



CRANE

ENGINEERING AND
FORENSIC SERVICES

Shedding Light on MD Dark Mystery:

*Candle
flames to
blame as
source of
"sooting"*

Houses these days are retaining more normal indoor-air contaminants than in the past – including cooking byproducts, cigarette and wood-burning fireplace smoke, moisture from poorly vented or unvented bathrooms and many others. For one thing, residential construction techniques used in last five or 10 years are making houses much “tighter,” so there is less air leaking into and out of them. In

addition, many homes use furnaces, fireplaces and even water heaters that are “direct vent” – meaning that both the intake air needed for combustion and the exhaust, or combustion products, are piped directly outside.

In recent years, there have also been numerous reported incidents of “sooting” in homes. Typical symptoms include dark soiling of wall surfaces, dark stains on carpeting in the areas

around heat registers or around room perimeters, discolored draperies and mysterious clean areas under furniture. Homes experiencing very serious problems have also noted “ghosting” on walls, usually exterior ones, where studs within the walls actually show up as darker stained areas.

It is clear that something within those homes is creating particles that are attracted to these various surfaces. Two possible sources are soot, which is a carbonaceous byproduct of incomplete combustion, and mold. As might be expected, many homeowners place the blame on a faulty or incorrectly installed furnace or gas fireplace. Mold is a much less prevalent – and more easily identified – problem, virtually always resulting from

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You can test a candle's soot production by burning a candle for a few hours near a known source of particle attraction, such as a TV screen. If soot collects on the screen, you may want to discontinue use of this type of candle.

PROPER

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Plymouth, Minnesota 55447

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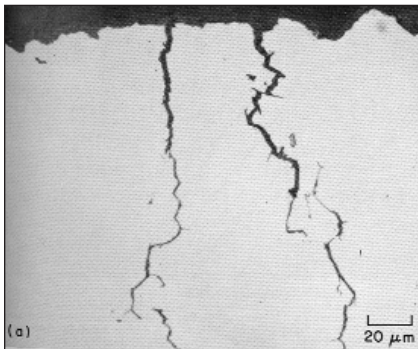
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Keep a Lid On It!

*Prevent disaster with proper
solvent handling*

There is a crispness in the air. Geese are heading south. The first frost has whitened the morning landscape and even a bit of snow has fallen. It is fall in Minnesota! Another annual autumnal occurrence here is the ritual of closing up the lake cabin – usually after a thorough cleaning to ensure the place is ready for visitors again next spring. This could be a problem.

Many cabins and/or manufactured homes in rural areas and around lakes are fueled with liquid propane (LP). Liquid propane may be used to fuel stoves for cooking and heating, water heaters and an occasional refrigerator.



This branching pattern is typical of stress corrosion cracking.

Typically, LP fuel lines are copper tubing with flared fittings at tees and connections. These flare nuts are usually made of brass, an alloy of copper and zinc.

Brass is quite susceptible to a problem known as stress corrosion cracking (SCC). As the name implies, this cracking occurs when a part is under some mechanical stress/loading and is also exposed to a corrosive environment. The combination can lead to a part's complete fracture. Brass is especially vulnerable to SCC in an atmosphere containing ammonia fumes – often found in household cleaners.

The fumes from an open container of ammonia cleaner can envelop a brass flare nut and initiate minute surface cracks. The progression of these cracks leads to fracturing of the flare nut, and this could result in an uncontrolled release of LP into the atmosphere. The propane could build up until an explosion or fire results, depending on the availability of an ignition source.

For this to happen, the part must also be under stress. A securely tightened flare nut has a stress load that is sufficient to ensure the progression of stress

corrosion cracking. The higher the zinc content of the brass alloy, the greater its susceptibility to SCC.

Many LP appliances have piping that traverses confined areas, such as under and within sinks and counters. This, of course, is where many people store their household cleaning supplies, including ammonia – the primary culprit in this scenario. If all containers are properly capped or sealed, corrosive fumes will not be emitted. It only requires a minimal amount of ammonia, however, to initiate and propagate stress corrosion cracking.

