

Ming Dih Factory Explosion: Lessons From a Chemical Factory Disaster

“ The explosion at the factory of Ming Dih Co., Ltd. caused massive damage to state, private, and public properties. It also created extensive environmental impacts. A large cloud of black smoke covered the entire area, and could be seen dozens of kilometers away. ”

On July 5, 2021, there was a serious explosion and fire in the factory of Ming Dih Chemical Co.,Ltd. A cloud of black smoke drifted dozens of kilometers away. Houses and cars were damaged. One person died, and at least 15 people were injured. There were 1,266 people registering for complaints. The initial damage was estimated at 3–4 billion baht. Such accidents are not new. In the past, Thailand has experienced many chemical accidents, such as the 1991 explosion and fire at a hazardous materials warehouse in Klong Toey Port of Bangkok. At least 6,000 people were affected and 30 people died. In 2012, there was a chemical tank explosion in the Map Ta Phut Industrial Estate, which injured at least 1,200 people, and killed 11 workers instantly.

This article analyzes the Ming Dih factory explosion, its causes and effects on life, property, and surrounding communities. This includes a brief review of disaster mitigation and chemical hazard management in Thailand from past to present, and concludes with recommendations for measures and policies in solving and preventing related problems.



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Causes and impacts of the Ming Dih factory explosion

On July 5, 2021, around 2:50 a.m., there was a severe explosion and fire in the factory of Ming Dih Chemical Co., Ltd. in Soi King Kaew 21, Racha Thewa Subdistrict, Bang Phli District, Samut Prakan. This is an EPS (Expandable Polystyrene) resin factory that uses a lot of chemicals in the production process, such as styrene monomer and pentane, etc.^{1,2} (At the time of the accident, there were more than 1,600 tons of styrene left in a 2,000-ton tank,³ in addition to a number of other chemicals of unknown properties and quantity. In addition, 20 tons of coal residue were found inside the factory.)⁴

After the explosion, related agencies such as the Department of Disaster Prevention and Mitigation, together with the Bang Phli District Office, issued an urgent evacuation notice for people within a radius of five kilometers from the factory.^{5,6} The Department of Health issued a warning to people in the area to wear masks to prevent inhaling the smoke and pollutants from the factory.⁷ The Pollution Control Department explained through the media that the chemical that burned was styrene (a precursor used to produce foam)⁸ Shortly after the explosion, the Air Quality and Noise Management Bureau of the Pollution Control Department measured the concentration of styrene in the blast area and found that, within a radius of one kilometer, the concentration of styrene exceeded the allowable limit, with risk of acute inhalation exposure.^{9,10} In addition, civil society played an active role in helping affected people such as e.g., the ENLAWTHAI Foundation and the Foundation for Consumers.¹¹

From the examination by experts and related agencies, the possible causes of the explosion were posited as follows:

1

A continuous exothermic reaction among the chemicals became uncontrollable (uncontrolled polymerization) and released a large amount of styrene gas inside the reaction tank; the pressure in the reaction tank climbed so high that it ruptured the containment disk, releasing gas into the atmosphere¹²

2

Any leaks in the pipes or valves that transport the styrene monomer to the reaction tank would cause a large amount to accumulate in the manufacturing process where the reaction tank is located, leading to combustible styrene monomer gas forming^{13,14}

3

Pentane gas may have leaked from pipelines or inlet valves to storage or production areas, creating a combustible combination of gases.¹⁵

The explosion at the Ming Dih factory caused extensive damage to state, private, and public properties. It also created a wide environmental impact due to the burning of toxic chemicals and materials. Immediately in the aftermath of the explosion, a large cloud of black smoke covered the entire area, and could be seen dozens of kilometers away. At least 70 houses and 15 cars were damaged, one person died, and at least 15 people were severely injured, including five volunteers.¹⁶ A factory building nearby was also heavily damaged by the explosion. Regarding compensation for damages, the Racha Thewa Subdistrict Administrative Organization opened registration for affected people to file a grievance during July 12–14, 2021, with a maximum amount of compensation not exceeding 49,500 baht per person. A total of 1,266 people registered, totaling 423 million baht worth of claims.¹⁷



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On damage and impacts on people and the environment, Sombat Hesakul, an independent academic in economics, assessed the damage according to economic principles, and advised that the government should impose some sort of penalty on the polluter in proportion to the scope of the damaged area and related factors. For example, the measurable damage value was estimated to be approximately 3–4 billion baht, as well as the potential damage in the future such as chronic illnesses of the exposed people, among other long-term effects, which was estimated to be approximately 5–6 billion baht.¹⁸ In addition, the incident also had an impact on investment and economic development at the local level. For example, real estate in the area surrounding the Ming Dih factory depreciated by an estimated five percent.^{19,20}

