

The Iron and Steel Society

A Division of the Institute of Materials, Minerals and Mining

Iron and Steel Society Newsletter

Issue 1, January 2019



Port Talbot Blast Furnace

Courtesy Tata Steel

Introduction from the Chairman of the Iron and Steel Society

Dear members,

As Chair of the Iron and Steel Society it is my pleasure to welcome you to our first Newsletter. Having been active in the industry for over 25 years I feel extremely privileged to take this lead role within our industry. This Newsletter aims to provide information, both technical and commercial, across a rapidly changing industry landscape.

The Iron and Steel Society's activities encompass all professional, technical and educational aspects of the steel industry and its supply chain as well as strategic aspects of the industry. This is achieved by interaction with all parties related to the iron and steel industry. The Iron and Steel Society Board is made up of volunteers from our industry with a mix of youth and experience. We are also making good progress in ensuring it is more diverse in its make-up.

We aim to involve the UK and worldwide iron and steel community and look to ensure the needs of younger members can be met – an example of which is through the Bessemer Master Class held annually in different parts of the UK – in 2018, it was held at the Steel and Metals Institute, Swansea University and provided participants with an opportunity to understand the positive impact the steel industry can achieve as it addresses the challenges of the Paris 2050 agreement.

As a major technical community within IOM3, we aim to provide valuable technical support to the industry and its members. Promoting a balanced image of the iron and steel sector is also something that we strive to achieve. Of course one of our key aims is to bring the community together at conferences to allow knowledge exchange, collaboration and networking.

As we move into 2019 it should be recognised that this is a significant milestone in the organisation's history, marking the 150th Anniversary of the formation of the Iron and Steel Institute. This exciting year promises to deliver some key activities from many of the technical communities within IOM3 and we are looking to showcase a number through the Iron and Steel Society. These include conferences on steel development and materials characterisation, a photographic competition for all members, and a digital exhibition. We are also looking to bring together further outreach activities in collaboration with Diane Aston, the Education Manager at IOM3. In May 2019, Materials World will be a bumper edition, looking back at our heritage but more importantly looking at our future and the role that young people can play in creating it. So look out for that!

Don't forget that you as members have the opportunity to submit nominations, via the IOM3 website (<https://www.iom3.org/nominations>), for our 2019 awards and prizes. The closing date is 31 January. I would encourage you all to do so, there are no doubt many worthy individuals from such an amazing industry as ours. There is more on the 2018 award winners later.

Please don't hesitate to get in touch if you have any thoughts on how we can improve on what we already do today.

Martin Brunnock – Chairman, Iron and Steel Society

Developments in UK Steel R&D Infrastructure

Steel and Metals Institute: Creating a 21st Century Steel and Metals Industry

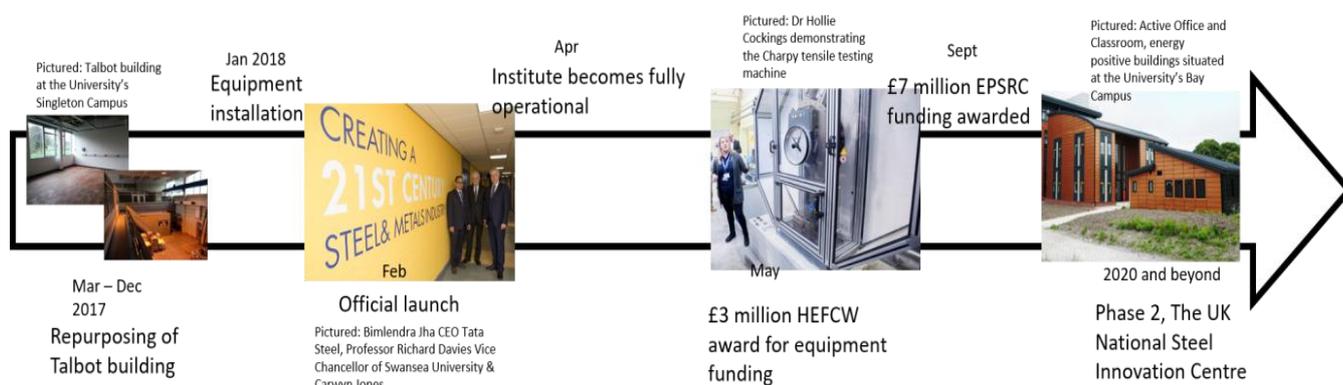
Opened in February 2018 by Rt. Hon. Carwyn Jones AM, First Minister for Wales, the Steel and Metals Institute (SaMI), is beginning its ambitious journey to becoming a global leader in steel and metals research.

