BMPCA
bulletin
The latest news & events from
BMPCA
British Manufacturing Plant Constructors Association
Issue 30 | November 2017

Specialist Melting Capability...

p14

Welcome

As we go to press with this issue of the BMPCA journal, the first interest rate in more than 10 years has been announced by the Bank of England, causing the pound to fall initially against the dollar and the euro.

Bank of England Governor Mark Carney also said within his statement that 'Brexit-related constraints' on investment and workers appeared to be holding back the potential growth of the economy.

That being said, economists have opined that the rise was unlikely to have a big effect on the economy because rates are still at the lows seen since the financial crisis.

So, what of our members and the industries and sectors they operate in? In fact, this issue is full of good news and an impressive ongoing commitment to development and innovation designed to ensure businesses are in the vanguard of development, with significant Unique Selling Points to offer.

The article about Industry 4.0 on page 4 makes a particularly fascinating read, outlining the changing landscape where digital meets manufacturing and Material Flow Analysis on page 10 is a must read! It's great too to hear of the new energy and investment that is helping to revitalise the steel industry and success stories such as Danieli in North America.

Interest rates and Brexit regardless, our members continue to lead the way with positive attitudes and great products and services - being the best they can be. And here's to that!

p3

BMPCA visit National Motor Cycle Museum

p5

Danieli is selected to supply Logan Aluminum...

p6

IAC extend sponsorship onto Dragons jersey

p7

Thermo Fisher Scientific: providing total solutions...

Message from the Chairman

We cannot avoid a mention of the Brexit negotiations. How many of us would want to negotiate a contract under such intense scrutiny? Trying to play your cards close to your chest is virtually impossible and no matter what you do, or whatever the result, there will also be intense criticism. It makes our job of negotiating with even the hardest of clients seem like child's play.

However, even with this uncertainty prevailing we have still seen a recent record high for the FTSE of over 7500. What would happen if this uncertainty was not around to supposedly temper the enthusiasm of the markets?

At the same time, most of the members of the BMPCA are enjoying an improvement in their businesses, regardless of whether they export or only cover the UK. This again suggests that the pessimism abounding in the press is somewhat overdone.

In the UK the recent owners of the steel production plants, Tata, Liberty and British Steel are all looking to invest in revamping, developing and even re-commissioning some of their plants. This renewed focus from the steel industry can only be good news for several of the BMPCA members who cover this market.

Over recent years many of the BMPCA members have been diversifying their business away from being dependent on the steel industry and therefore this increase in activity adds to their other workload coming from nuclear and other power industries. Even though the new nuclear build projects have been slow in developing, the de-commissioning of existing facilities has generated significant business for association members.

The Aluminium production market has also seen a renaissance with the Liberty takeover of the Lochaber Smelter and the development of an aluminium wheel manufacturing plant being proposed to utilise the output directly. The move to use more aluminium in vehicle production has also led to increased activity for Innoval around the globe as providers of consultancy specialists with production and process knowledge being utilised facilitating the changeover in many cases from less specialised production.

So to summarise, we have a near record FTSE, low exchange rate for the £ to both the $ and the € and most of our association members are enjoying increased levels of business.

Andy Orme Chairman

Please visit us at
www.bmpca.org.uk

BMPCA visits National Motor Cycle Museum

In keeping with the desire to hold our meetings in interesting venues, we visited the National Motor Cycle Museum at Solihull. Not only was the meeting room and the service we received first class, the museum itself just blew us away. In fact, it transported quite a few of us back to our misspent youth riding around on British made motorcycles!

There were literally hundreds of motor cycles on display, all of which were British made. Names that have long disappeared such as AJS, Matchless, BSA, Ariel, Vincent and many more. Models of bikes that were beyond our pockets then and even more so now. Each bike had been lovingly restored and was in showroom condition.

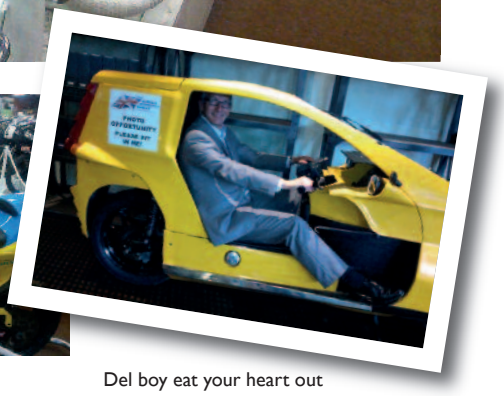
One model was a modern version of a classic Vincent motor cycle, illustrating how it might look if in production today. The Vincent 1000cc was one of the fastest production bikes that were available at the time and one to aspire too. The museum even has its own race team and their race ready Triumphs are on display.

The museum also had some rather eccentric models on show, including one that a member had taken a shine to! It was a wonderful experience and one that some of us will repeat.

Fully restored racing motor bikes


Modern day version of a Vincent 1000cc motor bike produced as a one off.


Race ready Triumphs


Del boy eat your heart out

Innoval Technology announces new Managing Director

As of August 1st, 2017, Dr Gary Mahon has become Managing Director of Innoval Technology (Innoval). Gary moves into his new position having been a Director of Innoval for the last 10 years. He is a metallurgist with 30 years aluminium product expertise and so is ideally placed to take the company forward.

Gary replaces Dr Tom Farley who, after much consideration, has decided to retire from the aluminium industry after 28 successful years. Tom joined Innoval at its inception in 2003 and was appointed Managing Director in 2007. Over the last 10 years he has successfully led the company and played a key role in the purchase of Innoval Technology by Danieli in 2012. The company would like to acknowledge his significant contributions and thank him for his commitment and dedication throughout the years.

SIEMENS

When *digital* meets manufacturing

John Inskip, Product Marketing Manager, Siemens UK & Ireland takes a look at some of the manufacturing possibilities afforded by the coming digital industrial revolution – commonly known as Industry 4.0.

