

# **14. BACKFLOW INCIDENTS**

## **14.1 A FAULTY SYSTEM AND HUMAN ERROR CAUSE DRINKING WATER AND ANTIFREEZE TO MIX AT A COLORADO SCHOOL, JANUARY 1990**

Human error and a faulty water system allowed antifreeze to enter a Brighton, Colorado middle school's drinking water. The incident sent eight students to the hospital on Tuesday.

But the middle school is to reopen today. Plumbers and contractors yesterday repaired and cleaned the water system, which mixed drinking water with antifreeze from the building's reservoir.

"Somebody left a hand valve open, and that's never happened before", said the principal.

The valve inadvertently was left open after a routine system check, he said. Regardless, a mechanical backup system should have separated the two systems' water, which comes from the same source.

"It appears that it was faulty design in the plumbing system, there was never a backflow device put on it, or one was on but not in the right place, so water could mix between the two systems. I am sure we are looking at the procedures. At the moment, we're just interested in getting it all cleaned up and that our students are safe".

Eight of the school's 450 students, ages 10 to 14, were taken to the Platte Valley Medical Center in Brighton, where they were treated for ethylene glycol poisoning and released. Blood tests revealed the students had no antifreeze in their blood stream.

The Colorado Department of Health will send a letter of non-compliance to the school district and the city of Brighton, but no one is to be cited in the case, said a spokesman from the Colorado Department of Health.

School officials are confident that the system has been repaired adequately. We have been flushing and flushing and flushing. We have engineers and a plumbing firm in to make sure we are doing the right thing.

## **14.2 THREE-HUNDRED FORCED FROM COLORADO SCHOOL, MAY 1982**

Three hundred students at Platte Canyon High School near Bailey, Colorado were sent home at noon Tuesday after the school's water fountains were contaminated with antifreeze, Principal Vern Craft said.

An undetermined amount of the toxic material seeped into water pipes from the school's solar heating system through a malfunctioning valve, Craft said. Six students were given medication to induce vomiting. None reported serious side effects, according to the principal.

Craft said the school, three miles west of Bailey on U.S. 285 will remain



closed for at least another day to make sure all the antifreeze is flushed from the system.

The antifreeze is being replaced with a non-toxic material that will keep pipes from freezing in the school's solar heating system, he added.

### **14.3 HUMAN BLOOD IN THE WATER SYSTEM**

Health department officials cut off the water supply to a funeral home located in a large city, after it was determined that human blood had contaminated the fresh water supply. City water and plumbing officials said that they did not think that the blood contamination had spread beyond the building, however, inspectors were sent into the neighborhood to check for possible contamination. The chief plumbing inspector had received a telephone call advising that blood was coming from drinking fountains within the building. Plumbing and county health department inspectors went to the scene and found evidence that the blood had been circulating in the water system within the building. They immediately ordered the building cut-off from the water system at the meter.

Investigation revealed that the funeral home had been using a hydraulic aspirator to drain fluids from the bodies of human remains as part of the embalming process. The aspirator directly connected to the water supply system at a faucet outlet located on a sink in the embalming room. Water flow through the aspirator created suction that was utilized to draw body fluids through a hose and needle attached to the suction side of the aspirator.

The contamination of the funeral home potable water supply was caused by a combination of low water pressure in conjunction with the simultaneous use of the aspirator. Instead of the body fluids flowing into the sanitary drain, they were draining the opposite direction-into the potable water supply of the funeral home.

