the Conduit

A quarterly publication from M&M Engineering Associates, Inc.

Vol. 14, No. 3

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It's Not always Bad News

By: John Molloy, P.E.
Principal Engineer

While not nearly as exciting as a failure, checking to make sure things are in good working order is just as important. M&M Engineering recently performed an evaluation of hoses used for supplying hot thermal oil. The equipment had been laid up for multiple years and there was concern that the hose's internal pressure liner may have corroded due to potentially corrosive contaminants in the oil. Hose samples were destructively analyzed to determine if corrosion of the inner liner had resulted in perforations to the pressure containing boundary.

Two hose samples, one large diameter and one small diameter, were received for examination. They were visually examined and there were no obvious signs of degradation. They were then longitudinally sectioned to facilitate inspection of the internal surface. The larger diameter hose was comprised of three layers: an external metal braid, a corrugated liner, and a strip-wound interlocked layer. The smaller diameter hose was comprised of an external metal braid and a corrugated liner. The corrugated liners that provided the pressure boundary were the focus of the investigation.

After sectioning and visual examination of the internal surfaces, the corrugated liners were cleaned and liquid penetrant inspected (PT) on the external surface to establish if through wall perforations or cracks were present. No recordable indications were observed.

The internal surfaces of the pressure boundary liners were inspected using a stereomicroscope. The larger diameter hose liner had no notable aberrations or deposits. The smaller diameter hose liner contained tenacious deposits biased to one side of the liner (Figure 1).

The hose liner material and internal deposits were analyzed using a scanning electron microscope (SEM) equipped with energy dispersive spectroscopy (EDS[1]) to determine their elemental compositions. The liner alloy was found to be similar to an 18-8 stainless steel, such as Type 321. The internal deposits contained elements that were native to the liner alloy. No corrosive species were observed.

Metallographic sectioning was performed on the smaller diameter hose corrugated liner in the area with tenacious deposits and superficial corrosion. High magnification examination of

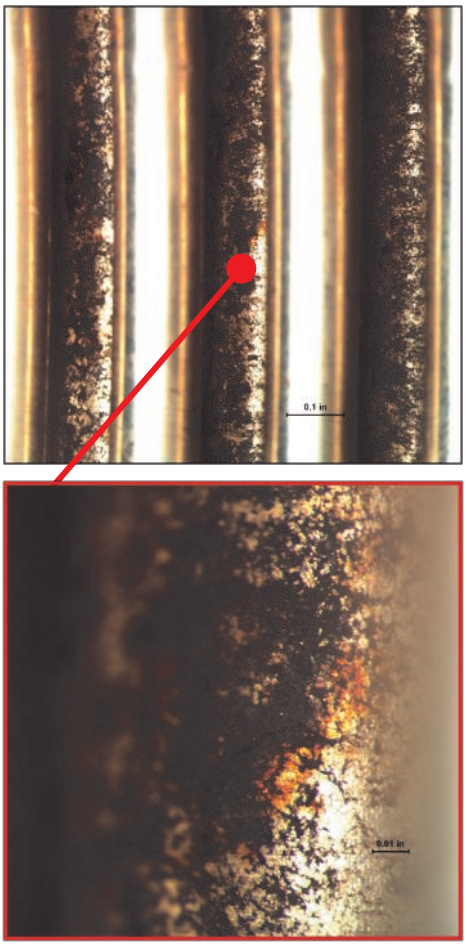

Figure 1. Photographs show images of the tenacious deposit and suspected corrosion observed on the internal surface of the liner from the smaller diameter hose.

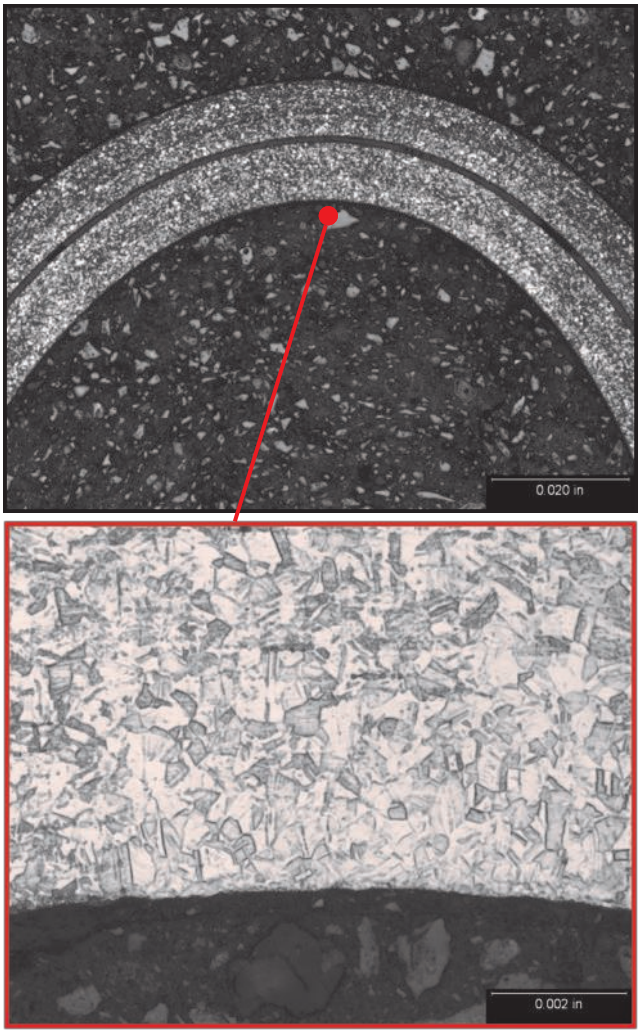

Figure 2. Photomicrographs show the internal surface of the hose corrugations with visible deposits. No corrosive penetration was observed. (Etchant: Aqua Regia)

corrugations with visible deposits and corrosion patina did not reveal any penetration into the base metal (Figure 2). The tenacious deposits and corrosion were superficial.

The conclusion: although some tenacious deposits were observed on the smaller diameter hose, only superficial corrosion was observed. No penetration into the bulk metal was observed. Based on the samples submitted for analysis, no corrosion problems were found and similar hoses were suitable for service.

1 EDS provides qualitative elemental analysis of materials under SEM examination based on the characteristic energies of X-rays produced by the electron beam striking the sample. Using a light element detector, EDS can detect elements with atomic number 5 (boron) and above. Elements with atomic number 13 (aluminum) and above can be detected at concentrations as low as 0.2 weight percent; lighter elements are detectable at somewhat higher concentrations. As performed in this examination, EDS cannot detect the elements with atomic numbers less than 5 (i.e., beryllium, lithium, helium or hydrogen). The relative concentrations of the identified elements were determined using semi-quantitative, standardless quantification (SQ) software. SQ electronically analyzed the EDS data, thereby lowering the detection limit to about 0.1 weight percent.

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Fractography

METALS FAIL in many different ways and for different reasons. Determining the cause of the failure is vital in preventing a reoccurrence. One of the most important sources of information relating to the cause of fracture is the surface itself. A fracture surface is a detailed record of the failure history, environmental effects, and material quality. The principal technique used to analyze this evidence is electron fractography. Fundamental to the application of this technique is an understanding of how metals fracture and how the environment affects the fracture process.

Fractography is the term coined by Carl A. Zapffe in 1944 following his discovery of a means for overcoming the difficulty of bringing the lens of a microscope sufficiently near the jagged surface of a fracture to disclose its details within individual grains. The purpose of fractography is to analyze the fracture features and to attempt to relate the topography of the fracture surface to the causes and/or basic mechanisms of fracture.

