XPS Bulletin
ISSUE 15 – WINTER 2016

The Need to Innovate…

Innovation is a more effective device or process that typically results from a new idea. Innovation can be viewed as the application of better solutions that meet new or existing requirements, in-articulated needs, or existing market needs. This is accomplished through more effective products, processes, controls, services, technologies, or ideas.

As discussed in my previous article, our industry continues to experience a competitive and challenging commodity market which is driving operations and projects to control what they control and seek new ways to improve performance for sustainability. To meet these challenges we must look to innovative ways to operate and change our processes with the objectives of lowering costs and improving metal recoveries.

Innovation is not to be confused with R&D; although some degree of R&D may be necessary, R&D turns money into knowledge, while innovation turns knowledge into money. Taking this one step further, R&D without a clear business case is just philanthropy.

Following these principles, XPS has a history of the development and implementation of value added innovative solutions to process problems and performing the high quality testing to prove up the associated business cases. Our present team of experienced and dedicated engineers and technicians along with most of the facilities, equipment, know-how and historical information from both Noranda (NTC) and Falconbridge (FTC) are available to work with you and collaborate with other 3rd party organizations to serve your needs and our industry needs well into the future.

XPS Organizational Changes!

Effective immediately, Mika Muinonen will assume responsibility for the Extractive Metallurgy and Process Mineralogy business at XPS! This includes Lab Services for both disciplines.

In addition, Gregg Hill is now XPS Technical Lead Mineral Processing and will support the lab and projects in all things mineral processing. This change will streamline our approach to finding multidisciplinary solutions to process problems.

Phil Thwaites, Manager Process Control and Wilson Pascheto, Manager Materials Technology continue to manage their respective businesses.

See the back cover for contact information for the new XPS Management Team.

In other news, Norman O. Lotter, has recently retired from XPS and has been engaged as an XPS Consultant offering specialist services in flowsheet development, sampling theory and collector systems. We would like to take this opportunity to thank Norm for his significant contributions to XPS over the years and look forward to our continued relationship.

Finally, Robert (Bob) Howard, XPS Building Services Coordinator has also opted for retirement after 49 years of dedicated service to Falconbridge, Xstrata and now Glencore. Bob's service is legendary but equally impressive are his contributions, including development of Ni crowns, the primary product from the Glencore's Ni Refinery in Norway to a dedication to safety and health that has contributed to the XPS/FTC overall safety record of over 10 years with no loss time accidents! We thank Bob for all his contributions and mentorship and wish Bob and his family all the best in his retirement.

We hope you enjoy this edition of the XPS Bulletin and as always we look forward to your feedback!

Dominic Fragomeni, P.Eng. FCIM
Director, XPS

In this issue

To Receive XPS Bulletin

If you would like to receive a copy of the XPS Bulletin please e mail your details to
info@xps.ca

Look us up on SAMSSA

XPS can also be found in the Sudbury Area Mining Supply & Service directory

SAMSSA
Made in Northern Ontario for the World

XPS Consulting & Testwork Services

6 Edison Rd., Falconbridge, ON, P0M 1S0
Tel: +1 (705) 699 3400, #3401
Fax: +1 (705) 699 3431
dominic.fragomeni@xps.ca

www.xps.ca

XPS Consulting & Testwork Services – A GLENCORE Company

XPS Builds a New Large Scale Pilot Roaster

XPS has built and commissioned a new 300mm (12”) internal diameter, 3-m-high pilot scale fluid bed roasting circuit. The roaster can be configured for various processes with the current configuration for sulphide roasting. The flow sheet includes oxygen enrichment, dry or slurry feed, fluid bed roasting and sulphur dioxide gas capture via two-stage SO_2 scrubbing.

The roaster was designed and built for Royal Nickel Corporation (RNC) to conduct a roasting pilot plant on nickel sulphide concentrate from their Dumont Ni Project. The roaster is capable of operating from ~50 to 200 kg/hour with a maximum operating temperature of 1200°C. A modern process control system has been installed to safely control and operate the roaster with a HMI located at a nearby operator’s station. The process control system continuously measures and records operating parameters such as, feed rate, temperature at various locations, off-gas concentration including oxygen and SO_2, and pH in the scrubbing system.