SaMI is an open access institute where academic researchers and industry technologists are co-located, jointly solving industry challenges. This significantly reduces the time taken for innovations to reach the marketplace. SaMI will take a leadership role in the Steel and Metals network to provide opportunities and facilities for collaborative research and innovation.

Based at its temporary location at Swansea University's Singleton Campus, housing research equipment donated by industry and supported by the Welsh Government, the Institute is a major step in growing the research capability for the steel and metals industry in Wales and the UK.

SaMI is equipped to enable companies to make advances in alloy and process development, mechanical testing and materials characterisation and will rapidly expand its areas of focus in the development of disruptive process technologies, circular economies and industrial symbiosis, zero-carbon steel making, product development and industry 4.0. SaMI has attracted interest from ferrous and non-ferrous companies across the UK.

The Institute has been created as the result of a long-term strategic agreement between Tata Steel and Swansea University. SaMI is the forerunner to the UK National Steel Innovation Centre (NSIC), funded through the Swansea Bay City Deal, which will be based near the University's Bay Campus and will incorporate energy-positive building technologies.



© The images of the Talbot Building, Official Launch, and the Charpy testing equipment were taken by Paul Harries. The image of the Active Office and Classroom was kindly provided by SPECIFIC.

Through the Prosperity Partnership initiative, Swansea University, Tata Steel and the University of Warwick, have recently been awarded £7 million of funding from the Engineering and Physical Sciences Research Council (EPSRC), for a new “virtual factory” which will allow developing and testing of new steel alloys to be 100 times quicker. This means newer and better steel products can be made ready for customers far more quickly. New steels are needed for more fuel-efficient cars, plastic-free packaging, energy-positive buildings and many other applications. This will allow users of steel to drive innovation with market need.

Committed to delivering innovation through partnerships, the world-leading research centre is working in collaboration with industry and UK and global centres of excellence to drive innovation in products and performance to create a steel and metals industry fit for the 21st century.

Sam Greenfield – Steel and Metals Institute

Standards Issues

Uncertainty Values in Mechanical Testing – How should they be Used?

Many steel products are released to a set of guaranteed mechanical properties such as yield strength, tensile strength, ductility and toughness. These properties are measured according to standardized test procedures designed to minimize the variability between repeat measurements. However despite this there are always differences, even if the measurements are made at the same site, on the same equipment and by the same person. These arise from a range of contributing factors in addition to the natural variability of properties between the different locations within the product of multiple samples.

This variation in values for repeated measurements is known as the uncertainty of measurement and is an expression of the level of confidence that a measured value falls within a given range, usually expressed as a 95% confidence interval. For example if the tensile strength of a steel sample is measured at 825 MPa but we know that the uncertainty of the measurement is 9 MPa then we would have a 95% confidence that if further measurements are made they will fall in the range 816-834 MPa (825 ± 9 MPa).

The uncertainty of measurement arising from the test method comes from a variety of sources. As an example for tensile testing these may include:

- The equipment used to make the measurements. For example different test machines are engineered differently and use software with different algorithms to analyse the data;
- The type of equipment used. For instance, the precision of a micrometer when measuring sample dimensions;
- Over time equipment may wear leading to drift or increased variability in measurements;
- The calibration process for the test equipment has an uncertainty associated with it which is imported into the measurement process;
- Other extraneous factors such as the skill or diligence of the person operating the equipment.

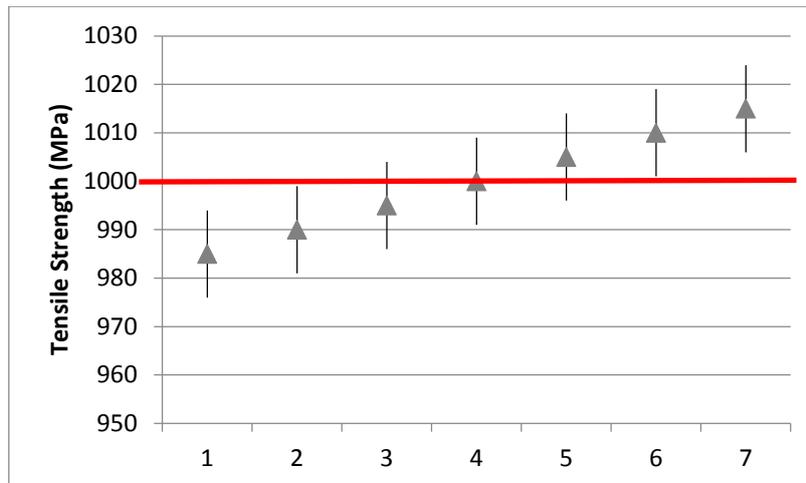
The effects of these factors can generally be estimated and combined to calculate the overall uncertainty of measured values for a particular test. It is not the purpose of this article to describe this process in detail but an excellent, simple to read, description of uncertainty and how to estimate it has been issued by the National Physical Laboratory and can be found at : http://publications.npl.co.uk/npl_web/pdf/mggp11.pdf.