John Percy, a prolific author on metallurgical subjects, described in 1875 six general types of fracture patterns:

Crystalline, with facets as in zinc, antimony, bismuth, and spiegeleisen
Granular, with smaller facets, as in pig iron
Fibrous, a general criterion of quality
Columnar, typical of high-temperature fracture
Vitreous, or glasslike.

Text Source: ASM Handbook, Vol. 12; Fractography

Failure Mechanisms Working in Collusion

By: Catherine Noble, P.E.
Senior Engineer

Failures are frequently not the result of a single event or mechanism. Instead, a sequence of events typically results in a failure. M&M Engineering recently investigated an example of this in a boiler floor tube.

Visual Examination

We received a boiler floor tube that contained a bulge and large blister on the hot side, with a likely through-wall failure at the peak of the blister (Figure 1). The tube was sectioned about 2 inches away from the blister to reveal significant thinning and gouging of the tube wall (Figure 2). The tube sections were then split longitudinally to examine the internal surfaces. Heavy, layered deposits that were red, gray, and white in color were noted within the gouge on the hot side (Figure 3).

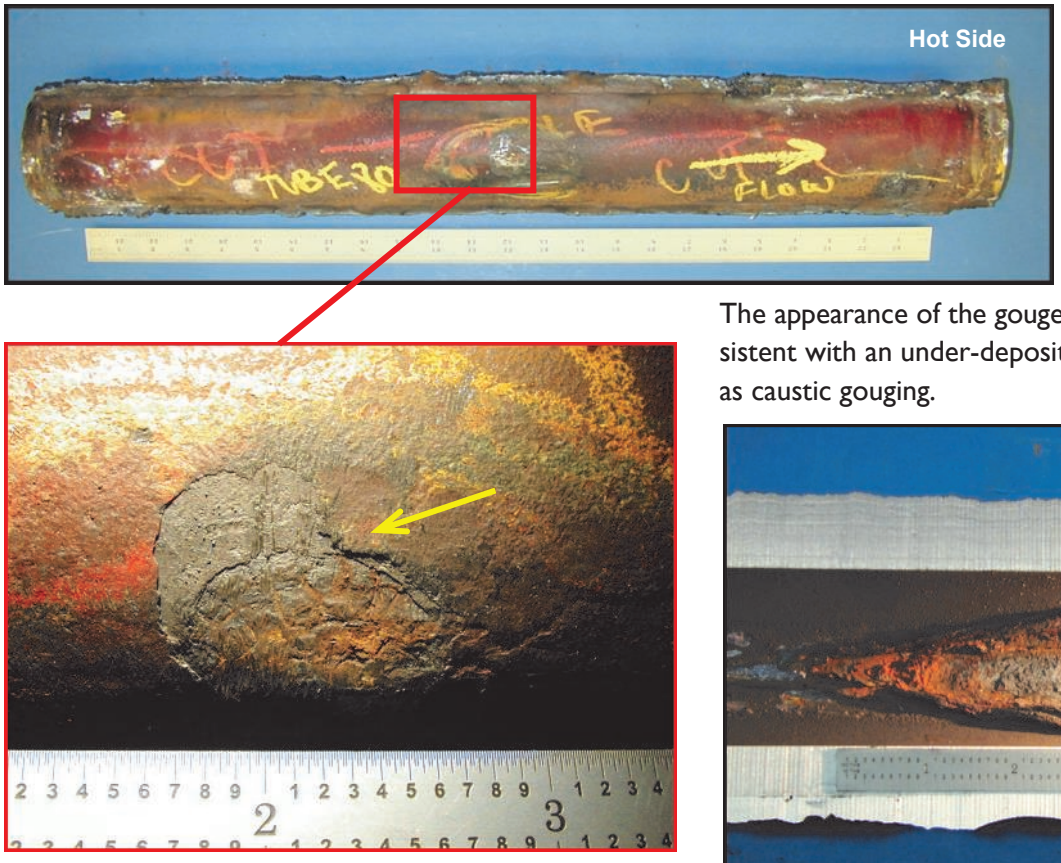

Figure 1. Photographs show the as-received condition of the floor tube. The failure was on the hot side of the tube (arrow). The tube was installed horizontally, putting the failure at the 12 o'clock position of the tube.

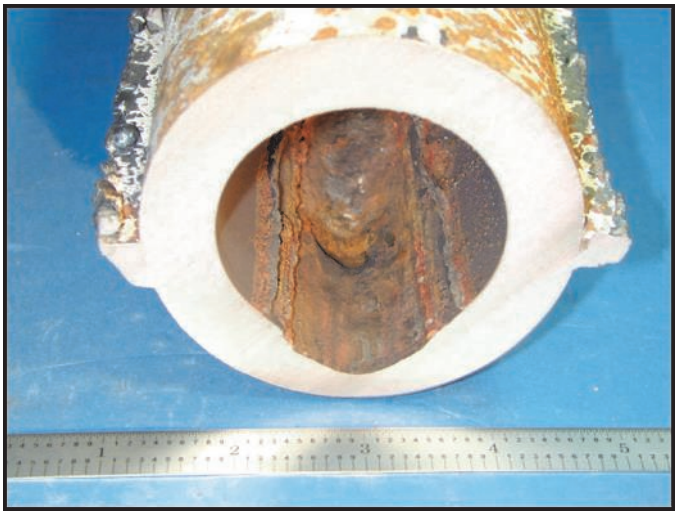

Figure 2. Photograph shows the cross section approximately 2 inches from the blister area. A deep gouge filled with deposit was noted on the hot side (on the top of the tube as-installed).

There were also some patches of green deposit and copper-colored deposits. The gouge was approximately 1.5 inches wide and ran almost the entire length of the tube sample (about 18 inches). The appearance of the gouge and the deposits was consistent with an under-deposit corrosion mechanism such as caustic gouging.

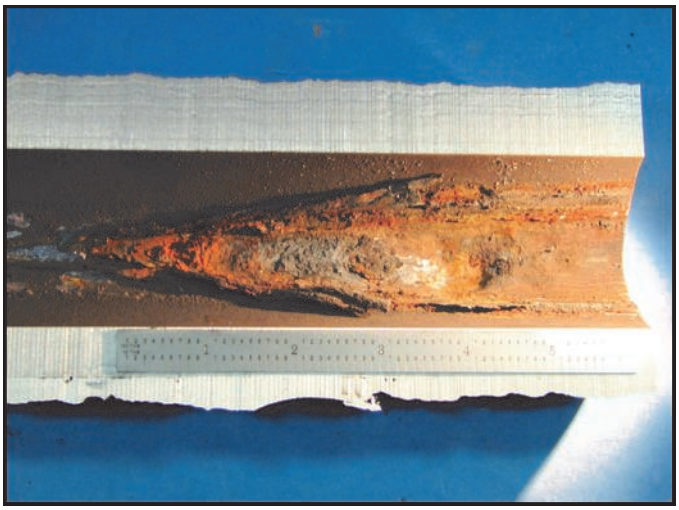

Figure 3. Photograph shows the internal surface of the tube in the failure area with layered deposits.

