WARILL ENGINEERING SALES (AUST) WISHES ALL OUR CLIENTS AND ASSOCIATES A HAPPY CHRISTMAS AND PROSPEROUS NEW YEAR.
AUSTIN FOUNDRY CORP., of Sheboygan WI, is a gray and ductile iron jobbing shop that has been producing quality castings ranging in size from one pound to 5,000 pounds for a wide variety of industries since 1946. Their molds are chemically bonded with Furan and some Pepset binders.

“We first considered a sand reclamation system a few years back, but with the recent downturn in the economy and our ever-increasing costs, becoming even more cost efficient became a priority. The cost savings potential of a DIDION® Sand Reclamation System became obvious”, says Sean Girdaukas, Vice President of AUSTIN FOUNDRY CORP.

“We sent sand samples to DIDION for testing, using their Rotary Lump Crusher/Sand Reclaimer System. DIDION’S patented design crushed the hard lumps, scrubbed the binder off the sand grains, screened the sand twice, recirculated the screen overs, and separated tramp metal. After evaluating the test results and their proposal, we purchased and installed a DIDION® Sand Reclamation System. Installation was fast and easy. We are very pleased with the quality of the reclaimed sand and the system is extremely reliable.”

“In the first eight months of use, we reclaimed over four million pounds of spent sand which would previously have been sent to a landfill. We were able to dramatically reduce our new sand purchases and disposal costs. In addition, we have been able to cut back on binder and catalyst usage with no ill effect. We anticipate saving a quarter million dollars annually. Helping the environment is saving us money”, concludes Girdaukas.

The team at Austin Foundry was excited to reclaim a buried treasure. Turn a waste stream into a revenue stream and keep the EPA and DNR inspectors happy. Contact DIDION to help you become more efficient and more profitable.
ADVANTAGES AND FEATURES

✔ Patented multi-chamber design combines lump crushing, sand scrubbing, sand conditioning, dual sand screening, and metal separation for the fastest payback.

✔ The time-tested design has the best performance/highest yield (up to 97%) in the industry.

✔ Significant savings from reduced binder consumption, lower new sand purchases, and minimal disposal costs.

✔ Additional savings from conditioned and higher quality reclaimed sand (which is more uniform/consistent) lowers finishing costs and reduces casting scrap.

✔ The patented design has the lowest operating cost per ton in the industry worldwide, with system sizes from 1-100 TPH.

✔ Highly efficient air-wash separation removes binder, dust, debris, and excess fines.

✔ Continuous improvement and development have made us the world leader in sand reclamation.
As we complete the year, we can easily see that never before have foundries faced such a convergence of transformative events. It is an era of seismic change – and it presents today’s managers with a once-in-a-generation test of leadership. This issue of Metals addresses the fast emerging need to embrace environment management for your business. Foundries use a lot of water and create a lot of emissions – the two key papers in this edition illuminate the need to remain alert to their affects and expect subsequent legislation.

In 2011 we have witnessed some giant changes - globalising competitors from emerging markets, innovative business models arising from new technologies and increased and forced focus on the environment with floods in Thailand and an earthquake and tsunami in Japan. This mix of new world activities and the need for environmental management presents foundry managers with a golden opportunity to galvanise their companies with a carefully designed and intelligently aggressive strategy. This is not the time to pull up the drawbridge and preserve the status quo. It is the time to be bold: enter new markets, acquire struggling competitors, invest in marketing, create new products and services and capitalise on new digital technologies and build new business models and be alert to the environmental demands which will face manufacturing industry – water and energy supplies.

Foundries in China and India and other emerging markets continue to charge ahead. China has a leading position in the world with casting tonnage at 40 million tonnes per annum accounting for 40% of the global output. Together with the Indian market as the second biggest producer of metal castings it automatically changes the profile of output and creates a new global market. This growth, together with other emerging markets, will become an environmental challenge within this decade. And I refer to sustainability.
To support the narrative that bold thinking is required, you will read in this edition about the challenges of water supply for China’s industry. It is a country with a scarce water supply and this will become a major “green” issue. Gopal Padki, as the author, points out in his paper that there are emerging tensions developing over water between urban and industrial life. This is indeed an important issue when it is clear that the Asia Pacific region is a key driver of global urban transition. In this coming decade the world is expected to have an urban population of 5 billion with 30% residing in the Asia Pacific. As Gopal Padki states in his paper: China makes up 22 % of the global population but has only 8% of the world’s renewable fresh water. Read Gopal Padki’s paper on water as an environmental issue and then add this valuable knowledge to what P. C. Maity offers in his paper about air emissions – some excellent guidance for foundry managers.

The normal contribution from Dr. John Pearce will not be available in this edition due to the devastating floods in Thailand. This flood has clearly illustrated the global market to be extremely vulnerable for world supply chains. The flooding is the worst in five decades and has also revealed to the world the scale of Thailand’s industrialisation and the extent to which two global industries, computers and cars, rely on components from here. Also this flood further compounded the global supply chain problems as it came just a few months after the earthquake and tsunami struck Japan and shut down facilities that produce car and electronic components.

As a measure of Thailand’s importance to the global automotive supply chain, the flooding has forced Toyota to slow production in factories in Indonesia, Japan, Malaysia, North America, Pakistan, the Philippines, South Africa and Vietnam. Honda, the carmaker most affected by the Thai floods, has also slowed production at factories in several countries.

We are living in a period of climate change and financial uncertainty with banks seemingly owning more power than governments and able to hold world growth to ransom. If the money doesn’t flow to enable business growth, it does need very smart business plans for companies to remain competitive. Talk to manufacturers in Greece, Spain and Italy. As stated at the beginning, never before has the world presented so many converging forces which have to be addressed by smart management.

However, the world in 2012 will continue to rotate and present many environmental and financial issues. But we must see these as challenges rather than problems. It will be in the process of confronting and dealing with the challenges that new ideas and sparks of creativity are provided and create new technologies to add to the world’s market place.

I sincerely wish you all a great holiday season and look forward to bringing you more quality knowledge and information to support your businesses on the pathway to increasing productivity and profits in 2012.
Large porous voids were detected in sample castings, despite the simulation results not showing any. The simulation inputs were all double-checked, all the process parameters were modified to the extremes of the possible, and yet the simulated defects varied only slightly. This meant that the casting defect was not shrinkage porosity after all, but that there was a condition in the process that was not being captured - core gas. The challenge in addressing this defect, and thus resolving it, is that MAGMASOFT® does not directly calculate the evolution of gas from core and mold binders at this time. However, the conditions that cause off-gassing of cores and their migration into the casting are accounted for by MAGMASOFT®.

In order for the core to emit a gas there must be uncured binder in the core/mold, and these core/mold materials must reach high temperatures. A comparison of the core temperature at the start of the filling cycle with the core temperature at the end of the cycle showed that the cores are severely overheated. This and the evaluation of a sectioned core with uncured binder reveal that the core possesses all the required conditions to produce gas.

The second condition that must exist for core gas related porosity is an entry point for the gas to get into the casting. The Fraction Solid results were used to identify the locations of the casting that formed a skin last and thus identified the entry point of the gas into the casting and the amount of time it was able to do so. The evaluation of the solidification progress shows that the defect prone region of the casting takes 140 seconds, after filling, to completely form a skin. The match of the real areas of gas defects of the sample casting with the simulation results showed a good correlation. Now that the true defect had been identified, Custom Casting’s engineering department reduced the binder content of the sand, which yielded a slight improvement in the defect severity. During their investigation of the cores, they also discovered that the core molds were not heating the core evenly causing the uncured binder issue.

With the use of MAGMASOFT®, Custom Castings has been using MAGMASOFT® for about one year to improve their casting quality and reduce sampling times. Substantiated by casting simulation results, they were able to acquire a 160 lb. (73 kg) part that had been previously produced as a gravity sand casting by another vendor.
Castings was able to resolve a complex casting issue in a short amount of time. They were able to easily determine that the cores were reaching temperatures that promoted off-gassing. They were also able to determine the most probable locations for the core gas to enter the casting cavity as well as the duration of time the gas was free to migrate. By being able to identify these key conditions of the casting defect, Custom Castings was able to take actions that resulted in a permanent solution to resolve the core gas porosity.

This success story is an impressive example of how a solution can be reached by combining MAGMASOFT® results with personal knowledge.
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Cover: Warill Engineering Sales (Aust) wishes all our clients and associates a Happy Christmas and prosperous New Year.
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POWERFUL INTEGRATED MEDIA PLATFORMS
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SOLIDCast simulates castings poured in cast iron, steel, aluminum, copper-base, magnesium, nickel-based and almost any other alloy. A database of several hundred alloys, with all pertinent properties, is included.

SOLIDCast can simulate molding processes such as sand, investment and permanent mold. You can use sleeves (insulating or exothermic), chills, hot topping, cooling channels, and just about anything else that is used in the metal casting process.

SOLIDCast contains both Gating and Riser Design Wizards™, tools that allow you to rig new castings in just a few minutes, using actual simulation results, not guesses based on simple geometry. Since casting alloy, mold material and mold inserts are all considered, there is no more accurate way to rig a casting than with the Gating and Riser Design Wizards!

Flow Path Tracing in an Aluminum Sand Casting

Optimization of casting process design using SOLIDCast™ and HyperOpt®

OPTICast™ is an amazing software tool that works in conjunction with the SOLIDCast™ solidification modeling system. OPTICast uses the HyperOpt® system from Altair Engineering, Inc., the leader in the field of optimization software.

What does OPTICast do?

OPTICast actually automates the simulation process! Start with an initial design for a casting, with gating and risering, typically created in the SOLIDCast modeling system, using the Gating and Riser Design Wizards™. Then select the following elements:

- Design Variables: Design elements that are allowed to vary. For example, the height and diameter of a riser. It could also be the metal pouring temperature, or the preheat temperature of an investment shell.
- Constraints: Used to determine whether a particular design is acceptable. For example, the foundry engineer might specify a minimum acceptable yield percentage, or a maximum acceptable level of macroporosity.
- The Objective Function: States what the foundry engineer is trying to achieve. Examples might be to maximize the yield, minimize shrinkage or minimize solidification time.