The explosion at the Ming Dih factory reflected the unpreparedness of state disaster relief, and the inefficiency of the relevant agencies in the management of chemical disasters. The main reason for unpreparedness is the lack of information on the types and quantities of chemicals that cause fires. However, Thailand does not have a law requiring the development of a central chemical database covering the volume of storage, use, production, release, and movement of various chemicals. There was also a lack of a mechanism to disseminate such information

via an online system that could be easily and quickly accessed by everyone. Such databases are important to help agencies and personnel dealing with emergency disasters to access and use the information for planning and to respond to the situation promptly, accurately, and safely. The lack of information is a major barrier and hazard for firefighters and disaster relief workers. They need to have protections against chemical fire, and proper chemical fire extinguishing equipment. The lack of such readiness and lack of information has resulted in needless injury and death to the volunteers.

Dangers of industrial chemicals in Thailand, past to present, and lessons from the Ming Dih disaster

Thailand has experienced several chemical accidents in the past, and at least two of them caused severe damage and widespread impact, such as the 1991 explosion in a hazardous materials warehouse at Bangkok's Klong Toey Port, whose fire lasted for almost a week before it could be extinguished. That disaster caused widespread damage, with 30 fatalities and more than 6,000 people affected. Over 600 homes and structures were damaged, valued at more than 100 million baht.²¹ There was the case of a chemical tank explosion at the factory of BST Elastomers in the Map Ta Phut industrial estate in 2012. In that disaster, at least 1,200 were injured, and 11 workers died instantly. More than 300 homes and surrounding structures were damaged, with estimated value of 1.5–1.7 billion baht.²² In addition to life and property damage, each event also left behind residue and pollutants which accumulate in the environment and can last for decades.

Over the 30 years from past events up to the Ming Dih factory explosion in 2021, it can be seen that agencies, organizations, and related entities still have not absorbed the lessons learned from these disasters. Accordingly, there has been little advancement in chemical disaster management and prevention in Thailand. The main chemicals that the Ming Dih Co., Ltd. used in the production of EPS (Expandable

Polystyrene) foam beads are classified as substances that, when burned, are harmful to the human body, both acutely and chronically, as follows.

1

Styrene monomer is a colorless or clear yellow liquid, which is thick like oil.²³ If burned, styrene will release carbon monoxide gas which is harmful to the respiratory system.²⁴ If inhaled, there will be irritation of the respiratory tract, coughing, and difficulty breathing.²⁵ Exposure to this chemical can depress the central nervous system, cause headache, dizziness, drowsiness, fatigue, nausea, and intoxication. High doses can lead to seizures and death.²⁶ If it gets into the eyes, styrene will cause irritation.²⁷ Styrene is a carcinogen.^{28,29}

2

Pentane is a clear, colorless liquid. It smells like gasoline and is flammable. If inhaled it will cause irritation to the respiratory tract, shortness of breath, pneumonia, adverse effects on the central nervous system, drowsiness, headache, dizziness, coughing, lethargy, blurred vision, fatigue, spasms, loss of consciousness, and even death. If pentane vapors, fume, or mist comes in direct contact with the eyes, they will cause irritation. If these fumes are in contact with the eyes for a long time, they will cause conjunctivitis.³⁰

The above two hazardous substances are only two of the chemicals in the factory that have been disclosed to the public. However, in the manufacturing process of the Ming Dih factory, there were many other chemicals that were stored and used that did not come to public light. Still, both styrene and pentane can affect the environment and public health in the short- and long-term. Similarly, in the case of the warehouse explosion at the Klong Toey Port, a month after the accident, many people were found to have been hospitalized. The most common illnesses were respiratory disease followed by skin disease, gastrointestinal disease, eye diseases, nervous system disorders, circulatory system disease, etc.^{31,32} In the case of the chemical tank explosion at the BST Elastomers factory in Map Ta Phut Industrial Estate, in the first five days after the accident, toluene, benzene, and styrene were detected in the wastewater surrounding the plant.³³ This accumulation

of a large amount of hazardous chemicals in the environment continued to affect the health of workers and people living near the factory over time.

Another problem that goes hand in hand with this situation is system of management, storage, monitoring, and control of hazardous substances and chemicals that are raw materials of a factory. In Thailand, these oversight mechanisms are not effective enough, or only the minimum precautions are taken just to barely comply with the law. In such a lax legal environment, the risk of catastrophic chemical accidents is ever-present, and the consequences are even more severe when the factory is located near a residential community.

