TerranearPMC Safety Share

Week of May 15, 2017 – The Great Molasses Flood

Undoubtedly when we are pressed to think of great disasters in history, the tragedy of the Titanic comes to mind. And while the story of the titanic has a multitude of points to be learned, other tragedies have their stories that should not be forgotten; if not for the memory of the unfortunate and unsuspecting victims, but to remember that by not examining a particular process or piece of equipment thoroughly, potential hazards can, in a most devastating fashion make us take notice, albeit, oftentimes too late to stop the calamity or even to lessen its blow.

One such event was the Great Molasses Flood that occurred in Boston on January 15, 1919; only seven years after the famed Titanic disaster. On that day, at the Purity Distilling Company facility, a large molasses storage tank burst and a wave of molasses rushed through the streets, killing 21 and injuring 150 people. The incident occurred at about 12:30 in the afternoon. The specific tank stood 50 feet tall with a diameter of 90 feet and, at the time, contained as much as 2,300,000 gallons when it collapsed. Witnesses reported that as it collapsed they felt the ground shake and heard a roar; something resembling the familiar rumble of the elevated train line that ran through the area. People said that they heard a tremendous crashing, a deep growling, or "a thunderclap-like *bang*!" And as the rivets shot out of the tank, unsuspecting residents reported machine gun-like sounds.

The collapse unleashed a wave of molasses as high as 25 feet, while moving at 35 mph. The force of this molasses wave was so powerful that it damaged the girders of the adjacent elevated railway while tipping a railroad car off the tracks. Buildings were swept off their foundations and crushed. Several blocks were flooded to a depth of 2 to 3 feet. *The Boston Globe* reported that people "were picked up by a rush of air and hurled many feet." Others had debris hurled at them from the rush of sweet-smelling air. A truck was picked up and hurled into Boston Harbor. In addition to the 150 inured people and 21 deaths, several horses were killed. Some were crushed and drowned by the molasses. In 2016, a team of scientists and students at Harvard University conducted extensive studies of the historic disaster, gathering data from many sources, including 1919 newspaper articles, old maps, and weather reports. The student researchers also studied the behavior of cold corn syrup flooding a scale model of the affected neighborhood. The researchers concluded that the reports of the flood's high speed were credible. In the same study, based on information where it was reported that two days before the disaster, warmer molasses had been added to the tank, reducing the viscosity of the fluid. When the tank collapsed, the fluid cooled quickly as it spread, until it reached Boston's winter evening temperatures and the viscosity increased dramatically. The Harvard study concluded that the molasses cooled and thickened quickly as it rushed through the streets, hampering efforts to free victims before they suffocated. The study results were presented at a November 2016 meeting of the American Physical Society.

First to respond to the scene were 116 cadets from USS *Nantucket*, a training ship of the Massachusetts Nautical School (which is now the Massachusetts Maritime Academy), that was docked nearby at the playground pier. They ran several blocks toward the accident. They worked to keep the curious from getting in the way of the rescuers, while others entered into the knee-deep, sticky mess to pull out the survivors. Soon, the Boston Police, Red Cross, Army, and other Navy personnel arrived. Some nurses from the Red Cross dove into the molasses, while others tended to the injured, keeping them warm and keeping the exhausted workers fed. The injured were so numerous that doctors and surgeons set up a makeshift hospital in a nearby building. Rescuers found it difficult to make their way through the syrup to help the victims. Four days elapsed before they stopped searching for victims; many of the dead were so glazed over in molasses, they were hard to recognize.

Cleanup crews used salt water from a fireboat to wash the molasses away, and used sand to try to absorb it. The harbor was brown with molasses until summer (remember this event occurred on January 15). Rescue workers, cleanup crews, and sight-seers had tracked molasses through the streets and spread it to subway platforms, to the seats inside trains and streetcars, to pay telephone handsets, into homes, and to countless other places. It was said that everything a Bostonian touched was sticky.

So how did this tragedy occur? After all, present accident theory insists that all accidents are preventable and by simply identifying a hazard and then to establish appropriate controls, such disasters can be avoided. According to available data gathered around the time of this event, it was noted that several factors that occurred on that day and the previous days seem to have been, at least, contributing factors. First of all, it was reported that the tank was constructed poorly and tested insufficiently. An investigation *first published in 2014*, applying modern engineering analysis, found that the steel was not only half as thick as it should have been for a tank of its size, even with the less-than-stringent standards of the day, but it also lacked manganese, a component used to reduce the brittle properties associated with steel.

An inquiry after the disaster revealed that Arthur Jell, who oversaw the construction, neglected basic safety tests, such as filling the tank with water to check for leaks. When the tank was placed in operation and was filled with molasses, observers witnessed that significant amounts of molasses leaked out of the tank. This resulted in the decision (by Purity Distilling Company) to painted the tank brown in an effort to disguise the leaks.

In addition to the questionable tank construction, due to the fermentation that is associated with this process, carbon dioxide is created and therefore may have increased the tanks' internal pressure. In addition, there was a rise in local temperatures from the previous day which would also contribute in increased pressure. Records show that the air temperature rose from 2 °F to 41 °F over that period. The failure occurred from a manhole cover near the base of the tank, and a fatigue crack that possibly grew to the point of criticality (Note: the hoop stress is greatest near the base of a filled cylindrical tank).

The tank had been filled to capacity only eight times since it was built a few years previously, putting the walls under an intermittent, cyclical load. As another possible contributing factor- one that deals with meeting time constraints – it has been suggested that the Purity Distilling Company was trying to outrace prohibition in the United States; the Eighteenth Amendment to the Constitution of the United States was ratified the next day (January 16, 1919), and took effect one year later. In the field of S&H, time constraints are often a route cause in accident events, which, in turn, cause safeguards and possible hazards to be overlooked.

Let's understand that this event occurred almost 100 years ago; way before OSHA existed and many of our current attitudes or knowledge about accident theory was far from being developed. Yet, if only one of these causes were recognized and corrected, there is a chance – and a good one at that – that the Great Molasses Flood would be only a tale of fiction based on someone's wild imagination; the only place where such a story should be.

Great works are performed not by strength but by perseverance

Samuel Johnson