Once these elements are identified, the user then launches an Optimization Run. This consists of a series of simulations in which the design conditions are varied under the control of HyperOpt, model changes are made and simulation results are evaluated, all completely automatically, until the desired result is achieved.

Using OPTICast, the foundry engineer can start with an initial design and allow the computer to do the work of modifying the design and running simulations to achieve an optimum result.

Now the technology of automated design is brought to the foundry in the form of a practical and easy-to-use design tool. OPTICast can help you to improve your yield and your quality to an optimum point, while freeing design engineers from the repetitive task of trial-and-error design.

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Why Use Casting Simulation From FSI?

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- World Wide Support

Solidification Analysis

Mold Filling

Feeding Zone Analysis for Riser Design

Casting simulation for the working foundry
Hunter Automated mourns the loss of its founder

William Allan “Al” Hunter, originator of the Hunter matchplate molding machine and mold handling system for sand casting, died at 89; pioneered many of the techniques and machine concepts used worldwide in the foundry industry.

Al Hunter passed peacefully on October 29, 2011 in Naples, Florida. A true giant in the world foundry market, Mr Hunter changed the way sandcasting was done, by his invention of the Hunter matchplate molding machine in 1964 and various mold handling systems beginning in 1970. He built his first machine, helped by his son and current president of the company, Bill, for sale to Moline Corporation of St. Charles, IL, a malleable iron foundry. He will be missed by all who knew him and appreciated his zest for life and especially his love of invention.

Born on the family farm in Wilkie, Saskatchewan on July 13, 1922, Al left home at 17, took a bus to Edmonton, Alberta and worked in a meat packing plant. In the Spring of 1940, he took a training course in airplane mechanics and then joined the Royal Canadian Air Force at 18.

Married to the late Margaret in Montreal in 1943 and released from military service in 1945, Al moved to Toronto to attend the university there; during these years, Al also worked as a floor molder at John T. Hepburn Foundry to support his family.

In 1951, Al received his BSME from the University of Toronto and moved back to Montreal to accept a position with Dominion Engineering. In 1957, Al brought his family to America and accepted a position as chief engineer at Beardsley & Piper in Chicago, a leading builder of machinery for metalcasting and the foundry industry at the time.

In the fall of 1963, Al left B&P to develop his concept for an automatic matchplate molding machine. In March of 1964, he founded Hunter Automated Machinery Corporation.

During his tenure at the head of the company, Al formed partnerships and reciprocal agreements with companies worldwide, a tradition that continues today, as Hunter Automated continuously seeks to serve its myriad customer needs for sand handling, testing, molding and finishing operations. Hunter Automated is known worldwide in the foundry industry and its machines are found on every continent.

During Al Hunter’s professional life, which spanned six decades, he invented and patented more than 80 machinery apparatus or method ideas, beginning in 1957 with Beardsley & Piper’s Rol-a-draw & “B Series” Speedmullor, among others. Al Hunter followed his departure from B & P in 1963 by starting Hunter Automated Machinery Corporation with the original HUNTER Model HMP-10 Automatic Matchplate Molding Machine in 1964. Many improvements and expansions of the Hunter product line occurred over the following years including - HMH, HV and HLH mold holding systems as well as larger flask size HUNTER molding machines.

Al developed various concepts used every day in foundry operations, including multi-level mold handling systems and automatic coresetters. His pioneering, can-do spirit will be missed by all who knew him and admired his total commitment to improving the world foundry market.

He was a member of AFS since 1960, was presented with the Society’s Management Service Citation in 1990 and received the foundry industry’s prestigious Grede Award in 2001. He held over 80 patents.

Al will be mourned by his 4 children, their spouses, his 13 grandchildren, 19 great-grandchildren and 1 great-great-grandchild, as well as his family of employees at Hunter Automated, who will carry on his legacy.

The Hunter family asks that interested parties please contribute in Al’s memory to the Foundry Educational Foundation, c/o AFS, 1695 N. Penny Lane, Schaumburg, IL 60173 or at www.fefinc.com. For more information, please contact Kevin Purdy, Vice President, Hunter Automated Machinery Corporation, kpurdy@hunterauto.com

Research fabrication facility to drive innovation

A cutting edge facility that will support key research and contribute to Australia’s innovative manufacturing sector has opened at The Australian National University in Canberra.

Opening the node of the Australian National Fabrication Facility (ANFF), Innovation Minister Senator Kim Carr said it would support cross-disciplinary research, addressing national and global challenges by researching and prototyping new materials.

This new initiative is a collaborative network involving more than 19 research institutions that gives researchers and industry access to state-of-the-art facilities which allow metals, composites, ceramics and polymers to be processed for application in sensors, medical devices, high resolution lenses and nanoelectronics.

Information on the ACT node is available at http://anff-act.anu.edu.au/

Green Car Innovation Fund grants

A further announcement by the Innovation Minister in Australia is to provide $6.2 billion in funding for the automotive industry to create lighter cars that will help reduce greenhouse gas emissions. It is expected that the new projects associated with this funding will create new technologies, skills and job creation.

The funding is being awarded to
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IMPORTANT: Personal Protective Equipment must be worn by anyone in proximity to molten metal.
component manufacturers CFusion, Toyoda Gosei Australia, Composite Materials Engineering and Hirotec.

The components being developed to retool the automotive industry are expected to reduce greenhouse gas emissions by around 133,000 tonnes and significantly reduce fuel consumption.

CFusion is using funding of around $1.4 million to commercialise the world’s first one-piece carbon fibre automotive wheel, at about half the weight of aluminium wheels.

Toyoda Gosei is using funding of over $2.3 million to introduce and refine technologies for manufacturing lighter components, namely body sealing products and safety system products, such as air bag modules and plastic interior trim products.

CFusion is using funding of $797,399 to develop a high strength, lightweight sandwich panel to be used in the load floor of Australian vehicles. This product will significantly reduce the weight of the load floor whilst meeting all of the performance requirements for this component.

Hirotec is using funding of over $1.6 million to produce lighter automotive components including aluminium hoods and deck lids using innovative product design to significantly reduce the overall weight of passenger motor vehicles.

Senator Carr said the Government’s $5.4 billion New Car Plan, which includes the Green Car Innovation Fund, was transforming the Australian automotive industry and ensuring significant co-investment from around the world.

For information on new opportunities for clean technology research and development, visit www.cleanenergyfuture.gov.au

China: lift in production for joint venture – SAIC and GM

The joint venture is proving a great success by raising its annual production capacity by 23 percent to 1.1 million units as well as just having completed expanding its plant at the cost of $173 million in the east China city of Qingdao. This enables production of 510,000 vehicles – up from 300,000 the previous year.

In addition to the Qingdao facility, GM has a second plant in Liuzhou that also is undergoing expansion. On completion of the expansion late next year, the Liuzhou plant will increase its annual production capacity to 800,000 units from now 590,000 units. This will raise the joint venture’s annual production capacity to 1.3 million units.

General Motors growth 7 -10 percent in China’s car market

GM has reported selling 240,244 vehicles in China during the month of September, up 15.3 percent from a year earlier. GM makes vehicles in China in partnership with SAIC Motor Corp. and FAW Group.

In 2010 18 million units sold. It has now reverted to a more subdued growth pattern after the government ended tax incentives for small car sales and subsidies for van buyers in rural areas.

Sales of passenger vehicles have held up better than the commercial market. Forecasts indicate passenger vehicle sales will rise 8.2 percent this year, while sales of light commercial vehicles are expected to decline 8.1 percent.

Manufacturing jobs and green innovation for Victoria, Australia

Cutting-edge power steering and drive line components that will make vehicles lighter and more fuel efficient will be manufactured by Australian workers and used around the world.

Nexteer Australia will receive $63 million in Commonwealth assistance over three years to help develop and manufacture its innovative lightweight technology and create more than 250 jobs.

Nexteer’s technology involves electric power steering systems, and lightweight steering column and drive line components – significantly reducing greenhouse gas emissions and fuel consumption. This technology will be supported by a new Melbourne Manufacturing Technical Centre, based in Victoria.


Australia and India cooperation to drive automotive opportunities

Building greater cooperation between the rapidly growing Indian automotive industry and world-class Australian firms will create new export opportunities and help secure the ongoing strength of the Australian auto industry.

Australia is looking to build closer links between its innovative automotive companies and the Indian market. The Minister for Australian Innovation said, “With the help of the Australian Government’s A New Car Plan for a Greener Future our auto industry has not only survived the global economic downturn but is transforming and becoming a world leader in new technology. This expertise makes our companies attractive partners for international companies. India is an extremely promising market for many Australian firms with Indian car sales over the past six years having grown by more than 130 per cent to a total of about 3.2 million vehicles.

The Indian automotive industry wants to develop more vehicle design, manufacturing processes and low emission technologies and Australia is well placed to provide these innovative products and technologies.

Earlier this year a new facility was created for SMR Automotive Australia—an Indian- owned company based in South Australia. The venture is creating new Australian jobs, skills and products through design and production of world-leading lightweight mirrors for cars.
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Australia's Bendigo Foundry wins global accreditation

Keech Australia, a 77 year old family owned foundry in Bendigo, Victoria, has achieved the seemingly impossible - an international quality accreditation.

"Two years ago we had no formal quality system. Our factory produces 74,000 different items for domestic and export markets, and we've had to develop procedures to ensure that every single one is produced to the highest international standard," explained Keech CEO Herbert Hermens.

"We worked with software developers Bendigo IT to create two computerised systems – The Way We Do Things and The Way We Make Things – to make sure our quality control process is spot on," said Mr Hermens.

The Global Mark ISO 9001 Quality Management is a worldwide accreditation program based on the established international standard ISO 19001 and required Keech to develop, among other things, a computerised quality management system to improve processes, product quality and production management.

Mr Hermens said achieving the Quality Management ISO 9001 Accreditation was crucial for Keech.

"ISO9001 underscores the capacity of our organisation to meet the highest standards of management control there is. As well, it gives our customers around the world confidence in our ability to meet their demands in terms of production and specialisation.

