Dr. Hira Ahluwalia, Material Selection Resources Inc.
Contact Information: hira@doctormetals.com

The Hidden Enemy: Corrosion Under Insulation
Abstract: Corrosion under insulation (CUI) is a well understood problem, and mitigation methods are well established. However, it is pervasive and continues to cost the process industry many millions of dollars annually. This presentation will discuss the parameters that lead to general corrosion of carbon steel and chloride stress corrosion cracking of 300-series stainless steels under insulation. The presentation will also discuss an effective CUI prevention strategy based on life-cycle costs that can significantly reduce costs due to downtime, maintenance repair, and inspection.

Speaker Profile: Dr. Hira Ahluwalia is President of Material Selection Resources, Inc., a materials engineering and corrosion consulting organization based in New Jersey, USA serving the chemical, food, pharmaceutical, fabrication and metal industries for the past 17 years. Dr. Ahluwalia has extensive experience in the field of corrosion and material science and has published numerous technical papers and books. His areas of expertise include stainless steels, material selection, corrosion testing, metallurgy, alloy development, and failure analysis.

Chris K. Davis, Solenis Chemical Company
Contact Information: ckdavis@solenis.com

The Impact of Oxidizers on Corrosion
Abstract: Oxidizers are used in many industrial process waters for several applications including biocides and bleaching agents. These oxidizers can aggravate corrosion. This discussion will describe and compare some of the various oxidizers, as well as how to measure them and monitor their impact on corrosion.

Speaker Profile: Chris K. Davis is a Senior Applications Engineer in the Microbiological Control group at Solenis. He has over 20 years of experience designing industrial water treatment programs in the paper industry and currently specializes in the application of oxidizing biocides. He is originally from Nekoosa, Wisconsin, and graduated in 1993 with a Paper Science degree from the University of Wisconsin at Stevens Point. He currently resides in Jacksonville, Florida.
Paul E. Glogowski, Valmet, Inc.
Contact Information: paul.glogowski@valmet.com

*Paper Machine Corrosion: Is It The Material, Or Is It The Environment?*

**Abstract:** This talk will cover 9 types of corrosion with examples that relate to the paper machine. It will cover typical operating environments and common materials used in each section of the machine.

*Dewatering with Solid Coat Technology*

**Abstract:** The second talk will feature a new option in dewatering elements for the forming and press section. A stainless steel substrate that can have a variety of different geometries is coated with the latest technology in thermal sprayed ceramics. This offers much more flexibility in form as compared to sintered ceramics.

**Speaker Profile:** Paul E. Glogowski received a Bachelor of Science degree in Paper Science from Western Michigan University in 1979, and a Master of Science degree in Materials Science and Engineering from Case Western Reserve University in 1999. He had twenty-one years of experience with Beloit, serving as engineer, R&D Corrosion and Materials; S2000 Project Leader for raw materials, generic hardware and utility products; and product manager thermal coating. He also had 14 years’ experience with Valmet as product manager, hard covers and technology transfer.

Margaret Gorog, Weyerhaeuser
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*Digester Corrosion*

**Abstract:** This talk will discuss damage mechanisms and corrosion control of batch and continuous digesters. Batch digesters are subject to hot plate boiling, which leads to very high corrosion rates—even with stainless steel. Most of the continuous digesters in North America are made from carbon steel. Older continuous digesters that were not stress-relieved are at risk of caustic stress-corrosion cracking. Newer continuous digesters running a modified cooking process can experience high corrosion rates in the lower regions of the vessel. A discussion of corrosion and cracking of auxiliary continuous digester equipment is also included in the presentation.

*Kraft Liquor Corrosion*

**Abstract:** This presentation will discuss corrosion of carbon steel, austenitic, and duplex stainless steel in white, green and black liquor environments. Generally, carbon steel has poor resistance in alkaline liquors. Where carbon steel remains passive, corrosion is not largely affected by sulfidity. Stainless steel is usually resistant except to high-solids black liquor, in which high corrosion rates can lead to catastrophic failure.
Duplex Stainless Steels for the pulp and paper industry

Abstract: Duplex stainless steels and their applications in the pulp mill, bleach plant and machine room will be discussed in this presentation. 2205, the workhorse grade, now sees widespread use in the pulp and paper industry. In combination with other grades, the family of duplex stainless steels outperforms the common austenitic grades of 304L and 316L stainless steel in terms of corrosion resistance and mechanical properties. They are not without limitations, some of which include weldability, high temperature resistance and availability.

