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Apr 30th, 1:00 PM

Paper Session II-D - Pinhole Construction W/Constructive Interference Through Current Carrying Conductors

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PIN-HOLE CONSTRUCTION WITH CONSTRUCTIVE INTERFERENCE THROUGH CURRENT CARRYING CONDUCTORS

Everything in life seems to have it's advantages and disadvantages. Living in Florida for example, this is naturally a beautiful state. The beaches, weather, environment, and lightning. Lightning is another thing that seems to have it's ups and downs. Lightning is amazing! It is also very unique and beautiful. The part of lightning that amazes me the most is probably it's power. However, as I develop my project more and more, I am learning what a disadvantage this can be for Florida homeowners.

"I moved into a large home two years ago. Since moving in, I've almost had 10 pinhole leaks repaired in "L" grade copper pipes in the basement. I've installed a water treatment system with food-grade phosphorus and other appropriate chemicals being added to reduce water acidity. Water tests all show acceptable pH levels (7.10 before treatment), acceptable Langolier index, etc. No one can seem to tell me why I keep getting pinhole leaks in my pipes... I'm fed up with the leaks and the cost of repairing them, and can't seem to get any answers. Does anyone have any ideas?"

-AJ

"I'm in the plumbing manufacturing business and religiously read all the trade magazines, not only because I advertise in them but to keep up on all available current events in the industry... The homeowner had a plumber repair such leaks several times, the leaks continued, the homeowner preceded to contact the pipe manufacturer whose name appeared on the pipe. She didn't get the problem resolved nor received an adequate answer to her inquiry. She contacted the local building department, they sent out an inspector, he couldn't find the cause either. He voluntarily surveyed homes in the area with copper systems having approximately the same age and found that a total of 50 homeowners were also experiencing the same problem..."

-Frank

Above are just two examples of homeowners showing concern because of their copper piping. In the first was a man fed up with paying the bills and making an effort to find out what is going on with his pipe system that is causing these numerous, constant leaks. The second man was responding to the first man's question. This man was a plumber himself puzzled by the leak mystery. He mentions a lady with similar problems who made an effort, but could not resolve the problem either. She even

tried to contact someone and get an inspector to come and take a look. This man goes on to say that 50 homeowners were having the same problem. I venture to say that these people are probably just a fraction of the worldwide population that are losing both money and patience due to this pipe mystery. This problem has also carried a various number of opinions of how and why these pipes are getting pinhole leaks.

“I have no ill will with copper, but it’s showing problems due to high pH levels in water in certain parts of the country.”

-Frank

“You haven’t mentioned checking out electrical grounding problems. Sometimes this can be the problem. Have a super qualified electrician check it out. What you are experiencing has also happened to many other people. That is one of the reasons, in my opinion, that copper will no longer be the water piping of choice in the 21st century.”

-Vic

“You don’t specify if it is pin holing on both hot and cold lines. If on hot only than it could be from a recirculating line. Sometimes the pumps are over sized and velocity can wear the pipe out. You can valve it down with a ball valve or put a timer on the pump.”

-John

Each of these above people came up with their own hypothesis of what could of happened. The first was Frank who we heard from earlier. He basically states that it might be the pH levels. However, if you read how AJ tried to resolve this problem, you will see that he did pH tests and found that acceptable before treatment.

The second person who responded to this question was a man named Vic. Again, this man is also involved in the plumbing business. His hypothesis is very different than what most people would probably think the problem is. He asks about electrical grounding problems. This is actually is very relevant to my project.

The third person, a man by the name of John, says that it could be the water velocity wearing out the pipe. He also states his own remedy to this problem.

Basically what I have tried to get across to you thus far is that copper pipe leaks are a problem. More and more people are having to dish out more and more cash for a problem that has not yet been given any true cause. This leads to my second point, solutions are being debated. There is a demand for an explanation. For these reasons, I think my project is essential.

Having stated the purpose of this project, I would like to speak about a man named Richard Dunham. He is a part of the Water Quality Laboratory at Orlando Utilities who has, beginning in 1984, been studying this problem on and off. He gives a different theory.

