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OUTLOOK

PRODUCERS AND FABRICATORS OF REACTIVE AND REFRACTORY METALS AND CHEMICALS

Allegheny Technologies
Specialty Materials That Make Our World

Sales Director SOLD ON Zirconium Knee

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Wah Chang's Gary Kneisel, a walking testament to ATI's specialty metals.

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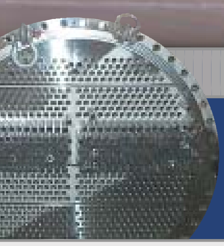

WAH CHANG
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Wah Chang Sales Director Sold

Wah Chang Sales Director Sold on Zirconium Knee

BY: KIRK RICHARDSON — *WAH CHANG*

When Gary Kneisel, Wah Chang's Director of Sales, was an 18-year-old with dreams of glory on the gridiron, he didn't spend much time contemplating what his life would be like in 30 years. He had that sense of invincibility that seems to come standard with youth. So, as Kneisel raced down the Astroturf to cover a punt during a high school football game in his hometown of Seattle, WA, he had just one thing on his mind: wipe out the return man. But instead of smashing the kick returner, he annihilated his left knee.

"I was able to come back later in the season; however, I had done serious damage to my knee," he says. Later, "in my first year of college, I decided to have my knee surgically repaired. The doc removed my cartilage (and) repaired my ACL (anterior cruciate ligament) and the medial ligaments. In the doctor's words, the standard triple threat repair job."

According to Kneisel, the "triple threat" surgery allowed him to lead an active life in his 20s and 30s. In his 40s, that changed.

By 2000, he was having severe problems with stiffness and pain — "to the point that when I turned in bed at night, it would wake me up," he recalls. "I decided to see my primary care doctor, who referred me to a local orthopedic surgeon." After carefully reviewing x-rays and a thorough examination, the surgeon had grim news: He said, "You need a new knee," as Kneisel remembers it.

Historically, people in their 40s with knee problems have to gut out the pain until later in life. "The age issue is all about wear of the knee components, and replacement can be a serious type of operation at 70-80 years of age," he says. "So the standard wisdom is to wait until you are over 60."

INSIDE KNEISEL'S KNEE

Oxinium® oxidized zirconium knee. The Oxinium® femoral component (top) slides against a polythylene insert (middle) locked in a tibial platform component (bottom). Photo courtesy of Smith & Nephew.

So Kneisel bought time and paid dearly. "I went on medications and shark cartilage in a glass of water," he says. "I also wore a wedge in my shoe to bend my leg since I was becoming bow-legged from the wear." Finally, the old football injury started causing other serious problems. "Late last year I started having problems with my hip, which was a result of the angle and severity of the knee," he says.

Kneisel and his doctor agreed that it would be a good idea to look for another solution. Searching for an answer, Kneisel contacted medical device manufacturer Smith & Nephew, a company that he worked with in the 1980s and 90s, applying and selling Wah Chang alloys for various medical applications. The implant maker helped him locate a local doctor who might have the solution to his escalating problems.

The solution Kneisel had in mind was an application of one of Wah Chang's own products: zirconium. "On my first visit, we discussed the merits of the various materials," he says, "and he was sold on the zirconium knee."

Smith & Nephew's Oxinium® oxidized zirconium knee, introduced in 2001, is made from a zirconium alloy, containing a small amount of niobium to enhance its strength. Oxidation of the alloy creates a hard, ceramic surface. The result is a material that combines the best qualities of ceramics and metals: superior wear resistance with reduced potential for fracture.

Kneisel scheduled surgery for July 31, 2002. "I was in the hospital for 3 days and spent two weeks at home," he says. "I could put weight on my knee the day of the surgery. I was walking on my new knee within hours of the operation (which took all of 75 minutes)."

Today, he looks forward to freedom from pain, but he understands his limitations: "I will no longer run or play basketball since the doctor wants to minimize the pounding motion to my knee. I will be able to golf, snow ski, and play tennis."

These days, Kneisel seems pleased that he's a walking testament to ATI's specialty metals. He's proud of the corporation that he works for and the life-changing products that it manufactures. "One of the great benefits of this job is working with the people at Wah Chang and ATI and the great things we bring to this world to make life better," he says. "We, at ATI, make some remarkable metals that do make a difference"...spoken by someone with firsthand...rather "first-knee" experience.