### **14.4 BURNED IN THE SHOWER**

A resident of a small town jumped in the shower at 5:00 a.m. one morning, and when he got out his body was covered with tiny blisters. "The more I rubbed it, the worse it got", the 60 year old resident said. "It looked like someone took a blow torch and singed me". He and several other residents received medical treatment at the emergency room of the local hospital after the water system was contaminated with sodium hydroxide, a strong caustic solution. Other residents claimed that, "The water bubbled up and looked like Alka Seltzer. I stuck my hand under the faucet and some blisters came up". One neighbor's head was covered with blisters after she washed her hair and others complained of burned throats or mouths after drinking the water. The incident began after an 8-inch water main, that fed the town, broke and was repaired. While repairing the water main, one workman suffered leg burns from a chemical in the water and required medical attention. Measurements of the pH of the water were as high as 13 in some sections of the pipe. Investigation into the



cause of the problem led to a possible source of the contamination from a nearby chemical company that distributes chemicals such as sodium hydroxide. The sodium hydroxide is brought to the plant in liquid form in bulk tanker trucks and is transferred to a holding tank and then pumped into 55-gallon drums. When the water main broke, a truck driver was adding the water from the bottom of the tank truck instead of the top, and sodium hydroxide backsiphoned into the water main.

#### **14.5 HEATING SYSTEM ANTIFREEZE INTO POTABLE WATER**

In a small town in Maine, water department employees discovered poisonous anti-freeze in a homeowner's heating system and water supply. The incident occurred when they shut off the service line to the home to make repairs. With the flow of water to the house cut off, pressure in the lines in the house dropped and the antifreeze, placed in the heating system to prevent freeze-up of an unused hot water heating system, drained out of the heating system into the house water lines, and flowed out to the street. If it had not been noticed, it would have entered the homeowner's drinking water when the water pressure was restored.

#### **14.6 SALTY DRINKS**

A nationally known fast food restaurant located in Southeastern United States complained to the water department that all their soft drinks were being rejected by their customers as tasting "salty." This included soda fountain beverages, coffee, orange juice, etc. An investigation revealed that an adjacent water customer complained of salty water occurring simultaneously with the restaurant incident. This second complaint came from a water front ship repair facility that was also being served by the same water main lateral. The ship repair facility investigation revealed the following:

A backflow preventer that had been installed on the service line to the shipyard had frozen and had been replaced with a spool piece sleeve.

The shipyard fire protection system utilized seawater that was pumped by both electric and diesel driven pumps.

The pumps were primed by potable city water. With the potable priming line left open and the pumps maintaining pressure in the fire lines, raw salt water was pumped through the priming lines, through the spool sleeve piece, to the ship repair facility and the restaurant.

#### **14.7 PARAQUAT IN THE WATER SYSTEM**

"Yellow gushy stuff" poured from some of the faucets in a small town in Maryland and the State of Maryland placed a ban on the drinking water supply. Residents were warned not to use the water for cooking, bathing, drinking or any other purpose except for flushing toilets.



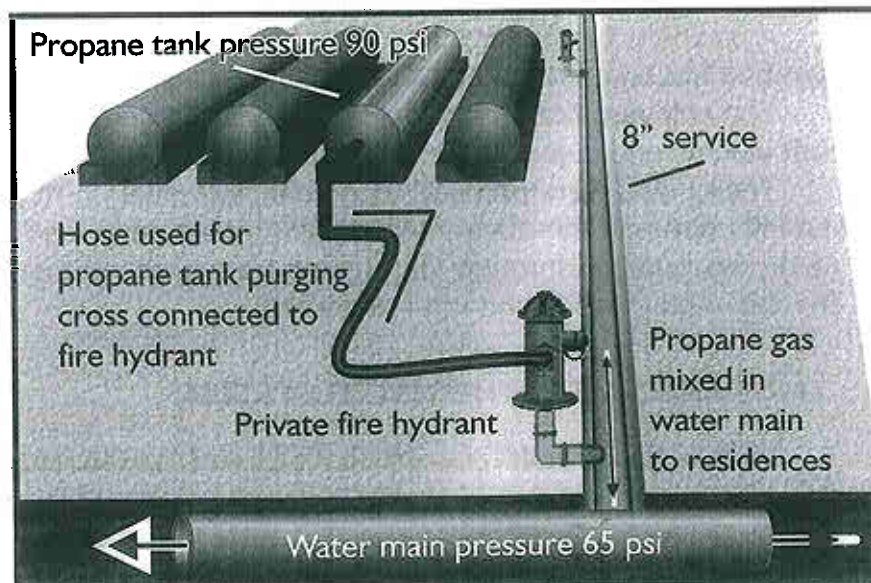
The incident drew widespread attention and made the local newspapers. As well as being the lead story on the ABC news affiliate in Washington, D.C. and virtually all the Washington/Baltimore newspapers that evening. The news media contended that lethal pesticides may have contaminated the water supply and among the contaminants was parquat, a powerful agricultural herbicide.

