2022 ISSUE 04: APRIL

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THE LATEST NEWS FROM OUR UK HQ

TECHNICAL ARTICLE: WELDING KNOWLEDGE PART 5

WELD PURGING PRODUCTS INNOVATORS, MANUFACTURERS AND INTERNATIONALLY REIGNED SPECIALISTS
Dear Reader,

Welcome to issue four of Weld Purging World for 2022.

It has been an incredibly exciting month for everyone here at HFT® with Indutrade announcing the acquisition of Huntingdon Fusion Techniques HFT®. It is business as usual for us and we will continue to sell our products through our Worldwide Exclusive Network of Distributors.

We also have some VERY exciting product news to share with you... In May, we will be launching the UPDATED PurgEye® 100.... read more on page 4!

If you have any information that you would like to be featured in future issues of this publication, please contact me.

As always, we hope you enjoy the issue.

Best wishes,

Michaela
Marketing and Social Media Manager
michaelahess@huntingdonfusion.com
Indutrade UK have recently announced the acquisition of Huntingdon Fusion Techniques HFT®.

HFT® will become part of the ALH Systems Group and will continue to operate from our facilities in Burry Port, Carmarthenshire.

There will be no change to our day to day operation and will continue to sell our products through our Worldwide Exclusive Network of Distributors.

Indutrade is an international industrial group that sells high-tech products and solutions helping customers to improve their own products as well as streamline their own production processes. They are growing steadily through acquisitions of well managed and profitable companies. They acquire companies with technical nice expertise and today comprises of over 200 companies in 28 countries on four continents, with combined annual sales of exceeding 10 billion and over 5,000+ employees worldwide.

ALH Systems Group Managing Director, David Lyes said, “We are delighted to welcome HFT to our Group and we look forward to working with Luke Keane and the wider HFT teams as they expand their product range and international sales footprint”.

![Image of Indutrade staff]
We have some VERY exciting product news to share with you.....

Next month we will be launching our new look PurgEye® 100.

The main update sees the plastic casing updated to a metal one. The updated Weld Purge Monitor® will function in the same way, reading accurately down to 100ppm.

The Argweld® PurgEye® 100 is our hand held, battery operated 100 ppm, IP65 rated Weld Purge Monitor® with innovative push button auto calibration, enlarged screen, low sensor indicator, tripod mount, sleep mode, vacuum sealed leak-tight probe assembly, wrist or neck strap, rubber housing protector and so much more.

Look out for more information coming soon!

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CALENDAR: EVENTS IN THE INDUSTRY

**Tube 2022**
20 - 24 Jun 2022
Düsseldorf

**TechniShow**
30 Aug - 2 Sep 2022
Holland

**Adipec**
31 Oct - 3 Nov 2022
Abu Dhabi

**Fabtech**
8 - 10 Nov 2022
Atlanta, USA
Measurement of the Dew Point for Critical welds has never been easier than with the revolutionary HFT® PurgeNet™ Dew Point Purging Gas Moisture Sensor™.

Here are some of our Frequently Asked Questions.

1.0 What is ‘Dew”?
Dew is expressed as drops of liquid water that condense from the atmosphere and onto any solid surface like metal.

2.0 What is ‘the Dew Point’?
The dew point is the temperature in °C or °F at which air is saturated with water vapour (also referred to as humidity). Below the dew point, water will begin to condense on solid surfaces in the welding environment.

3.0 How does water moisture affect the quality of the weld joint?
Under arc conditions, water is broken down into hydrogen and oxygen in atomic form which, when present in weld metal, cause porosity and are known to create cracking in the weld joint.

4.0 Why should I use a Dew Point Purging Gas Moisture Sensor™?
Using the PurgeNet™ Dew Point Purging Gas Moisture Sensor™ while welding is the easiest method for indicating when water will condense on solid surfaces in the welding zone. Water can form as moisture on metal surfaces while welding and it is important to be able to measure ‘Dew Point” while welding lengthy critical joints as conditions can change during the welding process.

