perform any other duty for ensuring maritime safety and security or do all matters incidental thereto ("Malaysia Maritime Enforcement Agency Act 2004," 2004).

Meanwhile, s 6(3)(a) to s 6(3)(d) mention on the responsible of the Agency on the high sea. The first responsible under s 6(3)(a) is for the performance of maritime search and rescue on the high seas, the second responsible under s6(3)(b) is for controlling and preventing maritime pollution on the high seas, the third responsible under s6(3)(C) is for preventing and suppressing piracy and the last responsible under s 6(3)(d) is for preventing and suppressing illicit traffic in narcotic drugs on the high seas ("Malaysia Maritime Enforcement Agency Act 2004," 2004).

7.0 Conclusion

Shipping activity had been identified as the main cause of marine spill in Malaysia. Among the type of maritime accident, collision had been identified as the main cause of marine pollution in water off Malaysia. While for the substance, crude oil is the highest substance in term of quantity that had been spilled since 1976 to the present. The response to marine spill in Malaysia lead by DOE as conferred by the national law and in accordance with the three tiers response that base on the severity of the spill and area of responsibility. The legal basis for the marine spill response is base on the relevant national environmental law and the relevant international conventions. It was found that the response capacity of marine spill control equipment is insufficient to counter the magnitude of the spill. However, the risk of the full magnitude of the spill is unlikely. Nevertheless, it is difficult to determine the ideal capacity for the marine spill control equipments of Malaysia. As for the compensation for the marine spill, Malaysia is applying two out of three level of compensation scheme under the relevant ratifications of the relevant international liability and compensation conventions.
Reference


Merchant Shipping Ordinance 1952 (1952).


Appendix I

List of Marine Oil Spill Incident in Malaysia (Sources: DOE and Marine Department Malaysia)