The off gas passes through a cyclone at the top of the roaster, the underflow is fed back to the roaster (in this configuration) and the overflow gas is cleaned in the scrubber. Feed is fed into the bottom of the roaster using a venture eductor. The bed is manually discharged at the bottom into sealed stainless steel drums. Isolation valves are in place to allow safe and secure emptying while the roaster is operating. Although designed for nickel sulphide testing the roaster is capable of handling various sulphide feeds such as copper concentrate, pyrite, or nickel sulphide matte.

XPS also operates and performs roasting evaluations using 50 mm and 100 mm diameter continuous roasters where sample quantities are limited. The roasters along with extensive operations and academic experience, Thermal Gravimetric Analysis (TGA) and FactSage modeling can result in efficient, stream-lined roasting studies for most materials. XPS and its partners are the premiere facility to perform roasting studies, process design and techno-economic analysis in the world.

XPS 300 mm Diameter Pilot Scale Roaster

For further information on roasting capability, contact Mika Muinonen at mika.muinonen@xps.ca.

Process Mineralogy for Virtual Flowsheeting

As part of a recent flowsheet development program, XPS took a new approach to using QEMSCAN generated process mineralogy data to improve upon an existing and complex baseline flowsheet. The approach resulted in significant improvements in concentrate grade and recovery performance, simplified the process and reduced the capital and operating costs. The use of these novel process mineralogy tools streamlined the flowsheet develop effort and reduced the testing cost with a shorter schedule to completion.

The original flowsheet was based on a complex MF2 arrangement with stage grind and flotation in two steps. XPS was challenged to replace this high capital and operating cost flowsheet with one which was equally effective in recovery of all primary and secondary Cu sulphides to one final concentrate while reducing coarse locked Cu sulphide losses to tailings and SiO_2 dilution to the Cu concentrate.

To achieve this, kinetic flotation tests were completed on a composite representative of the first 5 years of mine production at various primary grinds. The composite sample selection was based on the XPS approach of matching lithologies, mineral types and grade distributions from the mine block model to the sample (*see* article page 4, XPS Bulletin Issue 13). Size-by-size mineralogy was then performed on all kinetic concentrates and tailings on the three best performing grinds. From there, the Cu sulphide kinetics based on liberation and particle and mineral grain size were used to design a flowsheet.

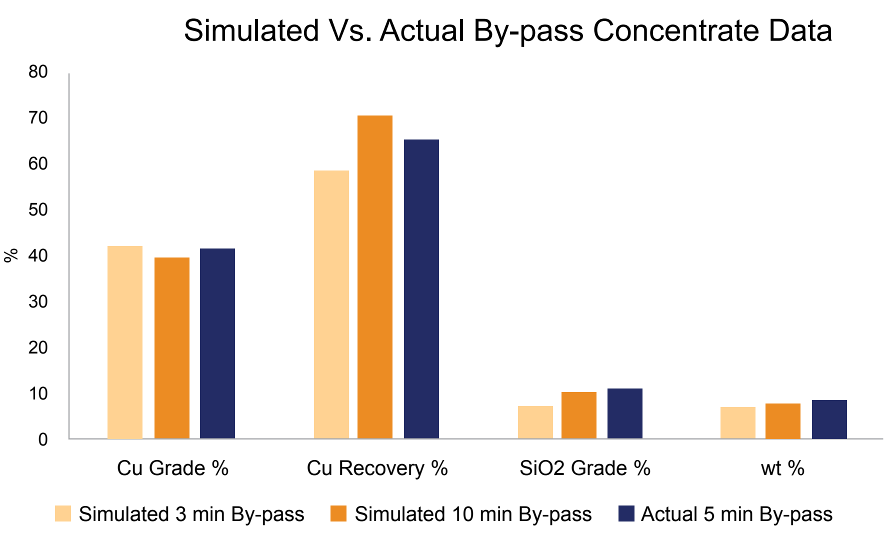
The Cu orebody is known to have mineralogy of a very fine grained nature (8-10µm) sufficient liberated Cu sulphides were present at a coarser grind to warrant a bypass cleaning circuit to minimize entrainment of SiO_2 to final concentrate. Tailings Cu losses was achieved by minimising fine grained, coarse locked losses, through a particle size scalp avoiding unnecessary regrinding.