"It is an incredible achievement and reflects the reality that Bendigo people can lead the world when it comes to innovation and quality," said Mr Hermens.

Keech Australia is continuing their work towards securing more international accreditations and is on track to achieve Certification Standard AS 4801:2001 by the end of 2011. Their goal is to secure the OHS 18001 Accreditation at the start of next year and the Environment Management System - EcoWise Accreditation by the end of 2012.

Thailand - biofuels from non-food biomass

A form of renewable energy carrier, which is readily available in an agricultural country like Thailand, is biomass. Biomass can be converted directly into liquid fuels for transportation and other needs.

Thailand has well established R&D on renewable energy such as solar cells and in producing biofuels from non food biomass such as jatropha. The two most common biofuels are ethanol and biodiesel. Ethanol is mostly used as a fuel additive to lessen carbon monoxide and other smog-causing emissions from vehicles. Biodiesel can be used as a diesel additive to reduce vehicle emissions or as a diesel substitute. Thailand was the first country in Asia to fully commercialize bioethanol and biodiesel in all regions.

The Thai Biodiesel Producers Association established in June 2010 with 10 member companies estimates that current biofuel production capacity is around 6 million litres/day.

In collaboration with industry and universities in Thailand and Japan the National Metals & Materials Technology Centre (MTEC) has conducted a long term study of the use of ethanol-blended (10%) diesel or diesohol E10 in light-duty vehicles. MTEC research projects such as new design of screw press machines for oil extraction, new catalysts for biodiesel reaction, new oxidation stability substances and modification of the agricultural machine parts to allow direct vegetable oil/biodiesel usage. With the aim of standardizing and upgrading biodiesel fuel quality engine dynamometer and other test facilities at MTEC are financially supported by New Energy and Industrial Technology Development Organization, Japan (NEDO) grants under co-operation with the National Institute of Advanced Industrial Science and Technology, Japan (AIST). Funding support for biodiesel research is also provided by the Japan Science & Technology Agency (JST) and the Japan International Co-operation Agency (JICA).
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Severe flooding damages Thai industry

In Thailand the most severe flooding in 50 years has caused considerable damage to industrial estates and manufacturing industry. Across Thailand some 10 million people have been affected as one quarter of the country has been under water from run-off from higher than normal monsoon rains in the North. Due to their location in the Chao Phraya River flood plain seven major industrial zones in Ayuttaya and in Pathumthani in the northern part of Bangkok, where many Japanese automobile and electronics manufacturers are located, were submerged under floodwaters deeper than 1 metre and in some cases up to first floor ceilings. These estates are key centres for auto-parts manufacture for the vehicle assembly plants located in Chonburi and Rayong. At least 900 factories and 500,000 employees have been directly affected by the floods with damage to foreign investment companies estimated to be at least 150 billion baht. All production at the flooded Honda plant on the Rojana estate in Ayutthaya which normally turns out 1000 cars each day has been stopped.

Production is not expected to resume until the early part of 2012 or later since flood damaged production equipment and materials must be replaced and office and laboratory facilities restored. The Thai Board of Investment has stated that import duties will be waived on machinery and parts from Indonesia and Malaysia and international companies are importing parts from Indonesia and Malaysia and some are considering moving production to other countries such as China. Any longer term resourcing will add to the suffering of the Thai SME parts producers.

The Science and Technology Ministry in Thailand has forecast that climate change effects could result in 25-50 percent more rainfall as the rainy season is likely to start one or even two months earlier. Thailand normally has around 200 billion cubic metres of rainfall per year so the extra amount of water to be managed could be 50-100 billion m³.

Japanese companies who are the main investors in Thailand say that they intend to remain but have asked for comprehensive reviews and plans to ensure protection of plants from future flooding, especially with respect to possible climate changes. Current flood protection embankments and pumping facilities having proved to be inadequate and significant investment in infrastructure is needed to guard against future floods. For example, it is estimated that at least 1.2 billion baht will be needed to improve flood protection at the Rojana Industrial Park in Ayutthaya.

The clean-up, which started in November, has to tackle considerable environmental problems from floodwater, debris and deposits contaminated with waste and industrial chemicals. If future flooding is to be prevented the much wider environmental aspects of deforestation, water management and development planning to avoid disruption to natural drainage must all be correctly addressed.
Heat treatment focus is on energy

Like melting, heat treatment and surface engineering processes in industry consume large amounts of energy and the by-products of combustion and the dangers presented by salt baths and quenching oils, etc. add to environmental problems. The IFHTSE Global 21 project identified energy and the environment as the main external drivers for the future of heat treatment and surface engineering. IFHTSE has long established technical committees to deal with energy saving and environmental & safety aspects such that these important areas have nearly always been given special sessions at major HTSE conferences. Following a successful “pilot” event in Romania IFHTSE is jointly organizing with MTEC (National Metals & Materials Technology Centre, Thailand) the “1st International Conference on Energy and the Future of Heat Treatment and Surface Engineering” to be held in Bangkok from 25-27 June 2012. To cover as many aspects as possible the conference will have two tracks:
1. Energy management in heat treatment and surface engineering
2. Heat treatment and surface engineering in the manufacture of clean mechanical energy generation and supply systems.

The meeting in Polana Braov, Romania, held in November 2010, was under the theme "Reduction of energy consumption in heat and thermo-chemical treatment technologies and installations" and was organized by ATTIS – the Romanian Heat treatment and Surface Engineering Association. In the field of energy management in heat treatment & surface engineering this event identified some key topic areas for future discussion, namely:
- Information for effective control – data collection and evaluation, loss & waste tracking for feedstock and processes
- Energy auditing
- The legislative and regulations context
- Process changes and developments (shorter cycle times, lower temperature treatment, emission reduction, cleaner HT shops, new approaches, etc)
- Material aspects and the need for further research
- Energy sourcing strategies (alternate and renewable sources, short & long term solutions)
- Energy management as a subject in the education and training of engineers.

In the track on energy generation the following are considered important:
- Demands on HTSE practice imposed by components including tools and dies needed for their manufacture for energy generating systems
operating in difficult maintenance environments
• Low friction engineered surfaces
• Surface engineering to improve corrosion resistance
• Heat treatment of new and improved materials for seawater environments
• Processing of components manufactured from non-ferrous metals and non-metallic materials for energy purposes including fuel and solar cells.

It is hoped that the pioneering event in Bangkok will attract presentations in all of these areas and that the programme will appeal to plant and control equipment designers and manufacturers, HTSE plant operators, process modellers and suppliers of fuel, energy and atmosphere controls. Further information can be obtained at www.mtec.or.th/EFhtse2012.

Boeing deal could increase casting opportunities

An extended supply agreement between Allegheny Technologies Inc (ATI) Pittsburgh, USA and Boeing Co, Chicago is expected to provide an opportunity for greater use of ATI’s cast titanium products.

The agreement will be extended until 31 December 2018 and is focused on value-added titanium mill products with emerging opportunities for castings and forgings.

“The extension agreement recognises today’s supply chain requirement to provide more value-added titanium products,” said Rich Harshman, ATI’s chairman, president and chief executive officer.

“ATI’s strategic investments and acquisitions over the past several years provide the capacity and capability to produce titanium products from raw material to value-added mill products, as well as highly engineered and technically complex forgings and castings. ATI is well positioned to benefit from the expected unprecedented growth in Boeing’s build rates during the years of this agreement.”

Liquid Quenchants database project launched at IFHTSE 19th Congress in Scotland

Just over 150 delegates from 30 countries attended the 19th International Federation of Heat Treatment and Surface Engineering Congress held at the Grand Central Hotel in Glasgow, Scotland during 17-20th October (www.ifhtse2011.org). The conference was well supported by 15 sponsors and exhibitors. During the technical sessions 83 papers and 35 posters were presented with emphasis on existing and emerging surface engineering processes, modeling of processes and phenomena, quenching and distortion engineering, and on thermal & thermo-chemical processes for ferrous and non-ferrous alloys. Special sessions were held on multi-scale modeling of surface systems and on the IFHTSE “Global 21” project.

The aims of the Global 21 project, which began in 2005, are to review the current status (science, practice and business) of heat treatment and surface engineering and to look at the changes and developments that are needed during the 21st century [1]. To date some 14 keynote papers have been published by IFHTSE under the Global 21 banner to act as an ongoing reference source for both industry and research. Global 21 identified the need for a reliable database of the cooling intensities of different liquid quenchants characterized by testing under both laboratory methods and workshop conditions [2]. This has lead to a new international collaborative project entitled “Global database: cooling intensities of liquid quenchants” which was launched at the Glasgow congress. The collaboration involves IFHTSE, R and D centres, universities, heat treaters and suppliers of quenchants and equipment.

Phase 1 of the project will compile the database on a range of liquid quenchants so that the information can be used in Phase 2 for the development of advanced computer simulation models to eventually be used by industry as standard practice in predicting and hence optimizing quenching processes. The aim is reliable prediction of microstructure, hardness and residual stress levels in real components. In this way the difficulties in avoiding distortion and cracking in quenching work pieces with complex geometries can be considerably reduced.

Further information on this project can be obtained from IFHTSE (Robert.wood@ifhtse.org) and from the project leader Dr. Felde Imre, Bay Zoltan Foundation for Applied Research, Budapest H-1116, Hungary (felde@bzaka.hu)


AeroG Exoskeletal Arm Pioneer wins The Wall Street Journal’s Technology Innovation Award

The zeroG® Exoskeletal Arm Pioneer is being taken up by foundries throughout the world transforming the way castings are fettled and making this difficult task easier and safer for the operators.

Equipois Inc developer of the zeroG® mechanical arm technology, has been awarded a 2011 Technology Innovation Award from the Wall Street Journal. The company won the Innovation Award in the Manufacturing Technology category.

Equipois’s zeroG® technology is a mechanical exoskeletal arm that enables workers to maneuver tools and other objects as if weightless, with unmatched freedom of motion. As a result, companies can significantly reduce workplace injuries and increase quality and productivity, with annual returns on investment that can reach 200-500 percent. Many of the world’s top companies in aerospace, automotive, heavy machinery, and other manufacturing industries have adopted zeroG® as a new best practice.

