



Contents lists available at ScienceDirect

Journal of Loss Prevention in the Process Industries

journal homepage: www.elsevier.com/locate/jlp

Improvements of safety management system in Korean chemical industry after a large chemical accident

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ARTICLE INFO

Article history:

Received 1 April 2015

Received in revised form

12 August 2015

Accepted 23 August 2015

Available online 30 August 2015

Keywords:

Chemical accident

Safety

Korea

Hydrogen fluoride

Accident response

ABSTRACT

This study addresses the systematic changes in laws, regulations, business cultures, and accident responses of organizations on a national level for chemical safety management after a large chemical release accident. The hydrogen fluoride leakage accident in Gu-mi City, in which 5 workers were killed and 18 were injured, has led the government to construct more practical plans and guidelines for managing and responding to chemical disasters. The governmental reorganization against chemical accidents such as Joint inter-agency The Chemical Emergency Preparedness Center, which is a specialized agency focused on responding to chemical disasters, has also contributed to the technology used in responses to chemical accidents, and as a result, it has become possible to cope with disasters more efficiently through cooperation among relevant agencies. Regarding relevant laws and regulations, the government has launched and clarified various acts and programs for the handling, management, and assessment of chemical substances and chemical-related accidents. Moreover, private enterprises have been also making efforts to systematically manage safety issues and expand high-level safety culture. In this paper, we discuss the changes in approaches to handle chemical accidents from various perspectives and present a case in which the relevant agencies succeeded in responding relatively efficiently to a major chemical accident because of these changes.

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1. Introduction

Chemical accidents, such as chemical release, fire, or explosion, can cause major catastrophic consequences not only for employees in a workplace but also for residents and the environment. In addition, the financial losses resulting from damage caused to facilities are enormous, and restarting facility operations may require a long time. These effects result in other serious impacts, such as the provision of insufficient supplies of raw materials to related industries.

To prevent such major industrial accidents, many developed countries, including the US and EU, have implemented emergency management systems ranging from accident prevention,

emergency preparedness, and emergency response to accident relief.

In most developing countries, growth in the industrial sector is being encouraged for its important contributions to economic development. In particular, the rapid and continuing industrialization of Asian countries because of the increased demand for important chemical products has resulted in the rise of the manufacturing sector, including the chemical industry. This industry demands huge amounts of specialized chemicals to produce electronics, machinery, and a vast assortment of other chemical products. According to the American Chemistry Council, the overall chemical production in the Asia–Pacific region is expected to increase by 5.2% in 2015 (UNEP, 2010). As the overall chemical production in Asia outpaces that in other regions of the world, safety issues relating to the manufacture, use, and disposal of various types of chemicals represent a growing concern among local, regional, and national governments in most Asian countries (Asian Disaster Preparedness Center, 2015).

Concerns about chemical safety and safety during chemical-

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related activities and processes have led to the implementation of enhanced laws and regulations and advanced programs and acts for accident prevention and management. Nevertheless, the safety of chemicals and chemical processes has not been a primary issue in economic development. However, after experiencing disastrous chemical accidents, concern from both the public and social sectors regarding the prevention of such accidents and the minimization of the consequences has become increasingly important.

Chemical disasters incur the release of severely hazardous materials into the atmosphere and are typically very difficult and expensive to forecast and, once an accident occurs, highly fatal. One internationally representative chemical disaster is the accident that occurred at a chemical plant in Bhopal, India, which caused enormous damage to both the country and its neighbors (Mannan et al., 2005). As the global chemical industry has increased in size in recent years, chemical accidents, such as fires, leaks and explosions, have occurred repeatedly, and concerns regarding the lack of chemical safety management at the global level have emerged. In fact, countries worldwide are paying increasing attention to chemical safety. In particular, the US is leading the world by implementing a systematic approach and appropriate programs, such as The National Atmospheric Release Advisory Center (NARAC) (Bradley, 2007). Additionally, the EU has addressed chemical safety through safety regulations, known as the Registration, Evaluation, and Authorization of Chemicals (REACH), which consists of stringent laws regarding chemical safety (Hansen et al., 2007). However, Asia is still insufficient in the chemical safety field and has experienced some chemical disasters.

In addition to the Bhopal disaster in India (1984), accidents such as the ones that occurred in Jilin in China (2005) and Rayoug in Thailand (2012) are typical examples of Asian chemical disasters that caused many casualties and substantial economic losses (Asian Disaster Preparedness Center, 2015).