Speaker Profile: Margaret Gorog received her B.A.Sc in Metallurgical Engineering from the University of British Columbia. She has worked as a Materials Engineer at Weyerhaeuser for 25 years. She supports Cellulose Fibers Manufacturing Services in the areas of corrosion control, materials selection, metallurgical failure analysis, tank and pressure vessel integrity and process safety management. She is an active member of the TAPPI Corrosion and Materials Engineering Committee.

J. Peter Gorog, Houghton Cascade Holdings, LLC
Contact Information: peter.gorog@houghtoncascade.com

Selection of Refractory Bricks for Use in Lime Sludge Kilns

Abstract: Kilns used to regenerate lime in the Kraft process are very energy-intensive. Throughout the 1990’s, in response to increasing fuel prices, the pulp and paper industry used back-up insulation in conjunction with high alumina brick to line the calcining zones of their kilns. Over the last decade, due to the dramatic decline in the price of natural gas in combination with mounting pressures to increase production of existing assets, in some areas, many mills have been focusing more on increasing uptime and capacity as opposed to energy savings. To this end, a growing number of mills are using a combination of basic (magnesia-based) and high alumina bricks to line the calcining zone of the kiln. In this study, a cup corrosion test was used to evaluate a wide variety of refractory bricks in order to determine which bricks are least susceptible to chemical attack by the feed. In designing a refractory lining, there are tradeoffs between energy efficiency, capacity and uptime. Recommendations are made based on the results of this work to help mill personnel to design a refractory lining that is optimized for their specific situation.

Speaker Profile: J. Peter Gorog received his B.S. and M.S. in Metallurgical Engineering at Michigan Technological University and a Ph.D. in Metallurgical Engineering from the University of British Columbia. Currently, he is the Managing Director for Houghton Cascade. Prior to joining Houghton Cascade, for more than 20 years, he worked for Weyerhaeuser. Over his career, in addition to providing technical support to pulp mills, his work focused on modeling of recovery boilers and kilns,
Nonlinear Ultrasonics for Material State Awareness

Abstract: Predictive health monitoring of structural components will require the development of advanced sensing techniques capable of providing quantitative information on the damage state of structural materials. By focusing on nonlinear acoustic techniques, it is possible to measure absolute, strength-based material parameters that can then be coupled with uncertainty models to enable accurate and quantitative life prediction. Starting at the material level, this talk will examine a combination of sensing techniques and physics-based models to characterize damage in metals. These nonlinear ultrasonic measurements can sense material state, before the formation of micro- and macro-cracks. Typically, cracks of a measurable size appear quite late in a component’s total life, while the material’s integrity in terms of toughness and strength gradually decreases due to the microplasticity (dislocations) and associated change in the material’s microstructure. These nonlinear acoustic techniques are acoustic wave-based, so component interrogation can be performed with bulk, surface and guided waves using the same underlying material physics. The talk will consider applications to characterize fatigue, thermal embrittlement, and irradiation damage in nickel-base superalloys, aluminum, steels and stainless steels.

Speaker Profile:
Associate Dean for Academic Affairs in the College of Engineering at the Georgia Institute of Technology and Professor of Civil and Environmental Engineering and Mechanical Engineering, Dr. Jacobs received his PhD in Engineering Mechanics from Columbia University and joined the faculty of Georgia Tech in 1988. Professor Jacobs’ research focuses on the development of quantitative methodologies for the nondestructive evaluation and life prediction of structural materials. This includes the application of nonlinear ultrasound for the characterization of fatigue, creep, stress-corrosion, thermal embrittlement and radiation damage in metals. His work in cement-based materials includes the application of linear and nonlinear ultrasonic techniques to quantify microstructure and progressive micro-cracking in concrete.

Laurence J. Jacobs, Professor and Associate Dean for Academic Affairs, College of Engineering, Georgia Institute of Technology.
Contact Information: laurence.jacobs@coe.gatech.edu
Dr. James R. Keiser, Oak Ridge National Laboratory
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Materials Selection For Biomass Thermochemical Liquefaction (and Gasification) Systems

Abstract: Use of biomass-derived liquid fuels offers the potential for a net reduction in CO₂ production as well as a reduction in use of fossil-derived fuels. However, the significant oxygen content of biomass results in formation of organic liquids that contain high concentrations of oxygen-containing compounds. Studies have been conducted to assess the behavior of metallic structural materials in the environments developed during the production, processing, transport and storage of these biomass-derived products. These studies, which will be described in this presentation, include characterization of the biomass-derived products, laboratory corrosion studies of candidate structural materials in the products, exposure of samples in operating biomass processing systems and examination of components removed from some of these processing systems. The goal of this work is to assess and define the extent of corrosion issues and provide the understanding necessary to select the most durable, lowest-cost materials to aid widespread scale-up and commercial adoption of these technologies.