For more information on Smith & Nephew's Oxinium® oxidized zirconium knee, check out the 4th Quarter 2001 issue of *Outlook* at www.alleghenytechnologies.com. For further details about Wah Chang's zirconium and other metals, visit wahchang.com or call 888.926.4211. ■

DuPont Heat Exchanger Design a Real Balancing Act

BY: KIRK RICHARDSON — *WAH CHANG*

The word balance is derived from the Latin word bilanx, which means, "having two scale pans". The success of recent heat exchanger designed by DuPont and fabricated by Ellett Industries hung in this state, pivoting around a four-foot diameter tube of material and design challenges.

Selection of the corrosion resistant alloys to build this complex piece of replacement equipment (destined for stripper column service at one of the chemical giant's Gulf Coast plants) fell to Mike James, DuPont Materials Engineering Consultant. In making this decision, James had to find equilibrium between corrosion resistance and life cycle costs.

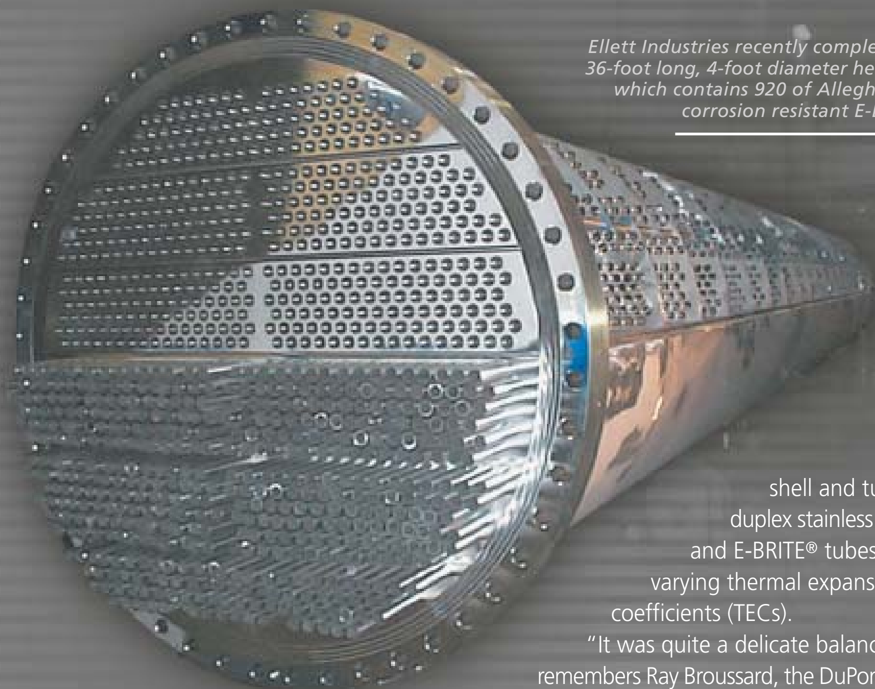
"We've been doing field corrosion coupon testing in this process over the years, starting back in the early 80s," according to James. "The service is a complex process that changes during the operating run," he explains. Among varying elements, the media includes large doses of phosphoric acid, ammonium carbamates, and other ammonia compounds. "It operates in the 150-160°C range," he adds. "For this process, E-BRITE® has always been the best choice (for tubes) from a life cycle cost standpoint."

So what exactly is E-BRITE®? It's an alloy in the truest sense, a specialty ferritic stainless steel that contains a cocktail of elements, including chromium, molybdenum, nickel, copper, manganese, phosphorus, sulfur, silicon, carbon, nitrogen, and even a little niobium. According to manufacturer Allegheny Ludlum, an Allegheny Technologies Company, the alloy's chromium (26%) and molybdenum (1%) "confer general corrosion resistance and resistance to pitting and crevice corrosion."

In addition, the ferritic structure of E-BRITE®, combined with controlled low levels of nickel and copper, provide resistance to stress corrosion cracking. Ultra-low carbon and nitrogen content, plus a controlled addition of niobium provide resistance to intergranular corrosion and give the alloy superior ductility when compared to conventional ferritic stainless steels.

Though DuPont's previous heat exchanger for this application also contained E-BRITE® tubes, the new unit posed new challenges, including a more stringent ASME stress code. Finding materials tough enough to withstand the severe processing environment and meet the stiffer stress code was an impediment to solving the puzzle.