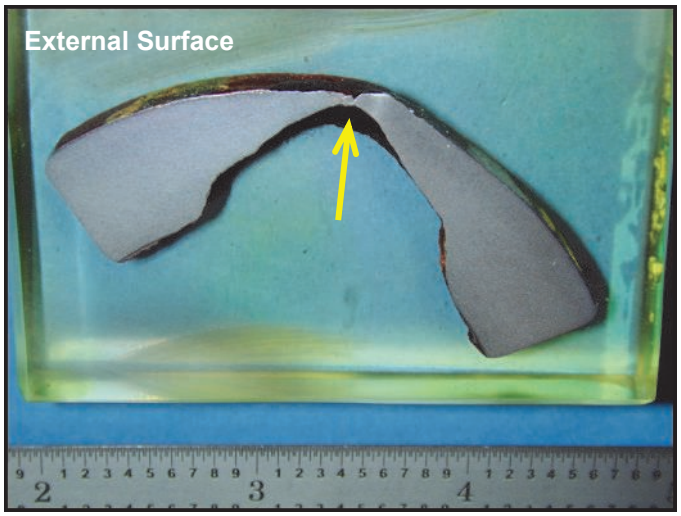

Figure 4. Photograph shows the prepared cross section of the tube, with the failure indicated by an arrow.

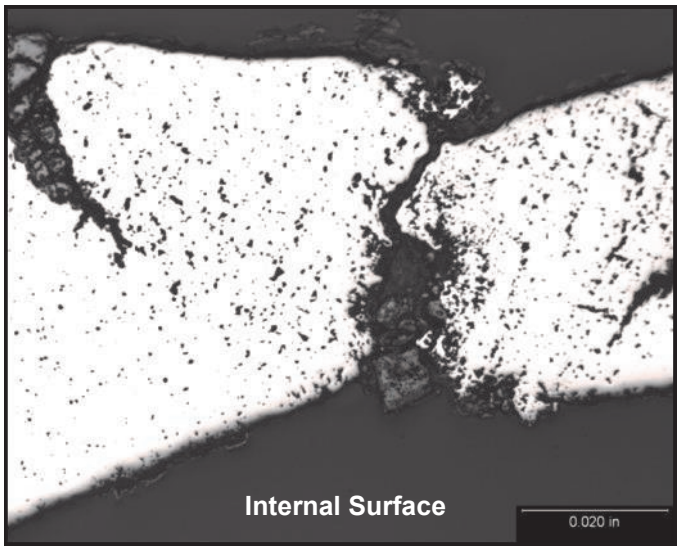

Figure 5. Photomicrograph shows the failure at a higher magnification, where voids were noted. The sample is in the unetched condition.

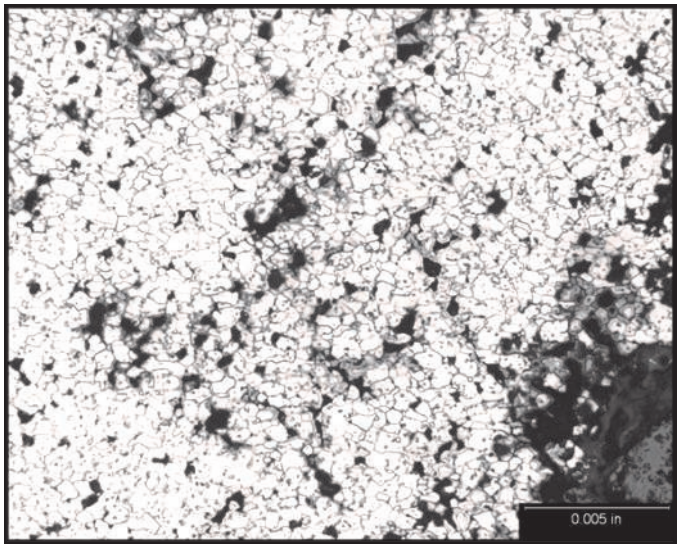

Figure 6. Photomicrograph shows the microstructure at the failure at a higher magnification after etching. (Etchant: Picral-Nital)

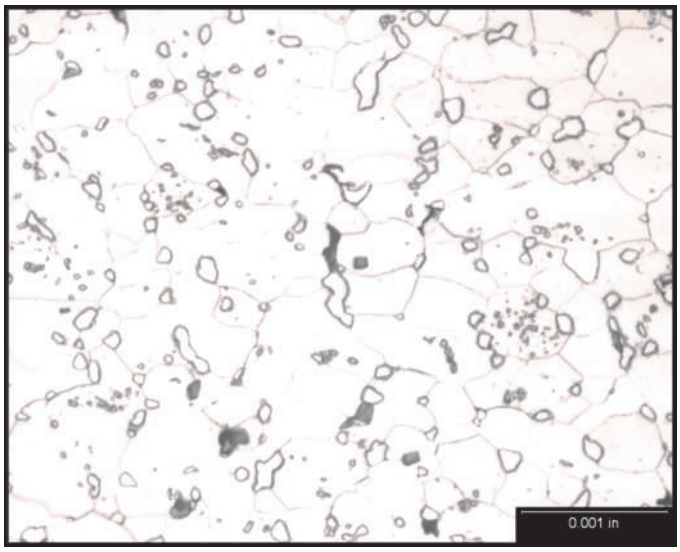

Figure 7. Photomicrograph shows the heat affected microstructure near the failure at higher magnification. Carbide spheroidization was observed slightly away from the failure. (Etchant: Picral-Nital)

Metallography

A cross section was removed through the failure and prepared for metallographic examination (Figure 4). Voids were noted at the failure (Figure 5 and Figure 6). The voids appeared to be due to long term overheating damage. The lack of pearlite combined with spheroidized carbides just slightly away from the failure further supported this conclusion (Figure 7). The tube microstructure away from the failure consisted of banded pearlite in a ferrite matrix and was typical of carbon steel tubing exposed to moderate service conditions.

The external and internal surfaces were also examined. A significant oxide/deposit layer was present on the internal surface with a noticeable layer of copper on the top layer of the internal surface deposit (Figure 8). A typical oxide layer was present on the external surface. Thinning of the tube wall initiated on the internal surface and was due to corrosion and oxidation. Away from the failure, a decarburized layer was present on both the internal and external surfaces. Decarburized layers are often produced as a result of tube manufacturing. Their presence indicates that negligible wastage occurred away from the failure.

Given the presence of copper and observed voids, a hydrogen etch test was performed to determine if hydrogen damage had occured. The etch test was inconclusive. Hydrogen damage may have been present but was not the sole source of the observed voids.

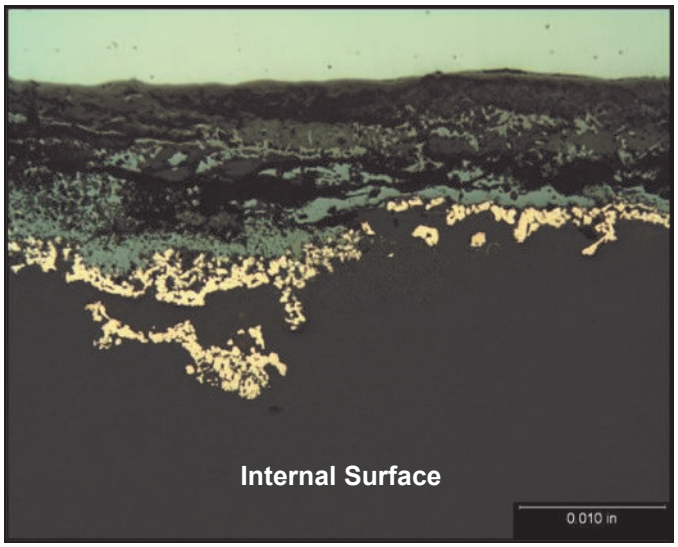

Figure 8. Photomicrograph shows copper on the internal surface (bright layer) and corrosion of the internal surface into the wall thickness.

