# READER FEEDBACK

## Cause of Complaints Traced to Dip Tubes

I've experienced mysterious particulate complaints from customers. They found uniformly colored gray particles in screens on sinks and showers. We assumed it to be calcium from [the] hot water tank or aluminum from the hot water heater sacrificial anode.

We were unable to digest this material, regardless of the acid used. Eventually we learned (from a plumber) that this was plastic chips from deteriorating dip tubes in the hot water heater (various brands).

I've learned from colleagues (including via [the] AWWA technical forum) that this is widespread, and we have all followed the same path, i.e., following the dead-end assumption that this is calcium- or aluminum-based. One went as far as performing infrared spectral analysis on the chips!

It appears that manufacturers have switched to an inferior material for these dip tubes.

# WATER HEATER DIP TUBES – WHY ALL THE FUSS ?

*Editor's Note:*

*One year ago, in the December 1997 issue of* ***Opflow****, a reader wrote to us about how he traced a problem with particulates to dip tubes in water heaters.*

*That letter led to a lively dialogue via Our Reader Feedback forum (May 1998, July 1998, October 1998) discussing ways to determine if the problem is dip tubes. The topic also was discussed via AWWA's On-line Conference Select the search button to find the thread.*

*http://www.awwa.org/publications/opflow/*

*abstract/articleid/17705.aspx*

*This article provides more insight on why and how the problem occurs, and offers some practical solutions*

**by Danny T. Hutchins, PhD**

In 1995, the Charter Township of Clinton (Mich.) Water and Sewer Department investigated complaints at an apartment building for seniors. In two apartments, tenants had found small, white or light green-tinted particles in their aerators and strainers and had problems with pressure and flow in their hot water supplies.

The investigating crew removed strainer screens in the dishwasher, the aerator screen on the kitchen sink, and the showerhead in both apartments. In the first apartment, the sink aerator was plugged with white, granular, or eggshell-like particles. The tenant said she had to clean the aerator every other day. She also said the sink fixture had become plugged so badly that it had to be completely taken apart. Water to her washing machine and dishwasher had been completely blocked. The crew found that the hot water temperature at the kitchen sink was 141°F (6°C).

In the second apartment, the sink aerator and the showerhead were partially plugged with the particles. T he tenant said that he often ran out of hot water much more quickly than when he had first moved into the apartment. The hot water temperature at the kitchen sink was 128°F (530°C).

Samples of the particles and the hot and cold water were collected from both apartments. Initially, the particulate material collected was tested to determine what percentage of the sample, if any, consisted of calcium or magnesium. No calcium or magnesium was found. Portions of the sample were observed through a surface microscope at 100 x, 1,000 x, and 1,500 x. Pieces of the sample had smooth sides and a non-crystalline structure. Further analysis indicated that the sample was some type of plastic. To validate the analysis, it was decided to remove and dissect one of the two water heaters.

The mechanical staff removed the hot water heater from one of the apartments and replaced it with a 40-gallon (150-L) heater. The crew also cleaned the strainers in the dishwasher and washing machine and the aerators in the kitchen, lavatory, and shower fixtures.

### Water Heater Autopsy

The water heater was cut open to analyze the epoxy lining, dip tube, drain plug, and any plastic plugs, washers, or seals that might have been used as part of the heater's construction. As soon as the heater tank was opened, it was obvious that the dip tube was missing. The epoxy coating was intact but exhibited serious damage. On the tank wall were a dozen spots where a white, oatmeal-like paste was found. A close examination revealed that this oatmeal-like paste was the same plastic material taken from the apartment aerators.

In the bottom of the heater, larger pieces of tube were found. When examined, several of the pieces crumbled into a grain-like mush. Analysis of the tube-shaped pieces and the oatmeal-like paste showed that they were the same material as the samples collected from the aerators and strainers-plastic dip tube.

### What Happens In the Heater

The dip tube is an extension of the cold-water inlet to the water heater tank, extending nearly to the bottom of the tank. *Figure 1* shows a normal dip tube as it extends from the copper cold-water inlet pipe down into the tank. The dip tube directs cold water to the bottom of the heater to be heated, allowing hot water to rise to the top of the tank. By directing cold water to the bottom of the tank, the incoming cold water pushes the heated water out in front of it. This allows the hot water to be used without diluting the temperature of the hot water that occupies three-fourths of the tank.