There has been a lot of media attention regarding the term Industry 4.0, what it means, and how it will revolutionise manufacturing in terms of flexibility, productivity, efficiency and customer interaction.

Central to its successful adoption across the UK is the uptake of digital technologies and work is underway to ensure this happens. The launch in January 2017 of the Industrial Digitalisation Review, on the back of the UK Government's Industrial Strategy, aims to forge a roadmap on how best UK companies can adopt digital technologies and make the most of the opportunities the digitisation of industry offers the economy, in terms of supporting growth, high value job creation, skills and improving national productivity.

The panel leading the review will spend time reviewing and talking to stakeholders, influencers and large and small businesses to see how the design, development and deployment of digital technologies will support and drive the UK's digital industrial revolution – more commonly referred to as 'the fourth industrial revolution'.

This technological revolution will influence how we interact and relate, and will touch everybody from political representatives, academics, businesses and employees. The introduction of the cyber-physical world will change how manufacturing makes things and interacts with customers.

Without going into the history of the industrial revolution and the evolution stages that have happened over the past several hundred years, Industry 4.0 is being seen as a game changer.

But, what does this mean?

Industry 4.0 promises so much yet, many manufacturers currently view it as solely a strategy for large corporate organisations. This perception has led to a lot of scepticism and misunderstanding around the topic but, let's examine some of the facts.

Industry 4.0 is a confluence of several major innovative technologies which are in a state of stability and maturity. These technologies have the ability to transform manufacturing through tools such as robotics, advanced sensors, 3D printing, the Internet of Things, cloud computing and digital fabrication and simulation. Supporting this, new business and marketing models will underpin the new technology and manage a more organic relationship with customers and their requirements; linking all these requirements to the real world via smart phones/tablets and laptops.

Many of the technologies are spoken about from a silo perspective without joining together their combined respective strengths. For example, using cloud data can allow users to analyse their process and products and the condition of their machinery but, it can also build trends and analyse current performance and how to improve execution in the future.

Customer perspective

Looking at digitalisation from a customer point of view, we can predict scenarios where they could order goods and services from their device and the request is sent directly to the factory, customised to their individual requirements.

This type of interaction between business and customer requires more flexible and adaptable machines and processes with a requirement for interaction between human, robotics and machine solutions.

All of these resources will require enhancement, training and more design and how they interact with the outside world. For example, robots and machines could be capable of learning and optimising their performance to suit demand, intelligently monitor their own health and request maintenance. Human skill would encompass a better understanding of analytics, electronics, coding and mechatronic skills. Soft skills such as people management, emotional intelligence and complex problem solving are also seen as key.

When we look at product conception, PLM (product lifecycle management) 3D printing and digital fabrication, are methods by which a manufacturer can vastly reduce development timescales and costs and create rapid prototyping. PLM software can assist in the lifecycle and design of a product, ensure optimum design, and use 3D printing for models and to trial products. Based on such information, factory and machinery layout can be adapted to provide the optimum operational performance and efficiency to deliver the finished product.

How customers engage with businesses will also evolve into a more interactive and organic process. Customers may even be involved in the concept and design process, using customer feedback and experience to help refine the design.

A changing landscape

Do all these new found efficiencies, refined designs and optimised processes now allow manufacturers to investigate alternative ways of addressing the challenge of growth? Could knowledge-based services with manufacturers acting as consultants and service providers for their products, become feasible? Could the whole purchase model change so the user leases the product rather than undertaking full purchase?

Supply chains could also experience change, in addition to lean manufacturing practices, by becoming completely flexible. For example, the requirement for raw materials and delivery could be determined by plant cycle time and customer demand, and, in some cases, seasonal adjustment.

Future technology provider partnerships will be paramount for Industry 4.0 to succeed and the wide scale adoption of digital technologies to be successful. It will require a number of fields of expertise and we will see a number of key players working in partnership to drive maximum customer benefit.

To deliver the true potential of Industry 4.0, manufacturing, and even other industries such as health services, must prepare for digital transformation. Data management and cyber security will be paramount to both businesses and customers and many organisations may seek to adopt a two speed approach to Industry 4.0 to ensure the transition is smooth and does not disrupt business.

The coming digital revolution is an exciting time for manufacturers, service providers and customers and provides the opportunity to gain maximum insight into each other's requirements. It will revolutionise how we perceive manufacturing and will be the cornerstone of advanced manufacturing that will bring everlasting change to how we create, communicate and make 'things'.

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Danieli is selected to supply Logan Aluminum with the Worlds most Advanced & Productive Cold Mill

Tri-Arrows Aluminum Inc., which supplies rolled aluminum sheet for beverage cans and automotive uses, is investing $125 million to locate a cold rolling mill at Logan Aluminum Inc. in Logan County, in Western Kentucky.

Headquartered in Louisville, Tri-Arrows is a subsidiary of Tri-Arrows Aluminum Holdings Inc. (TAAH). TAAH was established in 2011, and is 75 percent owned by UACJ Corp., 20 percent by Sumitomo Corp., three percent by Itochu Metals Corp. and two percent by Itochu Corp.

Integral to this expansion is a new Danieli DiamondFlex 6-High Cold Rolling Mill (CM4 designation) to be installed in a dedicated new building on the Logan site for can-stock and for the forecasted substantial increases in demand for automotive flat products.

Logan has a worldwide reputation for the highest productivity mills with excellent product quality. The new Danieli DiamondFlex Mill (CM4) will further enhance Logan's capabilities by rolling 29,500 kg [65,000 lbs] coils with maximum strip width of 2133mm [84"] at speeds of up to 2200 m/min [7217 ft/min]. As well as CM4 being the fastest Cold Mill in the world, it will also be the most powerful with a nominal stand power of 9500kW [12,916 hP].

> "We are beyond excited for this expansion..."

