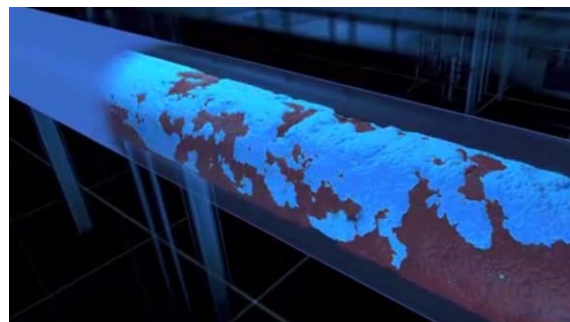


Hydrate Hazards

January 2016



The October 2015 *Beacon* discussed several hazards of water in process plants. Another potential hazard from a mixture of water and some materials is the formation of a hydrate (more specifically, gas hydrate or “clathrate” hydrate). Hydrates were first described by Sir Humphrey Davy in 1810 in a lecture to the Royal Society in England. A hydrate is a crystalline, ice-like solid made up of water and another material. Usually the other material is a gas, but it can also be a liquid. Some examples of materials that can form hydrates include hydrogen sulfide, acetylene, methyl mercaptan, chlorine, vinyl fluoride, carbon dioxide, ethylene, methane, ethane, natural gas, and other hydrocarbon gases. When a hydrate forms it can plug piping, instrument connections, valves, and other equipment causing process upsets which may be hazardous. In addition to presence of a material that can form a hydrate, generally three conditions are required:

- Free, condensed water
- Sufficient pressure (how much pressure depends on the material, and some materials – for example, methyl mercaptan – can form a hydrate at atmospheric pressure)
- Low temperature (the temperature depends on the material and the pressure, and a hydrate can form at a temperature well above the freezing point of water)

Once formed, hydrates can be very stable, and difficult to remove. Clearing a blockage from hydrate formation could be a routine or non-routine work activity that is hazardous if not done properly. Potential hazards include the release of flammable, combustible, corrosive, or toxic material, or unexpected pockets of pressure in pipes and equipment blocked with solid. It may be necessary to open pipes or equipment to clear a hydrate blockage, with all of the hazards associated with opening process equipment. If you try to remove a hydrate plug in a line by applying pressure to one side of the blockage, the plug may break free and the solid material may rapidly move through the pipe. This can cause a rupture if the solid plug impacts the pipe at a tee, an elbow, or other bend.

The United States Chemical Safety Board recently described an incident resulting in 4 fatalities that occurred when methyl mercaptan was released during attempts to clear a line blocked with a methyl mercaptan-water hydrate (<http://www.csb.gov/dupont-laporte-facility-toxic-chemical-release/>).

What can you do?

Make sure you know if you have any materials in your plant that can form hydrates. If you do handle materials which can form hydrates, you should understand:

- What temperature and pressure conditions can result in hydrate formation
- What design features and operating procedures your plant includes to prevent hydrate formation
- How to recognize hydrate formation if it occurs
- What procedures you must follow to safely remove hydrates if they form

Be sure to do a hazard evaluation before doing any non-routine task such as clearing blocked equipment.

Does your plant handle any material that can form a hydrate?

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Questions:

1. **(5 min)** List at least two hazards of working with hydrates.
2. *****(20-30 min)** Explain at least three measures for preventing hydrate formation in a plant environment. *Hint:* You may find this [resource](#) helpful.
3. **(5 min)** *What did you learn?*
What lessons have you learned from this article or from researching hydrate formation about the best ways to remove a hydrate blockage?