

A Study on Process Safety Management (PSM) Effectiveness Based on Human, Technological and Organizational Factors in an Oleochemical Plant

A.J.M. Ezuan, R. Azizan* and A. Nurulain

Faculty of Industrial Sciences and Technology, College of Computing and Applied Sciences, Universiti Malaysia Pahang, 26300 Gambang, Kuantan, Pahang, Malaysia

* azizanramli@ump.edu.my

Abstract: Oleochemical industry produces chemical products such as fatty alcohols, methyl esters and glycerin. However, the industrial revolution increases the industry risk level to people and the environment. Their activities could result in risk of exposures to hazardous chemicals. The decay of process safety performance in most chemicals industries noticed in recent years are due to human, technological and organizational factors. Thus, this study intends to emphasize on the Process Safety Management (PSM) effectiveness based on these three factors. A total of 118 questionnaires were distributed, and 40 valid questionnaires were returned with response rate of 35%. Methods used to conduct this study were questionnaire, semi structured interview and field observation. Fourteen elements of process safety management (PSM) were identified. Strength, Weaknesses, Opportunities and Threat (SWOT) Analysis of PSM implementation based on human, technological and organizational factors in an oleochemical plant were identified. The level of effectiveness of PSM implementation survey was conducted using a questionnaire adapted from the United State Department of Energy Process Safety Management for Highly Hazardous Chemicals. The elements of PSM were analyzed by ranking all the mean score obtained for each element. The result revealed that the level of effectiveness for element of mechanical integrity was the highest (13.48) while the level of effectiveness for element of trade secret was the lowest (1.95).

1. Introduction

Oleochemical industry is making new world standard in manufacturing, biological industry and also chemical processing. An oleochemical plants produces chemical products such as fatty alcohols, methyl esters and glycerin mainly used in palm oil and palm kernel oil. However, the industrial revolution increases the industry risk level to employees, environment and people who live in close proximity to the industrial area. The impact of oleochemical manufacturing would emerge as harmful items such as occupational diseases, industrial accidents and environment degradation. Process Safety Management (PSM) is a framework that is comprehensive in managing hazardous chemical and operation integrity. Its objective is to prevent and reduce losses in the lifecycle of operation. Loss events can initiate fire, explosion or toxic release and causing a huge amount of death [1]. In addition, PSM is a management system that gives attention to prevention, preparation, reduction, response and recovery from chemical disaster release or energy from process related to facility [2]. Unexpected releases of toxic gases, reactive, or inflammable liquid in process which involve chemical substance have been reported for years. Incident continues to occur in various industries which use hazardous chemical substances.

Recent major accidents have highlighted the need to increase focus on human factors. US Chemical Safety Board reported that the lack of human factors is one of the main contributors to catastrophic accident at BP's Texas City refinery which occurred in March 2005. Human factor deficiencies mainly involve lack of control, poor interface design of human system, poor communication over radio or telephone, inaccurate and outdated working procedure, and weak communication between rotating shift worker. Human interfaces in engineering, maintenance and operation

practices are to be considered in human factor engineering [3]. Furthermore, human factor is an information group on human faculty, human limitation and human features which related to plan [4].

In addition, organizational factors also have significant contribution to most of process safety incidents. Organizational factors have large effects on the process safety systems in chemical industrial facilities. However, these factors were ignored in many earlier incident investigation reports. Under terms of organizational factors in the context of safety performance are described as factors that can cause the condition coincided. Furthermore, organizational factors can be influenced by external factors such as economic, socio-technical, environment and national culture [5]. After years involvement in technical safety method and process design, many organizations have found that accident rate, factory loss process and profit have achieved plateau outside that improvement seemingly impossible to be achieved. Another finding is although in organization with generally good safety record, once in a while, large-scale disaster happened that shake public confidence towards industry of chemical processing. The factor that encountered is human error problem. Human error is an important risk source in any organization. Management uses various patrols and operational obstacle including policies, procedure, work order, training, auditing, and others, to reduce human error possibility. According to the studies by Institute of Human Performance (IHP), almost all major accidents investigation in recent years (such as Texas City, Piper Alpha, Phillips's Explosion 66, Feyzin, Mexico City) have shown that human error is an important causal factor during design, operation, maintenance and process management. Moreover, many incidents are also caused by technical, organizational or operational failures ranging from minor accident such as single toxic agents to major accident such as industrial,