RISK ASSESSMENT USING POOL FIRE AND HEALTH INDEX ANALYSIS AT BIOENERGY PLANT

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ABSTRACT

Risk assessment is recognized as a complete process of identifying a hazard and evaluating the risk either in absolute or relative terms. Risks at Vance Bioenergy Sdn Bhd are measured by identifying the most hazardous and flammability of raw material used in methyl ester and refined glycerin plant. As a result, methanol is the most flammability; hence the study focuses at the methanol storage tank. The area affected is determining using pool fire analysis. Besides that, the study also identifies the air emission from the stack sampling based on the secondary data obtained from preliminary environmental impact assessment study. The health effects from the air quality within Vance Bioenergy Sdn Bhd. and their surrounding areas are determined constantly to verify whether it could affect to human or not. Overall, the health index at three sampling point showed averagely 0.7, which is less than 1 and presume it could not give any significant impact to health. Beside that, the air quality also complied with the Malaysian Recommended Environmental Air Quality Guidelines. An Emergency Response Plans (ERP) is proposed to mitigate and prevent any risk or accident during the plant operations.

ABSTRAK

Penilaian risiko merupakan proses lengkap dalam mengenalpasti bahaya dan menilai risiko kemalangan sama ada secara keseluruhan atau fokus kepada sesuatu bahagian. Risiko di Vance Bioenergy Sdn Bhd dilakukan dengan mengenalpasti bahan mentah yang paling merbahaya dan mudah terbakar. Daripada kajian yang dijalankan, metanol merupakan bahan yang sangat mudah terbakar. Untuk itu kajian ini dijalankan di tangki simpanan methanol. Kawasan yang terjejas dikenalpasti menggunakan analisis *pool fire.* Selain itu, kajian ini juga mengenalpasti kualiti udara yang dilepaskan oleh cerombong dandang di Vance Bioenergy Sdn Bhd berdasarkan kajian lepas. Kesan terhadap kesihatan dari kualiti udara di Vance Bioenergy Sdn Bhd dan kawasan sekitarnya ditentukan untuk memastikan sama ada udara yang dilepaskan dari cerombong member kesan dar segi kesihatan kepada manusia atau tidak. Secara keseluruhan, index kesihatan yang diperoleh adalah 0.7 iaitu kurang dari 1 dan tidak memberi sebarang kesan kepada kesihatan manusia. Selain itu, kualiti udara juga memenuhi Standard Kualiti Udara Malaysia. Seterusnya, *Emergency Response Plans (ERP)* dicadangkan untuk mecegah dan menghindar sebarang risiko atau kemalangan semasa loji beroperasi.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Risk can be defined as a dangerous or unpleasant occurrence that possibly creates a dangerous situation. Risk assessment is a proper measurement at workplace that could cause harm to people, seriousness of the hazard level and to propose a mitigation procedure that could reduce the risk to the acceptable level. It is very important to ensure nobody gets hurt and free from contamination environment (USEPA, 2008).

Risk characterization is an integral component of the risk assessment process for both ecological and health risks (Fowle, 2000). A human health risk assessment is the process to estimate the nature and probability of adverse health effects in humans that may be exposed to chemicals in contaminated environmental media, either current or the future situation. An ecological risk assessment however is the process in evaluating the environmental impact from an exposure to of or more environmental stressors such as chemicals, land change, disease, invasive species and climate changes (USEPA, 2008).

In Malaysia, National Institute of Occupational Safety and Health (NIOSH) and The Department of Occupational Safety and Health (DOSH) are two organizations that responsible in enhancing occupational safety and health. DOSH is a department under the Ministry of Human Resources. This department is responsible for ensuring the occupational safety, health and welfare of people at work as well as protecting other people from the safety and health hazards arising from the activities of various sectors such as manufacturing, mining and quarrying, construction, hotels and restaurants (DOSH, 2007).

The role of occupational safety and health has been in existence since 120 years ago, in the late 19th century. It started with steam boiler safety and then followed by machinery safety. After that, it was continued with industrial safety, industrial safety and hygiene and lastly occupational safety and health that cover every work sector. Factories and Machinery Act 1967 (Revised - 1974), Occupational Safety and Health Act 1994 (Act 514) and Petroleum Act (Safety Measures) 1984 (Act 302) are three acts that being forced by DOSH (DOSH, 2007).

NIOSH was launch on December 1, 1992 as an intention to improve the safety and health of workers at the workplace in Malaysia. Training is an integral part of Occupational Safety & Health (OSH). To ensure the success of any OSH programme at the workplace, adequate and effective training must be adapted at all level associated with OSH. Training enables managers, supervisors and workers to understand the workings of safety management systems and the legal compliance required. They will also understand their own responsibilities and the necessary actions to be taken towards upgrading safety and health at their respective workplaces. Many training provide by NIOSH for example, Occupational Safety & Health Act 1994, Safety & Health Officer Examination Workshop and Safety in the Use of Chemicals (NIOSH, 2008).