In the case of Korea in particular, because of rapid industrial growth and the high dependency on the refinery and petrochemical industries, the implementation of a more robust chemical safety system is required. Recently, in Korea, both small and large chemical accidents, such as the Gu-mi hydrogen fluoride leak, have occurred repeatedly (An et al., 2015).

2. Status of Korea chemical processing industries and chemical accidents

Korea is ranked 6th in the world in chemical industry market share and accounts for 3.4% (138.7 billion USD) of the world's chemical market (4.1 trillion USD), behind China (21.9%, 903.4 billion USD), the US (17.5%, 720.0 billion USD), Japan (8.2%, 338.2 billion USD), Germany (5.5%, 228.8 billion USD), and Brazil (3.6%, 149.6 billion USD) (Ministry of Environment, 2013). Currently, there are 25,000 types of harmful chemical substances that are commercially available in the domestic market.

As shown in Fig. 1, the amount of toxic chemicals distributed has increased each year, and approximately 400 new types of chemical materials are introduced and produced in the Korean market every year (Moon, 2014). In addition, the number of domestic chemical manufacturers registered in Korea 2010 was 16,547, most of which are older than 20 years.

However, increases in the use and production of such chemicals poses a risk of chemical accidents that can cause severe harm to people, the environment, and the economy because most chemical substances are hazardous during one or more stages of production, storage, transport, and use. In their various states (solid, liquid, or gas), these chemicals can be flammable, corrosive, explosive, and toxic.

Importantly, procedures relating to handling chemicals and

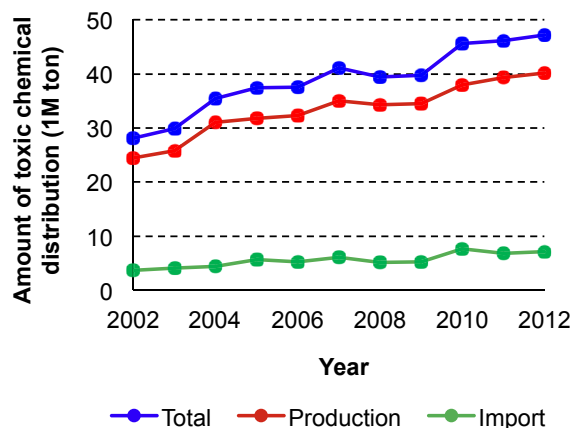


Fig. 1. The amount of toxic chemicals distributed in Korea.

chemical accidents are unable to prevent such accidents or minimize the resulting damage. The United Nations Environment Programme (UNEP) has announced that Korea remains at the level of an underdeveloped country in terms of chemical industry safety, similar to other Asian countries (UNEP, 2010). For example, the annual damage caused by industrial accidents can be up to 15 trillion KRW (16.9 billion USD), and the government has estimated the death toll at 2200 individuals. The number of accidents that occurred in the chemical industry was as high as 2,800, and the number of victims of chemical accidents exceeded 2900 in 2012 (Moon, 2013).

The Korean government has recognized that it is necessary to prepare countermeasures and provide support to reduce chemical accidents. Korea has made an effort to reduce the loss resulting from chemical accidents since the 1980s. Indeed, the number of gas-related accidents has steadily declined since the establishment of the Korea Gas Safety Corporation (1983) and the Institute of Gas Technology Training (1995). Additionally, the establishment of the Korea Occupational Safety & Health Agency (1987) and the introduction of Process Safety Management (1996) have had a great impact on reducing the number of industrial disasters (Korea Gas Safety Corporation, 2012; Korea Occupational Safety and Health Agency, 2012; Ministry of Employment and Labor, 2012). As a result of these concerns and efforts of the Korean government, the number of chemical accidents has decreased significantly, as shown in Fig. 2.

However, despite the steady decrease in the number of chemical accidents, the damage caused those that did occur increased in severity because of the complexity and diversity of the chemical industries involved, as shown in Fig. 3. For example, the hydrogen

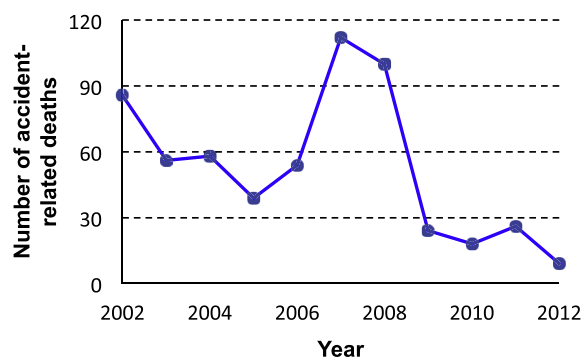


Fig. 2. The number of chemical accidents in Korea per year.

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