As it turned out, the ideal materials of construction created less than ideal teammates when welded or mechanically joined. The biggest hurdle? The soon to be united 316 stainless steel shell and tubesheet, duplex stainless steel baffles, and E-BRITE® tubes had widely varying thermal expansion coefficients (TECs).



Ellett Industries recently completed DuPont's 36-foot long, 4-foot diameter heat exchanger, which contains 920 of Allegheny Ludlum's corrosion resistant E-BRITE® tubes.

"It was quite a delicate balancing act," remembers Ray Broussard, the DuPont Consulting Engineer tasked with finding a way around the design obstacles. He explains that the materials' different TECs and the range of operating metal temperatures, combined with stricter ASME code requirements from the old unit's original design basis, made it "much more difficult to get a flanged and flued expansion joint to work." Broussard points out that "the problem was solved with a higher strength expansion joint material (FERRALIUM® 255), which had higher allowables, that could handle the stress induced by the differential expansion of the tubes."

No small effort later, Broussard prevailed, developing a workable design, which he handed off to equipment fabricator Ellett Industries.

David Clift, Manager of Production

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Ferralium® is a registered trademark of Langley Alloys LTD

Fabrication complete, the heat exchanger heads south for stripper column service at one of DuPont's Gulf Coast plants.

Zirconium versus H_2O_2

BY: MIKE ABRAHAM — *WAH CHANG*

Mike Abraham, Manager of Wah Chang's Corrosion Laboratory, submitted this issue's Q&A column, which covers zirconium in hydrogen peroxide service. Mr. Abraham's professional background started with service in the U.S. Navy as a Nuclear Propulsion Engineering Officer. After a five-year stint with computer disk manufacturer HMT Technology/Komag, Inc., the chemical engineer joined Wah Chang in early 2001. Mr. Abraham has been a presenter at the company's Corrosion Seminars and is a frequent contributor to *Outlook*. He can be reached at 541.926.4211 x6521.

Question:

Is Zirconium a Smart Material Choice for Equipment in Hydrogen Peroxide Solutions?

Answer:

Yes, zirconium can be an ideal option for working safely and efficiently with hydrogen peroxide. Hydrogen peroxide, H_2O_2, is one of the most powerful oxidizing agents known and has increasingly become an important chemical in a wide variety of manufacturing processes. It is used as a cleaning solvent in the electronics, pharmaceuticals and food processing industries; as a bleaching agent for pulp and paper; and as an additive for treating solid, liquid and gaseous wastes.

In addition to superior oxidizing power, one of the key characteristics of H_2O_2 is its instability. Hydrogen peroxide naturally decomposes to form water and oxygen. While this makes it an environmentally appealing choice for many of the applications above, the continual decomposition has significant disadvantages. The effectiveness of hydrogen peroxide is considerably reduced as its concentration decreases, and heat is also produced in the decomposition reaction; this heat can create a tremendous safety hazard in combination with the buildup of oxygen. Temperature, pH, and impurity levels must be carefully controlled when handling and storing hydrogen peroxide solutions, as each of these variables can affect the rate of decomposition.

Zirconium is one of the few metals whose ions do not catalyze the decomposition reaction for H_2O_2. Most of the equipment materials currently used in hydrogen peroxide applications require additional chemical stabilizers to be added to the H_2O_2 to prevent its breakdown. Not only does this add the cost of the extra chemicals themselves, it also adds impurities. These unwanted impurities can be significantly detrimental to the product or process streams where the tolerances for contamination are extremely low, such as in the semiconductor and pharmaceutical industries. This key advantage should make zirconium an appealing alternative to the current materials of construction.

Another benefit of using zirconium equipment in hydrogen peroxide applications is the improved safety aspect. This can be a very critical consideration; by reducing or eliminating decomposition and the subsequent oxygen and heat formation, selecting zirconium significantly lowers the risk and dangers of fires or explosions. Zirconium also has one unique characteristic that is particularly important in many hydrogen peroxide applications where product color is critical: zirconium ions are colorless and will not visually contaminate process streams or products. Last, but definitely not least, the corrosion resistance of zirconium in hydrogen peroxide is excellent. As shown in Table 1, zirconium exhibits no measurable corrosion over a wide range of temperatures and concentrations. While H_2O_2 is not generally considered highly corrosive, it can cause problems for many metals and alloys under certain conditions, limiting their usefulness to specific pH ranges. If there is variation in the process conditions, corrosion of one of these materials could proceed and lead to accelerated decomposition of the H_2O_2. Zirconium has excellent corrosion resistance to hydrogen peroxide for almost all conditions and has been successfully used in process equipment handling H_2O_2 at concentrations of up to 90%, with a service life of over ten years.