<table>
<thead>
<tr>
<th>No</th>
<th>Year</th>
<th>Name of Ship</th>
<th>Location</th>
<th>Cause</th>
<th>Type Quantity of Oil Spill</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1975</td>
<td>Showa Maru</td>
<td>Straits of Singapore</td>
<td>Grounded</td>
<td>Crude oil 4,000 tons</td>
</tr>
<tr>
<td>2</td>
<td>1975</td>
<td>Tola Sea</td>
<td>Straits of Singapore</td>
<td>Collision</td>
<td>Fuel oil 60 tons</td>
</tr>
<tr>
<td>3</td>
<td>1976</td>
<td>Diego Silang</td>
<td>Straits of Malacca</td>
<td>Collision</td>
<td>Crude oil 5,500 tons</td>
</tr>
<tr>
<td>4</td>
<td>1976</td>
<td>Mysella</td>
<td>Straits of Singapore</td>
<td>Grounding</td>
<td>Crude oil 2,000 tons</td>
</tr>
<tr>
<td>5</td>
<td>1976</td>
<td>Citta Di Savonna</td>
<td>Straits of Singapore</td>
<td>Collision</td>
<td>Crude oil 1,000 tons</td>
</tr>
<tr>
<td>6</td>
<td>1977</td>
<td>Asian</td>
<td>Straits of Malacca</td>
<td>Collision</td>
<td>Fuel oil 60 tons</td>
</tr>
<tr>
<td>7</td>
<td>1978</td>
<td>Esso Mersia</td>
<td>South China Sea</td>
<td>Collision</td>
<td>Fuel oil 505 tons</td>
</tr>
<tr>
<td>8</td>
<td>1979</td>
<td>Fortune</td>
<td>South China Sea</td>
<td>Collision</td>
<td>Crude oil 10,000 tons</td>
</tr>
<tr>
<td>9</td>
<td>1980</td>
<td>Lima</td>
<td>Straits of Singapore</td>
<td>Collision</td>
<td>Crude oil 700 tons</td>
</tr>
<tr>
<td>10</td>
<td>1981</td>
<td>MT Ocean Treasure</td>
<td>Straits of Malacca</td>
<td>Human Error</td>
<td>Fuel oil 1,050 tons</td>
</tr>
<tr>
<td>11</td>
<td>1984</td>
<td>Bayan Platform</td>
<td>South China Sea</td>
<td>Human Error</td>
<td>Crude oil 700 tons</td>
</tr>
<tr>
<td>12</td>
<td>1986</td>
<td>Bright Duke/Mv Pantas</td>
<td>Straits of Malacca</td>
<td>Collision</td>
<td>(information not available)</td>
</tr>
<tr>
<td>13</td>
<td>1987</td>
<td>Mv Stolt Adv</td>
<td>Straits of Singapore</td>
<td>Grounding</td>
<td>Crude oil 2,000 tons</td>
</tr>
<tr>
<td>No.</td>
<td>Year</td>
<td>Vessel/Location</td>
<td>Sea/Area</td>
<td>Event</td>
<td>Fuel Type and Quantity</td>
</tr>
<tr>
<td>-----</td>
<td>------</td>
<td>-----------------</td>
<td>----------</td>
<td>-------</td>
<td>------------------------</td>
</tr>
<tr>
<td>14</td>
<td>1987</td>
<td>Elhani Platform</td>
<td>Straits of Singapore</td>
<td>Grounding</td>
<td>Crude oil 2,329 tons</td>
</tr>
<tr>
<td>15</td>
<td>1988</td>
<td>Golar Lie</td>
<td>Straits of Singapore</td>
<td>Grounding</td>
<td>(information not available)</td>
</tr>
<tr>
<td>16</td>
<td>1992</td>
<td>Nagasaki Spirit/Ocean Blessing</td>
<td>Near Medan</td>
<td>Collision</td>
<td>Crude oil 13,000 tons</td>
</tr>
<tr>
<td>17</td>
<td>1993</td>
<td>Maersk Navigator/Sanko Honour</td>
<td>Andaman Sea</td>
<td>Collision</td>
<td>Crude oil (quantity not available)</td>
</tr>
<tr>
<td>18</td>
<td>1996</td>
<td>-</td>
<td>Bintulu (South China Sea)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>19</td>
<td>1997</td>
<td>Evoikos / Orapin Global</td>
<td>Straits of Singapore</td>
<td>Collision</td>
<td>Heavy Marine Fuel oil 28,500 tons</td>
</tr>
<tr>
<td>20</td>
<td>1997</td>
<td>An Tai</td>
<td>Straits of Malacca</td>
<td>Material Fatigue</td>
<td>Fuel oil 237 tons</td>
</tr>
<tr>
<td>21</td>
<td>1999</td>
<td>SS Sun Vista</td>
<td>Straits of Malacca</td>
<td>Sunk</td>
<td>Fuel Oil 14,000 barrels</td>
</tr>
<tr>
<td>22</td>
<td>2000</td>
<td>MT Natuna Sea</td>
<td>Straits of Singapore</td>
<td>Grounded</td>
<td>Crude Oil 49,000 barrels</td>
</tr>
<tr>
<td>23</td>
<td>2000</td>
<td>MV Double Brave</td>
<td>Tg. Po Anchorage Sarawak (South China Sea)</td>
<td>Collision</td>
<td>Fuel oil (diesel) 116 tons</td>
</tr>
<tr>
<td>24</td>
<td>2001</td>
<td>MT Singapura Timur (tanker)</td>
<td>Straits of Malacca</td>
<td>Collision</td>
<td>Fuel oil (diesel) 67 tons and Bitumen 1,500 tons</td>
</tr>
<tr>
<td>25</td>
<td>2001</td>
<td>MV Endah Lestari</td>
<td>Johor Port, Johor</td>
<td>Capsized</td>
<td>Toxic Chemical Phenol 650 tons and Fuel oil</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>2004</td>
<td>Pipeline</td>
<td>Leaked Pipeline</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>2005</td>
<td>Pipeline</td>
<td>Leaked Pipeline</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>2007</td>
<td>MV Sahelderberg (container)</td>
<td>Collision</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>2007</td>
<td>Pipeline</td>
<td>Leaked Pipeline</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>2010</td>
<td>MT Bunga Kelana 3 (container)</td>
<td>Collision</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **(tanker) Straits of Singapore (diesel) 18 tons**
- **2004 Pipeline Labuan (South China Sea) Crude Oil. Quantity unknown.**
- **2005 Pipeline MCOT Lutong River Miri, Sarawak Crude Oil. Quantity unknown.**
- **2007 MV Sahelderberg (container) Straits of Malacca (Off Tg. Piai) Fuel oil. Quantity unknown**
- **2007 Pipeline MCOT Lutong River Miri, Sarawak Crude Oil. Quantity unknown.**
- **2010 MT Bunga Kelana 3 (container) Straits of Singapore Crude Oil 2,000 tons**
Appendix II