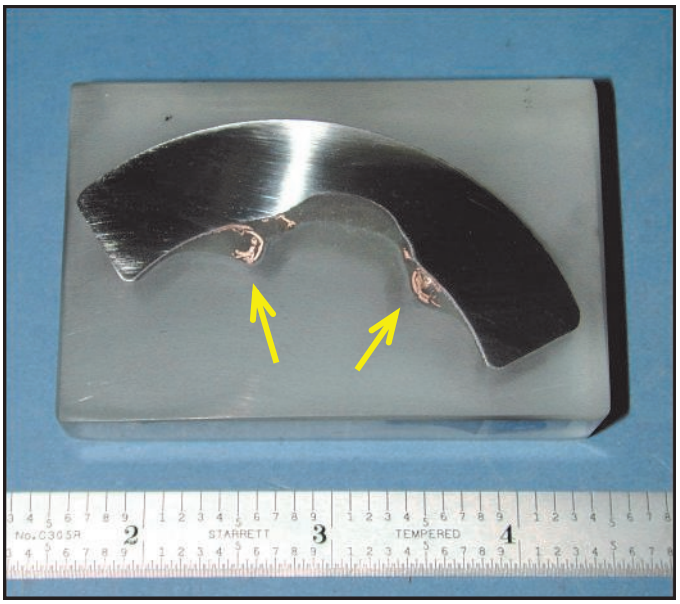

Figure 9. Photograph shows the cross section near the failure after preparation for *in situ* deposit analysis. Significant amounts of copper were noted within the internal deposit (arrows).

Dimensions

Wall thickness measurements at the failure showed thinning of approximately 92%. The wall thickness opposite the failure was in-line with the measurements on the cross section remote from the failure and illustrated the localized nature of the wall thinning.

EDS Analysis

Internal deposits were examined *in situ* on a cross section near the failure. Metallic copper was visually apparent on the internal surface of the cross section (Figure 9). The deposits within the gouge were analyzed in a scanning electron microscope (SEM) equipped for energy dispersive X-ray spectroscopy (EDS[1]) to determine their elemental composition. In addition to spot checks of various deposit layers, an elemental dot map was constructed of the surface deposit to assess where certain elements in the deposit were concentrating

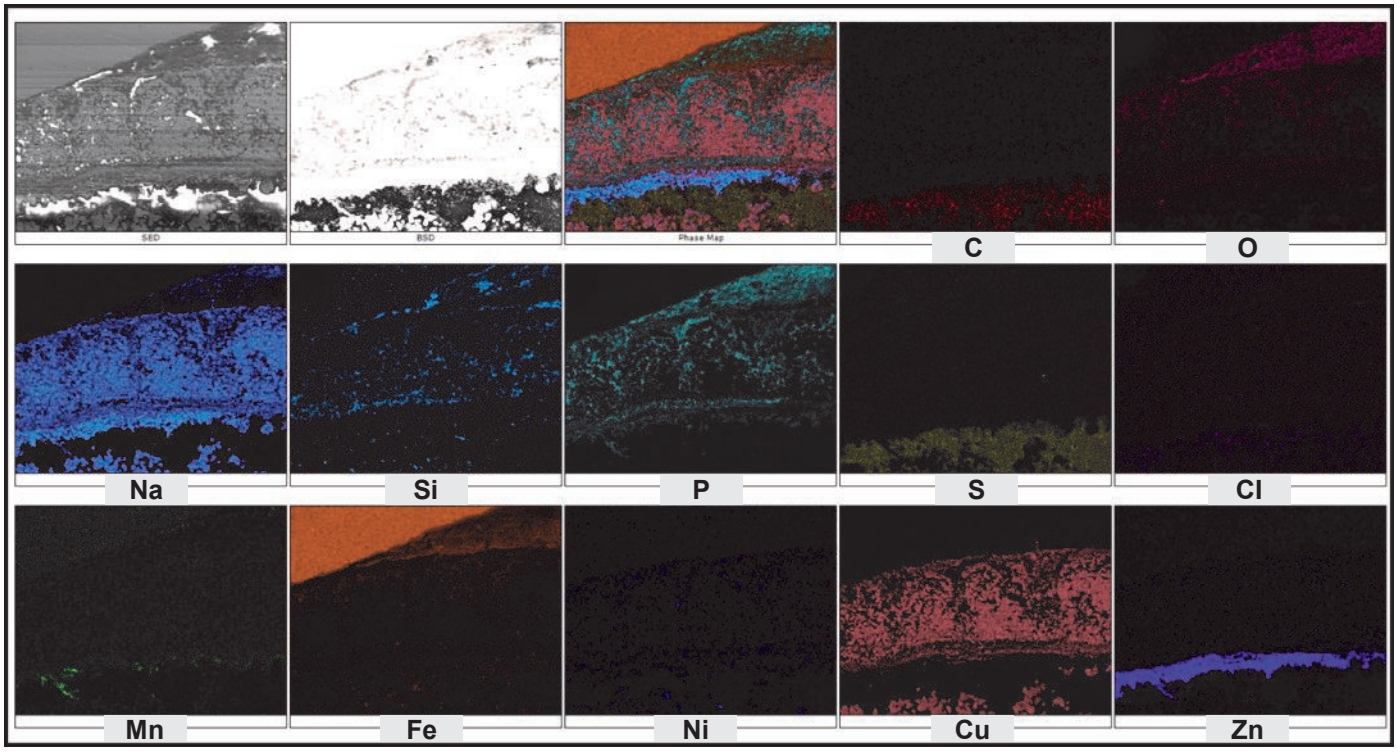

Figure 10. Dot map shows the elemental concentrations within the surface deposit. (115X)

(Figure 10). Sodium, phosphorus, and copper were fairly well distributed throughout the deposit, with phosphorus more highly concentrated in the dark layer immediately adjacent to the tube surface. Iron concentrations were also higher in the darker layer. Sulfur, chlorine, and zinc were mostly present in the thin, lighter layer furthest away from the tube surface.

Discussion

The tube was subject to several factors that caused thinning and ultimately led to failure. There appeared to be two major contributing factors that led to accelerated deposition and deposit buildup on the internal tube surface. The first was departure from nucleate boiling (DNB) due to flow issues in the floor section. With DNB, the steam bubbles no longer break away from the top side of the tube, but instead bubbles dominate the tube surface, and the heat flux dramatically decreases. This vapor channel essentially insulates the bulk liquid from the hot tube surface. The second factor was water chemistry upsets that resulted in excess caustic (sodium) in the tube deposits. Both of these resulted in buildup of deposit on the top side of the tube and allowed under-deposit corrosion to occur in the form of caustic gouging.

Once the heavy deposit was present, it also insulated the tube wall and promoted long-term overheating. This is how the damaged microstructure was produced. Thinning due to corrosion and microstructural damage due to overheating both combined to cause the tube failure. It is also possible that with the high amount of copper present in the deposit, that some of the voids produced in the microstructure were due to hydrogen damage, an additional form of under-deposit corrosion that would have contributed to the failure. The hydrogen etch test was inconclusive so the contribution of hydrogen could not be confirmed.

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Silver in Technology

Silver's use in technology has greatly expanded its role in the global silver market in recent years. A number of factors have played a crucial factor in this growth, not the least of which is silver's unique technical proficiency, which makes it suitable for a wide range of applications while also limiting the ability of industrial users to shift in favor less-costly alternatives. Silver is one of the best electrical and thermal conductors, which makes it ideal for a variety of electrical end uses, including switches, multi-layer ceramic capacitors, conductive adhesives, contacts and in silvered film in electrically heated automobile windshields. Silver is also used as a coating material for optical data-storage media, including DVDs. Silver is employed as a catalyst and used in brazing and soldering as well. It is also incorporated into health and medicinal applications given its natural antibacterial qualities.

