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THE LATEST NEWS FROM OUR UK HQ
TECHNICAL ARTICLE: ENCLOSURES

WELD PURGING PRODUCTS INNOVATORS, MANUFACTURERS AND INTERNATIONALLY RENOWNED SPECIALISTS
Welcome to the July issue of Weld Purging World 2021.

Another busy month here at HQ. On page 3 you can see new images of our ID Argweld® Weld Trailing Shields®, which provide an additional inert gas coverage when welding the inside of large pipes and metal chambers. Our Qwik-Freezer™ Pipe Freezing System was also called on-site recently to help freeze 6” pipework where repairs were needed.

On page 10 you will find our Technical Article about our Enclosures, which outlines the advantages of choosing a Flexible Enclosure over a metal glove box.

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
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It comes as a surprise to many that inert gas is probably the highest cost consumable in welding, second only to the cost of filler wire. Arguably, the very high cost of cleaning oxide discolouration, also known as heat tint could be a major cost as well especially for stainless steel and titanium welding. More important then, that control is exercised when inert gas is used in weld purging.

The most efficient purge systems minimise the use of inert gas. HFT® Trailing Shield® system design is such that gas used is carefully controlled. There is virtually no loss due to leakage and turbulence.

Argweld Weld Trailing Shields® are designed for high quality gas coverage of titanium and stainless steel during welding to prevent oxidation and weld defects.

They will fit any make of TIG (GTAW) or plasma (PAW) welding torch for manual or automatic welding, on flat sheet or plate and the outsides or insides of tubes or pipes.

For pipes and vessels the radiused versions for welding from the outside are manufactured to suit all diameters from 1 inch and upwards.

For welding pipes and vessels on the inside, the internally radiused shields (as pictured) are manufactured to suit diameters from 4” upwards.

By using an Argweld Weld Trailing Shield® welds will be left bright and shiny and eliminate discolouration and oxidation.

The replacement gasket is resistant to temperatures up to 230ºC.

Argweld Weld Trailing Shields® will reduce gas consumption, save re-work and eliminate wasted material costs due to oxidation and weld defects.

Argweld Weld Trailing Shields® can be used for welding stainless steels, duplexes as well as titanium and zirconium and any other weldable metal where discolouration or oxidation needs to be eliminated.
Our Qwik-Freezer™ was recently used on-site where repairs were needed to 6” pipes containing water.

The CO₂ Pipe Freezing System uses specially designed jackets, which are wrapped around the pipe at the point or points where the freeze is required. A nozzle on the jacket is coupled to a cylinder of liquid CO₂ by means of a special hose.

When liquid CO₂ is injected into the space between the jacket and the pipe, it immediately expands to form a solid carbon dioxide (dry ice) at a temperature of -70°C (-108°F). This low temperature quickly freezes the water inside the pipe, forming a secure ice plug beneath.

**Accu-Freeze™**

Also available is Accu-Freeze™ for freezing liquids that have a lower freezing point than water by using liquid nitrogen.

For small diameter tubes and pipes, jackets as mentioned above can be used.

For diameters over 8”, it is possible to wrap copper tubing around the pipe where the plug is to be made instead of using jackets.

In addition for the larger diameter pipes, aluminium shells are available to fit precisely on the pipe, where the freeze is to be carried out.

Once the copper piping, jacket or shell have been added to the pipe, the LN₂ is then injected via the Accu-Freeze™ control system which takes over by automatically injecting the LN₂ and freezing to a temperature set by the user.

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**CALENDAR: EVENTS IN THE INDUSTRY**

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A LOW COST EYE ON YOUR WELD PURGE

PURGEYE® 300 NANO WELD PURGE MONITOR®

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The Pipestoppers® Division at Huntingdon Fusion Techniques HFT® manufacture a range of Inflatable Stoppers for fast, reliable and safe stopping, blocking and testing of pipes, joints, channels, inlets and a number of other uses.

Customer application: An export customer required a large stopper for blocking hot fumes from a chimney stack measuring 114” (2,896 mm) diameter to carry out vital maintenance and repair work. HFT® manufactured two Inflatable Stoppers, their largest size to date.

A Heat Resistant Cover was also required to protect and prevent the Inflatable Stopper from being damaged. The recommended maximum temperature for this type of stopper is 90°C (194°F) but with a Heat Cover fitted this increases to 300°C (572°F).