Another item used to transfer fuel gas to appliances is a flex connector. Earlier ones were made of uncoated brass; connectors produced today are either coated with a protective material, such as Teflon®, or made of stainless steel. The stainless steel flex connectors are not affected by ammonia but are affected by chloride compounds. Household bleach is one such compound. Exposure to chlorides can cause SCC in stainless steel.

It would be wise for LP users – whether Minnesota cabin owners or not – to heed this simple warning: Keep the cap or lid on any cleaners or solvents! The simple act of sealing the containers could prevent a fuel gas system from experiencing stress corrosion cracking and resulting in a fire or explosion that could destroy a lifetime of memories. ■

*- John E. Brynildson, P.E.
Metallurgical Engineer*

SEM More Information

So you're in the know

The word “versatile,” defined as “adaptable to many uses or functions,” is the perfect descriptor for the Scanning Electron Microscope (SEM)/Energy Dispersive Spectrometry (EDS) system. In spite of its versatility, however, the SEM/EDS is sometimes perceived as extremely high-tech and therefore only applica-

ble to specialized tasks. Not true!

In particular, a JEOL 5800 LV model has several unique capabilities. The large sample chamber – capable of accepting samples up to about 6"x 8"x 3" – has the option of “low-vacuum” operation, which permits the examination of wet samples, such as biological tissues or drops of “unknown” liquids.

As it turns out, the SEM/EDS system is versatile enough to work well for almost everything! A quick review of samples examined includes categories such as medical devices, food and food processing equipment, industrial samples, forensic samples and many others.

Medical samples include heart

continued on next page

SEM continued from previous page

valves, catheters, various implants, biological tissues (“dripping wet,” as mentioned above!), staples, sutures, sponges, syringes, replacement hip and knee joints, and many others. This testing is possible only due to the SEM’s low-vacuum capability.

Just a few of the items in the food category are popcorn, cake mixes, French fries, soda cans (whole – the advantage of the large sample chamber), unknown materials in fast food samples, and rollers used to process cereal.

Well-known to heavy industry, the SEM/EDS is frequently the first stop in the analytical process. Requests include the identification of foreign material; examination of plating failures, solder joints, cracks and welds; surface roughness of cylinder walls; and analysis of manufacturing defects.

The forensic category is also vital since investigation of all types of failures and fire is critical to legal and insurance professionals. Quick access to on-site SEM testing and analysis is

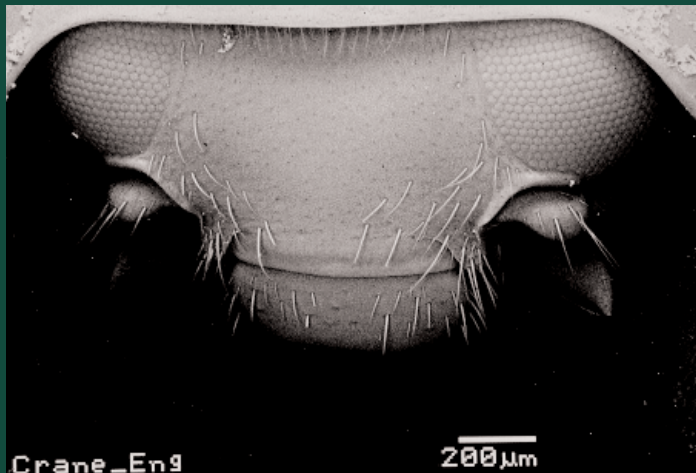
invaluable in many cases.

Demonstrating the diversity of SEM applications, the miscellaneous category includes numerous museum pieces (verifying materials as original), rocks, candle sticks, religious icons, paints and varnishes, appliance parts, Christmas lights, roller bearings,

shingles and airplane turbine parts.

The possibilities are endless, with the versatile SEM/EDS system serving as an invaluable investigative tool for nearly any application. ■

- Jean L. Schlosser
Electron Microscope Lab Manager



E.T.? This creature isn't really an alien, but it sure staged an invasion in Minnesota this fall. See page 4 for the answer to this issue's mystery image.

Norm's Corner



Candles? Soot? Don't these people have anything better to do with their time? Personally, I can think of several things. I get hungry during the day, much more often than you might think. Instead of fiddling with pieces of wax that no doubt have come from some insect's behind, the engineers who work here could have been giving me treats.

