

## Water, Water Everywhere...

**W**ater can be found throughout most chemical processing facilities — whether it is being used to clean buildings and equipment or as a lubricant, seal flush, or process solvent. Water also serves as a common heat-transfer fluid, suitable as cooling water, mixed with salts or glycol as a refrigerant, and as steam for heating. Despite its ubiquity, water can be surprisingly dangerous if it gets into the wrong place. Here are some examples:

**Reactive chemical.** Water reacts with many materials, and the reactions can produce heat, pressure, or toxic products. The event that initiated the Dec. 1984 Bhopal, India, tragedy (Photo 1) — the worst industrial disaster in history — was contamination of a tank of methyl isocyanate with water. The reaction generated heat and pressure, releasing toxic material into the community and causing thousands of fatalities and injuries.

**Reaction catalyst.** Water can serve as a catalyst for some chemical reactions, such as decompositions. For example, contamination of a distillation residue with 1% water reduced its decomposition temperature by 100°C. The temperature of the

steam heating the pipe containing the contaminated residue was above that lower decomposition temperature. The residue decomposed and ruptured the pipe (Photo 2), but fortunately nobody was in the area and no injuries were reported.

**Physical explosion hazard.** Water boils at 100°C — below the operating temperature of many processes. If water contacts hot material or equipment, it may boil and generate pressure in closed or inadequately vented vessels. When it vaporizes to steam at atmospheric conditions, the volume of water can explosively increase by 1,600–1,700 times.

In 1947, workers were incorrectly instructed to add water to a blast furnace in a Pennsylvania steel mill (Photo 3) to prepare it for replacement of the brick lining, despite this being contrary to the standard operating procedure. The furnace, however, still contained molten iron and other hot materials. On contact, the water boiled, creating steam, increasing the pressure, and blowing a hole in the bottom of the furnace. Molten metal was released and engulfed nearby workers, resulting in 11 fatalities.



## What Can You Do?

- Be aware of chemical reaction hazards with water in your plant, including water's role as a reactive chemical and as a catalyst for other reactions. Understand the design features of your plant that guard against hazardous interactions with water.
- Remember that water can present a hazard if it contacts hot (above 100°C) equipment or materials.
- Follow standard operating procedures designed to keep water from places where a dangerous chemical or physical interaction could result.

- Never set up a temporary water supply to get water to an area where its use is forbidden. If there is a need to use water in the area, determine and follow the standard operating procedure for this special activity. The procedure may include special precautions, and a permit may be required. If precautions and permits are not specified, carry out a thorough job safety analysis or management of change review, and follow all procedures identified by that review.

**Water — common but it can be dangerous!**

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