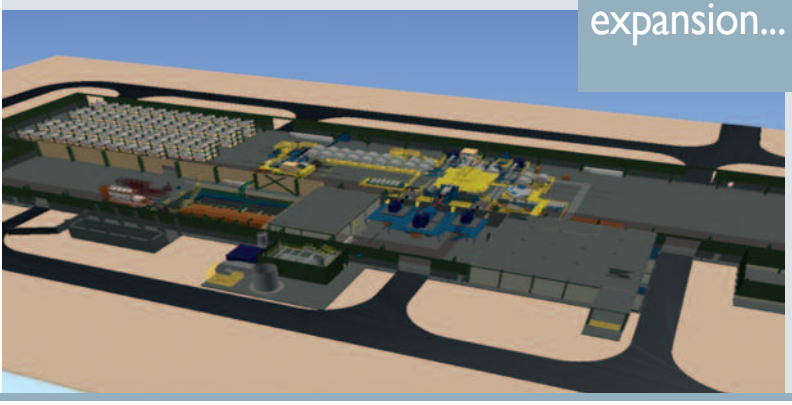
The close collaboration and partnership between Logan and Danieli will ensure that the CM4 Mill will encompass Logan's experience and expertise in operating and optimising high performance mills.

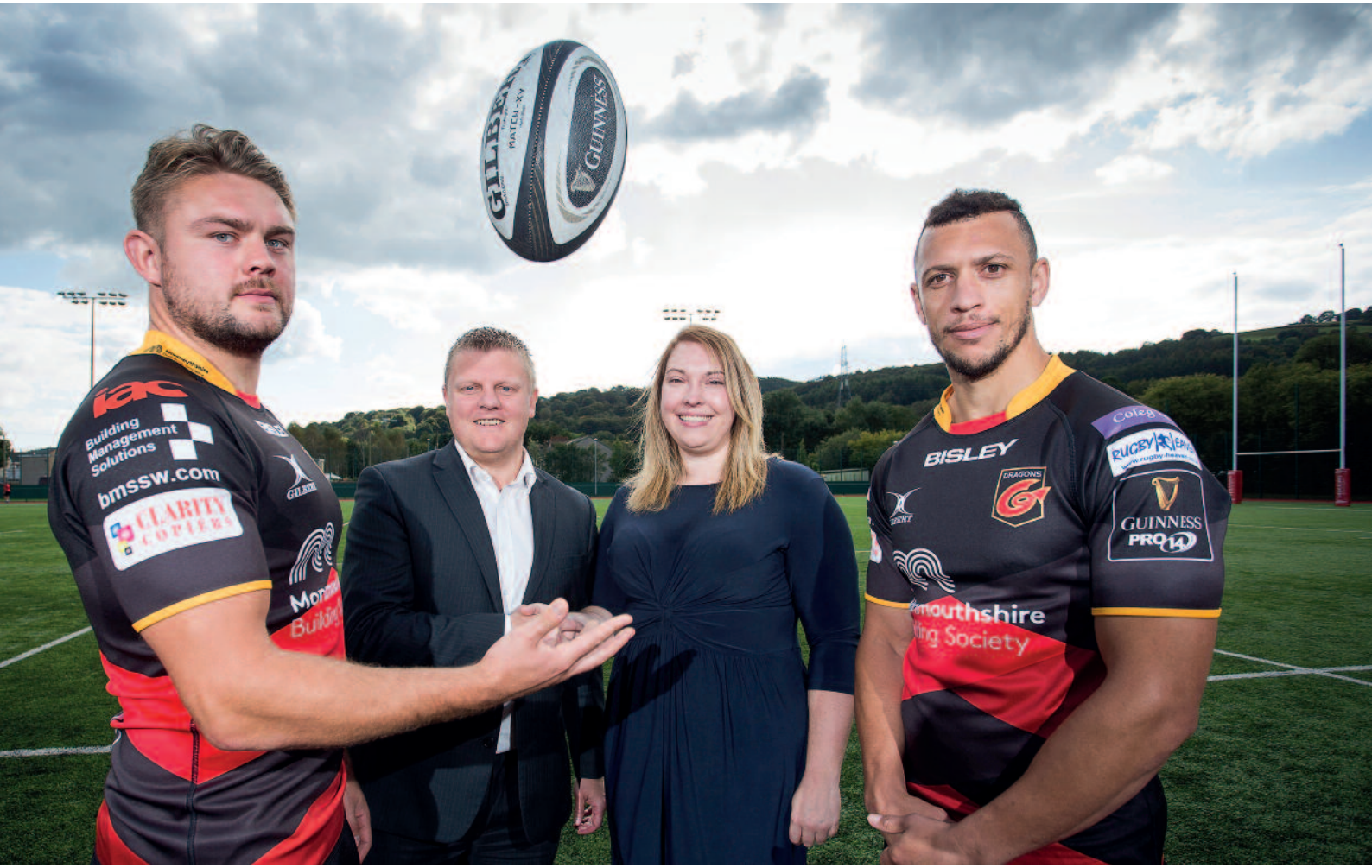
Henry Gordinier, Tri Arrows Aluminium, Inc. President "The Tri-Arrows, Logan Aluminum, and Danieli teams have worked closely to realize a project that will have a lasting impact, both to the future of our companies and to the markets we serve. This Danieli cold mill will expand our manufacturing capabilities to a broader range of products and significantly increase our overall capacity. As result, Tri-Arrows will be better positioned to serve our customers and the growing North American rolled aluminum sheet market."

Ken Perdue, Logan's Interim President "We are beyond excited for this expansion. This significant investment will allow us to be well equipped to maintain a strong position within our industry. Danieli was selected as the mill builder because of their flexible and collaborative approach to integrate Logan's operational experience and process knowledge into Danieli's design.

Furthermore, this project is important to our associate's customers, as well as our community's economy and the livelihoods of over 60 additional employees and their families".

Logan Aluminum Inc. is jointly owned by Tri Arrows Aluminum, Inc. and Novelis Inc. It is a world class manufacturer of aluminum sheet products with capabilities and experience in ingot casting, hot rolling, cold rolling, and finishing operations. Logan Aluminum, Inc. presently employs approximately 1250 employees.