Flowchart of Tier 1 Oil Spill Response (Source: DOE)

- For oil spill in port, oil terminal and offshore platform
- Provided resources is adequate for Tier 1 response

DOE State Director coordinate and monitor clean up works

Polluter Activate Tier 1

Inform DOE State Director on the activation of the local contingency plan

Spill beyond Tier 1 capability

Implement clean up works

Submit report to DOE State Director

yes

no

Refer Tier 2
Appendix III

The Structure of District Beach Clean Up Committee (Source: DOE)

- **Report of Oil Spill at beach/riverbank**
  - **District Officer** (Chairperson of District Beach Clean-up)
    - **Department of Environment** (Coordinator for the operation)
    - **Media**
      - **Department of Environment** (Coordinator for the operation)
      - **Chemistry Department**
      - **Fire Department**
      - **Fisheries Department**
      - **Public Works Department**
      - **Local Municipal Information Department**
      - **Military**
      - **Civil Defence Department**
      - **Non-Governmental**
      - **Forest Department**
      - **Health Department**
      - **Drainage & Irrigation Department**
      - **Marine Department**
      - **Information**
Flowchart of Tier 2 Oil Spill Response (Source: DOE)

1. Activate Tier 2 Response

2. Form State Oil Spill Control Committee & Open Small Oil Spill Centre

3. Appoint Area Coordinator (DOE State Director) & On Scene Commander (Marine Department)

4. Acquire Bank Guarantee Bond from the Polluter

5. On Scene Commander performs the clean up operation

6. If oil spill spread beyond national waters or equipments and personnel are inadequate

   a. Yes: Report work progress to Area Coordinator
   b. No: Activate Tier 3

7. Beach Clean up Committee at State and District level

8. Disposal of oil recovered

9. Report work progress to Area Coordinator

10. Yes: Refer DOE Director General

11. No: Acquire Bank Guarantee Bond from the Polluter

12. Yes: On Scene Commander performs the clean up operation

13. Disposal of oil recovered

14. Report to DOE Director General
Appendix V

The Structure of State Beach Clean up Committee (Source: DOE)

State Secretary
(Chairperson of State Operation Committee)

State Director
Department of Environment

District Officers
(Coordinator for Beach Clean Up Operation)

Chemistry Department
State National Security

Fire Department
Forestry Department
Health Department

Fisheries Department

Public Works Department

Local Municipal Department

Marine Department

Wildlife Protection Department

Drainage & Irrigation

Media

Information Department

Military

Non-Governmental Organisation

Civil Defence Department

Report of Oil Spill at beach/riverbank
Appendix VI

Structure of National Oil Spill Control Committee (Source: DOE)