The purpose of his project was to study the effects of electrical grounding on water quality. In his research papers, Dunham talks about the theory that stray currents conducted along the copper plumbing caused the leaks. Ironically, he found that there was no evident correlation between stray currents and elevated copper levels or evidence that the stray current caused the pin-holes. However, he found that while it was normal to have thunderstorms here in Florida, on the days that the storms were "exceptionally intense," the dissolved copper levels had gone sky high.

Dunham gathered that "lightning in some way, had contributed to the excess dissolved copper in the water samples. Taking this observation to it's final conclusion leads to the theory that lightning could cause pin-holes in the copper plumbing."

"The majority of the leaks in this area are caused by lightning," said Cliff Russell also from Orlando Utilities. They say lightning, not old age or corrosion, punctures pipes.

As you have read about these conclusions and this project you will find that it is rather similar to mine. This project actually inspired mine. The question remains in this project, does lightning cause pin-hole leaks? I am performing a project similar to his, but with a different perspective. His project has left me curious. For this reason I took a different twist. I plan to run with it and hope it will take me to a true conclusion. Furthermore, I am very curious because our copper pipe actually got struck by lightning. We were gone for the weekend and came home to a flooded home. Our answering machine, garage door opener, my stereo, our VCR, and a couple other items were ruined. About a year later we found an article in the newspaper that sparked my interest entitled, "Lightning Blamed for Pin-hole leaks." This article was the origin of my project.

How is lightning formed? Since this project does involve lightning, it is essential to know how it comes about. Thunderstorms bring strong currents of air and winds. The air that is moving causes an electric charge in the clouds. In an instant the charge jumps between the cloud and ground, forming a lightning strike. This happens when the electrical potential between two clouds or between a cloud and the earth reaches a high value, around 10,000 V per cm or around 25,000 V per inch.

The electric charge was first recorded in 550 BC by Thales of Miletus

in Greece. He noted that if amber were rubbed with fur, it attracted small objects, bits of cork. He also found objects act similarly when rubbed with certain materials. An example of this would be a glass rod will become electrified when rubbed with silk.

It is not fully understood how thunderclouds become charged. However, most thunderclouds are negatively charged at the base and positively charged at the top. Most meteorologists believe that ice is necessary for lightning, because lightning is not usually observed until ice is formed in the upper layers of these clouds.

Lightning rods protect buildings from lightning. These rods extend from the ground to the highest part of the roof. This provides a path for the lightning so that it does not damage the structure itself. Power lines and radio sets are also protected with a gas-filled gap between the line and ground wire. "This gap offers a high resistance to ordinary voltages, but a lightning discharge, which has a potential of tens of millions of volts, causes the gas in the gap to ionize, providing a low-resistance path to earth for this discharge," according to Earl Cook, author of an article on lightning.

The most damaging and dangerous type of lightning is called Cloud-To-Ground Lightning. This type can have a direct affect on us and is the type that my project involves. The flashes of this type originate near the lower-negative charge center and deliver negative charge to Earth, according to a recent encyclopedia.

Lightning is very beautiful and amazing, but it is also very dangerous. If you are struck by lightning, charge will flow through your body and hurt you. There is a chance that you might be electrocuted and killed by it. In the U.S. about 100 persons are killed and many injured by lightning each year, surprisingly more than by tornadoes or hurricanes. Around 75,000 forest fires are started by lightning in a years time. Forty percent of farm fires in a year are also caused by fire. Don't second guess the power of lightning.

According to the Microsoft Encyclopedia, the principle use of copper is electrical, because of copper's extremely high conductivity, which is second only to that of silver. Copper is so very ductile, it can be drawn into wires of any diameter form about 0.025mm upward. It can be used in outdoor power lines and cables, as well as in house wiring, lamp cords, and electrical machinery such as generators, motors, controllers, signaling devices, electromagnets, and communications equipment.