IAC extend their sponsorship onto Dragons jersey

Dragons are delighted to announce that Industrial Automation and Control Ltd (IAC) have furthered their sponsorship with the region for the coming seasons.

The Queensway Meadows, Newport-based company will take pride of place on the Dragons home and away jerseys on the right hand side shoulder.

IAC is one of the leading industrial control systems integrators in the UK, with operations world-wide. The company operates from a modern facility in Newport, South Wales, employing over 65 people at this site and another 30 around the world.

Commenting on the new deal, IAC Ltd Marketing and HR Director Kath Lewis, said: "We are long term backers of the Dragons and are delighted to have been able to boost our support for the local team in this way."

As well as featuring on the playing kit, IAC Ltd will sponsor newly signed South African International Zane Kirchner and Dragons stalwart Lewis Evans.

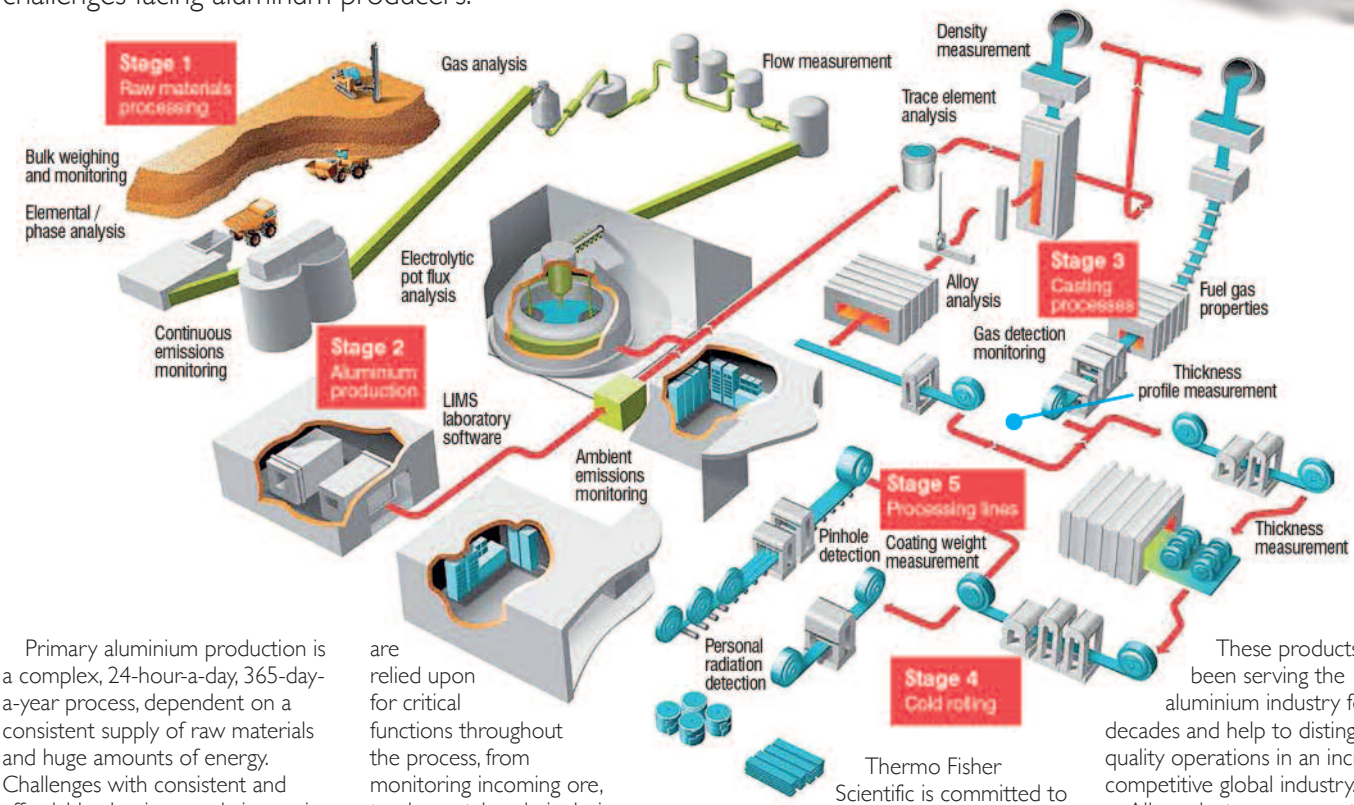
Dragons Commercial Sales Manager, Dai Jenkins added; "IAC have been a partner of the Dragons for many years.

"The company is an avid supporter of the Region and have a business in South Africa which works hand-in-hand with the expansion of the Guinness PRO14. It's a very exciting time for the company and we are delighted that they have chosen us to help promote their brand."

ThermoFisher SCIENTIFIC

Thermo Fisher Scientific: Committed to providing **total solutions for the Aluminium industry**

Aluminium is important to our way of life. Its resistance to corrosion, light weight, high strength and recyclability have made it an essential and often preferred material for products ranging from automobiles to building materials to beverage cans. It´s no surprise that aluminium production worldwide has grown dramatically, but as demand has increased, so have the challenges facing aluminum producers.



Primary aluminium production is a complex, 24-hour-a-day, 365-day-a-year process, dependent on a consistent supply of raw materials and huge amounts of energy. Challenges with consistent and affordable alumina supply, increasing energy costs and industry consolidation have prompted aluminium producers to develop new methods for gaining efficiency to remain competitive.

For producers and manufacturers throughout the aluminium process, Thermo Fisher Scientific offers a complete range of technologies to help aluminium production from primary or secondary sources, to end-product several-inches thick or less than one-thousandth of an inch. These instruments improve plant efficiency and product quality and are relied upon for critical functions throughout the process, from monitoring incoming ore, to elemental analysis during electrolysis, online measurements in the rolling mill and managing process data plant-wide.