The combination of zirconium's attributes in hydrogen peroxide solutions makes it ideally suited for material selection in equipment with a high ratio of metal surface area to solution volume, such as piping systems, pumps, valves and heat exchangers, where there is a greater risk of corrosion and the potentially damaging consequences it can produce. When ultra high purity H_2O_2 is needed, zirconium's superior corrosion resistance should make it the metal of choice in equipment fabrication.

The complete datasheet, "Zirconium in Hydrogen Peroxide Applications", is posted on our websites, www.wahchang.com and www.corrosionsolutions.com. Additional datasheets covering other zirconium and reactive metal applications are also available. ■

Table 1.

CORROSION OF ZIRCONIUM AT VARIOUS TEMPERATURES AND H_2O_2 CONCENTRATIONS

H_2O_2 Concentration (wt %)	Temperature (°C)	Corrosion Rate (mpy)
5	70	< 0.01
10	70	< 0.01
20	70	< 0.01
30	21–102	< 0.01
35	21–80	< 0.01
50	100	< 2.00
90	66	< 1.00

The Effect of Oxidizers on the Corrosion Resistance of Reactive Metals

BY: MIKE ABRAHAM — *WAH CHANG*

The presence of oxidizing ions in solution can have a very significant impact on the corrosion resistance of reactive metals. Understanding how these chemical species affect the dynamics of corrosion processes can be very important when selecting materials of construction for plant equipment, as well as in making process design and control decisions.

A simple definition of an oxidizer is: any chemical species that actively promotes the oxidation of another. In aqueous solutions, this oxidation occurs by an electrochemical reaction involving the transfer of electrons; the oxidizers take electrons from atoms at the surface of the base metal, leaving behind positively-charged metal ions that fall out of the metal matrix into solution or react to form other corrosion products. While oxygen (O_2), chlorine (Cl_2), and some metal ions, such as ferric (Fe^{+3}) or cupric (Cu^{+2}), can all function as oxidizers, each affects the corrosion of reactive metals differently. Oxygen, for example, reacts on the surface of reactive metals to create the adherent oxide layer that is responsible for the excellent corrosion resistance of these metals in many harsh chemical environments.

Corrosion depends not only on the presence of any oxidizers, but also on the behavior of the metal in the bulk solution. The laws of thermodynamics are useful in determining when a particular oxidizer may be beneficial to the corrosion resistance of a specific metal and when it may lead to corrosion. Electrochemical tests performed in the laboratory are a useful tool for this purpose, and provide a graphical description of the corrosion behavior for a metal in a particular chemical environment.

A key variable for making these calculations is the amount of energy released in the oxidation reaction, which is measured as electric potential (E). While there are other factors that will influence whether or not corrosion will take place, the oxidizer must be strong enough to initiate the reaction and pull the electrons away from the base metal.

For example, Figure 1 shows the relationship of the corrosion current or corrosion rate to the electrochemical potential for zirconium and titanium in acidic chloride solutions; these are called potentiodynamic scans. The difference between the two curves can help explain why oxidizing contaminants, such as ferric (Fe^{+3}) ions, improve the corrosion resistance of titanium, but are detrimental to zirconium in this type of solution.