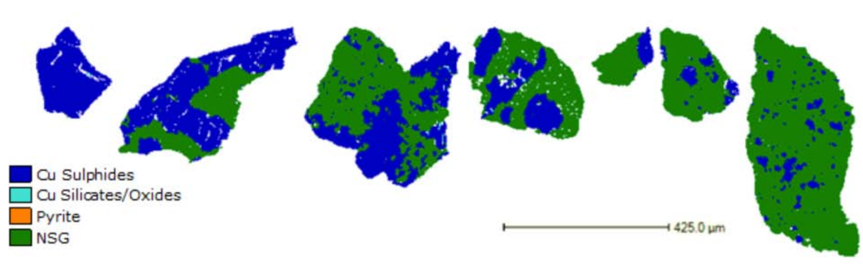
Prior to any testwork, flowsheet options were modeled using Excel and the QEMSCAN mineralogy data. The QEMSCAN data quantifies mass and liberation class of each particle size increment and measures the grain sizes of minerals to target primary and regrind sizes. This quantitative data lends itself to simple mass and mineral balances and makes simulation of various process responses simple and low cost when compared to full testing and trial and error approach. Once established, testwork can be more focused and cost effective.

Since 1998, XPS has institutionalized the use of process mineralogy data to aid in flowsheet development efficiency and robustness. This exciting highly quantitative and predictive approach has further improved efficiency of the process development effort and will continue to be used at XPS to reduce cost and time to final frozen flowsheets.

The figure below shows the simulated flowsheet performance of the ore with optimum grind size and flotation time selected from the mineralogical measurements in comparison with the physical confirmation lab tests. This shows that process mineralogy can be used as a predictive tool for flowsheet development and represents another step towards reducing cost and time in the lab testing on a trial and error basis. The particle images are an example of the range of liberation observed in the sulphides.

For more information contact
Elizabeth Whiteman, Senior Geoscientist
elizabeth.whiteman@xps.ca





Particles images from +106µm fraction sorted by decreasing Cu sulphide liberation.

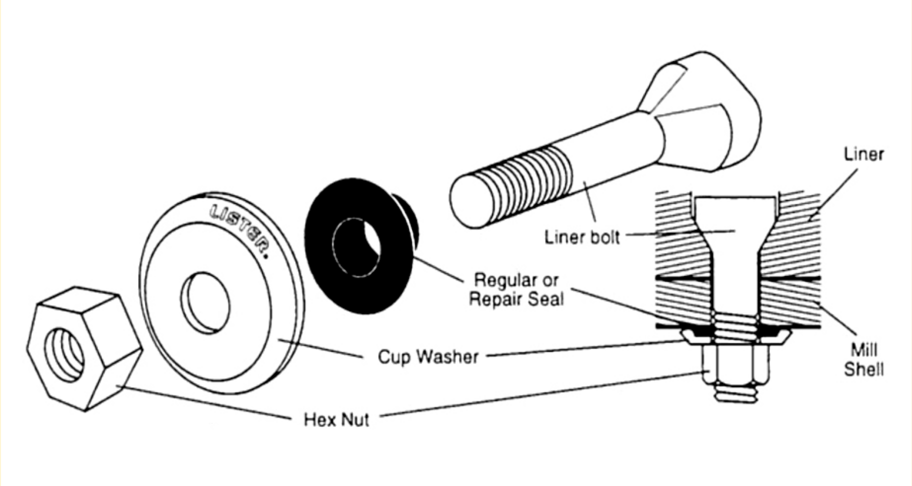
Application of Wireless Load Cell Combined with Failure Analysis to Investigate Rod Mill Liner Bolt Breakage

Strathcona Mill experienced a significant number of rod mill liner bolt breakages over a period of several months. Liner bolts are used to fasten liners to the inside of the rod mill shell. Unexpected failure of rod mill liner bolts while in operation causes interruptions to production, which eventually leads to metallurgical losses and production downtime. Also multiple bolt failures on the same liner increase the risk of liner loss or in many cases can damage the mill shell.

