

## The Role of the Chemical Industry in Chemophobia

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The perception of the chemical field by the public has degraded proportionally with the growth of the industry. Chemical plants, as the largest source of chemical production and storage, have significant impact on the levels of chemophobia harbored in our society. Specifically, chemical disasters not only create significant loss, but they also work to propel the common distrust of chemistry in a dangerous direction. Repeated mishandling of distinct compound types coupled with disasters across the world harming thousands sends the message that our industry is unsafe and out of control. The preventable nature of these events demands that we seek means to curb the errors behind these major events within the industry required to support their importance to our economy and way of life in the United States. Additionally, we must strive to use educational approaches and constant dialogue as tools to surmount unfounded fears and augment public understanding of the nature and value of chemistry.

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### Chemical Plant Economics

Chemical plants are large manufacturing centers used to produce and store refined chemical products from raw materials. The chemical industry is one of the most diverse areas of manufacturing in the United States and is responsible for developing the basic materials and intermediates needed to create virtually every consumer product sold. The United States is the top chemical producer in the world, contributing to one fifth of the world's total production. The US chemical industry is a keystone of our economy, sustaining over 4 million jobs and annually comprising 2% of the United States gross domestic product.

Chemical plants have also been great sinks of spending by the United States in terms of damage costs and relief funding. For example, the explosion on May 4, 1988, at the Henderson Rocket Fuel Plant in Texas destroyed the entire plant and its supplies that were valued at ~ \$100 million. Welders were believed to have ignited drums of ammonium perchlorate during the construction of new storage containers, killing two people and injuring 372 in a series of blasts felt 600 miles away. Texas experienced a similar later explosion (2013) when failing safety measures could not prevent the detonation of a more than 40-ton stockpile of ammonium nitrate held at the West Fertilizer Company, killing 12 first responders and 3 civilians with almost 300 injured. Insurance losses were estimated to reach \$230 million, while the federal government provided more than \$16 million in disaster relief.

## **Perception of the Chemical Industry and Chemophobia**

Though ignited by two separate means, the repeat mishandling of ammonium salts in Texas portrays the image that the chemical industry has lacked or avoided updates in safety precautions over several decades. As such, it represents how the damage from chemical plant disasters goes beyond a quantifiable loss of life, product, and money. These events contribute to a society-wide phenomenon of chemophobia, or an irrational aversion or fear of chemicals now seen throughout the general population.

Chemophobia is primarily addressed and studied by the scientific community at the level of the average consumer. The public's association between synthetic compounds and issues of toxicity is the most common trigger of chemophobia, but it is not the only form. Industrial disasters represent an extreme source of the complex chemophobic attitude of the public. The media coverage of industrial disasters removes the localized nature of an impact because these types of events gain national attention. The scale of these disasters is beyond the local containment of chemophobic effects and economic burden. As an upstream source of the entire market of consumer product manufacturing, the reach and size of the industry demands attention when mistakes are made. In turn, this demands our understanding of their effects on the public. Research into chemophobia has not focused on the chemical industry and subsequent disaster events as a source.

## **Industrial Regulation and Public Knowledge**

Chemical production and storage have become necessary for our way of life, yet they harbor the most fear and unrest due to associations with danger and a lack of control. The chemical sector is perceptually cornered in an awkward position, where this industry of major societal importance and critical dependence is the target of high societal distrust. As scientists, the perception of our field and the preventable disasters that have occurred demand two courses of action. We must not only strive to review and update the safety measures by which chemical plants and laboratories are operated and maintained, but we must also work to find alternatives to the common raw materials and base products we depend on for safety and renewability. In addition, we must address public opinion and reverse common fears directly through education that represents several disciplines and applications of our field.

The chemical sector in the United States is largely regulated by the Consumer Product Safety Commission (CPSC), U.S. Department of Labor Occupational Safety and Health Administration (OSHA), and most notably the Environmental Protection Agency (EPA). While CPSC and OSHA primarily focus on product quality and worker safety, the EPA regulates chemical plants most with regards to plant pollution, waste, chemical toxicity, and risk management planning. Risk management planning by the EPA is commonly categorized by chemical, as each can require unique protocols and protective measures to properly store and utilize. Methyl isocyanate (MIC), for example, is among the compounds listed on the EPA's list of regulated substances, known historically as the leaked compound in the worst chemical disaster in history, the Bhopal Gas Tragedy in late 1984. Incident reports throughout the plant had begun to accumulate before the accidental release of over 40 tons of the toxic gas, killing over 15,000 and affecting over half a million workers and nearby residents. The aftermath continues to pollute the area to this day. The preventable tragedy was the direct result of ignored warnings, failing equipment, and the inability to move and contain the MIC at risk. The greatest prevention and protection plan we can strive for directly outlines all safety measures, includes

secondary containment structures, and provides proper training of personnel. Additionally, shifting towards lower risk chemical alternatives can increase on-site safety and long-term sustainability.

Education is paramount for healthy understandings, thoughtful insights, and key decision-making to address chemophobia. The importance of education, as we move forward to improve the chemical industry, widens the path of opportunity for growth and allows for the public to serve as a supporting force rather than a fearful opponent. The general population should be given both a proper foundation of chemical concepts and the knowledge of chemistry's role in society. The introduction of chemistry into mainstream recognition primarily has come through advancements in the medical field and pharmaceuticals throughout the 20<sup>th</sup> century with the idea of 'living better through chemistry.' While that idea still rings true, how chemists are working to benefit the common good can sometimes be out of the public eye. In the same way that we must dissociate 'synthetic' from 'toxic,' we must also work to display the lengths and the applications chemists are pursuing to advance the knowledge of our community and live better. Moving forward, the chemical sector must recognize and disseminate the critical role of safety and education to change the narrative behind society's chemophobia and the harmful perception of our industry.

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