Speaker Profile: Dr. James Keiser received a B.S. in Materials Science from Northwestern University and a Ph.D. in Metallurgical Engineering from the University of Missouri-Rolla. He spent two years as a post-doc at the University of Illinois, then accepted position in the Corrosion Science and Technology Group at Oak Ridge National Laboratory. For the last 40 years, his studies have addressed the performance of metallic and ceramic materials in environments containing gaseous and liquid corrodenents. Environments studied have included molten fluoride, chloride, sulfide, nitrate and carbonate salts, molten metals, mixtures of hydrocarbon liquids, as well as aggressive gaseous species such as hydrogen sulfide, steam, sulfur dioxide and hydrogen chloride. Current and recent projects include corrosion issues in biomass pyrolysis and gasification, corrosion issues in superheater tubes in biomass-fired boilers, material performance in supercritical carbon dioxide, corrosion-fatigue studies of receiver tubes in concentrating solar power systems, and performance of alternate fuel rod clad materials in high temperature, high-pressure steam and hydrogen. Has over 200 publications and is a Fellow in ASM and NACE.
**Plenary Talk**

**Pulp & Paper Industry Corrosion Problems: Past Dilemmas – Future Challenges**

**Abstract:** The pulp and paper industry has undergone many process and equipment changes during the past fifty years or more which resulted in unacceptable costs due to materials failure by corrosion. Past responses to reduce corrosion costs have been through a combination of: research and educational institutions, suppliers of equipment to the industry, professional societies, and by pulp and paper manufacturers themselves. The presentation leads us through a few critical turning points in the past culminating in corrosion failures, and the industries' responses to the problems. Future challenges in corrosion control facing the industry will be presented.

**Speaker Profile:** Mr. Moskal is Principal Engineer at M&M Engineering. He graduated with a B.S. in Metallurgical Engineering from the Colorado School of Mines, 1958. Moskal first worked on paper machine dryer failure problems in 1964 while employed with the Continental Can Company, later becoming Stone Container. During his career, Mr. Moskal has been responsible for project activities involving corrosion, failure analysis, materials specification, and welding. He has worked on all critical equipment problems in pulp and paper mills, and pioneered the use of duplex stainless steel for digesters in North America. Moskal, a TAPPI Fellow, has served in all chairs of the TAPPI Corrosion and Materials Engineering Committee and is active in BLRBAC. He won the TAPPI Engineering Division Beloit Award in 1995 and the Leadership Service Award in 1990.

**Dr. W. B. A. (Sandy) Sharp, Sharp Consultant**

**Identifying Microbially-Influenced Corrosion in White Water and Mill Water Environment**

**Abstract:** Bacteria can cause Microbially-Influenced Corrosion (MIC) in papermaking and cooling water environments where inadequate disinfection allows biofilms to grow on metal surfaces. Although the presence of free-swimming bacteria in the waters does not prove that the corrosion was caused by MIC, factors such as the presence at the corroding surface of bacteria that can cause MIC, the presence of chemical indicators of MIC in the corroded area, features of the corrosion damage that are characteristic of MIC and recent operational changes that could have enhanced the activity of microorganisms can combine to provide compelling evidence.

**Recovery Boiler Corrosion and Cracking Environments**

**Abstract:** This presentation will review the environments that cause corrosion and cracking in the various regions of a recovery boiler, and how they arise during the recovery of pulping chemicals. Understanding these environments enables mill engineers to develop
appropriate strategies to prevent each type of tube damage and to minimize the lifetime costs of the recovery boiler. Many recent trends in kraft recovery processes and in recovery operations have increased rates of damage to boiler tubes. Although detailed discussion of corrosion control strategies is beyond the scope of this paper, general principles for controlling corrosion and cracking in each environment will be presented.

**Speaker Profile:** Sandy Sharp has master’s degrees in metallurgy and in corrosion from Cambridge and London Universities in the U.K., and a Ph.D. in Chemistry from the University of Ottawa. His 4 decades of experience in corrosion control and materials engineering include 28 years leading corrosion control programs for Westvaco (now MWV). For many years he also supervised Westvaco’s microbiology research group. He has published 60 technical papers, was elected a TAPPI Fellow the first year he was eligible, became the first NACE (Corrosion Engineers’ Association) Fellow from the pulp and paper industry and is also a Fellow of the Materials Technology Institute.