This article highlights one of the tools used in the investigation process. Scanimetrics Inc., Wireless Load Cell Technology is an intelligent strain gauge technology that was used to improve understanding of the failure mechanism, identify scope for improvement and monitor progress.

With the assistance of XPS Process Control engineers, Strathcona Mill sourced and installed six load monitoring washers on the "A" Rod Mill to monitor clamping force of the liner bolts as shown in Fig. 2. These sensors were installed on the same row from the discharge end to the feed end to get a complete clamp force profile across the Rod Mill. Three load cell washers are connected by wire to one wireless 'mote', which transmits data wirelessly to a server off-site. It can be configured to receive high speed data which enables monitoring of each individual mill rotation. One of the reasons these load cells were preferred for the monitoring application is their ability to be installed with the existing bolt assembly without significant modification.

Liner bolts are specially design for the application and custom modification to accommodate any new feature was not trivial. The load cells provide time series



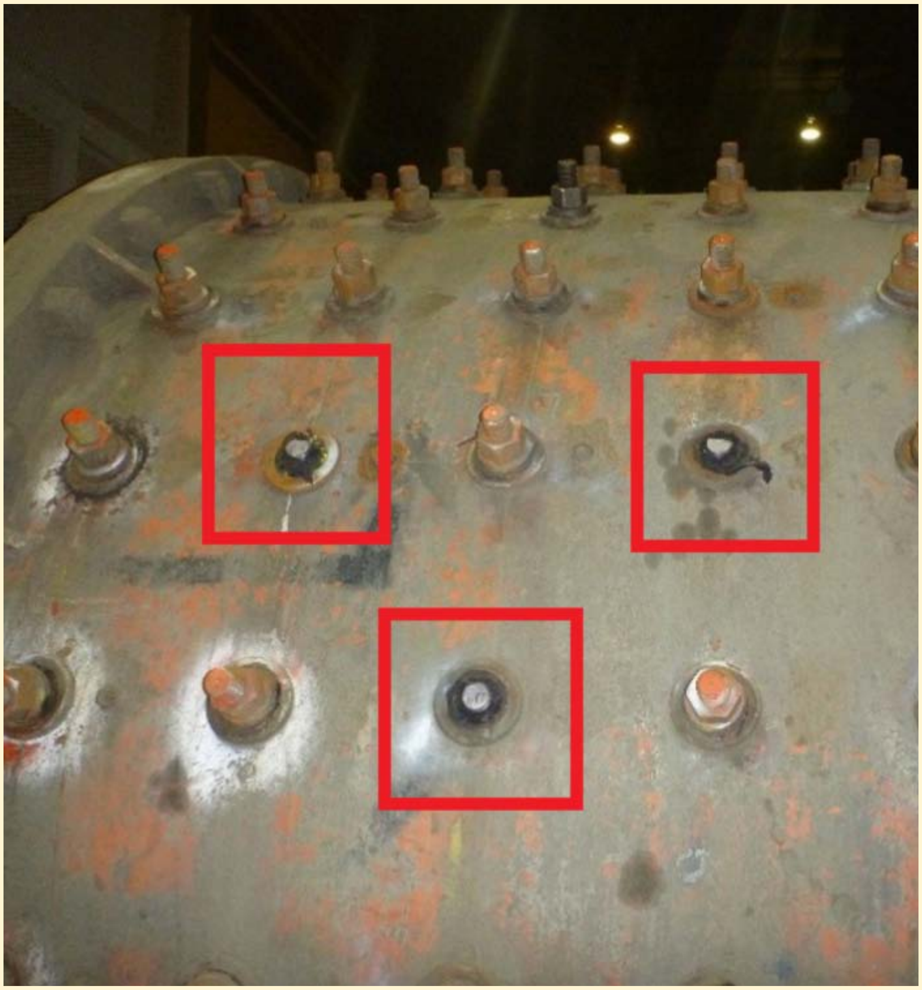


Fig. 1: A typical Rod Mill Liner bolt assembly (left), some broken liner bolts

Fig. 2: Load cell washers connected to the wireless ‘mote’ (left), installation on the Rod Mill (right)

clamp force data and hence data for each of the individual load cycles. This can be correlated with process conditions, .e.g., tonnage, pulp density, grind out or conditions. The wireless technology and ability to directly measure clamp load made this the preferable choice.