From its role as a conductor in nearly all of our appliances to its life-saving qualities in operating rooms around the world, the uses of silver in technology are many and far-reaching. Did you know that NASA's Magellan spacecraft relied on silver-coated quartz tiles to protect it from solar radiation during a four-year scientific mission? Or that the world's strongest alloy, made of silver and aluminum, is an essential component of the Air Force C17 transport and the Army's Apache helicopter? From flight to space travel, silver is one substance that helps us continue to raise the bar on our capabilities.

You'll find silver in many of the electronic devices we use today, including cell phones, plasma-display panel televisions, personal computers and laptops. Silver is also incorporated into button batteries, water-purification systems, automobiles, and it is a component of the growing photo-voltaic industry, to name just a few of its applications.

High temperature semiconductors, which will revolutionize the transmission and storage of electrical power and the efficiency of motors and most other electrical equipment, rely upon silver to operate. As do many chemical processes including the production of polyester fabrics, hydraulics, engine antifreeze and flexible plastics. When we take a broad look at the latest technological advances and the most important ones of the last century, we see the role of silver in nearly every major field of advancement.

Source: https://www.silverinstitute.org/site/silver-in-technology/

ANNOUNCEMENTS

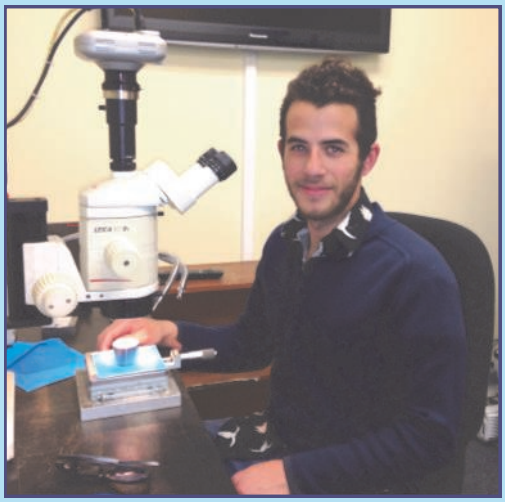
Congratulations Ron Lansing

Dennis M. Anliker Award for Sustained Uplifting Contributions to the Spirit and Accomplishments of the TAPPI Corrosion & Materials Engineering Committee

Mr. Lansing was selected to receive the Dennis Anliker Memorial Award from the Corrosion and Materials Engineering Committee of TAPPI. The award will be presented at the Opening Session of the 2014 PEERS Conference, which will take place on Monday, September 15, 2014, at the Hotel Murano in Tacoma, Washington.

TAPPI's Corrosion & Materials Engineering Committee Dennis M. Anliker Award recognizes outstanding service to C&ME and is the highest C&ME honor. The award, initially created in 1983, was named to honor Dennis M. Anliker in 1989 after his tragic death on a business trip to Europe. The Anliker award was endowed by Champion International to members of the C&ME who promote the positive, friendly, helpful, cooperative participation that Denny so thoroughly personified. Everyone who knew and worked with Denny at TAPPI and Champion enjoyed and benefited from the experience. The award is peer recognition of the awardee's sustained, positive, and collegial cooperation and substantial contributions to the C&ME committee's success and accomplishments through task group and conference activity. This award is presented no more often than annually.

Nominations for the award from any member of the C&ME committee member are accepted by the Past Chair of the committee for voting by the C&ME Steering Committee. The honoree receives a unique plaque with a medallion hand made by Max Moskal, probably the longest-standing member of the C&ME committee, who also is a part of the M&M Engineering Associates family.



Welcome David Stone

David joined M&M Engineering Associates, Inc. in May 2014 as a Laboratory Technician. He is currently pursuing a bachelor's degree in Physics at University of Texas at Austin and is scheduled to graduate in December, 2014. In his spare time, David is an avid cyclist and enjoys mountain biking, he is an award winning screen printer, and has held an occasional photography show. David has also recently taken to creating pottery on his new potter's wheel.

Join us in welcoming David; we are excited to have him on our team!

Why These Two and Not the Others?

By: Jon McFarlen
Consulting Engineer

M&M Engineering Associates, Inc. received four strainer baskets that had been removed from the suction side of a main feedwater pump. During routine maintenance, it was noticed that two of the four strainer baskets had failed. As such, M&M Engineering was asked to examine the baskets noting differences in fabrication and materials that might possibly explain why one set of baskets failed, but not the other.

Visual Examination

The four strainer baskets and corresponding fragments that had been collected from the pump impeller and the pump casing were visually examined. Baskets B2 and B4 had failed while Baskets B1 and B3 had not. For reference, a typical strainer basket that had failed is shown in Figure 1. During a cursory visual examination, minor differences in fabrication methods were noted between the strainer baskets, such as:

- Baskets B1, B2, and B4 had rounded handles, while Basket B3 had a square handle.
- Baskets B1, B2, and B4 were fabricated by folding the perforated plate over a flange ring and "sandwiching" in between a second flange ring. Both flange rings were subsequently stitch welded together (Figure 2). However, Basket B3 was fabricated by folding the perforated plate and wire mesh over a single flange ring followed by spot welding to secure it in place (Figure 3).

The perforated plates used to construct the two groups of baskets were also different. The perforation diameter was slightly smaller (~2%) for Basket B3 as compared to the other baskets. However, the ligament thickness of Basket B3 was nearly double the ligament thicknesses of the other baskets (Figure 4).

Fractographic Examination

Upon closer examination, it was noted that the inside flange edge on Basket B2 displayed rub marks. A coupon was removed from this area and was examined using a stereomicroscope. The fractured ligaments dis-

Figure 1. Photograph shows a typical failed strainer basket.

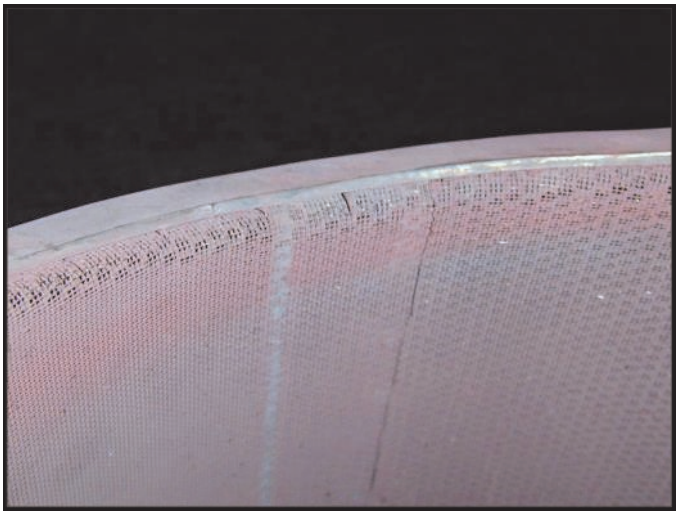


Figure 2. Photograph shows one of the flanges that were stitch welded.

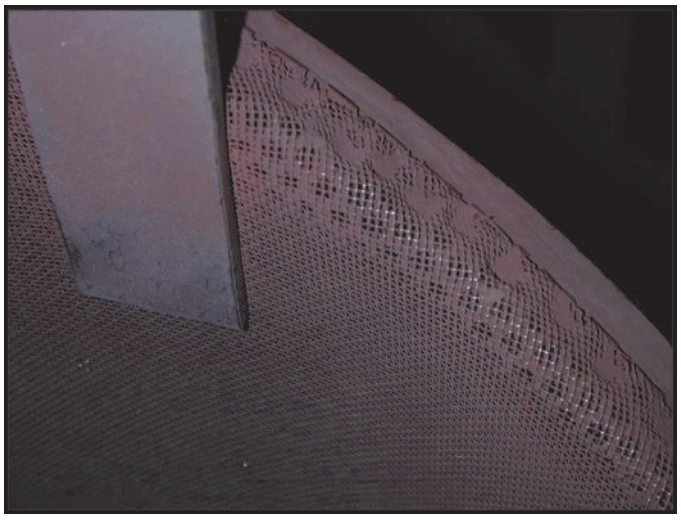


Figure 3. Photograph shows the flange that was spot welded.

played "beach marks" indicative of progressive crack propagation such as fatigue (Figure 5).