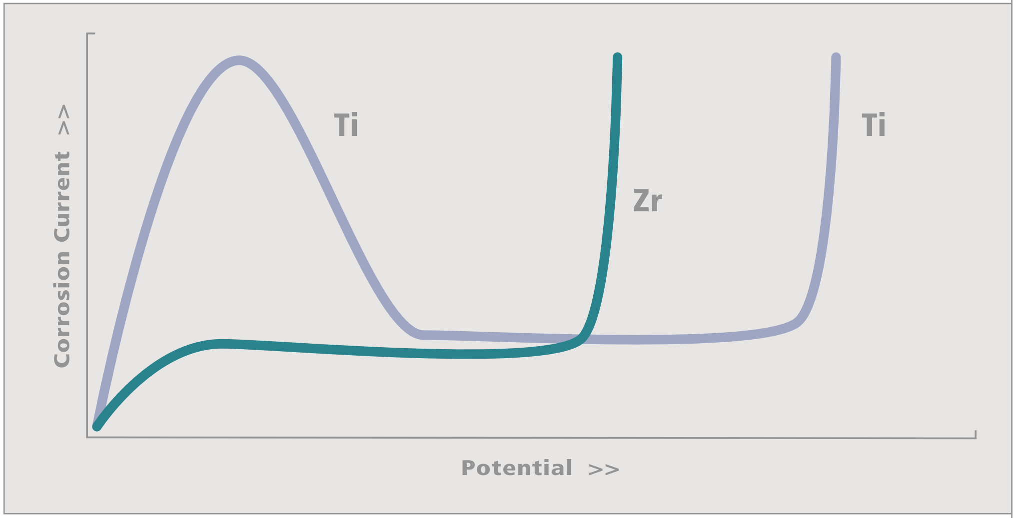

FIGURE 1. *Behavior of zirconium and titanium in an acidic chloride solution.*

At low potentials, zirconium remains in a passive region, with a very low corrosion current and little corrosion taking place; titanium, however, has an active corrosion region at low potentials, where the corrosion current reaches a maximum prior to returning to a passive state. In both cases, the metals exhibit a transpassive region above a threshold potential, where the corrosion current increases rapidly. This breakdown potential, where the protective oxide film breaks down and corrosion occurs, is significantly higher for titanium than it is for zirconium.

When a strong oxidizer like the ferric (Fe^{+3}) ion is present in the solution and the conditions are favorable, the ferric (Fe^{+3}) ion will react at the metal surface, gaining an electron while being reduced into the ferrous (Fe^{+2}) ion. This reaction releases 0.77 volts of energy and raises the potential of the solution.

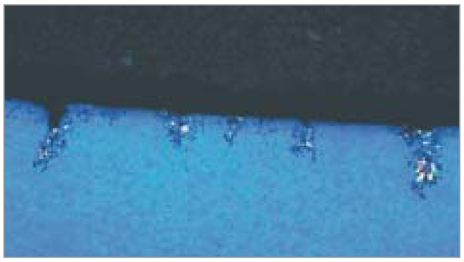

FIGURE 2. *The corrosion effect of oxidizers — pitting in zirconium.*

In the case of titanium, the added energy raises the potential into the passive region, where the oxide layer remains protective; for zirconium, however, the potential is raised above the breakdown potential, and corrosion occurs. The type of corrosion that occurs is dependent on the solution chemistry and the conditions at the zirconium surface. For hydrochloric acid solutions below 20%, pitting is the mechanism of attack. Figure 2 shows an example of pitting in zirconium caused by an oxidizing contaminant in a hydrochloric acid solution.

As this example shows, oxidizers can have a major impact on corrosion. In pure hydrochloric acid solutions, zirconium is the material of choice at high temperatures and concentrations, while titanium is limited in its corrosion resistance. When strong oxidizers are present, however, zirconium is susceptible to corrosive attack and the performance of titanium improves significantly. Niobium is also an alternative for material selection when oxidizers are present in hydrochloric acid solutions, as it behaves similarly to titanium in this particular case.

While the detrimental effects of oxidizers may be easily observed, their presence in solution is not always apparent. Identifying and eliminating the source of potentially harmful oxidizing impurities is an important part of corrosion prevention. Common sources of contamination from ferric (Fe^{+3}) or cupric (Cu^{+2}) ions include the corrosion of upstream process equipment, reaction catalysts, and the tools used in fabrication or maintenance that are not properly cleaned or dedicated for reactive metal

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EVENTS

SVC Technical Conference

May 3-8, 2003
San Francisco, California

The Society of Vacuum Coaters 46th Annual Technical Conference will take place May 3-8, 2003, at the San Francisco Marriott, San Francisco, California. The focus of this conference is on New Developments in Vacuum Coating Technologies. The conference also features a two-day Exhibit with over 200 displays and a comprehensive Education Program of over 26 courses. Wah Chang will be among those supporting the event at booth 504.

The Technical Conference of the Society of Vacuum Coaters is a forum for the interchange of information between those engaged in the use and development of vacuum coatings for large- and small-scale applications. The Plenary Address on Sunday evening, May 4 will be given by Dr. Alton D. Romig, Jr., Vice President, Sandia National Laboratories, on the miniature world of microtechnology and nanotechnology.