Primary production methods have improved significantly over the past decade, and production from recycled materials is accounting for a larger portion of the total aluminium supply. However, these shifts in production require producers to be aware of, and willing to adopt, the latest technologies to lead the industry, both commercially and environmentally.

Thermo Fisher Scientific is committed to helping aluminium producers optimise their production process at every critical stage, from incoming raw materials to the final coating line. As the global leader in scientific and process instrumentation, they offer an unmatched breadth of products and services, extensive geographic reach and a long history of proven operational expertise. Thermo Scientific products are easy to integrate, set new standards for accuracy, and consistently generate the information essential to improve production and end-product quality.

These products have been serving the aluminium industry for decades and help to distinguish high quality operations in an increasingly competitive global industry.

All products are supported by an extensive network of qualified application engineers, who work closely with producers to understand and evaluate specific production parameters. These experts help aluminium producers choose the right instruments for their application, then keep them performing to spec. Their goal is to optimise processes today and lay the foundation for easy upgrades in the future.

thermo scientific

Flat sheet gauging

Thermo Scientific gauging systems provide accurate, fast, non-contact and non-destructive measurements online.

Thickness gauges for hot- and cold-rolling mills provide precise real-time measurements during high-speed production of aluminium plate, sheet and foil.

Sophisticated alloy compensation algorithms based on fundamental physical properties have been developed to meet the tightest tolerances for all alloys and clad products. The range of paint, primer and organic coating weight gauges offer cross-profile measurements for coil coating lines to ensure uniformity for better quality and less waste.

Emissions monitoring

Thermo Fisher Scientific has a breadth of products for monitoring ambient air and process gases during various stages of production. At the power plant, continuous emissions monitoring systems are able to extract a sample from the source, filter particulates, remove moisture and dilute the sample for analysis of the sample gas. Ambient air analysers are integrated systems complete with gas analysers, meteorological sensors, data recording devices and signal transmission instrumentation. These analysers ensure that the Selective Catalytic Reduction (SCR) and Flue Gas Desulfurization systems are operating at peak performance, reducing operating costs and lessening environmental impact. For process and personnel safety, oxygen, hydrocarbon and toxic gas sensors, housed in explosion-proof structures, are also available.

Elemental/phase analysis

The detection and analysis of trace elements and alloys throughout production is faster and more accurate using Thermo Scientific spectrometry technologies. Both X-ray fluorescence (XRF) and X-ray diffraction (XRD) techniques are offered to meet the need for greater sensitivity along with lower limits of detection, from raw materials processing through alumina extraction (electrolysis) in the production of aluminium and its alloys. Optical emission spectrometers (OES) bring laboratory analysis to the rolling line as well for high performance in a rugged, stable system. All systems feature modular construction for optimal configurations along with operator friendly control software.

The quality of the analysis results can be further enhanced with automated sample-handling systems that improve dependability by eliminating subjective factors. The Sample Manipulation System (SMS) is a robotics-based platform that fully automates sample preparation and analysis, including registration, result distribution, instrument control and standardisation.

Gas analysis

Thermo Scientific high resolution mass spectrometry systems take discovery and sample analysis to new heights with high throughput, quantitative workflows for many applications.

The mass spectrometer product range provides fast on-line accurate analysis of the properties of a wide range of fuel gases. These measurements include calorific value, density, specific gravity, Wobbe Index, stoichiometric air requirement and CARI as well as complete compositional analysis.

Flow, density & level measurement

Thermo Fisher also offers a line of density gauges to help control bauxite slurries or the mix of additives under the most challenging process conditions, in pipe sizes that range from 1 to 40 inches.

For level measurement both continuous and point level gauges can be supplied to enable tighter control of process materials in vessels and hoppers.

These density and level instruments are powered by unique measurement technology that provides highly accurate readings via extremely small energy sources, to minimise capital expenses and increase plant safety.

In addition, a patented Dynamic Process Tracking system is available: This system immediately responds to changes in the process, then returns to stable operation, ensuring continuous, reliable measurement.

Data acquisition and management

Thermo Scientific information management systems acquire, track and store data from samples collected at all stages of the aluminium process: These systems make it easier to compare process data with production and adhere to regulatory standards by effectively capturing information and exporting it to other plant systems. Functionality designed to ease compliance includes management of training records, instruments, stocks and suppliers, and ensures that only trained analysts and in-service instruments can be selected. In-built workflows make it easy to graphically configure the system so that it drives users through the unique processes that exist in every lab and automates decisions throughout the subsequent production processes.

For more information on the complete range of Thermo Scientific measurement and analysis equipment for the aluminium industry, visit www.thermofisher.com/metals

Material Flow Analysis: a simple approach

by Helen Forrest
Helen's areas of expertise are in the tools and techniques of Lean Manufacturing, knowledge management and marketing communications

Sometimes it's the simpler improvement techniques that are the most effective. Material Flow Analysis is one such technique. In this article I'll outline the benefits of a simplified version and tell you a little about what's involved.

BENEFITS OF MATERIAL FLOW ANALYSIS

Material Flow Analysis is a very straight forward but effective way to improve efficiency whilst engaging your workforce. Any plant, regardless of product, can do it.

The purpose of Material Flow Analysis as I describe it here is to:

- **Reduce the number of non-value adding activities, such as moving material around the plant**
- **Minimise handling damage**
- **Reduce inventory**
- **Decrease lead times**
- **Improve customer deliveries and service**

Furthermore, if material moves around the plant in a logical and efficient manner, it makes everyone's job safer and easier.

THE MATERIAL FLOW ANALYSIS PROCESS

Material flow analysis has been around for a long time and there are many ways of doing it. Often the method involves creating a complex and detailed flow chart using different symbols to represent different types of activity. These activities include operations, transportations, storage, delays and inspections. Sometimes 'handling' and 'decision making' can be included too.