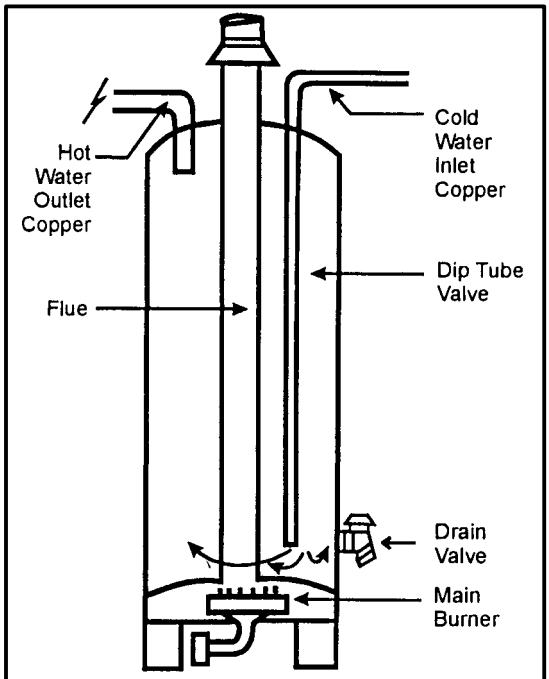

Figure 1

*Figure 2* shows that heat has softened the plastic dip tube, and turbulence created inside the water heater has caused the dip tube to break off. With the dip tube broken away, the cold water comes into the top of the tank, creating more turbulence while reducing temperatures and requiring the thermostat to be adjusted upward. The hot water continues to change the structure of the nonmetallic dip tube, causing it to become brittle.

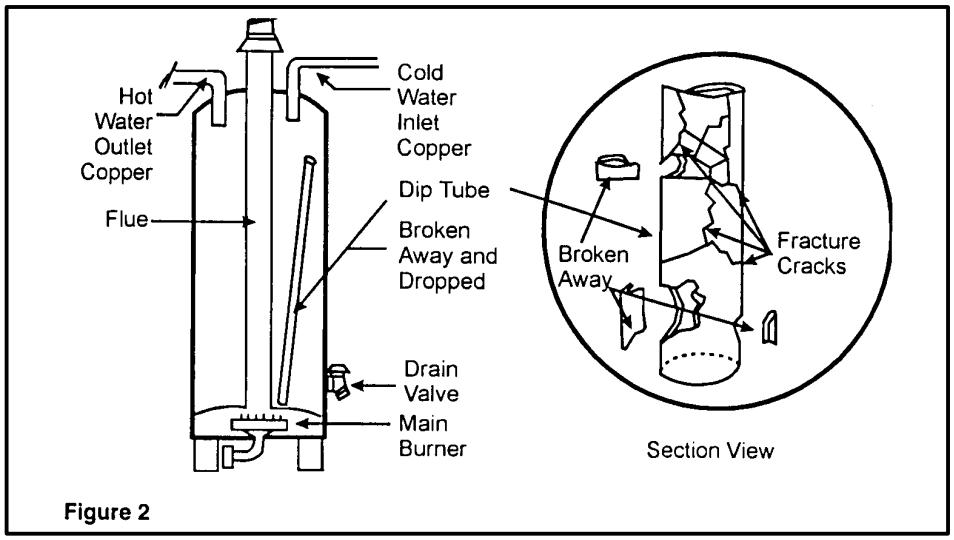

Figure 2

*Figure 3* shows that over time, the dip tube continues to change. Cracks and fractures form all over the dip tube surface. The turbulence created inside the tank breaks the tube into increasingly smaller pieces. The pieces are eventually flushed out of the tank through the hot water outlet. The missing dip tube also reduces the supply of hot water.

**Remedies**

*1. Flush the debris from the heater tank, install a new dip tube, and flush the strainers and aerators.* In order to flush the heater tank, a full-port drain valve has to be installed for each heater. In the case of the apartment complex, the approximate cost to flush the heater and replace the dip tube was $280 to $300 per unit. It took 45 minutes to an hour to clean all the strainers, aerators, and fixtures in one apartment.

*2. Replace the water heater and clean and flush the strainers and aerators.* The cost of this method was projected at $450 to $500.

Regardless of the approach you use, the fixtures, strainers, and aerators will have to be cleaned over and over until all of the small pieces of the dip tube are flushed from the distribution piping.

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***OPFLOW – December 1998***

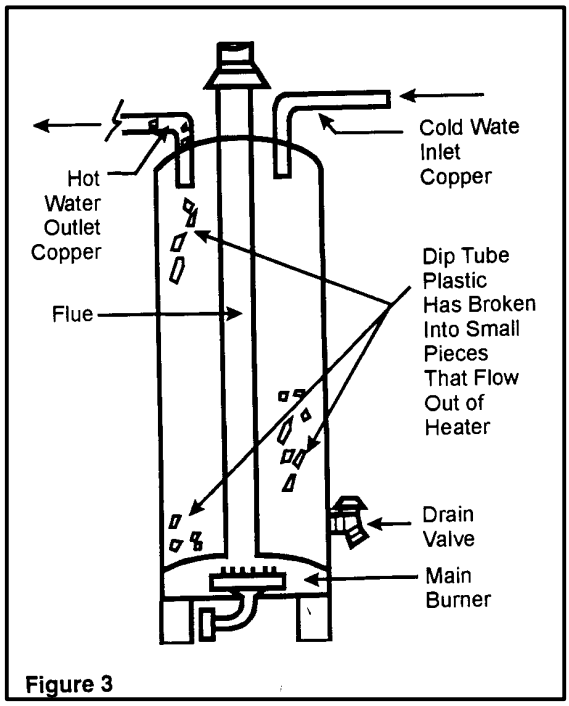

Figure 3