5.0 How does the Dew Point Purging Gas Moisture Sensor™ give readings?
The PurgEye® Dew Point Sensor accessory has been designed to integrate with most of the Argweld® Weld Purge Monitors® via the PurgeNet™ lead that is supplied with them, thereby giving values and water present on the same screen. In this way, the user is not forced into the purchase of an expensive, separate Dew Point Monitor that will give its reading elsewhere.

6.0 Which Weld Purge Monitors® are compatible with the Dew Point Purging Gas Moisture Sensor™?
The PurgeNet™ Dew Point Purging Gas Moisture Sensor™ is compatible with the PurgEye® 200, 500 Desk, 600, 1000 Remote and 1500 Site.
SAFETY FIRST use Thoria-Free Tungstens

THORIA is RADIOTOXIC and CARCINOGENIC

TIPS for REDUCING HAZARDS:
Use a NON-CARCINOGENIC ELECTRODE such as MULTISTRIKES®
Use a DUST EXTRACTION and DISPOSAL FACILITY

MULTISTRIKE® ELECTRODES
ADVANTAGES:
Total traceability to help compliance with ISO 9000 and other quality control standards

Environmentally friendly:
- Electrodes containing a selected oxide mixture for better performance
- Non-carcinogenic

Eliminates:
- Carcinogenic hazards
- Variable and inconsistent performance

Improves:
- Arc Striking
- Operational Life
- Arc Stability

MultiStrikes®
After more than 200+ welds!
Blue tip

2% Thoriated
After only 20 welds!
Red tip

MATERIALS and HAZARDS:
MultiStrike® Tungsten Electrodes contain oxides to assist arc striking and improve life, those with thoria present a health hazard.

Thorium - Oxide is likely to remain in the lungs for years after inhalation, deposits on the lungs can lead to pulmonary fibrosis and pneumoconiosis.

MULTISTRIKE® TUNGSTEN ELECTRODES
The Safe Alternative

For more information and details of your local stockist, please visit www.huntingdonthft.com
Basic Arc Welding Metallurgy - Introduction

Metallurgy plays a crucial role in the arc welding process and a basic understanding of this role is necessary if welding engineers are to fulfil their responsibilities effectively.

Many learned texts have been published (ref 1,2) on welding metallurgy, particularly the excellent book written by John Lancaster, but very few approach the subject from a practical point of view. The majority of published work explains crack propagation, chemical reactions, alloy composition and heat flow in considerable detail but this document, part of the series published by Huntingdon Fusion Techniques Ltd, approaches the subject on a much more practical basis.

The principle aim when fusion welding is to create a joint where the physical properties are identical to those of the parent material. In reality this is quite impractical. A large number of variables affect the final weld properties so we will examine the influence of the most significant variables. For simplicity we have to make some sweeping generalisations throughout but this approach, simple though it is, serves as a basic introduction on how to minimise metallurgical disturbance during welding. Following each section, we have identified a useful reference where more detailed or specialist information is required. These references have been carefully selected and represent some of the best sources of further information.

Let’s first of all define Weldability. At its simplest this is a measure of how easy it is to make a weld in a specified material with adequate mechanical properties and with acceptable resistance to degradation in service. In practice this means comparing it with other joints. A standard test – for example the Patch Test (Ref 3) – can establish the sensitivity to cracking. Other tests may be required to assess corrosion resistance, mechanical strength etc.

1. The Welding Process

Arc welding here is taken to include GTAW, GMAW, SAW and PAW, all of which can have a significant influence on weldability. Other arc welding processes are in regular use, but the same principles apply to these.

Which technique is used for a particular application will often have been defined in a Welding Schedule, (Welding Specification and Welding Procedure are also terms used to define how a joint should be made), a document prepared to instruct the welder on specific aspects of creating the joint. These aspects are examined later but the general rule is to create a Schedule that aims to produce a weld that is fit for purpose at an acceptable cost.

The total thermal input and the rate of heating and cooling can have significant effects on joint metallurgy. A fast process overall, such as GMAW, may well be economically attractive but much better control is normally exercised by the GTAW technique.

High rates of heating and cooling, particularly when welding low alloy and carbon steels, result in major structural changes that can make the weld and adjacent heat affected zone (HAZ) brittle and therefore prone to cracking. Low heat input processes generally produce wider welds and this can give rise to distortion.