However, the method I'm going to touch on here is much simpler. I have used it many times in aluminium extrusion plants, and I have been able to measure the impact it's made. The best part is that you don't need anything other than an Excel spreadsheet, some paper, pens and a small team. Your team should be a mixture of people from different departments, and include both shop floor and office personnel if possible.

There are many different flow paths within a plant, so the first thing to do is to analyse the different flow paths by volume. You should choose the highest volume flow paths for analysis. This ensures the improvements you make will have the greatest impact.

CAPTURING THE CURRENT SITUATION

First of all, you need to thoroughly examine the current material flow for the flow paths you've chosen. You can do this by breaking down the material flow into a sequence of activities. To keep it as simple as possible, you should describe each activity as either an **Operation**, a **Transportation** or **Storage**.

Every time the material moves, for example via a conveyor, crane or forklift, you should record it as a Transportation. Whenever the material waits, and this could be in a designated storage area or in a queue for the next piece of equipment, you should record it as Storage. Everything else is an Operation.

By breaking the material flow down into these component parts, you can easily identify how you can make the flow more efficient.

To a flow analysis 'purist' this is an over-simplification. However, the aim is to get the team out onto the shop floor and questioning the status quo as quickly as possible using a method that everyone can understand.

WALKING THE SHOP FLOOR:

- **Working in pairs and starting at the beginning of the process, follow a unit of material through the plant to the shipping area. A unit of material might be a basket in an extrusion plant, a coil in a rolling plant or a box of components in a fabrication shop.**
- **Record and measure EVERYTHING that happens to the unit on a log sheet. For an Operation you should record its duration (in minutes). For a Transportation you should record the distance travelled (in metres) and the time taken (in minutes). Finally, for Storage you should record the number of units and the average time spent waiting (in minutes).**
- **You should also trace the unit's path on a plant drawing to give you a visual representation of the material flow.**

It's very important to physically follow the material around the shop floor. This is because you must record what actually happens, as opposed to what you believe is supposed to happen!

iStock.com/zdravkovic

Figure 2.
When analysing material flow, it's important to physically follow a unit of material around the plant so you record what really happens.

MAKING IMPROVEMENTS TO MATERIAL FLOW

Often inefficient activities, such as moving a container from one storage area to another without any value-adding activity, become part of everyday life. It usually takes an activity such as Material Flow Analysis to examine what is actually happening on the shop floor and to question it.

istock.com / Albert Karimov | istock.com / photonewman | istock.com / photonewman

Figure 1. From extrusion billet to warehouse. How efficient is the material flow and can it be improved?

When examining a flow path it is important to think about every activity within it and to ask yourself these questions:

- **Why is this activity necessary?**
- **Where should it be done?**
- **When should it be done?**
- **How is the best way to do it?**

When trying to improve flow you should also consider the following:

- **Can you eliminate unnecessary activities?**
- **Is it possible to safely combine activities?**
- **Can you rearrange activities into a better sequence?**
- **Can you simplify the activities?**

A good example of combining activities is to pack straight from the line. If this is possible, you can eliminate several Transportations as well as some Storage. This is a popular solution for improving material flow in machine shops.

As you walk around the plant everyone in their pairs will see opportunities to improve the material flow. Therefore, it's best to work as a group to discuss the various ideas before coming to a consensus. You could end up completely reorganising parts of the plant!

You can compare your ideas for an improved flow with your current situation by looking at the numbers of each activity and their measurements. The best way to do this is by transferring the information for the current situation and your improved situation to an Excel spreadsheet. You should update your plant drawing too. Now it's time to arrange a trial.

Once you've made the improvements, it's a good idea to repeat the analysis to verify the benefits and to look for further improvements to the flow.

HELP WITH ANALYSING YOUR MATERIAL FLOW

Although material flow analysis is a very simple exercise, it often works best when facilitated by one of our consultants. We've done it many times before, plus we bring a fresh set of experienced eyes with us. We also have tools available to help with the recording and the analysis of material flow.

Usually after one 3-day workshop, your team will know the process well enough to repeat it themselves. If you'd like to know more, please get in touch.

Upcycling: an important addition to our vocabulary

by Geoff Scamans
Geoff is our Chief Scientific Officer. He has 40 years of experience in aluminium alloy science and technology, and he's a Professor of Metallurgy at Brunel University.

Recycling is not a new concept to the aluminium industry. Nearly 60% of the aluminium we use in the UK is recycled metal. However, the challenge now is to produce higher grade aluminium products from old scrap. This is what we term upcycling.

THE CASE FOR RECYCLING ALUMINIUM

The End of Life Vehicles Directive states that we should recover or reuse 95% of a vehicle's weight. On top of this, we need to reduce carbon dioxide emissions from metal production and vehicles.

Both of these mean that the amount of aluminium in a vehicle, and the amount of recycling, must increase.

Legislation aside, there is also a strong environmental argument. Remelting aluminium consumes only 5% of the energy needed to produce the primary metal, as well as preserving natural resources.

CHALLENGES TO RECYCLING

There are major challenges in terms of the quality of metal from recycled end-of-life scrap. This is proving to be a barrier to recycling aluminium, particularly into high performance automotive applications. Here, the use of primary metal based alloys predominates.

Figure 1: The target is to recover or reuse 95% of a vehicle's weight

Figure 2: We need to develop appropriate sensing and sorting technologies

Firstly, the industry needs to develop appropriate sensing and sorting technologies. We need these to separate wrought and cast aluminium alloys, and then to separate the wrought alloys into their families.

The main issue after this is the increased amounts of inclusions and impurity elements in recycled post-consumer scrap. These inclusions can cause severe losses in ductility and strength. Furthermore, certain impurity elements significantly reduce corrosion resistance.

Iron is the most significant impurity element to control. Conventional wisdom states that we must reduce the amounts of such inclusions and impurities by a chemical refinement approach. However, this is a high cost and low efficiency process.

The alternative is dilution with primary metal, but this adds both cost and embedded carbon, both of which we want to avoid.