For more information, visit http://www.equipoisinc.com.
New appointment to CSIRO Board – Australia

Dr Don Russell, Secretary of the Department of Innovation, Industry, Science and Research, has been appointed a part-time member of the CSIRO Board.

“Dr Russell has been an independent chair of State Super, a trusted advisor to Paul Keating in his position as Treasurer and Prime Minister and is a former Ambassador to the United States.

“His strong foundation in economics and his experience on a range of boards and councils will position him well to contribute to the corporate governance of CSIRO.”

Dr Russell will remain a member of the CSIRO Board for as long as he is Secretary of the Department, or until 2016.

Tod Morgan joins Dynaref Products

Dynaref Products is pleased to announce the appointment of Tod Morgan as Technical Manager, based in Sydney.

Tod commenced his working career in Sydney at Garden Island Dockyard Foundry in 1977, where he started as an Apprentice Moulder. Tod was the New South Wales representative in 1979 at the Melbourne AFI Apprentice Competition. In 1982 he was promoted to Foundry Foreman and in 1993 was made the Foundry Manager, he worked at the ADI Foundry until it was closed in June 1995. Tod joined Svenska Hoganas in 1996 as a Refractory Installer, and worked for Lafarge Refractories and Calderys as a Sales Engineer, he has trained overseas in the installation of refractories at the Lafarge Training School in France. Tod has been on the AFI council in New South Wales since 1993. In 1994 he became the President of the New South Wales branch of the AFI and has been the representative on the National AFI council since 1995.
**Adventure with Casting Technology – Wrap up**

The 2011 Australasian Foundry conference “Adventure with Casting Technology” was held at the Millennium Hotel in Queenstown, NZ in October.

Social events kicked off on the Sunday where attendees could choose from a variety of activities including: Golf, Fishing and a tour of a local hydroelectric power station – the Clyde Dam. Later that evening the conference was officially opened with a rousing Powhiri from a local Maori tribe.

Monday’s technical program started with a thought provoking paper from David Weiss, VP of Sales & Engineering at ECK Industries in the USA. David’s presentation was titled “The Final Frontier – The Next Thousand Years of Casting”. This paper kicked things off well for the day with other papers covering marketing and technical topics. Dr Morris Murray, then presented a paper on “Changes in High Pressure Die Casting Technology-Thin Walled, Heat Treated and High Dimensional Accuracy”. While there was only one high pressure die casting foundry present this paper was well received and gave us all an insight to the high pressure die casting world.

David Weiss finished off the day with a presentation on “Advanced Aluminium Alloys in the Foundry: New Chemistries and Composites”.

Monday night took us on a short ride to Moon Light Country for a “Southern Man” experience. Guests were welcomed off the bus with a dose of drench and cowboy hat. Later on a dog whistling competition was held provoking much laughter. Many people struggled to make a sound. Colleagues reported that some of them were silent for the first time ever.

Tuesday’s technical program was started with a presentation by Dr Gui Wang, Senior Research Fellow at CAST CRC on the “Ultrasonic Treatment of Steel Melts”. This was followed by our keynote speaker Alfred Spada, Editor/Publisher of the Modern Casting Magazine, USA. Alfred’s gave two excellent presentations, the first was titled “Global Casting, a Strength and Weaknesses Assessment”. Alfred finished off the day with a presentation titled “Developing a Metal Casting Strategy”.

Unfortunately due to the Qantas strike Daniel Leitner from Foseco was unable to make it to the conference to present his paper. This did however allow us to move the program forward so we could all watch the Melbourne Cup.

The conference was closed off later that evening with a banquet and a few drinks. Once again thanks to all those that attended and made the conference a great success.

- Gordon Muldrew - Chairman, Casting Technology NZ
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**Helping you:**

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- Increase throughput (more heats)
- Find the best value through the broadest range of products

**Visit us at Metal+Metallurgy China, May 9-12, 2012, Beijing**

欢迎于2012年5月9号至12号期间前来中国北京国际冶金工业展览会参观我们的展位

Come see the Z2 Syncarb, our energy efficient crucible for higher temperature applications. Only from MorganMMS.

一起来见证我们的Z2 SYNCARB 系列坩埚, 耐热温度更高，节能效能更佳。摩根熔铸系统全球独家供应。
BRIEFINGS

ACHT 2011 another successful conference

The 12th Australasian Aluminium Cast House Technology Conference and Exhibition (ACHT 2011) was held in September in Melbourne. The meeting, held biennially, was attended by more than 160 delegates from industry, research, suppliers and other associated groups.

The conference attracts an international audience with about 50% of the delegates from Argentina, Austria, Bahrain, Canada, China, Germany, India, Japan, Malaysia, Netherlands, New Zealand, Norway, Oman, South Africa, Spain, Sweden, Switzerland, United Arab Emirates, United Kingdom and USA coming together to discuss aluminium casting.

The technical program offers presentations that are both academic as well as those based on practical industrial experience. The 2011 conference was opened by Gretta Theobald Stephens from Rio Tinto Alcan providing an overview of aluminium production particularly in Australia. While aluminium prices are high, there are other challenges such as the volatility of the market, high Australian dollar, energy and emission costs, and labour pressures related to the resources sector boom. The need for continued focus on process improvements, cost reduction and innovation to meet customer needs set the scene for the meeting. There were presentations that looked both to the past and the future such as Ray Peterson’s (Aleris) presentation of dross processing patents. Peter Whiteley (Munimula Technology) presented a review of furnace developments with his usual passion. The Nilmani Best Paper was awarded to Guillaume Girard’s (Bell Bay) paper on alloying practices. Bound conference proceedings are available from Materials Australia.

The exhibition is an integral part of the conference which provides delegates with an opportunity to discuss products and services as well as networking opportunities. The sponsors and exhibitors included equipment manufacturers and suppliers as well as service and technology providers ably co-ordinated by Gabor Horvath (Furnace Engineering). A short course and cast house tour are also traditional offerings in conjunction with the conference. The short course on Billet Quality was presented by John Grandfield (Grandfield Technology) and Barbara Rinderer (Consulting in Partnership) to an audience of 27, and covered topics of extrusion, alloys, DC casting, melt quality and homogenisation. The site tour was to beautiful Tasmania and the Bell Bay smelter. Another successful meeting, and as one delegate commented, “One of the best conferences in the world”. ■
Shakeouts for every application

There are many options to consider when selecting the correct shakeout for your foundry. Throughput, casting metallurgy, and casting design play an important role in choosing a shakeout that will offer your foundry the highest level of satisfaction and payback.

General Kinematics offers every type of foundry shakeout available, as well as vibratory conveyors, casting coolers, and other technologies to create complete solutions for casting cleaning and transportation of your castings from the molding line to the cleaning area.

General Kinematics
Celebrating 50 years of innovative foundry solutions.

General Kinematics 5050 Rickert Rd. Crystal Lake, IL 60014 Ph. (815) 455-3222 www.gkfoundry.com
The abundance or resource strength of coal, sand, minerals, recycled metals, foundry consumables, refractories, and skilled labor and so on will be virtually redundant without adequate and uninterrupted supplies of water. Water should never be allowed to get scarcer than oil! Given China’s leading position in casting tonnage at 40 million tonnes a year, accounting for 40 percent of the global output, in excess of 600 million tonnes of steel, more than 25,000 foundries spread over State Owned, foreign invested wholly owned, JVs, local privately owned enterprises all will face serious viability challenges if this vital energy green issue – water is not given a priority today.

Currently, China's water consumption for every RMB 10,000 (approx. US$1,600) of industrial value-added is 5 to 8 times that of developed countries. Industrial water consumption mainly includes cooling water, water for heating power and machine tool and general washing. Among them, cooling water and its related systems account for nearly 80 percent of total industrial water consumption. The volume of fetched water in eight industries such as thermal power generation, iron and steel including foundries, non-ferrous metals, oil, petrochemical, chemical, paper mills, textiles, food and fermentation accounts for 60 percent of the national industrial fetched water (including direct cooling water for thermal power generation.) The efforts by the government to rely on “supply-side” solutions to water shortages, like the $60-billion south-north water transfer scheme, which is aimed at watering the arid north with water from the giant Yangtze River in the south, may not be sufficient unless the industrial sector restructures itself and innovates for future growth. In this context metal casting industries – be it foundries or steel mills or primary aluminum and NF smelting industries, should address “water challenges” and meet the same for sustainability.

Water is the fundamental source for the foundry world
Green is beautiful, valuable and it stands for longevity. Water is the fundamental energy source for the foundry industry. And foundries are the mother of all industrial utilities. This paper highlights the current water status in China, water challenges and a few concepts for us “the Foundrymen” to evaluate the same for conservation of water for future generations.

The current general status of water
The Chinese government has very ambitious plans for Year 2020. By then the economy is estimated to grow by 60 percent, and the proposals are to reduce water consumption by 60 percent for every dollar GDP growth in the 12th five year plan. Meaning virtually the same water volume of today to quench the thirst of its people and the industries! With increasing urban, rural and...
industrial water consumption, the water-consumption structure will undergo further adjustments. Therefore, requirements for quality water and guaranteed supply rate are getting high.

China is a country scarce in water resources. Its per capita water resource is about 2,200 m³, accounting for one fourth of the world average level. Because various regions are situated in different hydrologic belts and affected by the monsoon climate, China has an extreme imbalance in the distribution of precipitation over time and space. The distribution of water, land, mineral resources and related foundries, primary aluminum, copper and other NF and steel mills is not adapted to the structure of industrial and agricultural water consumption. With serious water pollution, the lack of quality water has exacerbated water supply shortages.

The growing concerns between the supply of and demand for water resources is obvious, current average national water deficit ranges from 35-40 b cubic meter, will be worse in times of excessive floods in one region and drought in other regions of China. Due to water scarcity, tension has grown from struggles over water between industries and urban life, agricultural production and the ecological environment. In recent years, urban water scarcity is also severe. The nature of water scarcity is shifting from engineering-oriented water scarcity to resource-oriented and quality-oriented scarcity. Urban water scarcity shows a tendency of evolving from a regional to a national challenge.