Reference 4. Welding Process Technology by Peter Houldcroft
2. Joint Design

Careful selection of joint design is essential if weld defects are to be avoided. This is particularly important in applications such as aerospace, power engineering, petrochemicals, pharmaceutical and the processing industries where the weld may be subjected to high stresses and corrosive environments and where failure can be catastrophic.

The simple fillet or lap joint may be quite acceptable when making garden furniture but fully penetrating joints are necessary to meet demanding service conditions. Consideration also needs to be given to the suitability for post-weld inspection, even if this only requires visual access. Ultrasonic and X-Ray examination, for example, pose quite different problems.

Reference 5. Types of Welding Joints by Rory Blake

3. Pre-Weld Preparation

Having chosen the most suitable design of joint but before beginning to weld, attention needs to be given to cleaning. This may involve a simple degreasing operation but some materials are highly sensitive to surface contamination and may require mechanical treatment by machining or wire brushing. Storage under clean conditions between preparation and welding may be essential.

Reference 6. Tips for preparing your material before welding by John Thompson

4. Pre-Heat and Post-Weld Heating

Some materials are likely to exhibit significant changes in metallurgical characteristics during the heating and cooling cycles – these include the creep resistant Chromium/Molybdenum/Vanadium steels. These changes, known to degrade the mechanical properties, can be avoided by modifying the thermal cycle.

Some materials are likely to exhibit significant changes in metallurgical characteristics during the heating and cooling cycles – these include the creep resistant Chromium/Molybdenum/Vanadium steels. These changes, known to degrade the mechanical properties, can be avoided by modifying the thermal cycle. Slowing down the rate of heating and cooling using an external heat source offers the opportunity to control the weld and heat affected zone structures so that mechanical properties are much less compromised and cracking due to high residual stress eliminated.

Reference 7. Preheating can be critical to welding success by Caleb Haven

5. Shielding Gas

Crucial to successful welding is the protection of materials at high temperature against contamination, particularly oxidation, from the environment. This is especially so with the GTAW and PAW processes in which tungsten, highly sensitive to contamination, is used as the electrode in the formation of the electric arc. Argon is widely used here to provide effective protection of the electrode but also to ensure that adjacent metal is also shielded. With SAW a blanket of powdered flux covers the arc and adjacent metal whilst with GMAW a range of gases are in use depending on specific applications.

Often overlooked is the subject of protection of the weld metal at the base of the joint. This will be explored later under ‘Purging’.
Selection of gas for any application depends largely on the materials being joined. Whilst argon and helium are in common use with GTAW, other gases such as nitrogen, hydrogen and carbon dioxide may be preferred when using GMAW.

Reference 8. Shielding the weld. Sandvik Technical Centre,

6. Electrode properties

With GMAW and SAW the filler wire also performs the task of an electrode. The only constraints here are that it is electrically conducting, clean and must be fed smoothly and at constant speed into the weld pool.

A non-consumable electrode is used in GTAW and PAW. Tungsten is normally used, but this material can oxidise unless protected by an inert gas. A carefully prepared electrode tip is necessary but this can degrade rapidly if not protected pure tungsten is not stable but by adding other materials this problem can be overcome. Thoria has been used as a stabilising compound for many years but is known to be radio-toxic and presents serious health hazards. Alternative oxides such as ceria have been used with success but the use of oxide mixtures to create what are referred to as multivariate electrodes such as Multi-Strike offer improvements in arc striking and longevity and are non-toxic.

Reference 9: Storage and use of thoriated tungsten electrodes. The Health and Safety Executive
Reference 10: Thoriated tungsten electrodes. American Welding Society

7. Filler Metals

A common practice when welding thin section identical materials using the GTAW or PAW processes is to melt both sides of the joint together without filler – autogenous welding. Where mechanical properties are important, for thicker materials or with GMAW and SAW it is necessary to use additional filler metal. This can perform the role of preventing undesirable chemical changes. An example is provided in welding some stainless steels where a filler with a higher chromium content is employed in order to compensate for chromium loss during welding.