Presentations will be made in technical sessions, May 5-7, 2003 on the following topics: Optical Coating, Vacuum Web Coating, Tribological & Wear Coating, Decorative & Functional Coating, Plasma Processing, Process Control & Instrumentation, Large Area Coating, and Emerging Technologies. Visit the SVC Web Site at www.svc.org to review the Preliminary Program and read the abstracts of the presentations.

For complete information on the SVC 46th Annual Technical Conference, contact the Society of Vacuum Coaters, 71 Pinon Hill Place NE, Albuquerque, NM 87122-1914, USA; visit the SVC Web Site at www.svc.org; or send a Fax to 505.856.6716 or an E-mail to svcinfo@svc.org. ■

PAC2003

May 12-16, 2003
Portland, Oregon

The 2003 Particle Accelerator Conference, the 20th in the series, will be hosted by the Stanford Linear Accelerator Center and the Lawrence Berkeley National Laboratory, May 12-16 in Portland, Oregon. According to the PAC2003 Organizing Committee, the conference will cover new developments in all aspects of the science, technology, and use of accelerators. The committee anticipates approximately 1200 attendees and more than 1000 papers at the event.

Representatives from Wah Chang will be available to answer questions at Booth 47 in the exhibit hall. Wah Chang is a major producer of niobium-titanium and other alloys for accelerator and other energy-related applications.

For more information about the conference, contact the organizers at 650.926.4931 or by e-mail at PAC03@slac.stanford.edu. ■

ACHEMA 2003

May 19-24, 2003
Frankfurt, Germany

Allegheny Technologies, a leading producer of corrosion resistant metals, ranging from specialty steels and nickel base alloys to titanium and zirconium, will be exhibiting at the upcoming ACHEMA 2003 International Exhibition in Frankfurt, Germany, May 19-24. ATI's Total Corrosion Solutions™ team of Allegheny Ludlum, Allvac, and Wah Chang will be on hand to answer customer questions in Hall 3.1, Booths K35-K39.

Show organizer DECHEMA e.V. expects ACHEMA to attract more than 4000 exhibitors from all continents and over 200,000 visitors from 100 countries. "The 27th ACHEMA will once again set the standards for the process industries and provide impulses for the future," according to DECHEMA e.V. Topics range from chemical engineering to environmental protection, biotechnology and more.

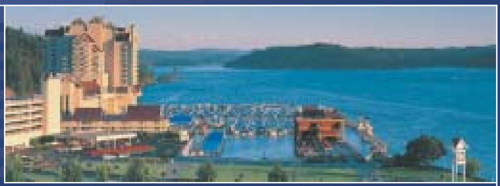
Allegheny Technologies' Total Corrosion Solutions™ team looks forward to a banner event and hopes to see you in Frankfurt this Spring. ■

Welding Classes

July 22-24 & August 5-7, 2003
Albany, Oregon

Are you interested in learning about or currently involved in welding of reactive and refractory metals? Wah Chang is once again offering two comprehensive summer courses on titanium, Ti-Nb, and zirconium welding. The combination classroom/hands-on events take place July 22-24 and August 5-7 in Albany, Oregon.

The instructors recommend that participants have some prior welding experience with stainless steels or aluminum alloys. For more information or to register, contact Sheryl Renzoni, Seminar Coordinator, at 541.926.4211 x6280 or e-mail sheryl.renzoni@wahchang.com. ■



Corrosion Applications Conference 2003

September 7-12, 2003
Coeur d'Alene, Idaho

Wah Chang's Specialty Metals in Corrosion Applications Conference, scheduled for September 7-12, 2003 at the Coeur d'Alene Resort in Coeur d'Alene, Idaho, is just around the corner. Speaker slots are filling rapidly, with only a few openings remaining. A small sampling of the preliminary technical program includes the following papers:

- Corrosion and the Nickel Laterites – Past, Present, and Future
- Corrosion Influence of Elastomeric Products on Specific Metals
- Failure Analysis for Reactive Metals: Methodology and Case Studies
- Grade 28 Titanium: A Highly Corrosion Resistant Pressure Vessel Alloy
- Large Titanium Heat Exchangers Design, Manufacture, and Fabrication
- Tin in Zr 702: Effect in Sulfuric Acid Applications (see abstract on page 7)
- Insurance Issues for Chemical Plants
- New Developments in CR Stainless and Nickel Alloys
- Pressure Equipment Directive 97/23/EC
- Reactive Metal Fire Prevention in the Petrochemical Industry
- Risk-Based Inspection and Highly Corrosion Resistant Alloys
- Routine Chemical Cleaning Operations Are Not
- Tantalum — From Mine to Mill Forms
- The Effect of Heat Treatment on the Corrosion Properties of Nickelvac®
- Zirconium in Acetic Acid Service
- Zirconium Coriolis Mass Flowmeter for Corrosive Fluids

Participants include Bayer, BP Chemicals, Caldera, Chemical Engineering magazine, Det Norske Veritas, DuPont, DuPont Dow Elastomers, Endress + Hauser Flowtec, ExxonMobil, Millennium Chemicals, Rohm & Haas, Sterling Chemicals, and many others. The conference will also include an exhibit hall, with vendors ranging from metals producers to equipment fabricators and engineering consultants.

For more information, to register, or to reserve an exhibit, contact Sheryl Renzoni at sheryl.renzoni@wahchang.com or at 541.926.4211 x6280. ■

Corrosion Applications Conference Abstract

Derrill Holmes, Senior Corrosion Engineer at Wah Chang, will present the following abstract as a full-length paper at the 2003 Corrosion Applications Conference in Coeur d'Alene, Idaho, September 7-12, 2003 (see related Events article on page 6). Mr. Holmes presentation will be one of approximately 40 technical presentations and panel sessions during this unique event.

Tin in Zirconium 702 — effect in sulfuric acid applications

by Derrill Holmes, Wah Chang

The effect of tin content on the corrosion resistance of Zr 702 in sulfuric acid was studied. Immersion and electrochemical tests were used to demonstrate the differences in corrosion of approximately 2400 ppm tin and low-tin Zr 702, containing approximately 1400 ppm tin.

Sample material, both welded and non-welded, was heat-treated at 770ºC for 1 hour. Standard immersion and autoclave tests were conducted in 20-75% sulfuric acid at elevated temperatures.

Updated 5 mpy iso-corrosion curves for welded and non-welded zirconium in sulfuric acid will be presented. The effect of heat treatment on corrosion resistance in sulfuric acid applications will be discussed.

This study has defined the upper reaches of temperature and acid concentration for efficient

Current and potential users of the alloy may also find this information useful. By knowing the limits of their current production equipment and if the chemistry of the Zr 702 is known or can be determined, process temperatures might be pushed upward. This may allow current users to increase their process efficiency without purchasing new equipment.

For more information on attending or exhibiting at Wah Chang's Fourth International Event, the 2003 Corrosion Applications Conference, visit corrosionsolutions.com or contact us at 541.926.4211 x6280. ■

Niobium Commemorative Celebrates 100-Year Anniversary of Wright Brothers Feat

BY: KIRK RICHARDSON — *WAH CHANG*

On December 17, 1903, Wilbur and Orville Wright, woke up in Kitty Hawk, North Carolina determined to successfully demonstrate an idea that they had been obsessed with since the 1890s. The dream? ...to soar like a bird in a powered flyer. Over the years, the two self-educated engineers had tinkered with a number of designs in their Dayton, Ohio bicycle shop... failing, learning, re-inventing.

By 1902, the innovative brothers were ready to test Wilbur's wing-warping mechanism (fine-tuned in the Wrights' own miniature wind tunnel) and its linked, hinged tail rudder. The novel system proved so successful that the brothers made hundreds of controlled flights that year, two spanning six hundred-plus feet.

Now a year later, their flyer equipped with a homemade engine (built by the bike shop's machinist) and a rotating wing called a propeller, the brothers shook hands, and Orville climbed aboard the contraption. Suddenly, the machine lurched forward, the wing tip slipping out of Wilbur's supporting grasp. Roughly 45 feet down the crude runway, it lifted into the air over Kitty Hawk's soft sands into glider friendly winds. One hundred and twenty feet and twelve seconds later, Orville and the world's first airplane touched down unscathed. That day, the Wright brothers made three more flights, the longest of which stretched 852 feet, and changed the world forever.