The loose fragments that were submitted along with the four strainer baskets were examined at low magnification and many displayed cracks (Figure 6). The cracks were relatively straight, tight, and did not show any evidence of plastic deformation, indicating that they too were likely progressive in nature.

Fractured ligaments on both Basket B2 and Basket B4 were visually examined, and many displayed a shiny, metallic appearance, likely indicative of plastic overload or post-failure rubbing. However, there were a few areas where non-shiny fractured ligaments were observed. It was believed that these fractures would be more representative of the failure mode. Coupons were removed from Baskets B2 and B4 for examination at high magnification using a scanning electron microscope (SEM). High magnification examination revealed areas with horizontally oriented striations (Figure 7). The striations are indicative of fatigue crack propagation.

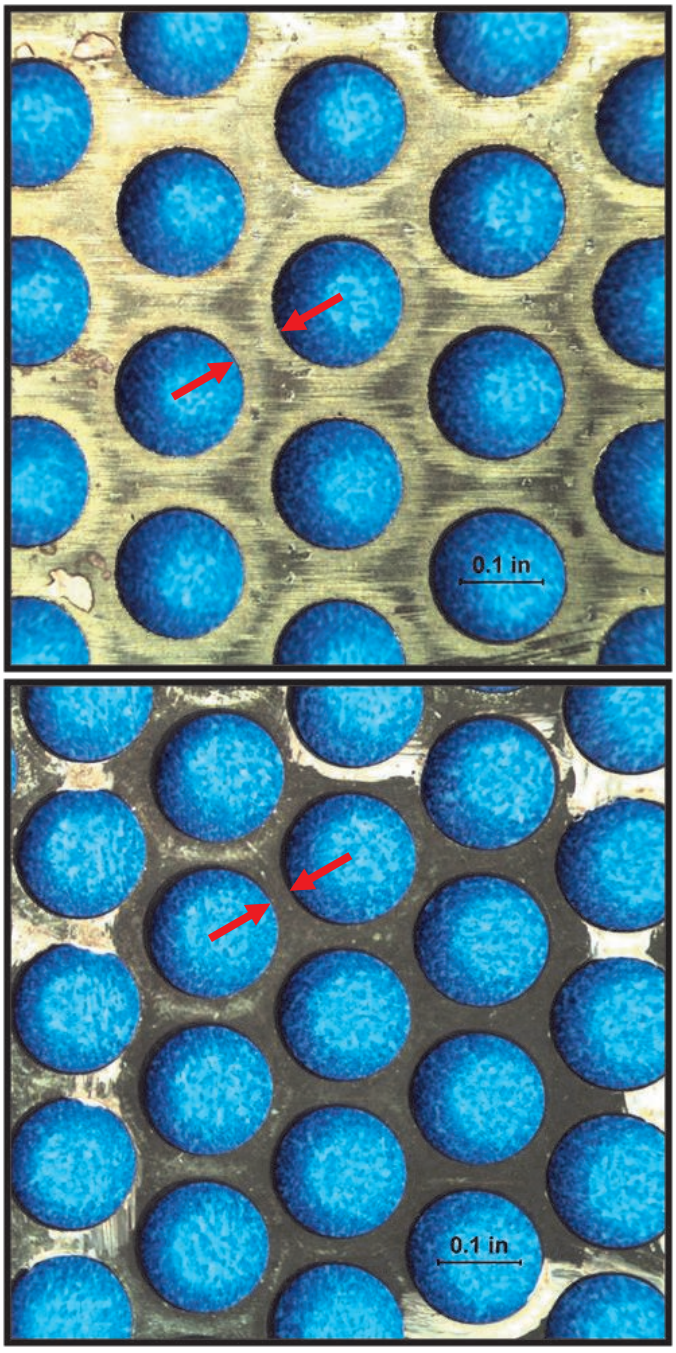


Figure 4. Photographs show that the ligament thickness of Basket B3 was nearly double the ligament thicknesses of the other baskets.

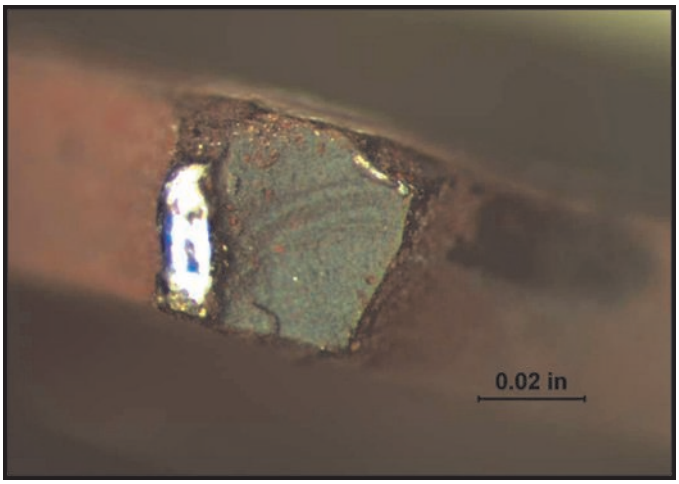


Figure 5. Photograph shows the fractured ligaments displayed "beach marks" indicative of progressive crack propagation such as fatigue.

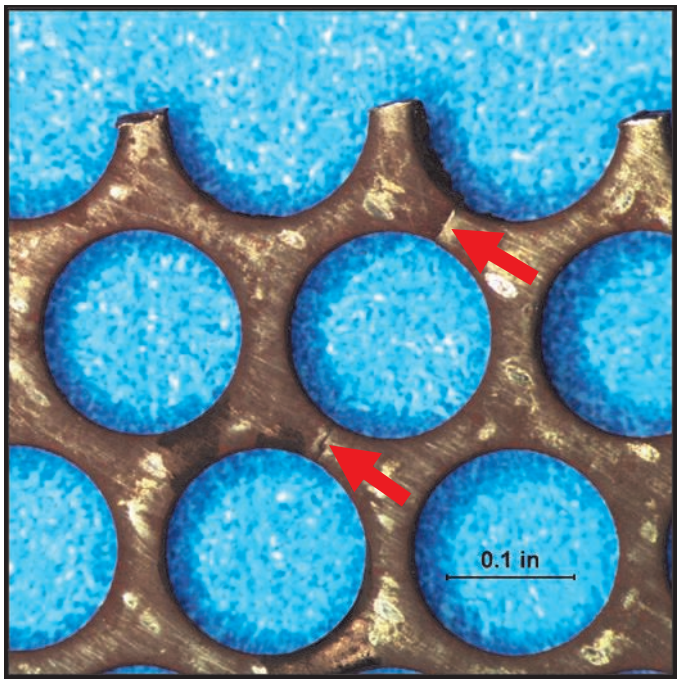


Figure 6. Photograph shows a loose fragment that was examined at low magnification. Many of the fragments displayed cracks (arrows).