With economic and social development, the demand for water continues to grow. The consumption structure is continuously evolving. Just a decade ago the proportion of agricultural water consumption (including forestry and wetland) of the total dropped to 66 percent from 88 percent in 1980s, while the proportion of industrial water consumption doubled to 22 percent and urban domestic water consumption increased five folds at 10 percent as compared to the 1980s. 

A view of the construction of the 3 gorges dam on the Yangtze River, China.
China water challenges

It was oil to begin with, and minerals for which China has become a major and aggressive player and consumer of global resources. The fact is these natural resources exploration, mining and processing only add immense constraints on earth’s water table and hence we see unprecedented water challenges in China and its immediate neighbor countries like Asean, India, Brazil, and Africa.

- Pacific Asia—the region encompassing China and its neighbors in East and Southeast Asia—is a key driver of this global urban transition. Within the next decades, the region will account for about one-third of the world’s urban population growth, increasing by about 750 million people in absolute terms. By 2025, the world is expected to have an urban population of 5 billion people, of which 30 percent will reside in Pacific Asia’s cities. China makes up 22 percent of the global population but has around 8 percent of the worlds’ renewable fresh water only!

- Just 15 percent of China is arable land as compared to India’s 48 percent, but compare population it is almost the same.

- Throughout Asia and in China water is underpriced hence no incentive for real water business enterprises. Add to this the ageing pipeline and distribution bottlenecks.

- A third of China’s 660 cities do not have any water treatment facilities and nationally, only 56 percent of urban waste water is thought to be treated.

- Urbanization is yet another problem for water shocks – nearly a new city of 1.0 m population is created every year, the US has 16 major cities having one or more million population, China today has 170 cities of this size, expect at least 200 more cities to develop in next ten years.

- Much of grain growth is in the north but water is abundant in the south. Hence this is a serious mismatch.

- The northern plain, which is home for 400 m people, produces about a quarter of China’s grain but the aquifer beneath it is falling by 1.5m meters a year!

- Nearly 70 percent of China’s mainland population lives on 10 percent of land only, hence are the added burden of density: water table, ground water quality related to industrialization, animal farming and sanitation are all cause of water concerns.

China – Water supply and demand gap

<table>
<thead>
<tr>
<th>Size of gap</th>
<th>Surplus</th>
<th>Moderate (0% to 20%)</th>
<th>Severe (30% to 80%)</th>
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<td>Northwest</td>
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</table>

Gap between existing and projected1 demand in 2030

Percent of 2030 demand

Water demand by sector
Withdrawals, billion m³

GAGR 2005-30

2005 2015 2030

Municipal & Domestic Industry

Agriculture

1 The unconsstrained projection of water requirements under a static policy regime and at existing levels of productivity and efficiency.

SOURCE: China Environment Situation Fact Book; China Agriculture Annual Book; Study of China water resources strategy; China grain security planning; basin annual bulletin; press search; 2030 Resources group.
**Industrial water conservation concepts for foundrymen**

Industrial water consumption mainly includes cooling water, water for heating power and craftwork and washing, among them cooling processes and systems account for 80 percent of the total industrial water consumption. The volume of fetched water in eight industries including thermal power generation, iron and steel, oil, petrochemical, chemical, paper mills, textiles, non-ferrous metals, food and fermentation accounts for 60 percent of the national industrial fetched water. Some concepts that are worthy of consideration as listed below:

- Water circulation and foundry water network-scrap cleaning, cooling systems and melting, reheating, holding furnaces, heat treatment furnaces etc. Conserve by enterprise, process integration. Apply vapor-cooling techniques for high-temperature equipment such as reheating furnaces.
- Develop and promote vapor condensation recovering and re-use techniques for metal smelting, reheating and processing lines including molding and settling lines.
- Develop steam traps with lower blowing arte with relatively higher backpressure.
- Optimize the dust and oil removal techniques of vapor condensation.
- Develop exterior wastewater drainage re-use and “zero-discharge” techniques. Encourage and support enterprise exterior wastewater (sewage) re-use after treatment especially for cooling and general utility washing.
- Employ thin walled and light weight industrial fans in heat exchangers for efficient cooling with lower energy inputs.
- Encourage and incentivize highly efficient new-type side-filters and eliminate inefficient counter-washing side-filter facilities that consume a lot of water.
- Eliminate water treatment operating techniques that have a concentration of less than three times.
- Encourage and where feasible provide incentives for the use of desalinated water for medium-pressure vapor equipment and the use of softened water for low-pressure vapor equipment. Popularize the use of closed cycle water-vapor sampling devices. Research and develop hot water boiler and vapor boiler water treatment techniques that can realize “zero-discharge”, boiler vapor ash ejecting techniques and “zero-discharge” non-block wet desulfurization techniques.
- Develop equipment-using water conserving washing techniques. Popularize recyclable detergents or all-in-one detergents and washing techniques. Encourage carbon dioxide ice washing, microorganism washing, sprinkler washing, water vapor pulse washing and non-stop in-service washing.
- Using nanotechnologies develop and research non-water washing techniques and equipment such as environmentally friendly dissolvent, dry-cleaning machines and ionosphere washing.
- Encourage the application of ozone, ultraviolet light and other second pollution-free disinfection techniques during wastewater treatment. Develop and popularize the application of techniques such as supercritical water treatment, photochemical treatment, biotechnology driven absorbent carbon adsorption, and membrane methods in industrial sewage treatment.
- Restrict and gradually eliminate traditional cast iron and galvanizing pipelines and speed up the development of water pipelines that have strong mechanical strength, rigidity and are convenient for installation. Develop valves and pipeline components that are non-leaking, convenient for operation and supervision and have a long service life.
- Develop techniques and equipment, systems for the direct utilization of seawater for cooling.
- Optimize techniques, tools, gauges for industrial water supply pressure, liquid surface and water volume control. Develop swift, practical industrial water pipeline networks and equipment (appliances), leakage examination equipment, and instruments and technology-digital and PLC embedded.
- Dry slags/drosses dusting, transfer systems in smelting and refining processes.
- Reduce use of iron ore; minerals put more emphasis on recycled metals and alloys.

**Some promising initiatives taken by the Chinese government:**

- To spend US$126 billion by 2010-2012 waste water treatment plants and upgrading water distribution systems. Veolia and Suez of France have been awarded big contracts in this respect.
- Suez in partnership with New World Developments of Hong Kong was awarded a 50 year contract in early 2000 to pipe water to more than 850,000 residents in Chongqing.
- Expect to have similar 20 JV projects around China.
- China to shift water from south to north via three massive canals stretching thousands of Kilometers, cost estimates run beyond US$60 b, plan to shift 50 billion cubic meters of water.
- China coastal cities to have dedicated desalination plants for fresh water source.
- There are more than 1000 waste water treatment plants in China, but some operate at 60 percent capacity and the most do it at less than 30 percent. The problem is not the quantity of sewage water it is about the shortage of pipe line to bring dirty water to the treatment plant! This challenge will create several hundreds of new projects for pipeline-ductile iron engineering foundries for water safety.

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Casting are produced in sand moulds and core or by other special casting processes such as die casting, investment casting etc. Base sand used for mould and core making contain fine clay particles and various types of binders are used with base sand to produce moulds and cores. Both base sand and binders are sources of two major types of air emissions, namely suspended particulate matters (SPM) and volatile organic compounds (VOCs). Other casting processes produce relatively less air emissions. In sand casting foundries, the level of air emissions depends on the fine content in the base sand and the type of binder and additives used in mould and core making. Although the emissions take place in other sections of a foundry such as pattern making, melting and fettling, the present article compares the air emissions arising out of different moulding and casting processes, that contribute to the pollution in the mould and core making, pouring and shakeout areas of the shop floor significantly.

Green sand mould and sodium silicate bonded sand moulds
Majority of the castings are produced in green sand mould. Bentonite and water acts as a binder in the green sand moulds. Most of the foundries add coal dust and occasionally a hydrocarbon resin to a green sand moulding system to improve the surface finish of iron castings and to facilitate the separation of moulding sand from the casting surface during shakeout. When coal dust is added to green sand, the mould generates hazardous compounds due to incomplete burning and cracking processes in presence of limited amount of oxygen inside mould when liquid iron is poured into the green sand moulds. The emitted gases contain aromatic compounds, benzene and carbon monoxide. The heat of liquid metal removes water from the green sand mould, Therefore the carbonaceous and oxide residues from coal dust and clay particles are a source of SPM during shakeout. Sulphur present in coal dust may also release traces of SO₂ to the atmosphere.

The emissions in sodium silicate bonded sand mould depend upon the type of additive used in the moulding sand as a break down agent. These agents are organic in nature and hence can produce VOCs. However, due to strong bond of sodium silicate, relatively less SPM are released in this sand system during shakeout.

Sand moulds and cores with chemical binders
There are three types of chemical binders commonly used in foundries:
- Heat-activated binders are used in shell moulding / core making, hot box, warm box and core oil based processes for core making
- No-bake binders are used in moulding and core making
- Cold box process produces cores of high strength

IN SAND CASTING FOUNDRIES, THE LEVEL OF AIR EMISSIONS DEPENDS ON THE FINE CONTENT IN THE BASE SAND AND THE TYPE OF BINDER AND ADDITIVES USED IN MOULD AND CORE MAKING.
Emissions of various types of solvents (e.g. benzene, toluene, ethyl benzene, xylene etc) and other organic compounds (e.g. phenols and formaldehyde) takes place due to the use of resins, organic solvents, hardeners and catalysts in moulding and core making. Vapours of the solvents and other hazardous organic compounds are emitted during the mould / core making by heat-activated processes such as shell, hot box and warm box processes. Organic hazardous air pollutant (HAP) emissions may also be released during pouring, cooling and shakeout of castings produced by these chemical binder based processes by the thermal decomposition of the organic compounds. Phenol emissions are often associated with the use of shell process of mould / core making. Formaldehyde emissions are released during curing of hot box binders. Cold box systems using organic solvents may generate emissions of VOCs during core production and storage. Amines as catalyst in this system are the most significant emissions that may pose a potential hazard due to their low odour detection and relatively low exposure limit. Various potential hazardous air pollutants from chemical binder based mould / core making are listed in Table – 1.