THE UPCYCLING CONCEPT

Innoval Technology is working with the Brunel Centre for Advanced Solidification Technology (BCAST) to develop recycling technologies to process aluminium scrap.

The technologies involve high shear melt processing. This is a simple low-cost method, developed by Zhongyun Fan at Brunel University. It produces higher grade aluminium products from old scrap. We call this approach upcycling as opposed to the current concept of recycling, where we convert scrap into an existing or lower grade alloy.

MELT CONDITIONING TECHNOLOGY

The BCAST high shear melt conditioning technology provides a family of step-change metal processing techniques. It produces high quality and low cost metallic components or feedstock materials directly from melts of post-consumer scrap. Following melt processing, solidification takes place under controlled conditions of uniform temperature, uniform chemistry, well-dispersed nucleation agents and fast heat extraction.

The technology is particularly effective for the direct chill (DC) casting of rolling blocks and extrusion billets. It's also effective for twin roll casting (TRC) of thin strip with a low force roll caster. The result is a refined cast microstructure with increased tolerance to inclusions and impurities, and improved mechanical properties, Figure 3.

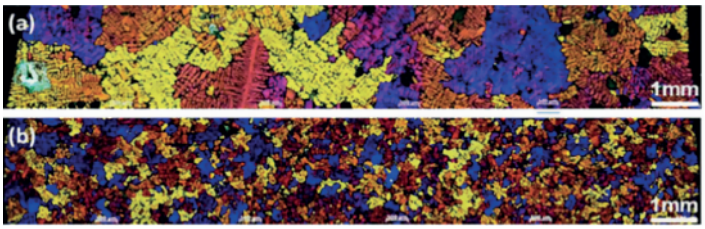


Figure 3: Microstructures of sand cast LM25 components (a) conventional sand casting; (b) melt conditioned sand casting.

This novel technology has the potential to blur the distinction between cast and wrought alloys. It aims to deliver alloys based on secondary metal with equivalent properties to those made from primary metal. As a result, upcycling could make aluminium more economically attractive to car manufacturers. Consequently, this could dramatically increase the amount of aluminium in automotive applications..

PARTNERSHIPS

We're delighted to be in partnership with BCAST and their main industrial consortia partners (Jaguar Land Rover and Constellium) to bring this exciting new technology to applications within the UK casting industry across all casting processes.

Solidification under Zero Gravity

We've been involved in some really fascinating projects over the years. However, the one I'm going to briefly describe in this article is definitely one of the more unusual ones. Have you ever thought what would happen if you cast aluminium in space? Or, rather more specifically, how solidification changes under zero gravity conditions?.

by Ceri Williams

Ceri is one of the newer members of our Materials Development team. She specialises in developing new analysis techniques to solve any materials related problems. Ceri holds a DPhil in Materials Science.

CASTING CHARACTERISTICS

Producing useful things from aluminium usually involves starting with molten metal. Hence, one of the most fundamental production routes is simply to pour the molten metal into a mould to produce a casting.

With cast products in particular, it is easy to see how the properties of the resulting component are linked to the solidification process. How the initial crystals nucleate, grow and interact with each other as the molten metal cools and solidifies can cause huge differences in characteristics such as grain size, precipitation and chemical segregation profiles. These then influence the mechanical properties and fracture behaviour of the final component.

THE EFFECT OF GRAVITY

There are complex physical processes at work at the dynamic solid-liquid interface, which is usually far from equilibrium. On Earth, gravity creates natural convection in the melt. Therefore where there are density differences between the solid and the liquid, the newly formed crystals may float away from the solidification front and re-melt. Solidification under microgravity is a unique way to remove the effects of buoyancy.

Innoval is working with academic partners at University College Dublin on the European Space Agency XRMON project to investigate the solidification of aluminium alloys under zero gravity conditions. As industrial partners, we've supplied some commercial alloy material as well as advice on commercially relevant alloys to study.

HOW IT'S DONE

In order to fully understand what's going on during solidification, it is invaluable to 'see' the process first-hand. One of the main aims of the project is to record the solidification process in-situ using x-ray radiography.

The mechanics of recording such data are difficult enough on earth. However, imagine the added complexity of trying to fit a controlled furnace, and the recording instrumentation, on a 17 inch diameter rocket! To achieve the zero gravity conditions required, the research team must do exactly this. Furthermore, the timing of the experiment has to be perfect. The rocket is fired over 50km above the earth's surface and experiences weightlessness for only ~6 minutes. It occurs as the payload separates from the fuel

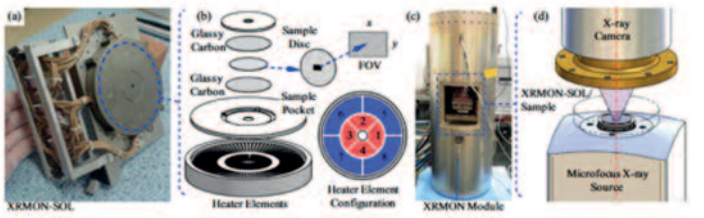


Fig.1. (a) Flight model XRMON-SOL prior to installation in the XRMON module on board the MASER 13 Sounding Rocket. (b) Exploded view of the internal XRMON-SOL furnace assembly showing the encasement of the sample disc (ϕ21.0 x 0.2mm) between two glassy carbon discs and then sealed within a boron-nitride pocket mounted on top of the heater elements. Labels 1-8 of the Heater Element Configuration indicate the relative location and arrangement of the eight independently regulated heater coils. The field-of-view (FOV) *x-axis* and *y-axis* represent the physical extent of the X-ray field-of-view relative to the sample diameter, horizontally (~4.1mm) and vertically (~2.7mm), respectively. (c) XRMON module with XRMON-SOL installed, prior to integration on board the MASER 13 Sounding Rocket. (d) *In situ* X-ray diagnostics configuration inside the XRMON module, comprising a microfocus X-ray source and X-ray camera mounted inline with the module/rocket axis.