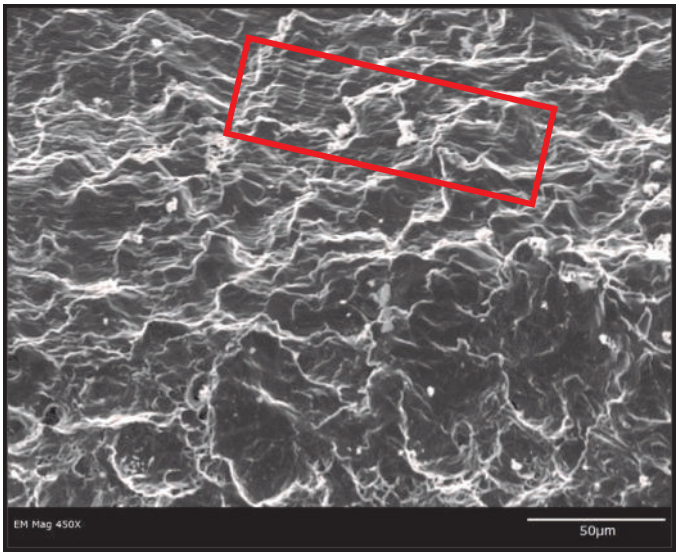


Figure 7. SEM image (boxed area) shows areas with horizontally oriented striations.

Metallographic Examination

Samples from all the baskets were prepared for metallographic examination followed by examination using an metallograph (Figure 8). This was done in order to evaluate the fracture morphology corresponding to the cracked ligaments and to identify any anomalies. Examination of the fractured ligaments showed that the fracture surfaces primarily had a transgranular (across the grain) morphology (Figure 9). Secondary cracks having a transgranular morphology were also noted. In addition, small pits along the perforated surface were observed. (At many locations, it appeared that the secondary cracks originated from the small pits.)

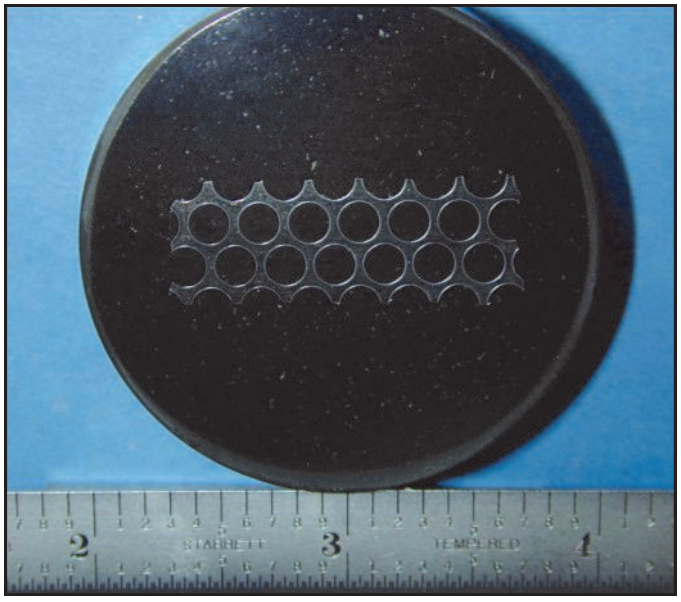


Figure 8. Photograph shows a sample of the basket as prepared for metallographic examination.

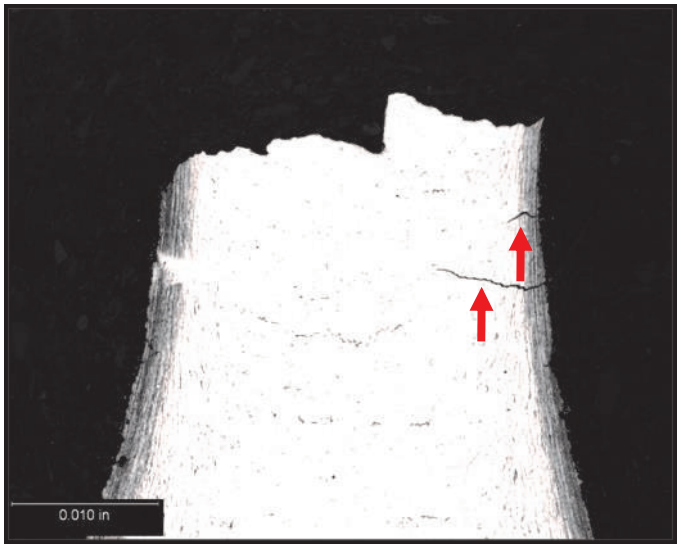


Figure 9. Photomicrograph shows that the fracture surfaces primarily had a transgranular morphology. Secondary cracks were also noted (arrows).

The typical appearance of the perforated plate from each strainer basket was compared to show the degree of pitting or lack of pitting. Basket B2 and Basket B4, both of which failed, were riddled with pitting where as Baskets B1 and B3 (non-failed baskets) were free of pitting. This comparison indicated that pitting played a significant role in the basket failure.

In Situ Deposit Analysis

Crack and pit deposits were analyzed using a scanning electron microscope (SEM) equipped with energy dispersive x-ray spectroscopy (EDS[1]). Doing so failed to detect any corrodants responsible for the observed pitting. However, based on the pit appearance, it was suspected that chlorides were responsible. The fact that chlorides were not detected is not unusual as chlorides are highly soluble.

Chemical Analysis

The perforated plates of each basket were analyzed to determine their chemical composition. It was found that all were fabricated using Type 316L austenitic stainless steel. No variations in the material composition were observed that would have made one basket more prone to pitting than another.

Discussion

Laboratory analysis of the strainer baskets revealed corrosion-fatigue as the mechanism responsible for failure of the perforated plates (the major component of the strainer baskets) in Baskets B2 and B4. Visual examination and SEM examination indicated that cracking of the individual ligaments was progressive in nature. Metallo-

graphic examination found that cracking was transgranular, which is typical of fatigue crack propagation. However, metallographic examination also revealed a corrosion aspect to the failure mechanism.

Corrosion-fatigue, as the name suggests, is the combined effort of corrosion and cyclical stresses to deteriorate a metallic component. With corrosion-fatigue, the propelling component can be more fatigue influenced or more corrosion influenced. In this particular case, corrosion in the form of pitting provided nucleation sites from which fatigue cracks initiated and progressed.

Metallographic examination of the perforated plates from the two non-failed baskets revealed that neither had any pitting. From this it is believed that had pitting not been present in Basket B2 or B4, cracking would have not initiated thereby preventing failure.

Conversations with plant personnel led to the conclusion that pitting most likely did not occur while the baskets were in service. Given the timeline of when the various baskets were installed, all four should have had pitting if it was service related. Therefore, the most likely scenario is that the two failed baskets (or the perforated plate used to make the baskets) were exposed to a corrosive environment prior to installation, making them prone to failure once installed and exposed to cyclical loading induced by the turbulent flow inside the strainer.

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Amorphous Metal

Metallic glasses, or amorphous metals, are novel engineering alloys in which the structure is not crystalline (as it is in most metals), but rather is disordered, with the atoms occupying more-or-less random positions in the structure. In this sense metallic glasses are similar to the more familiar oxide glasses such as the soda-lime glasses used for windows and bottles.

From a practical point of view the amorphous structure of metallic glasses gives them two important properties. First, like other kinds of glasses they experience a glass transition into a supercooled liquid state upon heating. In this state the viscosity of the glass can be controlled over a wide range, creating the possibility for great flexibility in shaping the glass. For example, the golfing putter.

Second, the amorphous atomic structure means that metallic glasses do not have the crystalline defects called dislocations that govern many of the mechanical properties of more common alloys. The most obvious consequence of this is that metallic glasses can be much stronger (3-4 times or more) than their crystalline counterparts. Another is that metallic glasses are somewhat less stiff than crystalline alloys. The combination of high strength and low stiffness gives metallic glass very high resilience, which is the ability to store elastic strain energy and release it.

Source: http://engineering.jhu.edu/materials/research-projects/metallic-glasses/#.VA9qGvldUZ5

Is it a Tube or is it a Pipe?

