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QUALITY WATER SOLUTIONS

Making the Electrical Connection:
The Damaging Effects of Electrolysis on Plumbing Systems

How do you respond to a customer who complains that he or she just replaced several pipes, and now they are leaking again? Have you been stumped by the question "Why does my water still smell and stain my fixtures despite my new water conditioning system?" If you have done all your investigating and still come up empty-handed, consider the electrical system.

In many states, it is required by law that a home's electrical system be bonded, or grounded, to the plumbing system to direct stray electrical current into the ground. Because a well is drilled deep into the earth, a steel well casing is considered an excellent choice for grounding. In states that have electrical codes requiring grounding rods be put into the ground, electricity may choose a well casing as its path of least resistance despite the placement of the rods.

Although this practice may prove very effective for the safe grounding of electricity, the plumbing system is endangered as a result of electrolysis. In turn, homeowners run the risk of expensive plumbing repairs, health problems, and contaminated well water. The challenge to plumbing and water conditioning professionals today is to properly diagnose electrolysis damage caused by bonding and work to develop both short- and long-term solutions to the problem. The following information has been compiled to help you understand the cause of electrolysis and spot its telltale symptoms. In the long run, construction codes must be changed so that alternatives to bonding to the plumbing system are supported by regulatory bodies and the electrical trades. Note that many homes have their electrical systems bonded to the plumbing system and never see any of the negative effects discussed here. But for those homeowners perplexed by their continual water problems, this option should be investigated.

Electrolysis is defined as "the decomposition into ions of a chemical compound in solution by the action of an electric current passing through the solution." For example, electrolysis occurs when a battery corrodes. Electrons move between two dissimilar metals via a solution high in total dissolved solids (TDS).

How is electrolysis caused as a direct result of bonding to the plumbing system? Electrical wires are grounded to the well casing. Electricity travels through the plumbing on its way to being grounded. Electrolysis occurs when two dissimilar metals which make up a home's plumbing system are made to conduct this electricity.

For example, if one metal (copper) is more conductive than the other (galvanized steel), the electricity will jump to the copper piping more readily, easily traveling through the highly conductive water. Upon leaving or entering these pipes, the electricity causes random, inconsistent arching, spitting, scaling, and spotting as it makes contact with the walls of the pipe.

The same effect can occur when static electricity grounds to the plumbing system. As air moves through heat ducts or cold or hot air runs, static electricity builds. Pipes that are run through these ducts or touch these runs may serve as a ground for this static electricity. Left unchecked, this arching can eat through the walls of pipes. One way to prevent this from happening is to wrap the pipes in electrical tape where they come in close contact with the air ducts. This will insulate them from a direct connection with the static electricity, thus preventing grounding through the plumbing system.

There are many possible symptoms associated with electrolysis caused by bonding. First, the homeowner may experience point-of-use problems. One faucet may have green copper staining, while others do not. The staining does not show up throughout the entire plumbing system due to the random nature of the arching, scaling, and etching. It often occurs near one joint that leads to a specific fixture in the home, but does not cause staining outside of that localized area.

Other manifestations include odor, irregular and random corrosion, irregular scale formation, and joints that are plugged with corrosion. All of these problems are unique in their random occurrence throughout the plumbing system.

Joints, in particular, are often hit hard by electrolysis because they are the connecting point of two dissimilar metals. Surrounding pipes may show no sign of corrosion. Plastic dialectic couplings used to connect pipes of two different metals may break the electrical connection and force the grounding to occur somewhere else. Keep in mind that the plastic couplings may not stop the path of electricity because it may still be conducted by the water. Entire plumbing systems of plastic usually do not exhibit signs of electrolysis caused by bonding.

One way to help break the electrical connections is to create your own dialectic connections by cutting out metal joints or pipes and inserting plastic couplings or pipe. I have found that just two feet of plastic pipe at the water meter can entirely correct the condition. However, electricians may put jumper wires around the plastic, thus rendering this remedy ineffective.

If the first 20 to 30 feet of metal drop pipe in a well are eaten away from the outside in, electrolysis caused by bonding may be the culprit. This pattern of damage shows the electricity is traveling from the pipe to the well casing on its way to being grounded. This may also cause the well casing to deteriorate to an alarming extent. Since the well casing usually deteriorates within the first zone of water, which is more prone to be contaminated, any hole that develops in the well casing allows the contaminated water a straight path to the safe deep-well aquifer. This contaminates not only the home's water supply, but the entire zone. This surface water can be contaminated by fertilizers, animal waste, or other harmful bacteria, causing serious health problems when used by humans for drinking or washing.

Electrolysis can also cause problems in water conditioning equipment. We use a special version of the Fleck 2500 control valve in which the casting is brass and the backplate is steel. In some units, heavy corrosion occurs in this area, eventually damaging the piston shaft and deteriorating the shaft seals. In many of these cases, the corrosion problem is eliminated when the electricity in the home is properly grounded.

When diagnosing a possible electrolysis problem, look for other signs of improper grounding. These signs may include stray voltage on farms causing shocks to cattle and damaging

their health, or frequent light bulb and electric appliance replacement in the affected home or building. Other potentially harmful grounds may come from telephone lines, cable television, or security systems.

There are several other big monetary and health risks associated with electrolysis caused by grounding. Pipes and joints need to be cut out and replaced, and these costs can be monumental. In commercial settings, school and hospital plumbing systems have been severely damaged by electrolysis caused by grounding. Well casings and drop pipes require repair or replacement. As a result of the deterioration of copper pipes, the copper level in the affected plumbing system can rise to dangerously toxic levels. Primary drinking water standards state that copper contamination is considered toxic at 1.3 parts per million. I have seen this concentration jump to over 10 parts per million where heavy electrolysis due to grounding has occurred. The copper is released into the water when the interior of the pipe is damaged by arching, etching, or spitting.

Although much attention has been paid to rural wells, the same type of damage can occur within cities and municipalities. City water mains, underground piping, and other laterals leading to a home can deteriorate in the same manner from electrolysis caused by bonding. In isolated cases, I have found that steel drainage systems can be the ground for an entire neighborhood. Because of its uninterrupted metallic connections, electricity both leaves and enters buildings and homes via the drainage system. In most cases, these electrical connections cannot be broken because grounding systems are often interconnected. In this situation, the most promising solution to the problem is a change in the building codes that require bonding to the plumbing system.

How can we help correct this problem? To find a long-term solution to these threats, these problems need the attention of all of us. First, call or write to your state building regulators to request a change in the building codes that require bonding to the plumbing system. Explain the potential risks to the plumbing system and health of the homeowner associated with this type of electrolysis. Suggest alternatives to this practice, such as drilling electrical ground wells that have a better potential ground than the plumbing system. Therefore, if a fault occurs, electricity will take the path of least resistance through the proper electrical ground instead of the plumbing system. In many cases, this is a difficult job, and will require the electrical companies to drill these wells. Secondly, work with your associations to build awareness in both the electrical trade and legislative circles.

Work in groups to propose cost-efficient and effective alternatives to grounding through the well casing that will not deteriorate plumbing systems. Make these proposals to your state regulatory agencies. Not only will you make these agencies aware of the problem, but you can play a role in developing its solution.

Caution: Never remove electrical grounds from plumbing systems without consulting a professional electrician. If no alternative electrical ground is provided, there is a risk of severe personal harm from electrical shock.