Analysis of the clamp force data determined variability in the clamp force applied. A review of the torque process was initiated to confirm that the proper procedure was being employed and best practice was being followed. Torque wrenches were recalibrated and new wrenches were sourced to match air pressure in order to deliver consistent torque. It was also established that bolts be retorqued after 24-hour and 7-days of initial installation and a standard practice of non-destructive testing (NDT) was implemented to proactively identify any cracked bolts.

The XPS Materials Technology group conducted a detailed failure analysis on some of the broken bolts and determined that bolt breakage mostly occurred between the hex nut and the cup washer, primarily with the discharge end bolts. All broken bolts analyzed were found to have failed by fatigue due to unidirectional bending. It can be seen from Fig. 3 that the fatigue crack area occupied more than 95% of the fracture surface, therefore the bolt strength and toughness was more than adequate for the application. However, a mismatch of nut and bolt material, grade 5 versus grade 7, was also found and corrected

In summary, wireless load cell technology and detailed failure mode analysis helped XPS and the Strathcona Mill team understand the failure mode, which in combination with other initiatives such as operating parameter review and optimization has substantially reduced the frequency of bolt breakage. Strathcona Mill continues to optimize the mill/liner system and is currently investigating options to minimize liner movement.

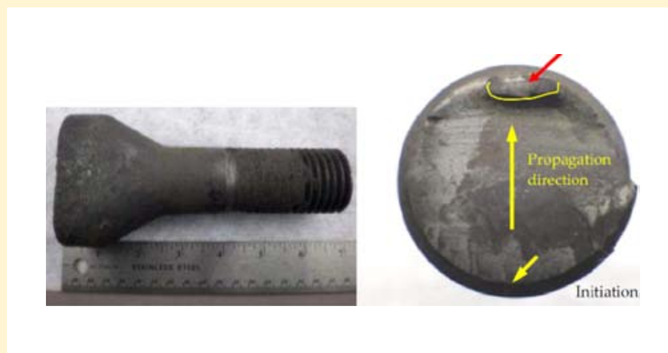


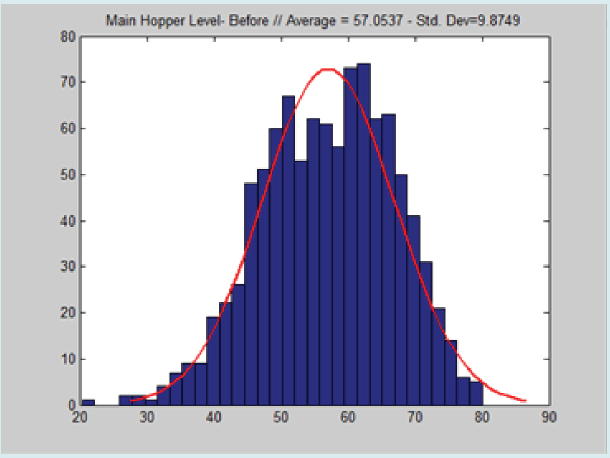
Fig. 3: Fatigue failure of the bolt and propagation direction (right)