Imagine, you are married and have three kids. You live in a nice home and have enough money to get by. One day your copper pipe

springs a little pin-hole leak. Slowly this costs you money for paying for the water you are slowly losing. You call a plumber and get it fixed and then sit back and think it wasn't so bad. A couple of weeks later the problem occurs again in your copper piping system. This is the repetitive pattern many people in Florida are facing.

You would wonder why this is happening. You would want to know what you can do about this problem. And in the case if you were preparing to build a home you would like to know the advantages and disadvantages of copper piping to PVC piping.

PVC also has it's problems. PVC manufacturing creates huge volumes of hazardous wastes. Vinyl chloride is directly linked to liver angiosarcoma among workers in plants that make this product. Lethal smoke emitted when PVC products burn raises the risks of fatalities from house fires. Sweden, Denmark and Switzerland even took steps in 1990 to ban PVC in some products and for some applications.

This problem can actually add up to be very cost worthy. It might start with one leak and end up draining your wallet. If you stop and think about it, you can't change your whole piping system because it is running through your foundation.

I hope this project will help me to gain a better understanding of electricity. I also hope this project will benefit people down the line. There is a lot of curiosity behind this project. Surprisingly, even NASA has had a run-on with pin-holes. I hope as I complete this project it will help from just the normal homeowner to maybe even NASA.

Problem

The purpose of this project is to study the phenomena of pin-hole construction with constructive interference through current carrying conductors.

Hypothesis

It is hypothesized that electrical current can cause pin-hole regularity in current carrying conductors.

Procedure

- 1. Contact a person from Failure Analysis Lab at NASA.**
- 2. Select wires and tubing.**
 - A. Purchase braided wires from gauges 14-24.**
 - B. Purchase 3/32 and 1/16 brass tubing.**

- C. Purchase 1/16 solid brass wire.
- 3. Apply selected voltages thought the wires/tubing using the DC Voltage Supply and the 6633A DC Power Supply at NASA.
 - A. Monitor voltage applied with Oscilloscope.
 - B. Video using the Red Lake Motion Scope 500.
- 4. Look for pin-hole regularity.
 - A. Measure distance from center of pin-hole to center of pin-hole.
 - B. In tubing, measure distance from center of blueing to center of blueing.
 - C. In tubing, measure length of blueing.
 - D. In tubing, measure length between blueing.
 - E. Divide measurements by lowest measurement.
 - F. Find average measurement.
 - G. Divide measurements by lowest measurement.
 - H. Divide measurements by average number.
- 5. Look for number regularity.
- 6. Compare patters from wire to wire, tubing to tubing.
- 7. Prepare Conclusions.

Abstract

Have you had a copper pipe leak? Do you wonder what causes many of them? Some research suggests that the phenomena is associated with lightning discharges. The researcher has modeled the phenomena of pin-hole leaks in current carrying conductors in an electrical failure analysis lab. The objectives of this modeling were to quantify and analyze this phenomena . It was hypothesized that electrical current could cause pin-hole regularity in current carrying conductors.

In the experiment, selected voltages will be applied to different gauge wires and brass tubing. The phenomena was observed and photographed by the researcher. Data related to pin-hole blowouts and blueing were taken from center of pin-hole to center of pin-hole. In tubing or when pin-holes did not occur, measurements were taken from center of blueing to center of blueing, distance between blueing, and length of blueing. The measurements will be compared to find pin-hole patterns and regularity.

Future Studies

People want answers! I have read and heard complaints upon complaints about pin-hole leaks. It is time to solve the mystery. Is it corrosion? According to Dunham and Russell, it's not! Is it lightning? It could be! I will continue this project next year. I would like to reduce the

variables in an effort to find a definite pattern, and I hope to be able to predict using conclusive patterns where the pin-holes would occur in different diameter copper pipes. This project is worth continuing!

Biography

I am currently in the tenth grade at Cocoa High School. I love to participate in science fairs, and have been since third grade at Saturn Elementary. I think sciences are very interesting. I hope to pursue a career in the science field. It's my dream to work at NASA and one day be an astronaut. I like to play tennis and basketball in my spare time, and I hope to play at and attend the University of Florida when I graduate.

Kelly Kimbrough

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