By: Karen Fuentes, P.E.
Senior Principal Engineer

What makes a pipe a pipe instead of a tube? Can a tube be a pipe? Can a pipe be a tube? Looking on my bookshelf I found the following…

Webster's Dictionary[1] defines a tube as "a hollow elongated cylinder; esp: one to convey fluids" and a pipe as "a long tube or body for conducting a liquid, gas, or finely divided solid or for structural purposes".

McGraw-Hill Dictionary of Scientific and Technical Terms[2] defines pipe similarly to Webster: "A tube made of metal, clay, plastic, wood, or concrete and used to conduct a fluid, gas, or finely divided solid." While tube is defined as "A long cylindrical body with a hollow center used especially to convey fluid."

The Piping Handbook defines pipe as "tubular products of dimensions and materials commonly used for pipe lines and connections, formerly designated as 'iron pipe size' (IPS)[3]."

It explains further that "Commercial pipe and tube products are grouped into various classifications generally based on the application or use and not on the manufacturing method. Most tubular products fall into one of three very broad classifications: (1) pipe, (2) pressure tubes, and (3) mechanical tubes. Each classification falls into various sub groupings, which may be defined and standardized differently by the different trade or user groups.[4]"

The Piping Handbook defines the subcategories of pipe as: *standard pipe* used for structural and mechanical purposes, *pressure pipe* used for conveying fluids or gases not subjected to external heat application, *line pipe* principally used for conveying gas, oil or water, water-well pipe used for conveying water, and *oil country goods* (casing) used as a structural retainer for the walls of oil or gas well.[5]

Tubing likewise has subcategories of pressure tubing that is commonly used in situations with external heat application (ex. heat exchanger, boilers) and mechanical tubing that is generally classified by the method of manufacture (e.g. seamless hot-finished, cold-drawn welded).[6]

Perhaps the most helpful resource for understanding pipe versus tube is found in Mark's Standard Handbook for Mechanical Engineers:

"There is no definite rule for distinguishing among the general terms pipe, tube and tubing: the proper designation has been determined by trade usage. The word pipe is generally used to apply to tubular products commonly used for pipelines and connections conveying fluid from point to point. The word tube (or tubing) is generally used to apply to tubular products used in heat exchangers and boilers and in the machine and aircraft industries.[7]"

Standardization in the piping (and tubing) industry is the function of many groups[8] including the American Society for Testing and Materials (ASTM), the American National Standards Institute (ANSI), the American Water Works Association (AWWA), the Pipe Fabrication Institute (PFI), and The American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC).

So it looks like a pipe can be a tube and a tube can be a pipe depending on where you work and who you ask.

1-Webster's New Collegiate Dictionary; pg. 866.
2-McGraw-Hill Dictionary of Scientific and Technical Terms, 3rd Edition; page 1218 and 1686.
3-Piping Handbook, 5th Edition; Crocker and King; McGraw-Hill Book Company, New York, New York; 1973; Page1-8.
4-Ibid, page 7-18.
5-Ibid, page 7-18 and 7-19.
6-Ibid, page 7-30.
7-Mark's Standard Handbook for Mechanical Engineers, 8th Edition; McGraw-Hill Book Company, New York, New York; 1978; page 8-148 and
8-Ibid, 8-147 and 8-148.

Seminars, Workshops and Publications

Ron Lansing, P.E., Senior Consulting Engineer at M&M Engineering Associates, attended the 2014 PEERS Conference (Pulping Engineering Environmental Recycling Sustainability), September 14-17, 2014, in Tacoma, Washington. Mr. Lansing also chaired a session titled "Stopping Corrosion Before It Happens".

Mr. Lansing was honored during the Opening Session of the 2014 PEERS Conference by receiving the Dennis Anliker Memorial Award from the Corrosion and Materials Engineering Committee of TAPPI for his outstanding service; it is the highest C&ME honor.

The PEERS conference was hosted by TAPPI (Technical Association of the Pulp and Paper Industry).

David Daniels, Senior Principal Scientist with M&M Engineering to present:

HRSG and High Pressure Boiler Water Treatment Operation

75th Annual International Water Conference

This workshop will cover the water quality required for high pressure (>900 psig/60 bar) steam boilers including the various treatments being used and new developments relative to protection from scale and corrosion. The course will also cover treatment issues related to pre-boiler systems and the condensate systems and a discussion of controls and troubleshooting techniques. Operators, utility plant supervisors, managers, and engineers can all benefit greatly from the practical information provided in this course.

Early Registration for the International Water Conference will be opening soon.

POWER

In September's issue of *Power Magazine*, an article by David Daniels, Principal Scientist with M&M Engineering Associates, has been featured which asks the question,

Water and Power? Will Your Next Power Plant Make Both?

In much of the developing world, two essentials are often in short supply: potable water and reliable electricity. Some countries have invested heavily in desalination and combined cycle technologies to simultaneously solve both problems.

In the U.S., people have come to assume that a cheap and abundant supply of clean, potable water will always be available at the turn of a valve. However, water supplies in some regions have developed serious problems, lately caused by drought. Meanwhile, coastal regions, such as Florida, are stressing underground aquifers to meet water demand while risking contamination from saltwater intrusion. Perhaps it is time to consider a new and virtually limitless source of freshwater—the ocean.

To read more of this article by Mr. Daniels visit http://www.powermag.com/water-and-power-will-your-next-power-plant-make-both/

A Penny for the Facts

INTERESTING FACTS ABOUT COPPER IN HOUSEHOLD PRODUCTS

Copper Fact 1

Most silver plate flatware (forks, knives, spoons) has a copper-nickel-zinc alloy base (nickel silver), which accounts for about 1.2 pounds of copper per set of (12 pieces). An average set of hollowware uses about 1.8 pounds of copper.

Copper Fact 2

In order for sterling silver to be usable as tableware, 7.5 percent copper is mixed with 92.5 percent silver, making the metal hard and sturdy.

Copper Fact 3

Copper cookware has long been the preference of gourmet chefs around the world. The metal's ability to transfer heat efficiently and evenly puts the cook in complete control. Although many U.S. companies used to manufacture solid copper cookware, today only Hammersmith Copper is still in business, according to the Cookware Manufacturers Association of Birmingham, Alabama.

Copper Fact 4

A pair of brass fireplace andirons weighs about 15 pounds. A copper fire screen uses about 12 pounds of copper. A set of fireplace tools is about 10 pounds.

Copper Fact 5

A solid brass bed weighs in at about 60 pounds.

Copper Fact 6

Brass tables use about 15 pounds each, while brass-framed mirrors use about 5 pounds each.

Copper Fact 7

Brass and/or copper floor and table lamps consume about 7 pounds of copper each for a total of about 60 million pounds - about half of all household products.

Copper Fact 8

Grandfather, grandmother and large wall clocks, on average, use about 9 pounds of copper, each.

Copper Fact 9

Decorative and instrumental bells consume about 4 pounds of copper alloy each, on average.

Copper Fact 10

Twenty-four carat gold is not always pure. Because gold is so soft, it can be molded with the hands and is subject to blemishing. Therefore, gold coins and jewelry are usually alloyed with copper to provide a degree of hardness.

Copper Fact 11

Advanced technology offers tough, new finishes for brass products that are brilliant and long lasting - many that come with lifetime warranties against corrosion, pitting and discoloration. Using various vapor-deposition processes, multiple coatings of semiprecious metals, only molecules thick, are applied to the brass. Final color coats produce bright brass, chrome, and other finishes.

Source: http://www.copper.org/education/c-facts/facts-print.html

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The Metal Never Lies

Planet Mars or Hydrogen Damage?