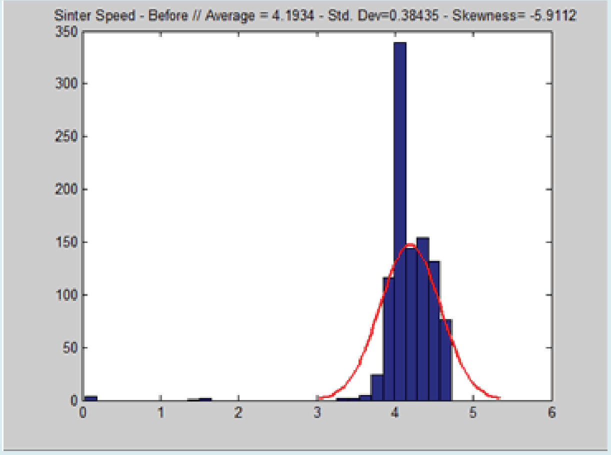
For further information on this and other mill integrity initiatives, contact Nasseb Adnan at naseeb.adnan@xps.ca.

Brunswick Plant Main Hopper and Sinter Machine

Automatic Speed Control Implementation

The Sinter machine speed at the Brunswick Smelter Sinter Plant is controlled by a Variable Speed Drive (VSD) of which the operators have had to monitor and manually change the setpoint usually every 15 mins. to maintain the level in the Main Hopper. The figure illustrates the hopper level statistical performance and the speed of the Sinter machine. Every time the level drops below 30% there is a possibility for a miss on the machine (a section of grate where there is not enough material, or no material at all), reducing production, dropping temperature, dropping SO_2 in the gas and delivering a poor quality sinter – impacting the Blast Furnace Operation and plant economics. Operators and Process Engineers have observed this over and over again over the years. It has been a challenge to implement automatic controls…until now.





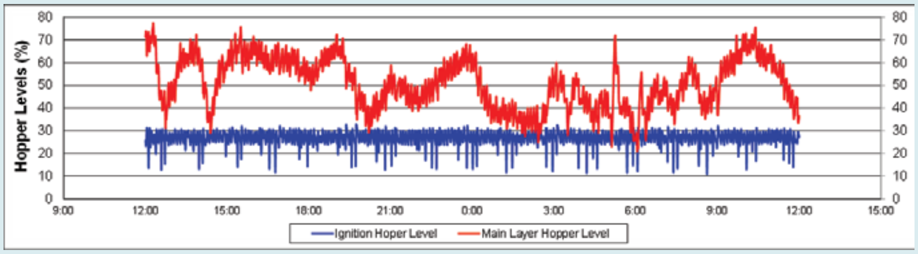
With the help of XPS Process Control team which includes a network of consultants, a control strategy was implemented to automatically set the speed of the Sinter machine in order to improve the homogeneity of the material delivered, and improve the quality of the sinter.

The plant data trends below show the bin level and consistency of feed rate before and after the implementation of automatic controls.

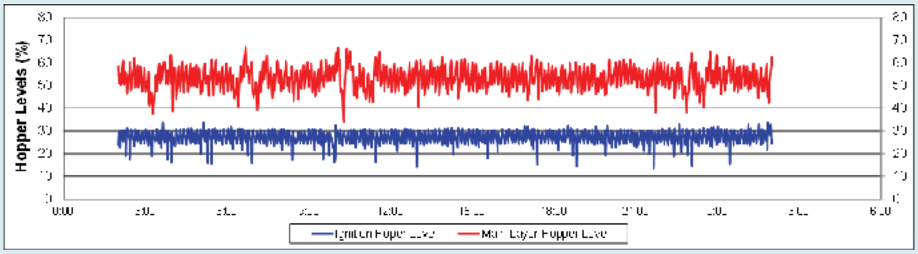
"Now we have an automatic system that works properly, it is to wonder how we ever ran the plant without this control and why it took so long for us to get it installed!"

Eric Betouney, P.Eng., Brunswick Smelter

Manual Control (before any changed)



Automatic Control (after changes)



The XPS team has extensive experience in tackling difficult control problems, complete with long dead times and noisy signals and would like to acknowledge the cooperation of the Brunswick Team!