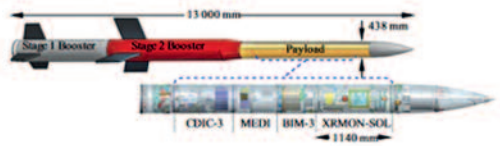


Fig.2. Schematic illustration of the fully assembled MASER 13 Sounding Rocket, consisting of two booster rocket stages, the payload assembly, and finally the nose cone/recovery system. The scientific experiment payload comprised four separate experiments, with the XRMON module mounted at the front, behind the nose cone/recovery system.

source and completes an arc on its return to the ground by parachute.

The team overcame the complex technical challenges with an experimental set-up similar to that shown in the schematics below [1]. They incorporated it into the MASER 13 (MAterial Science Experiment Rocket) seen in Fig.2.

WHAT THE RESULTS REVEAL ABOUT SOLIDIFICATION

Thankfully, the experiment was a resounding success. In microgravity, the team observed the equiaxed grains to be completely immobile during the majority of their growth. This is in comparison to gravity-driven motion and rotations of some grains seen in the ground experiment [1, 2].

The differences are phenomenal when we consider the 3-D structure of the casting and compare the results to terrestrial solidification in the vertical direction. This is normally when extensive grain movement happens. Consequently, this experiment means that for the first time we can attribute the equiaxed grain motion at the later stages of solidification, not to gravity, but to the late-stage shrinkage of the solidifying alloy [3].

The next phase of the project is to see how the results compare with solidification in a more industrially relevant alloy system. As a result, Prof. Browne and his team are expanding on this work by investigating some 7075 material. Watch this space to see how the project unfolds.

References:

[1] A.G. Murphy, R.H. Mathiesen, Y. Houltz, J. Li, C. Lockowandt, K. Henriksson, N. Melville, and D.J. Browne, "Direct observation of spatially isothermal equiaxed solidification of an Al-Cu alloy in microgravity on board the MASER 13 sounding rocket", J. CrystalGrowth, 454, 2016, pp. 96-104

[2] Browne, D.J., "Porosity formation and shrinkage effects in alloy samples solidified on earth and in space as observed in-situ by X-ray monitoring", TMS Annual Meeting & Exhibition, San Diego, CA, USA, 26 February – 2 March 2017

[3] Velayutham, S., Browne, D.J., "Quantification of equiaxed dendrite motion during spatially isothermal solidification of an Al-Cu alloy in microgravity", Proc. 6th Decennial International Conference on Solidification Processing, SP17, 25-28 July 2017, Old Windsor, UK. pp. 296-299.

Specialist Melting Capability at the Materials Processing Institute

The commercial manufacture of steel alloys at the Materials Processing Institute draws on decades of expertise in developing new and unconventional steel alloys for sectors including: rail, defence, automotive, offshore, aerospace and engineering. The steel processing expertise of the Institute includes sophisticated modelling, measurement and control technologies.

High quality steels are manufactured at short lead times, to client specifications. The Materials Processing Institute offers a range of steel alloys and revert melting services on a commercial basis. Product is available as ingots up to 6T, including products for specialist applications.

The main area of expertise is in melting, alloying and casting of semi-finished product, produced at the Institute's production facility in Middlesbrough, UK. A complete service can be offered, including downstream processing.

Steel alloys are manufactured to customer specifications with a high degree of cleanness, using vacuum degassing and argon purging.

Materials Processing Institute

Special Melting and Casting Service

Products include carbon steels, alloy steels and stainless steels which are available as 5.0T and 5.9T square ingot and 6.0T slab ingot. Smaller batch and cast sizes are also available on request, particularly suitable for revert melting.

Revert Melting which allows the recovery of valuable by-products. The resulting scrap and processing materials can be re-melted into a custom form of size, shape and weight, suitable to be re-used as a raw material according to client requirements.

Assay Melting which allows for accurate and independent analysis of as supplied scrap and is an increasingly popular service for scrap suppliers and steel and metal processors.

This is essential for both optimum process control and to assure the agreed specification of scrap supplied under a commercial contract. The ability to melt a 6T charge ensures that a truly representative sample of the scrap can be achieved and independently verified.

- **Small 5T and 6T batch sizes, reducing working capital for processors and stockholders**
- **Made to client specifications**
- **Short lead times**
- **High levels of quality and precision, particularly cleanness**
- **Manufactured in the UK**
- **Client support from the wider Institute for expert advice and analysis**
- **Competitively priced**

Facilities

Advanced steel processing technology and facilities are used to produce bespoke steel alloys, in cast sizes up to 6T. A range of smaller furnaces are also operated for specialist applications and sand casting facilities are available, particularly suitable for revert melting.

The primary melting facility is an electric arc furnace. Secondary steelmaking facilities include a ladle furnace and vacuum tank degassing, enabling a wide range of steels to be produced from conventional carbon/manganese grades, through to and including some complex, multi-alloy stainless steels.

Sample Analysis

Process control is achieved through sample analysis and optical emission spectroscopy, to continually update the alloy composition in the melt. The facility is supported by a suite of analytical laboratories for both metals and slags, including scanning electron microscopy.

Ingots are bottom filled using a trumpet and runner arrangement and can be purged and shrouded with inert gas.

Clients and Markets

The Institute supplies to a wide range of clients and markets, including forging operations, rolling mills, stockholders, supply chain management companies, engineering companies, steel manufacturers, rod and bar drawers, wire manufacturers, extrusion companies and recycling operations.

Geographical markets include the UK and more widely in Europe and end use applications include: nuclear, defence engineering, aerospace and marine.

> “...decades of expertise in developing new and unconventional steel alloys...”

BMPCA 2018
Meeting & Social Events Calendar

January 18th	Business Meeting – National Space Centre, Leicester
April 19th	Business Meeting followed by the Annual Dinner at the Cutlers Hall Sheffield
July 5th	Business Meeting
October 4th	AGM and Business Meeting
November	Annual Lunch - Date still to confirm

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