The investigation disclosed that the water pressure in the town water mains was temporarily reduced due to a water pump failure in the town water supply pumping system. Coincidentally, a gate valve between a herbicide chemical holding tank and the town water supply piping had been left open. A lethal cross-connection had been created that permitted the herbicide to flow into the potable water supply system. Upon restoration of water pressure, the herbicides flowed into the many faucets and outlets of the town water distribution system. This cross-connection created a needless and costly event that fortunately did not result in serious illness or loss of life. Door-to-door public notification, extensive flushing, water sample analysis, and emergency arrangements to provide temporary potable water from tanker trucks all contributed to an expensive and unnecessary town burden.

### 14.8 PROPANE GAS IN THE WATER MAINS

Hundreds of people were evacuated from their homes and businesses in a town in Connecticut as a result of propane entering the city water supply system. One five-room residence was gutted by a blaze resulting from propane gas "bubbling and hissing" from a bathroom toilet and in another home a washing machine explosion blew a woman against a wall. Residents throughout the area reported hissing, bubbling noises coming from washing machines, sinks and toilets. Faucets sputtered out small streams of water mixed with gas and residents in the area were asked to evacuate their homes.

This near-disaster occurred when the gas company initiated immediate repair procedures on one, 30,000-gallon capacity liquid propane tank. To start the repair, the tank was "purged" of residual propane by using water from one of two private fire hydrants located on the property. Water purging is the preferred method of purging



over the use of carbon dioxide since it is more positive and will float out any sludge as well as any gas vapors. The "purging" consisted of hooking up a hose to one of the private fire hydrants located on the property and initiating flushing procedures.

Since the vapor pressure of the propane residual in the tank was 85 to 90 psig and the water pressure was only 65 to 70 psig, propane gas backpressure backflowed into the water main. It was estimated that about 2,000 cubic feet of gas was involved. This was approximately enough gas to fill one mile of an 8-inch water main.

#### **14.9 CHLORDANE AND HEPTACHLOR AT THE HOUSING AUTHORITY**

The water services to seventy-five apartments, housing approximately three hundred people were contaminated with chlordane and heptachlor, in a city in Pennsylvania. The insecticides entered the water supply system while an exterminating company was applying them as a preventative measure against termites. While the pesticide contractor was mixing the chemicals in a tank truck with water from a garden hose coming from one of the apartments, a workman was cutting into a 6-inch main line to install a gate valve. The end of the garden hose was submerged in the tank containing the pesticides, and at the same time, the water to the area was shut off and the lines being drained prior to the installation of the gate valve. When the workman cut the 6-inch line, water started to drain out of the cut, thereby setting up a backsiphonage condition. As a result, the chemicals were siphoned out of the truck, through the garden hose, and into the system, contaminating the seventy-five apartments.

Repeated efforts to clean and flush the lines were not satisfactory and it was finally decided to replace the water line and all the plumbing that was affected. There were no reports of illness, but residents of the housing authority were told not to use any tap water for any purpose and volunteer fire department personnel gave them water that was trucked into the area. They were without their normal water supply for 27 days.

#### **14.10 BOILER WATER ENTERS HIGH SCHOOL DRINKING WATER**

A high school was closed for several days when a home economics teacher noticed the water in the potable system was yellow. City chemists determined that samples taken contained levels of chromium as high as 700 parts per million, "astronomically higher than the accepted levels of 0.05 parts per million." The head chemist said that it was miraculous that no one was seriously injured or killed by the high levels of chromium. The chemical was identified as sodium dichromate, a toxic form of chromium used in heating system boilers to inhibit corrosion of the metal parts.

