

Opinion: Cleaning up chemistry

October 7 2016, by Russell Hewitt

Chemical manufacturing is a huge industry that delivers much needed chemicals to a variety of industries. Almost all of the everyday things we buy or use have been made in part with man-made chemicals. Laws and regulations strictly control the use of chemicals to ensure that the chemicals we are exposed to are not harmful to consumers.

Chemists want to make the chemicals cheaply, but the manufacturing process should still be safe. This is important, not just for worker safety, but also for the environment and for the public who could suffer due to accidents at [chemical](#) plants.

News of chemical spills or explosions make for very scary reading. The latest most widely publicized one was the Tianjin explosions in 2015, which were started by chemicals that most [chemists](#) definitely wouldn't want to work with, such as the explosive nitrocellulose. But this is not an isolated case—there have been many instances of huge explosions or severe accidents occurring at chemical plants or storage facilities. The Bhopal disaster, for example, which was caused by the release of a highly [toxic chemical](#) used to manufacture an insecticide, is regarded as the worst industrial accident of all time.

Chemists can learn from these horrible stories, however, and try to clean up our operations. For example, we learned that by redesigning the synthesis process the toxic chemical that caused the Bhopal disaster could have been avoided. Thus by changing the reactions we set into motion, we can improve our processes, making safer chemicals in a safe way.

So how do we do this? When chemists first design a synthetic process we often go for the 'tried and true' methods, which typically use more potent chemicals that are often explosive, very toxic and highly flammable—so we need to be really careful when carrying out the process! With a little work however, many of these chemicals can be replaced with milder choices. We try to make the whole process safer both for the people doing the work and for the environment—this is called [green chemistry](#). If a chemical product is manufactured using green chemistry practices, a scenario such as the Bhopal disaster should not occur.

The great thing is, greener is often cheaper! Removing harmful chemicals means you cut costs associated with safety precautions. By careful design, we also can reduce the amounts of chemicals we use, cutting cost even more! As a result, green chemistry is now a huge focus for chemical manufacturing.

The biggest impact we can make to improve our processes in this manner is in solvent reduction. Chemists use solvents to dissolve our chemicals so we can make sure they mix and react together well, but we often use much more than we need. It is important to both reduce our consumption of these solvents and to remove the worse solvents in a process. Historically, diethyl ether, an explosive and extremely flammable solvent, was used for anesthesia—until doctors tired of explosions at the operating table and the resulting fatalities. Dichloromethane, a potent environmental polluter, is another solvent of concern, especially due to its high volatility. It is often used in paint thinners, but despite its relatively low toxicity, it has caused over 50 deaths since 1980 in the US alone. Because of these hazards, these solvents and others are either banned or are in the process of being phased out in drug manufacturing. In fact, the pharmaceutical industry is actually the front runner in this movement, with many voluntarily banning or reducing the use of harmful solvents.

Chemists are now trying to make our processes green as early as possible both to improve throughput and hasten the development toward commercial production. Ultimately this delivers the chemicals we need, in quantities that we can use, with a holistic view on safety for workers, the public and the environment.

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