A hundred years later, the Wright Brothers' fascination with air travel and spirit of discovery rages on. Allegheny Technologies Incorporated (ATI) companies Allegheny Ludlum, Allvac, and Wah Chang manufacture titanium and other important metals for this century's airplane and aerospace innovators. ATI's alloys are used in everything from commercial jet wings and rivets to satellite rocket thruster cones, where unique niobium alloys can handle the heat.

Bridging today's modern metals with yesterday's great achievements, Wah Chang has created the second in a set of commemorative coins saluting famous Firsts in Flight. Appropriately, the 2003 collectable celebrates Wilbur and Orville's first powered flight at Kitty Hawk. Like 2002's Charles Lindbergh/Spirit of St. Louis coin, this year's commemorative is minted from .999 pure niobium. Only 2350 Wright Flyer collectables were struck, each encapsulated in a removable plastic capsule and enclosed in gift box.

The Wright Brothers niobium commemorative is available for $30 plus shipping and handling (while supplies last), or together with last year's Lindbergh coin (also limited to supply on hand) for $59 plus shipping and handling. Individual Lindbergh coins are available for $35 plus shipping and handling. For more information or to order, contact Sheryl Renzoni at sheryl.renzoni@wahchang.com or by phone at 541.926.4211 x6280. ■

Keep a look out for sizzling buys like these First in Flight commemoratives as well as niobium jewelry, photomicrograph ties, and more at WahChang.com's HotMetalShop, opening soon!

DuPont Heat Exchanger Design a Real Balancing Act

[continued from page 3]

Engineering for Vancouver, BC-based Ellett, was responsible for transforming DuPont's engineering design specification into a 36-foot long, 920-tube heat exchanger. The usually affable engineer gets serious when describing the effort involved in building the equipment. "Working with E-BRITE® alloy required great care," he says, noting that the alloy galled when slid over 316L stainless steel surfaces.

Clift says that one of the most difficult elements in the job was building the exchanger's complex baffle system. "Everything had to be perfect," he says. "This was not a conventional design." The drawings called for 76 baffle segments, comprising a relatively complex cross-baffling system... no small feat of engineering. The 24-foot longitudinal baffle running down the length of the exchanger "had to be flat", as Clift puts it, to ensure that the top and bottom cross baffles aligned precisely. "Alignment of the cross baffles was critical," he says.

Ellett's David Clift (right) says that "everything had to be perfect" in fabricating the atypical heat exchanger. The tube holes [pointed out by Jim Hunt (left)] were drilled to tight tolerances.

Clift claims that his team not only met TEMA tolerances, but also exceeded them in some cases. He points out that the E-BRITE® tubes have higher strengths than the supporting 316L stainless steel tubesheets. "This presents a challenge when attempting to produce a mechanically expanded tube to tubesheet joint," he says. "Tube holes were drilled to tighter than TEMA special close fit tolerances (1.010 +/- 0.002), and a pre-production mock-up of the proposed joint was subjected to shear load testing."

In March 2003, Ellett Industries shipped the unit to the Gulf Coast for installation. Project team members are off working on other challenges, but can be proud of their recent efforts. All things considered, DuPont's and Ellett's successful balancing act adds weight to the word balance well beyond "two scale pans."

For more information on Allegheny Ludlum's E-BRITE® alloy and other corrosion resistant metals, please call 800.258.3586 or visit www.alleghenytechnologies.com. For further details about Ellett Industries capabilities, call 604.941.8211 or visit their web site at www.ellettindustries.com. ■

The Effect of Oxidizers on the Corrosion Resistance of Reactive Metals

[continued from page 5]

use. Pickling process equipment prior to service can be an effective preventative measure to remove oxidizing contaminants; it also minimizes the effect of oxidizing impurities present in solution by eliminating the preferred sites on the metal surface where the oxidizers are most likely to attack.

The differing effects of oxidizers on the corrosion resistance of reactive metals can be quite dramatic, as illustrated in the previous example of zirconium and titanium in hydrochloric acid solutions. This is just one specific case; each process solution is unique, and the corrosion behavior of each of the reactive metals in that solution is unique.

Laboratory and corrosion coupon testing can be helpful in determining how a reactive metal will perform in a particular chemical environment; with this information, intelligent decisions can then be made to minimize or take advantage of any corrosive effects caused by the presence of oxidizers.

For more information or to discuss a potential testing program, visit corrosionsolutions.com or contact the Corrosion Lab at 541.926.4211 x6521. Mr. Abraham can be reached by e-mail at mike.abraham@wahchang.com. ■

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