No students or faculty were known to have consumed any of the water; however, area physicians and hospitals advised that if anyone had consumed those high levels of chromium, the symptoms would be nausea, diarrhea, and



burning of the mouth and throat.

Fortunately, the home economics teacher, who first noticed the discolored water before school started, immediately covered all water fountains with towels so that no one would drink the water.

Investigation disclosed that chromium used in the heating system boilers to inhibit corrosion of metal parts entered the potable water supply system as a result of backflow through leaking check valves on the boiler feed lines.

#### 14.11 PESTICIDE IN DRINKING WATER

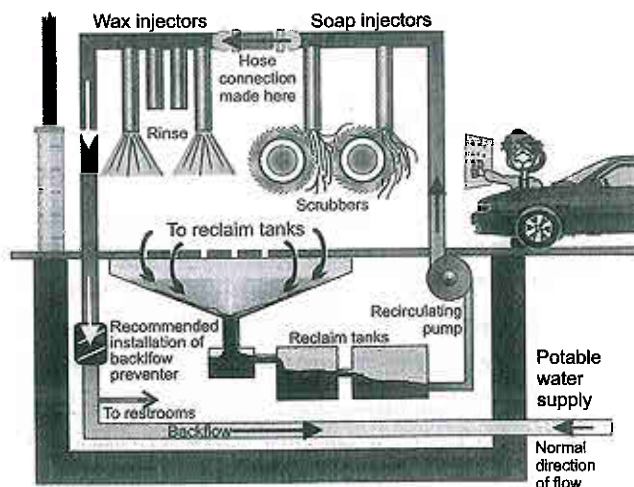
A pesticide contaminated a North Carolina water system, prompting the town to warn residents of 23 households not to drink the water. The residents in the affected area were supplied drinking water from a tank truck parked in the parking lot of a downtown office building until the condition could be cleared up. Residents complained of foul smelling water but there were no reports of illness from ingesting the water that had been contaminated with a pesticide containing chlordane and heptachlor.

Authorities stated that the problem occurred when a water main broke at the same time that a pest control service was filling a pesticide truck with water. The reduction in pressure caused the pesticide from inside the tank to be sucked into the building's water main. The pesticide contaminated the potable water supply of the office building and neighborhood area.

#### 14.12 CAR WASH WATER IN THE WATER MAIN

This car wash cross-connection and backpressure incident, which occurred in the state of Washington, resulted in a backflow chemical contamination of approximately 100 square blocks of water mains. Prompt response by the water department prevented a potentially hazardous water quality degradation problem without a recorded case of illness.

The water department received numerous complaints of gray-green and "slippery" water coming from the same general area of town. A sample brought to the water department by a customer confirmed the reported problem and preliminary analysis indicated contamination, with what appeared to be a detergent solution. Based upon the soapy nature of the contaminant, emergency operations and further investigations within the contaminated area



signaled that a car wash or laundry probably caused the problem. The source was quickly narrowed down to a car wash and the proprietor was extremely cooperative in admitting to the problem and explaining how it occurred. The circumstances leading up to the incident were as follows:

On Saturday, a high-pressure pump broke down at the car wash. This pump recycled reclaimed wash and rinse water and pumped it to the initial scrubbers of the car wash. No potable plumbing connection is normally made to the car wash's scrubber system.

After the pump broke down, the car wash was able to continue operation by connecting a 2-inch hose section temporarily between the potable supply within the car wash, and the scrubber cycle piping.

On Monday, the owner repaired the high-pressure pump and resumed normal car wash operations. The 2-inch hose connection (cross-connection) was not removed.

Because of the cross-connection, the newly repaired high pressure pump promptly pumped a large quantity of the reclaimed wash/rinse water out of the car wash and into a 12-inch water main in the street. This in turn was delivered to the many residence and commercial establishments connected to the water main.