National Oil Spill Committee

- DOE Director General (Chairperson)
- Marine Department
- Fisheries Department
- Meteorological Services Department
- Royal Customs and Excise Department
- Immigration Department
- Royal Malaysian Navy
- Royal Marine Police
- Royal Malaysian Airforce
- Ministry of Foreign Affairs
- National Security Unit
- Maritime Coordination Centre
- Fire Brigade and Rescue Department
- PETRONAS
- PIMMAG

Report of Oil Spill

Media

State Secretaries

(Chairperson of State Beach Clean-up)

State Director

Department of Environment

District Officers

(Coordinator for Beach Clean Up Operation)

Chemistry Department

Fire Department

Fisheries Department

Public Works Department

Local Municipal Department

Information Department

Civil Defence Department

Non-Governmental Organisation

State National Security

Forestry Department

Health Department

Marine Department

Wildlife Protection Department

Military

Drainage & Irrigation

Appendix VI

Structure of National Oil Spill Control Committee (Source: DOE)

National Oil Spill Committee

- DOE Director General (Chairperson)
- Marine Department
- Fisheries Department
- Meteorological Services Department
- Royal Customs and Excise Department
- Immigration Department
- Royal Malaysian Navy
- Royal Marine Police
- Royal Malaysian Air force
- Ministry of Foreign Affair
- National Security Unit
- Maritime Coordination Centre
- Fire Brigade and Rescue Department
- PETRONAS
- PIMMAG

Report of Oil Spill

Media

State Secretaries

(Chairperson of State Beach Clean-up)

State Director

Department of Environment

District Officers

(Coordinator for Beach Clean Up Operation)

Chemistry Department

Fire Department

Fisheries Department

Public Works Department

Local Municipal Department

Information Department

Civil Defence Department

Non-Governmental Organisation

State National Security

Forestry Department

Health Department

Marine Department

Wildlife Protection Department

Military

Drainage & Irrigation
Responsibility of each agency under the National Oil Spill Control Committee (Source: DOE)

<table>
<thead>
<tr>
<th>Agency</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department of Environment</td>
<td>Chairperson and Area Coordinator</td>
</tr>
<tr>
<td>Malaysia Marine Department</td>
<td>Provide technical advice related to vessels involve with oil spill and conduct the inspections.</td>
</tr>
<tr>
<td></td>
<td>Provide facilities for oil spill control operation and enforcement such as personnel, vessels and equipments as well as taking charge of oil spill.</td>
</tr>
<tr>
<td>Fisheries Department</td>
<td>Provide technical advice regarding fisheries industry. Provide ships, staff and other facilities for oil spill operations and their enforcement.</td>
</tr>
<tr>
<td>Meteorological Services Department</td>
<td>Provide advice and information relating to weather Conditions.</td>
</tr>
<tr>
<td>Royal Custom and Excise Department</td>
<td>Assist in the mobilization of equipments and personnel from abroad.</td>
</tr>
<tr>
<td>Immigration Department</td>
<td>Assist in the mobilization of foreign personnel and enforcement.</td>
</tr>
<tr>
<td>Royal Malaysian Navy</td>
<td>Enforcement and surveillance.</td>
</tr>
<tr>
<td>Royal Malaysian Police (Marine Branch)</td>
<td>Enforcement and surveillance</td>
</tr>
<tr>
<td>Royal Malaysian Air Force</td>
<td>Aerial surveillance, air transportation, aerial spraying of dispersants.</td>
</tr>
<tr>
<td>Aerial Unit, Royal Malaysian Police</td>
<td>Aerial surveillance and transportation.</td>
</tr>
<tr>
<td>Ministry of Foreign Affairs</td>
<td>Provide advice and coordinate with other countries if deemed necessary.</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>---------------------------------------------------------------------</td>
</tr>
<tr>
<td>National Security Unit</td>
<td>Provide advice on national security issue and communication and responses with the State Security Committee as well as beach clean-up operation that involve local authorities. Coordinate long term issues.</td>
</tr>
<tr>
<td>Maritime Enforcement Coordination Centre</td>
<td>Provide advice and coordinate activities with the Maritime Enforcement Agencies.</td>
</tr>
<tr>
<td>Fire Brigade and Rescue Department</td>
<td>To provide advice and services on includes aerial spraying of dispersants</td>
</tr>
<tr>
<td>Petroliam Nasional Berhad (PETRONAS)</td>
<td>Provide consultation on oil spill.</td>
</tr>
<tr>
<td>Petroleum Industry of Malaysia Mutual Aid Group (PIMMAG)</td>
<td>Provide technical advice on equipment operations.</td>
</tr>
</tbody>
</table>
Guidelines for Contributors