In this article, we want to consider how uncertainties should be used and more importantly not abused.

A thorough consideration of the elements in a particular testing process generally identifies those factors making the major contributions to the overall uncertainty and hence improvements concentrated on these can be used to most effectively reduce the uncertainty in measured values.

A common area of confusion is how uncertainty values should be used in determining whether a measured value meets the requirements of particular material standard.

Suppose a material standard requires a steel to be supplied to a minimum tensile strength of 1000 MPa and testing is carried out in a laboratory where the uncertainty on tensile strength values has been estimated at ± 9 MPa.



Consider a set of seven test results ranging from 985 to 1015 MPa in steps of 5 MPa together with their associated uncertainties shown in the figure above. Cases 1 and 2 are obvious failures and cases 6 and 7 are clear passes. Confusion can arise over cases 3-5.

Case 3 - measured value of 995 MPa there is 95% chance that the value is in the range 986-1004 MPa.

Case 4 – measured value 1000 MPa it could fall in the range 991-1009 MPa.

Case 5 – measured value 1005 MPa it could fall in the range 996-1014 MPa.

So have these test results passed or failed to meet the 1000 MPa minimum tensile strength requirement?

The answer is that cases 4 and 5 are compliant but case 3 is not.

Product standard requirements were decided upon by committees comprising experts in the particular field and the values set were not intended to be modified to account for testing uncertainty. In effect the property requirement can be considered to already have the uncertainty allowance built in. Thus making additional adjustments to specified values is, in effect, double accounting. Considerable discussion has taken place within both testing and product standards committees and statements regarding uncertainty have been incorporated into testing standards as they come up for revision. For example the current version of **BS EN ISO 6892-1:2016 Metallic Materials – Tensile Testing Part 1: Method of Test at Room Temperature** contains examples of how to estimate testing uncertainty but these are qualified by the following statement:

Product standards and material property databases based on this part of ISO 6892 and earlier editions of ISO 6892 have an inherent contribution from measurement uncertainty. It is therefore inappropriate to apply further adjustments for measurement uncertainty and thereby risk failing product which is compliant. For this reason, the estimates of uncertainty derived by following this procedure are for information only.

The testing and product committees clearly recommend that no modification should be made to product standard requirements to take account of testing uncertainty. Of course a customer may impose further requirements if they wish but these will be in addition to those currently laid out in the product and testing standards.

Peter Morris – Beta Technology

Bessemer Day 2018



Bessemer Day is run annually by the Iron and Steel Society; firstly to encourage the development of young professionals working in the iron and steel industry via a Master Class, and secondly, to recognise individuals who have made significant contributions to the sector. For 2018, the event returned to Swansea on 4 October and had three elements – a Master Class during the day (*kindly hosted by Swansea University at the Steel and Metals Institute*), and evening activities at *the National Waterfront Museum* consisting of the Iron and Steel Society awards presentation and the Sir Henry Bessemer Dinner [held in conjunction with the South Wales Materials Association (SWMA) Annual Dinner].

Bessemer Day 2018 was kindly sponsored by Harsco Metals and Minerals, Liberty Speciality Steels, Primetals Technologies and Tata Steel. Their support (in some instances for many years) is gratefully acknowledged.

The Master Class has been held annually since 2004 and its key aim is to create and foster an extended business community throughout the UK steel industry and its broader value chain. This year, the theme was *Application of the circular economy across the steel industry*, with an emphasis on helping delegates to understand the positive impact the steel industry can achieve by addressing the challenges of the Paris agreement. In particular it aimed to increase awareness of the major challenges the industry faces in improving resource efficiency and to help participants to become advocates for sustainability within their own organisations.

Almost 30 delegates attended the Master Class drawn from sponsor companies and a number of UK universities.