All Inflatable Stoppers are manufactured with an internal latex inflatable bladder covered in waterproof polyurethane coated nylon fabric. The standard range of Inflatable Stoppers available for immediate delivery are in sizes ranging from 1” to 96” (25 to 2,438 mm).

Many companies may have pipework systems such as sprinkler systems for example, that are full of water or other fluid that may need to be completely drained for the smallest of repair.

Companies facing system downtime can drastically reduce pipe and valve repair and maintenance costs with Accu-Freeze™ available from the Pipestoppers® Division of Huntingdon Fusion Techniques HFT®.

Luke Keane, Technical Support at HFT® said: “We carried out an installation of an Accu-Freeze™ System for a client who was contracted to repair pipework in large blocks of apartments. Working in the plant room, access was pretty tight as the pipes were only 6 – 8” from the ground. At one end of the pipe there was a pressure gauge and at the other, a 1,000 litre hot water cylinder. Ambient temperature in the pipe was approximately 38°C.”

“We used a copper coil on the 2” carbon steel pipe and had to wrap it about 10 inches along the pipe length, wound tight. We then performed a freeze using the Accu-Freeze™ System connected to a dewar of liquid nitrogen (LN2). Within 50 minutes a solid ice plug had been formed, blocking the flow from the cylinder to enable the pipe section to be cut out and replaced. Following the repair work, the ice plug defrosted naturally and the flow continued in the system. Minimum disruption, no system drain down, no air locks and extremely quick!”

Accu-Freeze™ works by reducing the pipe fluid to a temperature below its freezing point and developing a freeze plug. This controlled method of pipe freezing uses liquid nitrogen (LN₂) to freeze stationary liquids in a section of pipe or tubing. The nitrogen is passed through a coil surrounding the pipe producing a frozen plug inside and hence preventing flow through the part to be removed.
The metallic alloys we use today have evolved through decades of research and many represent the pinnacle of achievement in terms of strength and corrosion resistance. Without these materials, the remarkable advances that have taken place in nuclear energy, medicine, pharmaceuticals, power generation and petrochemicals could not have been realised.

One of the most significant early breakthroughs occurred in 1912 in Sheffield when chromium/iron alloys were found to be corrosion resistant. Since then we have witnessed the introduction of low alloy creep-resistant steels, nickel-based alloys with elevated temperature properties and, more recently, the development of lightweight titanium alloys offering high strength-to-weight characteristics.

Optimum properties of all these materials is only achieved by precisely controlling the balance of elements. The ideal composition for every application has only been realised thanks to intensive research work by metallurgists but if elements are lost during subsequent manufacturing processes such as welding or other elevated temperature excursions, the corrosion and mechanical properties can be affected significantly.

Fusion welding of stainless steels provides a good example where loss of corrosion resistance can be significant. If welding is carried out in air and even where oxygen levels are as low as 50 ppm, the effective chromium content can be reduced and since this is the principle element added for corrosion resistance, it is a major consideration.

Another consequence of chromium loss during welding is the effect on mechanical properties. In the chromium/molybdenum/vanadium materials for example, developed for their high temperature creep resistance, enhanced hardenability, wear resistance, impact resistance and machinability, any reduction in chromium content can affect these properties. Furthermore, the sensitivity of these materials to contaminating products such as hydrogen in the shield gases needs to be considered. Care needs to be taken in selection of consumables and it is essential that any shield gases are of high purity.

The thermal cycles along with any local contamination involved in fusion welding titanium alloys can give rise to embrittlement of the alloy. Their reactive nature makes it essential to address the requirement for thorough pre-cleaning and particularly oxidation at the high temperatures involved in arc welding.

All in all, then, there is a strong material case for eliminating oxygen and other contaminants from the locality of the weld by purging with inert gas such as argon. A wide variety of purging solutions have been developed to combat the problem, including tube and pipe weld purging systems and trailing shields but there is increasing demand for complex three dimensional components using alloys that are sensitive to oxidation and contamination. These are best fabricated in sealed enclosures where the entire welding operation is carried out in an inert atmosphere where contamination can be eliminated and oxygen levels reduced to well below 10 ppm.

Where quality and freedom from oxidation and contamination is crucial, total protection is afforded by using weld enclosures. Metal chambers and glove boxes have been in use for decades, and these are effective in providing a totally inert atmosphere during fusion welding.
Although a traditional metal glove box can provide adequate protection it has a series of limitations. These have now been addressed successfully with currently available flexible alternatives.