For further information on this and other process control solutions, please contact Phil Thwaites at phil.thwaites@xps.ca

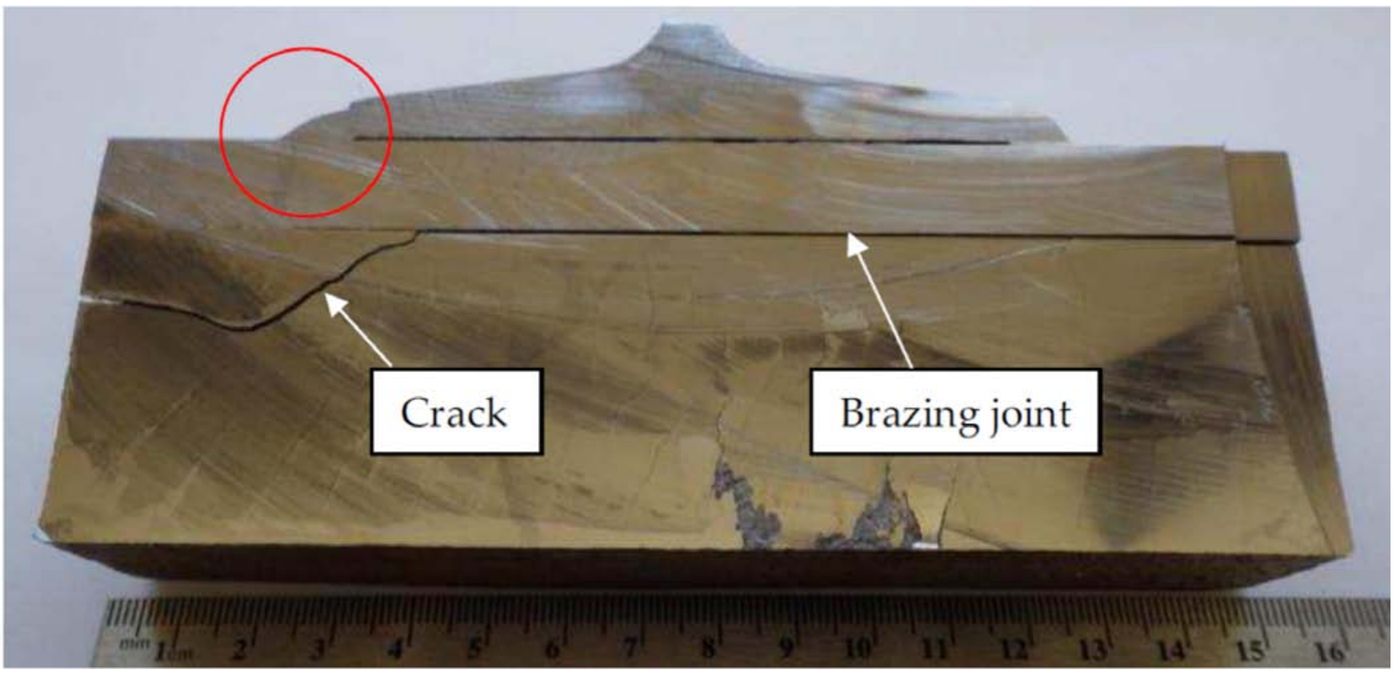
RCFA For Mining Industry

Root Cause Failure Analysis (RCFA) is the systematic investigation of the construction, application, and history of a failed component, equipment or system to determine the failure mechanism and underlying cause. RCFA may be employed for legal, insurance, safety, environmental or production reasons. Once a failure occurs, one can determine the basic cause(s) and recommend changes necessary to reduce or eliminate the risk of reoccurrence.