Within 24-hours of the incident, the owner of the car wash had installed a 2-inch reduced pressure principle backflow preventer on his water service and all car wash establishments in Seattle that used a wash water reclaim system were notified of the state requirement for backflow prevention.

### **14.13 HEXAVALENT CHROMIUM IN DRINKING WATER**

A well meaning maintenance mechanic, in attempting to correct a fogging lens in an overcooled laser machine, installed a tempering valve in the laser cooling line, and inadvertently set the stage for a backpressure backflow incident that resulted in hexavalent chromium contaminating the potable water of a large electronic manufacturing company in Massachusetts employing 9,000 people. Quantities of 50 parts per million-hexavalent chromium were found in the drinking water, which is sufficient to cause severe vomiting, diarrhea, and intestinal sickness.

The incident occurred as follows: Laser machine lenses were kept cool by circulating chilled water that came from a large refrigeration chiller. The water in the chiller was treated with hexavalent chromium, a chemical additive used as an anti-corrosive agent and an algacide. As a result, the chilled water presented a toxic, non-potable substance unfit for human consumption, but very acceptable for industrial process water. No health hazard was present as long as the piping was identified, kept separate from potable drinking water lines, and not cross-connected to the potable water supply.

A maintenance mechanic correctly reasoned that by adding a tempering valve to the chilled water line, he could heat up the water a bit and eliminate fogging of the laser lenses resulting from the chilled water being too cold. The



problem with the installation of the tempering valve was that a direct cross-connection had been inadvertently made between the toxic chilled water and the potable drinking water line.

Periodic maintenance to the chiller system was performed in the summer, requiring that an alternate chiller feed pump be temporarily installed. This replacement pump had an outlet pressure of 150 psig, and promptly established an imbalance of pressure at the tempering valve, thereby over-pressurizing the 60 psig, potable supply. Backpressure backflow resulted and pushed the toxic chilled water from the water heater and then into the plant potable drinking water supply. Yellowish green water started pouring out of the drinking fountains, the washrooms, and all potable outlets.

#### **14.14 EMPLOYEE HEALTH PROBLEMS DUE TO CROSS-CONNECTION**

A cross-connection incident occurring in a modern seven-story office building located in a large city in New Hampshire resulted in numerous cases of nausea, diarrhea, loss of time and employee complaints as to poor water quality.

On Saturday, a large fire occurred two blocks away from a seven-story office building in this New Hampshire city. On Sunday, the maintenance crew of the office building arrived to perform the weekly cleaning, and after drinking the water from the drinking fountains, and sampling the coffee from the coffee machines, noticed that the water smelled rubbery and had a strong bitter taste. Upon notifying the Manchester Water Company, water samples were taken and preliminary analysis disclosed that the contaminants found were not the typical contaminants associated with fire line disturbances. Investigating teams suspected that either the nearby fire could have siphoned contaminants from the adjacent buildings into the water mains, or the contaminants could have been caused by a plumbing deficiency occurring within the seven-story building itself.

Water pH levels of the building indicated that an injection of chemicals had probably taken place within the building. Tracing of the water lines within the building pinpointed a 10,000-gallon hot-water storage tank in the solar heating system. It did not have a backflow prevention assembly on the make-up supply line. As the storage tank pressure increased above the supply pressure, as a result of thermal expansion, the potential for backpressure backflow was present. Normally, this would not occur because a booster pump in the supply line would keep the supply pressure to the storage tank always greater than the highest tank pressure. The addition of rust inhibiting chemicals to this tank greatly increased the degree of hazard of the liquid. Unfortunately, at the same time that the fire took place, the pressure in the water mains was reduced to a dangerously low pressure and the low-pressure cut-off switches simultaneously shut off the storage tank booster pumps. This combination allowed the boiler water, together with its chemical contaminants, the opportunity to enter the potable water supply within the building. When normal pressure was reestablished in the water mains, the booster pumps kicked in, and the contaminated water was delivered throughout the building.