To minimize the pollution problem in shop floor from these chemical binders, various new resins has been developed during the last three decades. Conventional phenolic shell resins contain up to 10% free phenol. Newer resins contain up to 90% less phenol. Therefore use of these new resins can reduce phenol air emissions up to 90% during resin coating on sand. Formaldehyde emission is of major concern during the curing of hot box binders. New resins developed over the past decades has led to the reduction of the emission of formaldehyde up to 85%. In addition to VOCs, chemical binder based processes also produces SPMs during shakeout of castings, which are carbon based fine particulates.

**Die casting**

In die casting, die and plunger lubricants are the potential sources of air emissions. Both oil and water based lubricants can generate emissions of VOCs, particulate matters and possibly HAPs. Oil based lubricants typically contain naptha and can generate much higher emissions of VOCs than water based lubricants. VOC emission from die lubricants can be reduced by the use of water based or solid lubricants. However the types and level of emissions will depend on the specific formulation of the lubricant.

### Table – 1 Hazardous air emissions (VOCs) from mould making and core making.

<table>
<thead>
<tr>
<th>System</th>
<th>Type of Binder</th>
<th>Air emissions (VOCs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot box / Warm Box</td>
<td>Phenolic</td>
<td>Phenol, Formaldehyde</td>
</tr>
<tr>
<td>Shell</td>
<td>Phenol formaldehyde</td>
<td>Phenol, Formaldehyde, Methanol</td>
</tr>
<tr>
<td>No Bake</td>
<td>Furan / Acid</td>
<td>Benzene, Phenol, Methanol, Toluene</td>
</tr>
<tr>
<td>Phenolic /Acid</td>
<td>Phenol, Formaldehyde, Methanol, Toluene</td>
<td></td>
</tr>
<tr>
<td>Phenolic / Ester</td>
<td>Phenol, Formaldehyde</td>
<td></td>
</tr>
<tr>
<td>Phenolic / Urethane</td>
<td>Phenol, Formaldehyde, Methylene diphenyl disocyanate</td>
<td></td>
</tr>
<tr>
<td>Cold Box</td>
<td>Phenolic / Urethane</td>
<td>Phenol, Formaldehyde, Methylene diphenyl disocyanate, Triethylene</td>
</tr>
<tr>
<td></td>
<td>Phenolic / Ester</td>
<td>Phenol, Formaldehyde</td>
</tr>
</tbody>
</table>

### Table – 2 Comparison of Air Emissions from different Moulding and Casting Processes.

*1 to 10 indicates estimated level of air emissions from minimum to maximum respectively.

<table>
<thead>
<tr>
<th>Moulding / Casting Process</th>
<th>Input Materials</th>
<th>Estimated level of Air Emissions*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green sand mould / Sodium silicate bonded sand moulding / core making</td>
<td>Sand, clay, water, coal dust, sodium silicate, other organic additives</td>
<td>4</td>
</tr>
<tr>
<td>Chemical binder based moulding / core making</td>
<td>Sand, resins, catalysts, hardeners</td>
<td>10</td>
</tr>
<tr>
<td>Die casting</td>
<td>Metallic die, lubricants</td>
<td>2</td>
</tr>
<tr>
<td>Investment Casting</td>
<td>Wax / polystyrene, Ceramic particles, ethyl silicate / silica sol, wetting and anti-foaming agents</td>
<td>4</td>
</tr>
<tr>
<td>Lost Foam casting</td>
<td>Loose sand, polystyrene / PMMA foams</td>
<td>5</td>
</tr>
<tr>
<td>V- Process of moulding</td>
<td>Loose sand, EVA plastic films</td>
<td>2</td>
</tr>
<tr>
<td>Sheet metal mould casting</td>
<td>Loose sand, sheet metal</td>
<td>1</td>
</tr>
</tbody>
</table>
**Investment casting**

Emissions are generated at several process steps of investment casting. Particulate matters are generated at the mould making area, during removal of investment shell after casting and during cleaning and finishing. Due to stronger nature of the binder in this process, less particulate matters are generated during the cleaning of investment castings compared to other conventional moulding processes.

Wax and rarely polystyrene are used as pattern material in investment casting. These are expendable pattern materials and hence are removed from the shell mould. Wax fumes are generated during dewaxing stage. If polystyrene is used as pattern material, HAPs such as benzene can be released during the removal of polystyrene pattern from shell mould. Ethyl alcohol is evolved in case of ethyl silicate binder used to make ceramic shells. Wetting agents and anti-foaming agents added to slurry may also produce VOCs during oven drying and firing of ceramic shells.

**Lost foam casting**

Emission of particulate matters is negligible in case of lost foam casting, since loose unbounded sand is used in this casting process. Most coatings on expanded polystyrene patterns are water based and do not generate emissions. Minor emissions are possible from glue used to join pattern pieces, if these are solvent based. However there may be large amount of polystyrene vapour emission, since expanded polystyrene foam is used as pattern material in this process. Ethylene and benzene are the precursors of polystyrene. Hence benzene is one of the hazardous emissions in lost foam casting. In addition to it, styrene, toluene, ethyl benzene, X-Methyl styrene and cumene are the other emissions during pouring into lost foam castings. There is also considerable debate regarding the release of certain aromatic compounds such as anthracene, naphthalene, phenanthrene, benzofluoranthene and benzopyrene during pouring of castings. The types of emissions from combustion of polystyrene depend upon the metal temperature. Higher the metal temperature, organic compounds with lesser molecular weight and less toxicity are formed. Therefore, hazardous emissions are less in case of iron castings than those from non-ferrous castings.

**V-Process moulding**

V- Process or vacuum process of moulding uses a thin sheet of plastic film to create vacuum in the mould box. During pouring the plastic film comes into contact with the liquid metal and burns out. Burning of the plastic film produces various organic compounds depending upon the type of the plastic film. Generally Ethylene Vinyl Acetate (EVA) films are used in the V-Process moulding due to its good strength and stretching capacity. Therefore the combustion products of EVA are generated during pouring. Since the plastic film used is very less, negligible amount of VOCs are formed during pouring. Since loose unbounded sand is used in this process, there are no particulate emissions in V- process castings.

**Sheet metal mould casting**

This is newly proposed casting process yet to be commercialized. Sheet metal is used to produce the mould in this casting process. Sheet metal mould is embedded in loose sand. Hence the process generates no emission during pouring. However if lubricants are used to form the sheet metals, negligible amount of emissions may be released during pouring.

Comparison of the air emissions from the moulding and casting processes are summarized in Table -2. It shows that, die casting and Sheet metal mould casting produces very low level of air emissions, whereas the chemical binder based processes generates very high level of air emissions, both VOCs and SPM. However each process has its advantages and limitations with respect to metal temperature, shape and size of castings and ease of cleaning of castings. Hence processes with low air emission cannot be used for all castings. However it is desirable that the processes with low emissions should be used wherever applicable to have cleaner production of castings.

**HIGHER THE METAL TEMPERATURE, ORGANIC COMPOUNDS WITH LESSER MOLECULAR WEIGHT AND LESS TOXICITY ARE FORMED.**
As per August 2010 data 89,808 villages in India have never seen a light bulb glowing in their hutments. They have been forced to live through the pitch dark nights, no street lights, no fans during hot summers, not even a single light indoors, thus leading a tough & unsafe life. Currently, over 35 million people in India lack access to electricity. These communities mainly living in rural settings are not grid connected, or grid does not have supply due to power deficit. They are forced to light up their homes in the evenings with kerosene or other fossil fuels. Kerosene not only gives poor lighting but at the same time acts as an impediment for overall development as well as hazard for human and environmental health. The open flame, smoke and soot from kerosene lamps endanger lives by reducing indoor air quality and increasing the likelihood of fire. Kerosene is expensive for the poor villager’s monthly budget. If the kerosene lamp is replaced with a clean solar light, at no running cost, it would make a major difference to their economy, health and environment. Each solar lantern in its useful life of ten years displaces the use of about 400-500 liters of kerosene thereby mitigating about 1.45 tonnes of CO₂, assuming 4-6 litres of kerosene consumption per family per month. It’s estimated that for 1000 families of a village cluster, 1,450 tonnes of CO₂ will be saved from the atmosphere helping to alleviate global warming.

The author through his NGO, “AAS Centre for Human Hope” under Kamalni Nilmani Charitable Trust has been providing free solar lights in villages where there is no access to electricity.
This has made significant improvement to the life of villagers; children now can study in the evening at home in brighter light of solar lanterns charged by solar radiations during the day women can take up small jobs of sewing to increase their income. Some of these villages are inside the national park in areas of man-animal conflict. Villagers stay inside the huts after dark due to fear of attack by wild animals. NGO is now in the process of providing them street lights to create a safer environment. The objective of the NGO is to contribute in eradicating the energy poverty in Indian rural sector through the application of solar renewable energy.

Through this social work, the author got an excellent opportunity to understand the use of aluminium in Photovoltaic System and other major solar power projects that are proposed for the distributed power sector where aluminium extrusions will play a significant role. AAS Centre for Human Hope is accredited by the Ministry of New and Renewable Energy to work for off grid solar applications under Jawaharlal Nehru National Solar Mission.

Aluminium Extrusions in Photovoltaic (PV) Systems

Solar lanterns are the most basic PV system. Besides the PV solar panel, one of the key components of the lantern is small light bulbs LED (Light Emitting Diodes). They provide sufficient light and consume very small amount of power thus continuously alight up to 8 - 12 hours on a fully charged battery. Good quality lanterns use High Brightness LED. To increase the life of these LEDs it’s important that the heat generated by the HB LED is dissipated efficiently. Since the heat transfer coefficient of extruded aluminium alloys such as LM 24 is almost twice that of die cast alloys, extruded aluminium is preferred as heat sink in quality lanterns. The PV solar panels use extruded aluminium frames. If 35 million such lanterns with aluminium framed panels are to be provided, consumption of extruded aluminium as heat sink, panel frames and fixtures will be enormous.