**Douglas Singbeil, FPInnovations, Canada**

**Contact Information:** Douglas.Singbeil@fpinnovations.ca

**Corrosion of Spouts on Kraft Recovery Boilers**

**Abstract:**
Spouts are a critical component of kraft recovery boilers that are used to direct the molten smelt from the recovery boiler into the dissolving tank. They are water-cooled to protect them from corrosion by the molten smelt. Although the spouts themselves are not overly expensive to replace, any failure presents a high risk of generating a smelt/water explosion, with consequent safety risks and potential to cause significant damage to the boiler. Over the decades, operating and maintenance practices across the industry have evolved to ensure that spouts could function safely for 12 months between major maintenance outages, and general practice is to replace them after that period. However, early failures still occur, and many mills would like to operate their recovery boilers for longer periods between scheduled maintenance outages. This presentation reviews what is known about damage mechanisms for spouts in-service and looks at some of the contributing environmental factors.

**Speaker Profile:**
Doug has worked for FPInnovations (formerly Paprican) since 1981. His current position is Research Leader, BioEnergy and in that role, he leads groups working on corrosion/materials engineering, thermochemical processes, boiler optimization, and energy management in pulp and paper mills. In that position, he provides strategic direction and support for FPInnovations research programs on Biochemicals, Energy and Market Pulp.
Over the years, he has been a lead investigator or project leader on diverse topics ranging from materials for kraft recovery boilers to integration of biorefineries into existing forest product operations. He has authored or co-authored more than 60 external publications and papers, and developed significant collaborative activities with organizations like CanmetENERGY, Oak Ridge National Laboratory, Institute of Paper Science and Technology, VTT, and Sandvik Materials Technology. He has also provided or managed contract research services to clients in pulp and paper, mining, electric utility and chemical process industries. He is past Chair of the Engineering Division of TAPPI and is a Fellow of NACE International.

**Preet M. Singh, Professor, School of Materials Science and Engineering, Georgia Institute of Technology.**  
**Contact Information:** Preet.Singh@mse.gatech.edu

**Flow-Induced Corrosion in Pulping Liquor Environments**  
**Abstract:**  
Flow-induced accelerated corrosion and/or erosion-corrosion in pulp mill equipment, evaporators, and recovery boiler liquor feed equipment have been reported in recent years. Above a critical velocity, the passive film on most of alloys can get damaged, allowing the base metal to get exposed to the corrosive environment; film is reformed under most pulping environments. This process may repeat itself leading to an accelerated corrosion rate locally. This talk will discuss at some field failures and present data from simulated erosion corrosion tests in laboratory.

**Stress Assisted Corrosion in Boiler Tubes**  
**Abstract:**  
Stress assisted corrosion (SAC) of carbon steel boiler tubes is one of the major causes of waterside failure in kraft recovery and other industrial boilers. This talk will present some results from failure analysis of carbon steel boiler tubes from different kraft recovery boilers and show the role of carbon steel microstructure on crack initiation and SAC crack morphology. Simulation tests were done to understand the role of stress, temperature and dissolved oxygen in water on SAC, in an autoclave with recirculation loop. Results from this study indicate that the SAC crack initiation and propagation mechanisms involve magnetite film breaking and repassivation where dissolved oxygen plays a vital role.

**Speaker Profile:**  
Preet M. Singh is Professor of Materials Science and Engineering at Georgia Institute of Technology (Georgia Tech). His research is focused on the fundamental understanding of the environmental degradation of material properties, especially for metals and alloys, and their protection. His research work is related to the corrosion and SCC problems in the pulp and paper industry, bio-fuels, the energy industry, transportation infrastructure, and nuclear industry. Dr. Singh has published over 175 papers in refereed journals and conference proceedings.
proceedings. He is an active member of NACE, ASM, TMS, AIST, and ACerS. Dr. Singh is Fellow of NACE International as well as ASM-International.
Corrosion Repair and Corrosion Protection of Reinforced Concrete Structures in Pulp and Paper Mills

Abstract: This interactive presentation will cover understanding reinforced concrete corrosion, and corrosion case studies illustrating the investigation, repair and options for corrosion protection in bleach plants, paper machine foundations, clarifiers, and pulp chests. Pulp and paper case studies will be presented and discussed. The presentation will be geared toward the needs of plant maintenance and mill engineers. Time will be provided for questions and discussion.

Speaker Profile: David Whitmore is a registered Professional Engineer, a Fellow of the American Concrete Institute, and he serves on the corrosion and concrete repair committees of ACI, ICRI and NACE. David is President of Vector Corrosion Technologies, a company which specializes in the corrosion protection of steel in reinforced concrete structures. At Vector, Dave’s responsibilities include technical support and Vector’s corrosion research and development program which has resulted in the development of several patented technologies.

He is an International-certified National Association of Corrosion Engineers Cathodic Protection Specialist and has over 25 years’ experience in the concrete restoration industry.