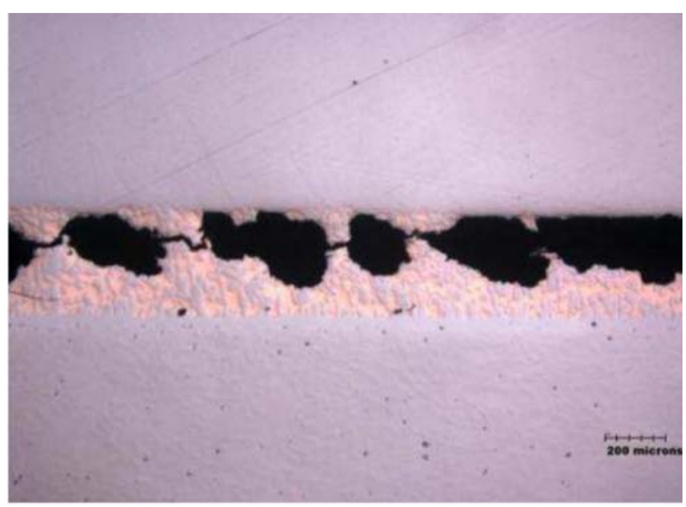
The XPS Materials Technology Laboratory, located in the XPS Centre in Falconbridge, is the only failure analysis and materials testing laboratory in Northern Ontario. Having investigated over 1,000 cases, the XPS Materials Technology group has extensive experience in metallurgical root cause failure analysis in machinery use in mine sites, concentrators, smelters, leach plants, acid plants and electrolytic refineries. Our field and laboratory experience allows us to make and implement practical recommendations to mitigate failures together with site expertise and suppliers. In this regard, our field experience in particular gives us a significant advantage over many other metallurgical failure analysis labs. Recommendations may include changes in materials of construction or design, fabrication or construction procedures, quality assurance during fabrication and/or construction, inspection plans during operation as well as maintenance and operating procedures.

In one example, white cast iron liners mounted onto mild steel backing plates cracked during the installation process for a mining wear application. Through RCFA, XPS Materials Technology engineers and technicians determined that the failure resulted from large residual tensile stresses from welds between a steel I-beam and the steel backing plate during fabrication by the manufacturer. These stresses were the result of the joint design, welding procedure and execution of the weld. Furthermore, there were many defects which originated in the brazing operation between the steel backing plate and white cast iron. Improvements were recommended in fabrication procedures (minimize heat input, smaller weld bead, control of inter-pass temperature, welding sequence) and quality assurance during fabrication.

Please contact Wilson Pascheto and his team of materials technology experts at wilson.pascheto@xps.ca



Cracking of White Cast Iron Liners



Defective Brazing Layer from White Cast iron to the Mild Steel Backing

Liz Whiteman Receives Prestigious MEI Young Persons Award

XPS is pleased to announce that Elizabeth Whiteman, XPS Program Mineralogist has been awarded the MEI Young Persons Award.

Elizabeth graduated from the University of Queensland in 2002 with her degree in Engineering, majoring in Materials and Metallurgy. From 2003 to 2008, she worked for Intellection Pty Ltd., the manufacturers of QEMSCAN, first in method development, and then as Manager of Customer Support, in which role she travelled internationally providing key training to client sites. She joined XPS Consulting and Testwork Services, Canada, in January 2009, where she has become a key member of the Process Mineralogy team.

As a member of the Mineral Science team, she has excelled at every aspect of the job, including technical work, project management, marketing of our services, and client interaction. She has particular skill in data modelling where opportunities for plant improvement are quantified. Along with traditional base and precious metal characterization, she has pioneered some of the first mineralogical studies on rare earths to be completed via QEMSCAN, and has developed new sample preparation methods and analyses for the potash industry. These new developments demonstrate her position at the forefront of innovation in mineralogy and QEMSCAN use. She is well respected by every professional with whom she interacts. She is a co-author of the best practices review paper entitled “Modern Sampling and Flotation Testing for Flowsheet Development”, presented to MEI’s Flotation ‘13 in Cape Town.

XPS is proud to have Liz as a valued member of our team and congratulates her on this well-deserved award.

Dominic Fragomeni, P.Eng., FCIM
Director, XPS
dominic.fragomeni@xps.ca