For the larger setup of solar panels on roof tops, aluminium extrusion is finding increasing use in the fixtures to hold the panels especially on the roof top. Aluminium in PV systems is used predominantly in construction/mounting structures (72% of total aluminium input), panel frames (22%), inverters (6%). High strength to low weight ratio and ease of mounting, fitting and corrosion resistance all these factors are driving the use of aluminium extrusions in solar systems. A recent review shows that between 23kg/kW to 59kg/kW of aluminium is used in the PV systems.

Since India lies at the tropic of cancer it gets abundant sunshine to make full use of solar energy. Solar energy has become an attractive source of renewable energy because of reduction in the cost of manufacturing of solar panel these days. In India, till September 2010, off grid installed capacity of solar PV power plants including street lighting was 100 MW.

“Jawaharlal Nehru National Solar Mission” was launched in India in January 2010, which promises to generate 1,000 MW by 2013 and 20GW by 2022, to deploy 20 million solar lighting systems and to achieve 20 million square meters solar thermal collector area. Current projections for the future indicate that the trend of 30% annual growth should continue for many decades to come. No village world wide should be left without solar power for lighting and other amenities that are taken granted by the urban population.

Note: Individuals or corporation who are interested in learning more about or supporting the efforts of the AAS Centre for Human Hope in reaching out to more villages in India that are living in darkness can go to the website: www.human-hope.org or contact Dr. Nilmami at ncsassociates@gmail.com for more information.
EUROGUSS 2012
When: 17-19 January 2012
Where: Nuremberg, Germany
From high-tech machines and new materials to efficient services, EUROGUSS sets the trends with innovative ideas and products. Around 400 exhibitors present the European die casting industry in Nuremberg— and you should be there too! Take this opportunity to approach your target group direct with your products, systems and services. As an exceptional dialogue forum for the entire die casting process chain, EUROGUSS 2012 is the ideal platform for this. Everything is perfect here: from the attractive accompanying programme and the quality of contacts to the professional organization.
Web: http://www.euroguss.de/en/

METAV - International Fair for Manufacturing Technology and Automation
When: 28 February – 3 March 2012
Where: Düsseldorf Trade Fair Centre - Germany
METAV, the marketplace for modern production engineering, is ideally suited for opening up new markets and cultivating contacts within the branch. Exhibitors at the METAV benefit from its cogent exhibition concept which attracts decision-makers in the relevant markets and brings supply and demand sides together. Visitors are offered ideal opportunities to gain an overview of the full scope of goods and services of modern production technology. This is where investment decisions are made!
Web: http://www.metav.com/

IFEX 2012 - The 8th International Exhibition on Foundry Technology, Equipment and Supplies, 3rd Cast India Expo concurrent with 60th Indian Foundry Congress & 2nd Asian Foundry Forum
When: 2-4 March 2012
Where: Bangalore International Exhibition Centre, India
IFEX will be an excellent platform for companies to showcase state-of-the-art technologies and services being offered to this vibrant industry to get exposed to new business opportunities. IFEX over the years has emerged as the most important platform for the foundry industry of the Indian Sub-Continent. IFEX with its rotational policy to organize the fair in different zones of India (North, South, East & West) on a pre-defined cycle helps its exhibitors to reach their potential customers from all over the country.

Cast India Expo 2012 – the first two editions of Cast India Expo organized concurrent to IFEX with exhibitors from across the country, who displayed their latest and innovative castings were very much satisfied with the outcome of these shows which was witnessed by leading casting buyers from India and abroad. With the success of these two editions we have taken the initiative to organize the third edition, Cast India Expo 2012 concurrent to IFEX 2012, 60th Indian Foundry Congress & 2nd Asian Foundry Forum. The presence of these casting manufacturers as exhibitors in the same venue will provide a ready customer base for Indian and International Suppliers.
60th Indian Foundry Congress & 2nd Asian Foundry Forum An annual event of IIIF, the 60th Indian Foundry Congress will be organized concurrent to IFEX 2012 & Cast India Expo 2012 at the same venue. Indian Foundry Congress is improving its standards and growing in terms of participation year on year. With 2nd Asia Foundry Forum also being part of this congress, the event is bound to attract more foreign delegates, exhibitors & visitors.
Web: http://www.ifexindia.com/index.html

eCarTec Paris 2012
When: 3-5 April 2011
Where: Porte de Versailles, Paris
After more than 100 years of development history of the combustion engine, electric mobility is now ushering in a new worldwide traffic era. The electrification of drives is an important prerequisite for future mobility. The federal German government has set a goal to put one million electric vehicles on German roads by 2020. But also the goal of France to have 100,000 vehicles on its roads by 2015 is rather ambitious. Countries such as the U.S., Japan and China have also recognized the enormous potential of electric mobility and are encouraging their industries with major programs in support of electrically powered traffic. eCarTec and its accompanying events provide a strong basis for international exchange on the leading markets in Germany and France. The trade fair covers the entire value added chain including materials, components, cells, batteries and the entire system and its application.
eCarTec Germany will be held October 23-25, 2012 at the New Munich Trade Fair Centre
Web: http://www.ecartec-paris.eu/
The 13th World Conference on Investment Casting
When: 15–18 April 2012
Where: Kyoto International Conference Center – Japan
The 13th World Conference on Investment Casting will be co-hosted by Japan Foundry Society Inc. (JFS), European Investment Casters’ Federation Society (EICF), Investment Casting Institute (ICI), and Cast Metals Federation (CMF). We hope that this conference will receive many participants that are the makers, the suppliers and the end users of investment casting all over the world.
Web: http://www.foundry.jp/wcic/index_e.html

Metal Metallurgy China 2012
When: 9–12 May
Where: China International Exhibition Center (New Venue), Beijing – China
China has become the most important engine for global economic growth. Foreign investors are showing a great interest in the Chinese market. China absorbed over $100 billion overseas investments in 2010. Beijing’s international influence also levelled and attracted over $6.3 billion in overseas funds. In 2011, China kicked off its Five-Year Plan (2011-2015). One of its targets is to speed up the construction & renovation of high speed rail networks, expressways, power grid and reservoir & irrigation systems. Great emphasis will be put on, and strict measures will be adopted for environmental protection, energy & resources saving, low carbon generation and scrap metal recycling to maintain the sustainable development of the metal and metallurgy industry and the whole economy at large. Take part in Metal + Metallurgy China 2012, and take advantage of this ideal platform to achieve greater Chinese market penetration.
Web: http://www.mm-china.com

ALUMINIUM 2012
When: 9–11 October 2012
Where: Messe Düsseldorf - Germany
ALUMINIUM is the world’s leading trade show and B2B-meeting place for the aluminium industry. It brings together high-calibre buyers, manufacturers, processors and suppliers. In Düsseldorf innovative products, the latest technology and services from primary aluminium production to semi-finished and finished products will be showcased.
Web: http://www.aluminium-messe.com

CastExpo ’13
When: 6–9 April 2013
Where: America’s Center in St. Louis, USA
Held every three years, CastExpo attracts thousands of decision-making metalcasters from around the world, all of whom are looking for the latest advancements in equipment, technology and services to advance their facilities.
The most recent show, CastExpo’10 held in Orlando, Florida in March, was a great success. The event attracted nearly 4,500 attendees and more than 350 companies from around the globe showcasing the latest technology, research and services available to the metalcasting industry. The attendees came with decision making power—27% were presidents, chief executive officers or owners, 22% were plant managers and 14% were vice presidents. The remaining 51% included engineers, sales representatives, and technical, production and maintenance personnel.
By popular demand, several of the new additions to CastExpo’10 will be included at CastExpo’13. The Cast in North America Pavilion on the CastExpo show floor allowed more than 40 metalcasting facilities (foundries and diecasters) to showcase their casting capabilities to buyers and designers in an unprecedented forum.
This area of the show was complemented by casting design and sourcing education in the Metalcasting Congress sessions. In addition, the Metalcasting Technology Theater, located on the exhibit floor provided practical shop-floor presentations for metalcasters.
Registration and exhibit information for CastExpo’13 will be available in 2012.
Email: dkruigman@afsinc.org
The mode of action of blind feeders

J. F. Meredith, Casting Solutions Pty Ltd

Introduction

One of the most fundamental problems facing the foundry engineer is developing an adequate design and position of feeders to compensate for the shrinkage that occurs as the metal cools. Most alloys contract as the liquid metal cools and solidifies, and this contraction must be compensated for by providing feeders (or risers) in appropriate positions. The feeder is essentially a reservoir of molten metal which flows into the casting cavity as the casting alloy cools and contracts, thus preventing shrinkage porosity from forming within the casting and ensuring a sound part.

Often, it is required to position feeders at low levels on a casting where it is neither practical nor economical for them to extend to the level of open top feeders. These low level feeders are completely surrounded by moulding sand and are commonly called blind feeders. The valve body casting in Figure 1 shows an example of open top feeders and low level blind feeders.

Figure 1. Model of steel valve body casting showing open top feeders and lower level blind feeders.

Figure 2. Mode of action of blind feeder, figure left at completion of pouring, figure right shows atmospheric release core penetrating through solid skin at top of feeder.
**Mode of action of blind feeders**

Shortly after pouring alloys such as steel, a skin of solid metal rapidly forms around the casting and feeder, this solid envelope isolates the liquid interior of the casting from the direct influence of atmospheric pressure. As the alloy continues to cool and contract, the pressure on the liquid interior will drop to below atmospheric and render the feeding system ineffective resulting in shrinkage in the casting.

After a solid skin has formed, a means must be provided to allow atmospheric pressure to act on the liquid interior of the feeder until after the casting has fully solidified. This is generally achieved by providing a sharply angled wedge or cone of moulding sand through the top of the blind feeder and penetrating into the feeder body. Such cores are commonly called “atmospheric cores” or “vacuum release cores”. The sharply angled point of these cores absorbs superheat from the metal and rapidly reaches a temperature in excess of the solidification temperature. The core aggregate must be permeable so that atmospheric pressure can act through it to the liquid interior. The depth of penetration of the core into the feeder body must be sufficient to ensure it reaches liquid until the end of solidification of the casting; generally a depth of 40% of the feeder diameter achieves this objective. This is shown schematically in Figure 2.