1.2 Problem Statement

The requirements of risk assessment have become more important particularly after the fatal explosions at Petronas oil terminal at Pasir Gudang Industrial Estate. The incidents occurred when two storage tanks containing petrol and a natural gas tank caught fire by lightning strike during a thunderstorm on 28 April 2006 (Bernama, 2006). Even though no injuries reported, this incident increases awareness among the people about the importance and purpose of risk assessment. Besides that, two incidents are also reported at methanol plant in Seberang Perai, Penang (The Star, 2004) and Labuan (The Star, 2007) on 2004 and 2007. The latest incident is at Tanjung Langsat on 24 August 2008 where a fire broke out at one of the eight oil storage tanks (Bernama, 2008).

Pasir Gudang Industrial Estate have various types of industry such as chemical, plastic, oil and gas, food and others. Most of them are involving with hazardous and dangerous materials. Vance Bioenergy Sdn. Bhd. is one of the industries at Pasir Gudang Industrial Estate that handling with contaminated and hazardous materials. Nearby Vance Bioenergy located heavy industry such as Chye Hup Heng Sdn Bhd (metal recycling), Panagawa Sdn Bhd (plastic manufacturing), White Horse Ceramic Industries Sdn Bhd (tile manufacturing) and Mox Gases Sdn Bhd (gas). Risk assessment should be carried out to ensure the possible and dangerous accident which can be minimized.

Air is one of the major problems in Malaysia. Beside incident from fire or explosion, another risky problem that may occur at Vance Bioenergy Sdn Bhd is from air. Air emission from stack will disperse to the surrounding and may pollute the air. Health index analysis is carried out to determine either the concentration of air pollutants may cause an impact to human health or not.

1.3 Objectives of the Study

The objectives of this study are as follows:

a) To determine the quantitative risk assessment on potential risk at methanol storage tank and health risk from air pollutant within the Vance Bioenergy Sdn Bhd.
b) To propose a standard procedure of emergency response plan (ERP) during any emergency events.

1.4 Scopes of the Study

The scopes of this study are as follows:

a) Identified the potential quantified risk within the Vance Bioenergy Sdn Bhd boundary using pool fire analysis.
b) Identified the health effect of air quality at Vance Bioenergy Sdn Bhd by calculating using an airborne health index equation.
c) Propose the emergency response plan (ERP) to be followed by workers, contractors or visitor at the industry in case of any accident occurs.

1.5 Background of the Company

Vance Bioenergy is a leading biodiesel production, marketing and trading company based in South East Asia. Vance Bioenergy's corporate headquarters is in Singapore and its production based in Malaysia**.** Vance Bioenergy is located at PLO

668 and 669 of Jalan Keluli 5, Pasir Gudang Industrial Estate, Mukim Plentong, Johor Bahru, Johor.

Currently, Vance Bioenergy is an established industrial biofuel manufacturing since 2006. Palm based Methyl Ester is the main product of Vance Bioenergy Sdn Bhd, while crude Glycerin and fatty acids solution is the by products of Methyl Ester facility. The existing Glycerin plant is producing at 24000 tons/yr or 78 tons/d. Now, Vance Bioenergy Sdn Bhd intended to increase their existing Glycerin facility to raise their production from 78 tons/d to 156 tons/d.

The main process in Vance Bioenergy is converted the crude palm oil into Methyl Ester, which identified as biofuel raw material. However during the separation process, the glycerin material could be extracted too. The main processes for the production of Methyl Ester and refined glycerin from palm oil are discussed on Chapter Two (2).

Figure 1.1: Location of Vance Bioenergy Sdn Bhd.

REFERENCES

Alara Risk Management Services Sdn Bhd. *Preliminary Risk Assessment for The Proposed Cracker and Polypropylene Plants in Pasir Gudang Industrial Estate* (1997)

Ball, D. (2006). *Environmental Health Policy*. United Kingdom: Bell & Bain Ltd. 27-34, 35-41, 42-51, 52-66

Berita Nasional Malaysia (Bernama) www.bernama.com

California Environmental Protection Agency (California EPA). A Guide to Health Risk Assessment (2001)

Canada safety Council, 2005 www.safety-council.org

Canadian Centre for Occupational Health and Safety (CCOHS) (2006) http://www.ccohs.ca/oshanswers/hsprograms/risk_assessment.html

Department of Environmental Engineering, UTM (2008). *EIA for Refined Glycerine Plant, Vance Bioenergy Sdn Bhd*

Department of Occupational Safety and Health (2000). *Assessment of the Health Risk Arising From the Use of Hazardous Chemicals in the Workplace*. 2nd ed. Malaysia: Ministry of Human Resources.