- There is a major cost difference. Typically, metal enclosures cost ten times more than flexible alternatives, size for size. As the size increases, this ratio increases.

- The difference in weight means shipment and movement is much easier – typically a metal enclosure weighs significantly more than of a flexible alternative.

- Flexible enclosures can be deflated and stored when not required. Without inflation a 1.25 metre diameter model occupies a mere 0.2 cubic metres and weighs only 8 kg.

- Manufacturing times for metal glove boxes/chambers can be very lengthy, extending into many months. Some flexible enclosures are available from stock: bespoke versions can be produced in less than 8 weeks.

- There are no sharp corners in flexible enclosures and consequently no likelihood of trapping air pockets.
There have been considerable advances in enclosure development since the concept was introduced over two decades ago. For example, Huntingdon Fusion Techniques in the UK has spearheaded a drive to design systems specifically for the welding industry. The company has been at the forefront in developing these enclosures and has exploited the opportunities offered by advanced engineering polymers.

These innovative products offer significant attractions over metal glove box alternatives; a significant reduction in cost, very small floor footprint and availability of a very wide range of sizes. The HFT® product has rapidly become the preferred alternative enclosure globally. The flexible option has played a significant part in 3-D production and additive manufacture using arc welding is now being undertaken with CNC or robot systems, together with welding plant, all accommodated inside enclosures, some the size of small rooms.

A commercial spin-off from Cranfield University in the UK uses flexible enclosures to produce aerospace parts with the Wire Arc Additive Manufacturing (WAAM) process.

**Technical Specification of Flexible Enclosures**

A combination of translucent pvc material and optically clear sheet is used depending on the viewing requirements of the customer. Ultra-violet stabilized engineering polymers are used throughout during manufacture. Material thickness is nominally 0.5 mm (480 microns).

Principle large access zips are fitted and additional entry points can be provided for operators’ gloves. A service panel incorporates access ports for welding torches and for electrical leads. A purge gas entry port and an exhaust valve to vent displaced gas to atmosphere are incorporated into each enclosure.

**Large Viewing Area**

Large sections can be manufactured using optically transparent engineering polymers. This offers the opportunity for use by several operators at the same time – ideal for training purposes.

**Multiple Access Points**

Systems can be manufactured with numerous glove ports and gas/electrical entries. Large leak-tight zips afford easy access for components.
Monitoring the purge gas oxygen content

The fact that even very small amounts of oxygen in the purge gas can cause discolouration around the weld underbead makes it desirable that sensitive instruments be employed to measure residual oxygen.

Two essential characteristics of a suitable instrument are that it must have an adequate measuring range and it must sample the gas for oxygen content inside the purge volume.

Although many commercial monitoring systems are available these are generally not sensitive enough to meet the requirements for quality welding of alloys such as some stainless steels and most titanium alloys where the presence of oxygen levels as low as 20 ppm are essential if loss of corrosion resistance and reduction in mechanical properties are to be avoided.

Typical of advanced monitoring systems is the PurgEye® family of instruments from Huntingdon Fusion Techniques Ltd in the UK of which the recently introduced Argweld® PurgEye® 500 Desk is totally compatible with the requirements to continuously monitor oxygen levels in flexible enclosures.
The instrument is fitted with an integral pump to deliver a regular flow of exhausting weld purge gas to the oxygen sensor to ensure consistent measurements and readings. Advanced software is used for control and communication purposes.

PurgeLog™ is employed for computer interfacing, data acquisition, storage and printing of results and graphs for quality control purposes.

PurgeNet™ is used for communicating the current oxygen reading to another piece of equipment such as a Dew Point Monitor with additional inter-pass temperature monitoring.

PurgeAlarm™ is an IP66 Rated visual alarm that displays a red indicator when the oxygen level is reading a greater value than the alarm threshold set by the user. An optional green indicator can be fitted above the standard red indicator and will illuminate only if the alarm is active and reading a value lower than the alarm threshold set by the user. A sounder is available as a further option to provide an audible alarm instead of a light.

References

TWI Job Knowledge. Welding of ferritic creep-resistant steels
WAAM3D Ltd, Milton Keynes, UK
Repeatable Strikes Everytime!

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