If a properly designed atmospheric core is not included in the feeder, subsequent solidification of the liquid inside the solid skin results in contraction which tends to form a vacuum. Atmospheric pressure acting on the surface of the solid skin may find a release where the skin is weak, such as at a sharp corner of the casting or feeder where skin formation is retarded. Figure 3 is

![Figure 3. Blind side feeder without atmospheric core on a steel Gate Valve.](image-url)
a steel Gate Valve casting sectioned through the blind side feeder and casting, the feeder (on right of photo) does not have an atmospheric core and atmospheric pressure has found release by puncturing the skin at the sharp junction of the side feeder neck and at a "hot-spot" corner of the casting.

Figure 4 shows a manganese bronze casting. Manganese bronze is a strong skin-forming alloy and the smaller blind side feeder also does not include an atmospheric release core. Atmospheric pressure has punctured the weaker skin in the corner of the feeder body and side neck.

With alloys which form a strong skin during solidification, atmospheric pressure acting on the liquid interior of a feeder can force feed metal well above the top of the feeder so as to feed parts of the casting at a higher level. Such an example is shown in Figure 5. In the case of steel with a liquid specific gravity of approximately 7, atmospheric pressure can theoretically support a column of liquid inside a solid skin of more than 1 metre above the height of the blind feeder.

Often it is required to include both open top feeders and blind lower level feeders on the same casting such as shown schematically in Figure 6 which represents the end of pouring.

As the casting cools and solidifies, and whilst there is liquid connecting the open and blind feeders, all feed metal is provided by the open higher level feeder (Figure 7).

In Figure 8, the connecting section between the upper and lower sections has solidified. From this time on continued solidification and contraction of the liquid in the lower sections will result in a pressure reduction and allow atmospheric pressure which is acting on the liquid in the blind feeder to force feed metal into the casting to compensate for ongoing shrinkage.

Figure 9 represents the end of solidification. Most of the feed metal has been supplied by the upper open feeder as it has supplied all feed until the connecting wall section has solidified. The lower blind feeder shows shrinkage initiated from the tip of the vacuum release core.

In cases such as this, the growth of the solid skin from the mould walls will be roughly the same in the casting as it is in the blind feeder. Therefore, it is necessary for the depth of penetration of the atmospheric core to exceed half the thickness of the wall section connecting the upper and lower sections to ensure the atmospheric core reaches the liquid interior of the blind feeder when the connecting wall has solidified. To be safe, it is better to make the depth of penetration equal to the connecting section thickness or 40% of the diameter of the blind feeder, whichever is greater.
Safety precautions during troubleshooting

Induction furnaces and their power supplies are high powered electrical units. Their operation routinely involves control of low voltage and high voltage power with currents in various components ranging from a fraction of an ampere to thousands of amperes. This equipment should always be treated as a high voltage system in which a shock hazard is deemed to exist. Therefore, the following safeguards shall be adhered to at all times.

Except for visual checks of the meters and lights on the outside of the furnace cabinet, **all troubleshooting, maintenance, and repair must be performed by a qualified maintenance person.** This qualified maintenance person must be able to recognize “shock hazards” and be trained in the safety precautions required to avoid possible injury or death.

DO NOT work alone when making measurements of circuits where a shock hazard might exist. Notify a nearby person that you are making, or intend to make, such measurements.

DO NOT touch any object which could provide a current path to the common side of the circuit under test or power line ground. Always stand on a dry insulating surface capable of withstanding the voltage being measured or that could be encountered.

Hands, shoes, floor, and area where test and repair is being performed must be dry. Avoid making measurements under humid, damp, or other environmental conditions that could affect the dielectric withstanding voltage of the test leads or test instrument.

For maximum safety, do not touch test leads or test instrument while power is applied to the circuit under test.

DO NOT make measurements using test leads of lesser safety than those originally furnished with the instrument or those recommended by the manufacturer of the test instrument.

Electrical equipment hazards

Electrical equipment hazards must be recognized at all times, therefore:

- Use extreme caution when making measurements where dangerous combinations of voltages (i.e., AC & DC) could be present, such as in the reactors, DC supplies, or leak detector systems.
- Remember voltages may appear unexpectedly in defective equipment. An open bleeder resistor may result in a capacitor retaining a dangerous charge. Therefore, “turn off” power and discharge all capacitors before removing a defective capacitor or before connecting or disconnecting test equipment to and from a power circuit being measured.
- Locate all voltage sources and accessible current paths before making measurement connections. Be sure the equipment is properly grounded and the right rating and type of fuse(s) is (are) installed (see National Electrical Code Section 250). Set the test instrument to the proper range before applying power.
- Open and lock out main circuit disconnect and be sure all capacitors are discharged before making any checks with an ohmmeter.

Voltage measurement

- Be extremely careful when working in high voltage power circuits. DO NOT touch the instrument or test leads while the power is on in the circuit being measured.
- When measuring line voltage, such as from a 120-volt, 240-volt, or 480-volt source, be sure that the range switch is set to the proper voltage position.
- Turn off power to the circuit and wait until the meter indicates zero before disconnecting the test leads and testing instrument.
- DO NOT change the range setting or function switches of the test instrument while the circuit under measurement is energized.
- Never disconnect the test leads from the circuit under measurement while the circuit is energized.
- Always turn the power OFF and discharge all capacitors that may be in the circuit before the setting of the switches is changed or the leads disconnected.
- Never exceed the circuit-to-ground voltage of the test instrument.

Grounding of electrical tools and test appliances

All electrical test devices, including tools and test appliances must be approved by a certifying laboratory (e.g., U.L.) and only approved grounding devices are to be used. They shall conform to the provisions of the National Electrical Code. All electrical tools for maintenance work shall be grounded in compliance with National Electric Manufacturer’s Association (NEMA) provisions.
All tools and appliances used in the melting system shall be equipped with the three-wire grounded power cord. These are to be used in conjunction with the grounded service outlets. Under no circumstances should any ground adapters or other means of “jumping” be used. Proper grounding practices must be maintained. If it becomes necessary to connect any temporary or special equipment to the power supply by some means other than a standard connection, electricians are to make certain that the equipment is properly grounded prior to use.

Inspect the power cord and test leads for cracks, breaks, or creases in the insulation, probes, and connectors before each use. If any defects are noted, replace them immediately.

Test instruments are designed to prevent accidental shock to the operator when properly used. Therefore, failure to follow directions for using the instrument could result in severe or fatal accidents.

When in doubt as to the voltage present, always use the highest voltage range as a protection to the instrument. If the voltage is within a lower range, the switch may be set for the lower range to obtain a more accurate reading. Be sure power is off in the circuit being measured and that all capacitors are discharged before connecting/disconnecting test leads or changing instrument ranges.

Mechanical equipment hazards

**Hot Surfaces** – personnel working in the furnace area should wear appropriate protective clothing to prevent burns and contact with hot metallic surfaces.

**High Pressure Blowout** – personnel must never try to tighten high pressure fittings with the system pressurized; hydraulic and other fluid systems shall be placed into a zero mechanical state (ZMS) prior to doing any work on the system. After turning the system OFF at its primary input source, verify that ON-OFF controls (downstream or interconnected at another point) are (OFF to verify a ZMS condition.)

If a joint leaks after being properly sealed, determine the cause and eliminate it. DO NOT attempt to stop leaking by tightening fasteners beyond their torque limits.

Uniform tightening of all nuts or bolts in a pressurized joint is of paramount importance to assure that all bolts and studs are equally loaded during operation.

Failure of safety devices could result in dangerous over-pressure if a pump continues to operate. Therefore, always check the safety valves with the pump operating.

Combustible and volatile fluids or materials must be kept away from the furnace area and modules to reduce the hazard of fire or explosion.

Equipment Guards – Guard must not be removed from the equipment for any reason, unless the machinery is tagged “out of service” and is physically and electrically disconnected. Equipment must not be operated without these guards.

The guards must not be cut, bent, or altered in any way except by authorized personnel performing authorized repair or replacement work. All mechanical equipment guards should comply with the Occupational Safety and Health Administration (OSHA) standards.

**Safety procedures during furnace relining**

Always wear approved respirators when handling dry vibrated refractory material.

Make sure ground probe wires contact the bottom of the furnace lining form or conductive crucible.

CAUTION: Failure to insure that ground probe wires are in contact with the lining form or crucible of the furnace could result in high voltage on the molten metal bath during operation. This could cause serious injury or death from electrical shock.

WARNING: The removal of slag or dross from the induction furnace lining is very important for several reasons.

Obviously, the removal of slag will eliminate the carry over of unwanted materials from previous heats that will contaminate alloys and will result in cleaner castings. In addition, the melting rate and efficiency of the induction furnace, which are a function of the ratio of the bath diameter to the coil diameter, will be maintained at a higher level if the bath is the full diameter for which the coil was designed.

Slag removal may substantially improve lining life as slag might trap metal against the lining and cause hot spots which would cause refractory damage. This could also result in an unusual but dangerous reaction that could cause the metal to erupt or boil over the top of the furnace.

When melting with conductive crucibles (of graphite, clay graphite, or silicon carbide), it is absolutely essential that the crucibles are kept clean. Slag or dross buildup on the crucible might cause overheating of the crucible.

In the case of a free standing crucible, this could result in cracking or blistering, leading to a runout.

In the case of a crucible installed with backup material, slag or dross build up could lead to localized overheating of the crucible which might cause a reaction between the crucible and the backup refractory. This reaction could result in the metal being thrown from the furnace, which might injure workers or onlookers.

In any case, overheating of the crucible is dangerous and would shorten crucible life and might lead to injury.

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**REFERENCES**


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Comprehensive display of the products and technology of foundry, casting, metallurgy, refractory and heat processing

Review of the 2010 Edition:
No. of Exhibitors: 1326 (Overseas: 256; Chinese: 1070)
No. of Visitors: 47693
Total Space: 106000 sqm

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