Department of Occupational Safety and Health, DOSH (2007) www.dosh.gov.my

DOE: *EIA Guidelines for Risk Assessment* (2004)

Duah, D. K. A. (1993) *Hazardous Waste Risk Assessment*. Florida: Lewis Publishers. 21-25.

EPA 1991b. (1991) *"Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplemental Guidance, Standard Default Exposure Factors,"* Washington, D. C.: OSWER Directive: 9285.6-03, Office of Emergency and Remedial Response Toxics Integration Branch, USEPA. 9-10, 15.

Fire At Tanjung Langsat Port Oil Depot (2008) Bernama Online

Fjeld, R. A., Eisenberg, N. A. ad Compton, K. L. (2007) *Quantitative Environmental Risk Analysis for Human Health*. New Jersey: John Wiley & Sons, Inc. 5-19. 199-198, 204-206,

Fowle, J. R. III and Dearfield K. L. (2000). *Risk Characterization Handbook.* EPA 100-B-00-002. Washington: U.S Environmental Protection Agency.

Hallenbeck, W.H and Cunninghum, K. M. (1986). *Quantitative Risk Assessment for Environmental & Occupational Health*. USA:Lewis Publisher Inc. 9-17,43-57,67-72.

Imran Yussof (2007) *Kajian Kualiti Udara Sekitar Kampus UTM.* Universit Teknologi Malaysia: Tesis Sarjana Muda

John Willey and Sons. (1980). *Environmental Risk Assessment*. USA: International Council Unions. 1-4.

Kolluru, R., Bartell, S., Pitblado, R. and Stricoff, S. (1996). *Risk Assessment and Management Handbook for Environmental, Health and Safety Proffesionals*. USA: McGraw Hill Inc.

Leeuwen, C.J.V and Hermens, J.L.M. (1995) *Risk Assessment of Chemicals: An introduction*. Netherlands: Kluwer Academic Publisher.1-9,43-57,61-72.

Modarres, Mohammad. (2006). Risk *Analysis in Engineering: Techniques, Tools and Trends.* Boca Raton, Florida: Taylor & Francis Group. 5-12,13-15.

National Institute of Environmental Health Science (NIESH) (2007), *Emergency Response*, http://www.niehs.nih.gov/health/topics/population/response/index.cfm

National Institute of Occupational Safety and Health , NIOSH (2008) www.niosh .com.my

Norazrina Bt Yusof (2006). *The Study of Air Quality in Pasir Gudang.* Universit Teknologi Malaysia: Tesis PSM

Norliana Bt Sarpin (2006). *Risk Assessment Process of Hazards in Construction Sites.* Universiti Teknologi Malaysia: Tesis Sarjana

Perunding Utama Sdn Bhd (2006). *EIA for Proposed Precious Metals & Solder Dross Recovery Plant, Hydro Metal Sdn Bhd.*

Ricci, P. F. *Environmental And Health Risk Assessment and Management: Principles and Practices*. (2006) Vol. 9. Netherlands: Springer. 113-123

Second fire at chemical plant (2004) The Star Online

Siti Noorshafarina Kamaruzaman (2007). *Kajian Kualiti Udara di Kawasan Pasir Gudang, Johor.* Universit Teknologi Malaysia: Tesis Sarjana Muda

Strong, C. B. and Irvin, T. R. (1997) *Emergency Response and Hazardous Chemical Management.* Florida: Taylor & Francis Group. 10-12, 19

Two hurt in blast at Petronas plant (2007) The Star Online

Three Fuel Storage Tanks At Port Catch Fire (2006) Bernama Online

UK Health and Safety Executive http://www.hse.gov.uk/

Uni-Technologies Sdn Bhd (2007). *EIA for Containing Recycling & Solvent Recovery, Ranama Resource Sdn Bhd.*

US Environmental Protection Agency (USEPA) (2008). *Risk Assessment,* http://www.epa.gov/risk/basicinformation.htm.

United State Nuclear Regulatory Commission (USNRC), *Estimating Radiant Heat Flux from Fire to a Target Fuel at Ground Level Under Wind-free Condition*. Version 1805.0

Vance BioEnergy (2008) http://www.vancebioenergy.com/index.html

Vendrell, G. E. (2001). *Developing the Emergency Response Plan.* Reprint Protection News: International Foundation for Protection Officers

Vendrell, G. E. (2001). *Responding to a Hazardous Materials Incident.* Reprint Protection News: International Foundation for Protection Officers

Wells, G. (1996). *Hazard Identification and Risk Assessment*. USA: Gulf Publishing. 1-2, 210-218.