Louis Brimacombe (Chair of the Sustainable Development Group at IOM3 and Visiting Fellow at the University of Sheffield) set the scene with a keynote address on *The role of steel in sustainable development* in which he introduced some of the background to the Paris agreement. He argued that optimisation will be a key route to achieving a more circular economy with greater use of life cycle analysis to assess the potential impact of activities on materials resources. In conclusion, he proposed that steel can meet the challenges needed and will be the foundation of a circular economy.

A series of presentations and discussions followed during the remainder of the day which looked at topics such as: overcoming barriers in the current steel scrap supply chain (Andy Dunsmore, Steel and Metals Institute); recovery and re-use of Iron bearing waste (Martin Allen and Mark Greenslade, Tata Steel UK); the potential to replace coking coal by non-recyclable plastic waste in the blast furnace (Peter Holliman, Swansea University); advances in carbon capture and utilisation (Brian Eddy, Steel and Metals Institute); and advances in 3D printing of steel (Nick Lavery, Swansea University).

Laura Baker (Tata Steel and Deputy Chair of the Iron and Steel Society) concluded the Master Class by inviting the delegates to consider what are the sustainability challenges in their own area of work and how might they address them. Delegates have been given the opportunity to give a short pitch about a project they have initiated or one they are involved in that is aligned to this challenge, with a chance to win a prize, at the annual Postgraduate Research symposium on Ferrous Metallurgy, to be held at the Armourers' Hall in London on 26 February 2019.

Following the Master Class, delegates were given a tour of the recently-opened facilities at the Steel and Metals Institute (for additional information on the Institute see article above). Some of participants also

took up an opportunity to visit the Advanced Imaging of Materials facility and the Advanced Materials Characterisation Centre at the Bay Campus, Swansea University on 5 October.

The evening events took place at the National Waterfront Museum in Swansea, where 150 people gathered for the South Wales Materials Association Annual Dinner (which this year incorporated the Sir Henry Bessemer Dinner). Luis Sanz, Managing Director of Celsa Steel UK, gave a brief, informative speech during dinner, in which he encouraged collaboration between industry and university. Martin Cox, President of IOM3, concluded proceedings with a vote of thanks.

Prior to dinner, Martin Cox presented the Iron and Steel Society awards for 2018. Those receiving awards were:

Bessemer Gold Medal - **Professor Indira Samarasekera**, University of British Columbia, Canada

For outstanding transformative research in the areas of casting and solidification of steels, with pioneering work that coupled heat transfer and transport phenomena to microstructure evolution during the continuous casting of steels, followed by academic leadership roles at the Universities of British Columbia and Alberta.

Adrian Normanton Medal - **Professor Han Jie Guo**, University of Science and Technology Beijing (lead author), collected the medal on behalf of himself and his co-authors, Sheng Chao Duan, Jing Guo & Xiao Long Guo.

Awarded for their publication - *A manganese distribution prediction model for CaO–SiO₂–FeO–MgO–MnO–Al₂O₃ slags based on IMCT* which was considered the best technical paper on the topic of steelmaking, or casting published in *Ironmaking and Steelmaking*.

Frank Fitzgerald Medal and Travel Award - **Alireza Valizadeh**, Brunel University

Awarded to an IOM3 member under the age of 35. Alireza has developed theoretical and practical experience of both traditional and advanced joining technologies, with expertise in welding stainless steels and quality assurance of steel products. He is currently studying for a PhD via research on bonding solid steel to liquid aluminium.

Dowding Medal - **Damian Shipton**, British Steel

Awarded for exceptional and often inspirational work in the development of hot rolling capabilities, especially in the Scunthorpe Rail and Section Mills, leading to the introduction of long-length rail production in the UK. This mill now supplies over 90% of the UK rail network track requirements and exports rail for networks in five continents.

Stokowiec Medal - **Dr Rebecca Higginson**, Loughborough University

Awarded for her extensive research (with significant industrial support) which explores the processing, use and in-service applications of steel and stainless steels; increasing understanding of how long term exposure at elevated temperatures in both parent and weld metal materials influences high temperature oxidation, microstructural changes and degradation in power generation plant

Tom Colclough Medal - **Dr Norrie McPherson**, University of Strathclyde

Awarded for a continuing contribution to the processing of steel products in a range of industrial sectors, with particular emphasis on welding engineering and technology, including the development of long-term collaborative relationships with universities.