The Journal of Occupational Safety and Health is concerned with areas of current information in occupational safety and health issues in Malaysia and throughout the world.

General Guidelines

- Prepare manuscripts in accordance with the guidelines given below.

- Submit a cover sheet including: article title, author(s) name(s), affiliation(s), and complete mailing address, phone, fax, and e-mail address of the corresponding author. If at any time during the review or publication process this contact information changes, please contact the secretariat with the updated information.

- Manuscripts must be printed double spaced on A4-sized paper using 12-point type (font Times New Roman). Include page numbers.

- Organisation of material for original research should follow standard reporting format - "Introduction", "Methodology", "Results", "Discussion" and "Conclusion".

- For editorials, review articles, short communication and case studies, appropriate headings should be inserted to provide a general outline of the material.

- Clarity of language and presentation are essential, and care should be taken to avoid unnecessary technical terminology. The publication uses English spelling (UK).

- An abstract, up to 250 words, should accompany the manuscript. This should summarize the study and include the subheadings "Introduction", "Methodology", "Results" and "Conclusion". It may not be necessary for all subheadings to be included, based on the nature of the manuscript.

- Authors must include five keywords or phrases for indexing.

- Each author should complete a declaration form.

- Define all abbreviations.

- Permission to reproduce published material must be obtained in writing from the copyright holder and acknowledged in the manuscript.

- Keep a copy of the manuscript for reference.

- The editorial office retains the customary right to style.

- All material submitted for publication is assumed to be submitted exclusively to the journal unless otherwise stated.

- Copyright of all material published lies in NIOSH Malaysia.
References:
All references must be formatted in accordance with the Publication Manual of the American Psychological Association (APA), Fifth Edition.

For example:
Journal Articles:

Book:

On-line Publication:

Government Publication:

Tables and Figures:
Tables and figures should be on separate sheets from the text, in accordance with APA style, numbered consecutively and given a short but explicit title. Title for table should be above table. Title for figures should be below figure. Figures must be supplied as glossy photographs or professionally or electronically drawn artwork using heavy white paper and black ink. A notation should be made in the text showing approximately where each table or figure should appear (e.g., Insert Table 3 here). When referring to a particular table or figure in the text always use its number. All tables will be re-set in the production process. All figures will be scanned from the original.

Computer Disks:
If you send a computer disk with your submission, please label it with the author(s) name(s) and manuscript title. Disks will not be returned. Only Microsoft Word format is accepted.

Contributor’s copy:
Each author will receive 1 copy of the journal.

Subscription Information
Journal of Occupational Safety and Health (ISSN 1675-5456) is published bi-annually by Communication, Business and Information Dissemination Division (CBID), NIOSH, Malaysia. Subscription is free.
To subscribe, kindly contact Roslina / Nor Akmar / 603-8911 3879 / 3867 or journal@niosh.com.my

Secretariat Address
National Institute of Occupational Safety and Health
Lot 1, Jalan 15/1, Section 15, 43650 Bandar Baru Bangi
Selangor Darul Ehsan, Malaysia
Tel.: 603-8911 3879 / 3867 / 3871 Fax.: 603-8926 5655
Email: journal@niosh.com.my Website: www.niosh.com.my
This page has been intentionally left blank
This page has been intentionally left blank