Another lesson from the case of the Ming Dih disaster is that these types of hazardous-materials factories need to be moved away from residential areas. Urban sprawl needs to be more strictly controlled through zoning so that spread of residential areas does not encroach on industrial sites with hazardous materials. There needs to be a buffer zone between the factory and these communities, and that separation needs to be part of town planning law. The Ming Dih factory disaster is an important case study of the lax enforcement of the town planning law, allowing such a factory to be located in the proximity of a large residential area. Somehow, housing estates, commercial buildings, and department stores were allowed to be close to the Ming Dih factory, with only a short concrete wall separating the factory and a community of hundreds of houses. It is no surprise then, when the explosion and fire occurred, there was significant damage to houses and residents living adjacent to the factory.³⁴

Based on retrospective information gathered from online media, it was found that fires in many factories were mostly among industrial plants engaged in plastic products and recycling plants. From 2017 to July 15, 2021, there have been at least 62 industrial fires. Although the previous fire disasters were not as severe and or damaging as the Ming Dih case, they affected health, life, and property just the same. Some factories even had repeated fires. Often, the exact cause of the fire could not be determined, showing that the current emergency response plan has not been fully implemented. If such countermeasures were implemented, then these disasters would not keep occurring with regular frequency, or at least not be as damaging and lethal as the Ming Dih factory explosion.



Opinions and recommendations

The case of the Ming Dih factory explosion, once again, exposed the laxity of the agencies and organizations involved in disaster preparedness, causing severe and widespread damage to residents, volunteers, the environment, and the public at large. Therefore, there should be actions to correct and prevent problems from occurring so often in the future, such as the following:

1

There should be an examination of the approval documents for Ming Dih Co. which allowed it to expand the production capacity from 2,400 tons per year in 1991 to 36,000 tons per year in 2019. This approval should be compared with the plan for pollution control and rapid urbanization in this area. Whatever the findings, it is clear that the government should have had more control over this company's expansion and production capacity.

2

There should be more serious enforcement of town planning laws in Samut Prakan Province. There should be a re-examination of the juxtaposition of urbanization, residential settlements, and the location of industrial factories. There should be buffer areas established, or some sort of protective divide between factories and the adjacent communities. If there are spatial constraints or a need to expand the factory, then re-location needs to be considered and enforced. The government must have good support measures for re-location, such as a compensation mechanism for the factory to move, or incentives to invest in new land in a safer area.

3

There should be mechanisms and follow-up measures to help those affected by such disasters as the Ming Dih factory. The offending company needs to be held responsible for damages to property to individuals, households, and the public at large. There must be commensurate compensation for damage to life and health, and effects from exposure to toxic chemicals and carcinogens. There also has to be compensation for ecological damage, such as repair and restoration of the local environment.

4

There should be continuous monitoring of health impacts of these industrial disasters by health authorities. There should be special monitoring of risk groups such as fire-fighters and disaster relief workers. They were on duty without any information of chemicals that would help them with protection and appropriate management.

5

There should be a law requiring the development of a central database covering the storage, use, production, release, and transport of various chemicals, and dissemination of such information via an online system that can be easily and quickly accessed by the public. Such a database is needed to lay a foundation for solving problems from pollution and hazardous chemicals that is effective, efficient, and accurate so as to prevent such accidents in the future. This information system is commonly referred to as Pollutant Release and Transfer Register (PRTR), and this is a part of the laws adopted in many developed countries to prevent chemical exposure, and to build public participation in the protection of health and the environment.

Summary

The case of the Ming Dih factory explosion reflects the laxity of the authorities involved in controlling and supervising industrial plants which use chemicals that are potentially harmful to people and the environment. There needs to be a stricter process of approving business expansion in areas with dense population settlements. There needs to be more disclosure and transparency about industrial chemicals, coupled with intensified disaster prevention and mitigation strategies. In the past, disaster management and remediation for those affected were inadequate and not timely. Therefore, the authorities need to learn from the lessons of such disasters as the Ming Dih factory explosion, and take strong action to correct and improve the situation for the long-term, such as seriously enforcing the town planning law. There should be mechanisms and measures to help those affected by these industrial disasters, and continuous monitoring of the health impacts of those who have been exposed to toxic chemicals and carcinogens. The state should enact legislation that requires the development of a central database, covering the storage, use, production, release, and transport of hazardous chemicals.

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