Thomas Medal - **Professor Abdel-Hady El-Geassy**, Central Metallurgical Research and Development Institute (CMRDI), Cairo, Egypt

Recognised for his distinguished work as an academic (with strong international links) in a number of areas including ironmaking, chemical and metallurgical engineering, and materials science.

Hadfield Medal - Professor **Jay Jaiswal**, ARR Rail Solutions Limited

Awarded for his substantial contributions in the area of rail steels, with particular emphasis on improved rail life and increased track integrity.

Geoff Hale, Consultant to IOM3

Nominations for IOM3 awards 2019

A reminder that nominations are open for the various IOM3 personal achievement awards for 2019. Details of the criteria for each award can be seen on the IOM3 website at <https://www.iom3.org/iom3-awards>. You do not have to be an IOM3 member to submit a nomination and nominees do not have to be IOM3 members, unless this is specified in the award criteria. The Institute is anxious to receive nominations from as broad a circle as possible.

A number of awards are linked specifically to the iron and steel sector. Details of these and the 2018 winners are given in the article headed Bessemer Day 2018.

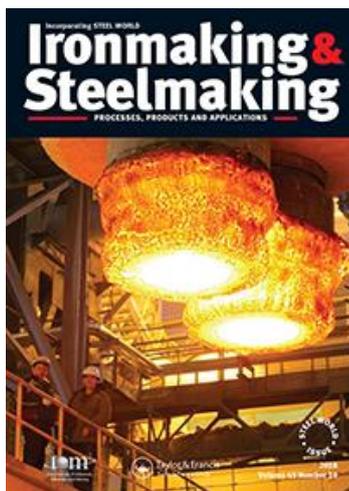
Please consider if you know of an individual that you could nominate for one of these awards or whether you could encourage someone else to do this if you believe they have more knowledge of the nominee's background and experience.

The Iron and Steel Society Board recommends that each nomination is supported by a written statement from both a nominator and a seconder. This is not (at present) a stated requirement on the online nominations system. Having information from two individuals helps when the Iron and Steel Society Board assesses the nominations and makes its recommendations. If the nominator and nominee work for the same organisation, the seconder must come from another organisation.

Online nominations are required for the personal achievement awards. Access to the online nominations system is via <https://www.iom3.org/nominations>. The closing date for nominations is approaching fast - **Thursday 31 January 2019** – so get that one you have been thinking about in now!

Geoff Hale, Consultant to IOM3

Ironmaking and Steelmaking Journal



Two recent issues of the journal contained 26 papers. The composition by country has approximately 50% of the papers originating from China. This has been an ongoing trend for some time now. The remaining papers originate from the UK (2), Canada (1), Germany (1), India (2), South Korea (1), USA (1), Russia (1), Austria (1) and Poland (1). Taken at face value, the papers published emanate from a wide demographic, but there is little consistency from one issue to the next.

The content is currently biased toward ore, coke and iron production, but there is a good remaining balance covering steel control (inclusions and analysis), slags and fluxes, rolling, continuous casting, and microstructure and properties.

It is important to recognise the scope of the journal. It is aimed at Processes, Products, and Applications. In the Applications sector there is a tendency to lose out to other journals, particularly in the areas of properties and microstructure. However, that is an author's choice.

In terms of submissions to the journal, 2018 saw the highest number yet, with over 500 potential papers submitted. However, high submission numbers do not always equate to quality, or suitability. As a result, the rejection rate is currently around 90%. This figure may appear high but it is essential to maintain the perceived high standards of this journal. One of the areas that remains of concern is the number of pure research / highly theoretical papers being submitted to the journal. There is a place for this grouping, but the ultimate aim of the journal is to have a balance of papers including ones which cover research and then demonstrate the application of that research into actual plant process operations – applied research, which should in time show financial returns.

Overall the journal is steadily building an improved reputation. This is evidenced by an approximately 20% rise in its impact factor which is an independent measure of the citation frequency of paper published in the journal.

All IOM3 members have free online access to *Ironmaking and Steelmaking* and other Institute refereed journals, published by Taylor and Francis. Access is via the IOM3 website at <https://www.iom3.org/journals>.

Norrie McPherson: Co-Editor-in-Chief, Ironmaking and Steelmaking

Contact us

Any comments regarding the content or format of the Newsletter are most welcome. Also we are happy to consider short articles on technical or commercial topics for inclusion in future editions

Please contact either Peter Morris (e - peter.f morris@virginmedia.com) or Geoff Hale (e - geoffhaleiom3@gmail.com)