Treat giving is a win-win activity: I get a tasty snack; they get the pleasure of seeing me eat a tasty snack. It is certainly more rewarding than investigating pillars of wax! I mean, they could have also been petting me. While cats will tell you that petting

them is more rewarding than petting dogs, I say petting is a more enjoyable pastime without the purring. Heck, if tennis wasn't as popular as it is, we wouldn't need cats at all. But I digress.

The point I am trying to make is that candles are the culmination of all things unpleasant. I don't know why anyone would even want candles in their house. More soot means more trips to the groomer, the most terrible place on Earth.

When you're there, the groomers torture you with all sorts of canine devices. First, they try to drown you in a vat filled with soap-flavored poi-

son. As if that's not enough, they follow it up by trying to roast you alive with a super-heated air cannon. If you're one of the lucky ones, you survive, only to have them cut off the ends of your toes with an evil metal pincer. They finish the process by dragging a hand-held tool with sharply pointed metal spikes over your coat, until bits and pieces of your coat are stuck between the points. So let that be a lesson to you: Using candles causes constant, excruciating pain. ■

-Norman Crane
Resident Canine Companion, Author

Shedding Light *continued from page 1*

excessive moisture within the home.

There is, however, another relatively common, if unexpected, source: candles. The popularity of candles has been growing tremendously; it is estimated they are used in 70 percent of U.S. households. In most cases, candles are used for special occasions, with perhaps one or two being burned for short time periods. Some candle enthusiasts, however, use a large number of candles on a daily basis.

How many candles are too many? There is no simple answer or formula for calculating a safe or desirable number. In a recent test, four candles were burned for a total of 15 hours each (for a total of 60 "candle hours") in a new model home. This was sufficient to produce soot that was visible

on the walls, drapes and appliances such as the refrigerator and dishwasher.

There are several factors affecting how "sooty" a candle may be. They include flame size, a function of wick size and volatility of the wax being burned; the presence of chemicals to generate an attractive scent; and the shape of the candle and its container. The basic problem with candles, however, is that the very thing that makes them attractive is soot from their inefficient combustion. Without it, there is no bright, dancing yellow flame; instead, it's blue, much like the flame of a gas stove!

It is safe to say that "all candles are not created equal" and that soot generation levels can vary tremendously among candle shapes and brands. One

simple way to test a candle's soot production is to place a new one near a known source of particle attraction, such as a television screen. Burn the candle for a few hours, then wipe the screen with a clean, white rag or tissue. If soot has collected during this period, continued use of this particular candle type is not recommended.

With candle popularity on the rise, all investigations of complaints of staining or sooting in a home should include an examination for evidence of candle usage. Experience shows that candle enthusiasts almost never suspect candles as the source of their problem! ■

- *David P. Hatz*
Consulting Chemist

NOTES

New Area Code Is 763. Please be sure to note our new area code 763 in your records.

Congratulations, John. Crane Engineering's John E. Brynildson, P.E., has been certified as a Corrosion Technician through NACE International: The Corrosion Society. The NACE professional recognition program serves as an impartial organization that assesses an individual's experience, knowledge and education. If the individual proves qualified, NACE recognizes the individuals and certifies them in the appropriate field of expertise.

Propane Training Held. Thomas R. Crane, P.E. and Scott A. Sollars, P.E.,

held a propane training seminar for the City of Plymouth this past summer. Crane Engineering has also conducted a similar seminar for the City of Maple Grove. If your organization or community is interested in offering a seminar on the care and handling of propane, just contact Carol Liljequist, general manager, at (763) 557-9090.

Student Visit. Crane Engineering again hosted students from the Minnesota Institute for Talented Youth's two-week summer "Physics is Fun" course. Students had a chance to hear from Crane's engineers and technicians and participate in actual experiments. We enjoy welcoming students into the real-world laboratory.

Tours Available. If you'd like a tour of our facilities, please call Carol Liljequist, general manager, at (763) 557-9090.

E-mail Address. You may contact us via email at <tcrane@skypoint.com>. ■

The answer to "E.1." Taken using Crane's SEM/EDS, the mystery image in this issue is a ladybug, which was found inside homes this past fall. Let's hope they come around again next spring to help control the annual crop of aphids!

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