Reference 11; Which filler metal should you choose? by Kevin Trik

8. Dissimilar Metals

With identical alloys, control can be exercised over the welded metal by the judicious choice of filler material. Fusion welding metals with different chemical composition together presents additional metallurgical problems. Avoiding the creation of compositions with poor mechanical properties is extremely difficult and, in some cases, impossible. Two examples can be given here.
Joints made between copper and aluminium lead to the production of extremely brittle alloys, referred to as intermetallic compounds, irrespective of what filler metals are used. They are thus of no commercial use whatever. The only way to make copper-aluminium joints successfully is to employ non-fusion processes such as friction welding and diffusion bonding.

A combination which for a long-time baffled welding engineers was the production of mechanically strong joints between stainless steel and low alloy steel. This a crucially important combination because it is needed in power generation where high temperature creep strength is required. Complex metallurgical changes take place leading to weld cracking. The basic solution is to separately clad the low alloy steel with stainless steel, referred to as buttering, and then make a stainless-stainless joint.

Reference 12; Dissimilar Metal Welds in Grade 91 Steel by Terry Totemeier

9. The Heat Affected Zone (HAZ)

This is accepted as the area of the base metal that wasn’t melted, but was heated to a temperature where the microstructure or mechanical properties was changed during welding.

Such temperatures vary widely. Some heat-treated aluminium alloys are susceptible to change if heated above 120ºC. On the other hand, plain carbon steels are little affected below 700ºC. The width of the HAZ itself is largely dependent on welding process – some have greater heat input than others – but the welding speed and thermal conductivity can have a major influence.

An often-overlooked aspect is the cooling rate of the HAZ. The quenching effect of a weld in a small component made from a 1% carbon steel can result in a HAZ hardness likely to induce cracking. Pre-heating and post-heating to control thermal gradients are in common use especially with heat treatable steels.

Reference 13; All you need to know about the heat-affected zone by Andrea Bustreo. The Fabricator June 2016

10. Inert Gas Purging

Additional to the need to provide an inert gas for protection of the electrode and adjacent metal during welding it is also desirable to provide protection of the weld root. This is particularly important with the more sensitive metals such as stainless steels, titanium alloys and other materials likely to suffer from oxidation or other contamination during the welding procedure.
Where access to the root of the completed joint is accessible eg with flat plate joints, the contaminated or oxidised metal can be removed mechanically, but with pipe or tube joints access is severely restricted. For this purpose, specialist inert gas purging equipment has been developed.

This type of fully integrated inflatable equipment, typified by the QuickPurge® and PurgEye® systems, provide inert gas protection with oxygen levels as low as 10 ppm.

‘A perfect welding result, without impairment of corrosion resistance and mechanical properties, can only be obtained when using a backing gas with very low oxygen content.

For best results, a maximum of 20 ppm O2 at the root side can be tolerated’. (Sandvik). When welding complex structures or individual components, the ideal solution to weld shielding would be to place the objects inside a chamber that can be evacuated of air and replaced with an inert gas.

Traditional chambers for this kind of work have been fabricated from metal with doors, windows and glove ports included. These enclosures are expensive, permanent and have a large footprint. Cost-effective enclosures made from engineering plastics are now in use in the aerospace industry and are readily available with volumes up to 5 cubic metres.

Reference 14; Gas Purging for Weld Root Control during Pipeline Fabrication by Georgia Gascoyne

Reference 15; Flexible Enclosure Welding by Ron Sewell

Conclusions

Whilst this introduction is very basic, albeit containing selected references to detailed aspects, it does bring attention to the prominent role played by metallurgy in welding. In particular it highlights the need for care when selecting tungsten electrodes, now that the toxic effects of some based on tungsten are better understood. Weld contamination caused by poor cleaning procedures and loss of mechanical strength and corrosion resistance due to inadequate inert gas protection need to be addressed.

Recent developments in equipment for inert gas purging and the availability of cost-effective protective enclosures have been introduced.

References

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8. Shielding the weld. Sandvik Technical Centre, Sandviken, Sweden
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10. Thoriated tungsten electrodes. American Welding Society, Safety and Health Fact Sheet No 27
12. Dissimilar Metal Welds in Grade 91 Steel. Totemeier T., Structural Integrity Associates News and Views. Issue 44 Spring 2018
13. All you need to know about the heat-affected zone. Bustreo A. The Fabricator June 2016
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