WELDWELL Spectrum

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IN SERVICE TO THE WELDING COMMUNITY

Editorial

Dear Readers,

Greetings from the Weldwell Editorial team. We are pleased to place Spectrum Volume 31 Issue # 3 in your hands.

Copper and Nickel(Atomic Numbers 28 &29) lie beside each other in the periodic table and are both completely soluble in each other. The Copper- Nickel combination is very versatile and has many applications especially in the marine industries. The two main groups of this combination are Copper based and Nickel based. The article "Cupro-nickel Alloys -Welding Applications" describes the classification, welding and applications of these alloys. The article "Monel- The first Nickel alloy developed" discusses the characteristics, welding consumables & challenges faced during welding.

Today, revolutionary changes are occurring in manufacturing and one such is using additive technology i.e. layer by layer building components. "Metal Additive Manufacturing- An Overview" introduces the reader to the principles and describes both the popular technologies based on using Powder and Wire as feedstock.

Automation in welding is gaining ground with lots of development in the equipment. An important aspect of this depends on sensing the profile during welding. 'WireSense: The Wire Electrode that doubles as a Sensor' describes the new development wherein no external device is needed to control the variations in the profile of the weld joint.

The new practical education column 'Simple Ways of Identifying SS'; Trivia: 'Nickel New Facts" and the 'Event: 13th, ASEAN SHINYO KAI Meeting' are also covered in this issue.

It is hoped that you will find all these informative and interesting. You are requested to kindly offer your comments and feedback.
Happy reading!!

Yours truly,

Ashok Rai
Editor

- **Cupro - Nickel ALLOYS–Welding Applicatioms**
- **MONEL The first Nickel alloy to be developed**
- **Metal Additive Manufacturing An Overview**
- **Wire Sense - Electrode that doubles as a Sensor**
- **Event - 13th. ASEAN SHINYO KAI Meeting**
- **Trivia - Nickel New Facts**
- **Simple Ways of Identifying SS**

CUPRO-NICKEL ALLOYS – WELDING APPLICATIONS

Copper and Nickel are two of the most important metals for energy technologies. Both of them easily combine to form alloy groups viz. Cupronickel and Monel, which have high strength and corrosion resistance in a variety of temperatures and environments. They are often used in applications that involve extreme heat and high-temperature corrosion. However, they differ in their composition and applications. *Composition:* While, Cupronickel is a copper alloy with less than 30% nickel, Monel is a nickel alloy with 63–70% nickel. Cupronickel also contains strengthening elements like iron and manganese.

Applications:

Cupronickel is used in seawater systems, marine hardware, and high-quality boats. It is resistant to corrosion by salt water, so it is used for piping, heat exchangers, condensers, propellers, propeller shafts, and hulls. Monel is used in marine engineering, chemical and hydrocarbon processing equipment, valves, pumps, shafts, fittings, fasteners, and heat exchangers. This treatise focusses on Cupronickel and Monel is discussed separately.

Cupro-Nickel Grades

Cupronickel alloys with 2 to 30 % nickel, provide good tolerance to oxidation and tension resistant to corrosion cracking, but have moderate resistance and thermal stability at high temperature levels. The strong oxidation tolerance of these alloys is evident in hot air and vapour. Most frequently used grades are:

Alloy	ASTM/UNS	ISO	CEN
90-10	C70600	CuNi10Fw1Mn	CW352H
	C70620 *		
70-30	C71500	CuNi30Fe1Mn	CW354H
	C71520 *		

*Note: *C70620 and *C70520 -are weldable*
Table 1:Designations and Standards

Chemical % Composition	Alloy 90-10 UNS# C 70620	Alloy 70-30 UNS# C71520
Cu (Min.)	>86.5	>65
Ni	9-11	29-33
Fe	1-1.8	0.4-1.0
Mn Max	1.0	1.0
Zn Max	0.5	0.5
C Max	0.05	0.05
Pb Max	0.02	0.02
S Max	0.02	0.02
P Max	0.02	0.02
Other Max	0.5	0.5

Table2: Chemical Composition of the Weldable Alloys

The properties of the copper-nickel alloy vary with composition. Copper 90/10 and Copper 70/30 both exhibit excellent corrosion resistance, particularly sea water; however, Copper 70/30 is stronger and has superior corrosion resistance to impingement. On the other side, the 90/10 alloy shows a marginally better tolerance to biofouling.

Properties	Alloy C 70620	Alloy C 70520
0.2% Proof Strength N/mm	100	120
Tensile Strength N/mm2	300	350
Elongation Min %	30	35
Hardness HV	90	100

Table3: Mechanical Properties

Welding:

All the commonly used welding processes are applicable to the Cu-Ni alloys. Autogenous welding is not recommended and filler metals, typically contain 0.2 to 0.5% titanium, as deoxidants to minimise porosity. 90/10 (BS 2901 type C16) and 70/30 (BS2901 3 type C16) are common welding consumable grades used. A nominal 70-30 Cu-Ni filler metal with titanium as a deoxidizer is almost invariably used to weld all of the Cu-Ni alloys. A 90-10 Cu-Ni bare filler metal and a covered electrode is available and occasionally used, but the bare wire is generally limited to gas tungsten arc welding (GTAW) gauges up to 0.125-in. (3-mm) thick. Welds made with 90-10 Cu-Ni fillers should be limited to non-wetting surfaces since the weld may be anodic to the base metal. Cupronickels (containing up to 30% Ni are single-phase (low thermal conductivity) and readily weldable using inert gases (GMAW or GTAW), generally without preheat (high quality welds can be obtained with all these welding processes. The latter often being carried out using DC—electrode. Special shielding gas such as H / He (2/12) are used to reduce the incidence of surface oxides, which can form on these materials, especially during multi-pass welding. Common sources of the contaminating elements sulphur and phosphorus are marking crayons, paints, temperature indication markers, cutting fluids, oil and grease. Oilor grease-base contaminants must be removed by solvent cleaning. Acceptable methods include immersion in, swabbing with or spraying with alkaline, emulsion, solvent or detergent cleaners or a combination of these; by vapor degreasing; by steam, with or without a cleaner; or by high-pressure water jetting. Thorough cleaning of these alloys before welding is required. GMAW is the most widely selected process for surfacing.

Cupro-Nickel Welding Consumables are classified as AWS A5.6 ECuNi and AWS A5.7 ERCuNi.

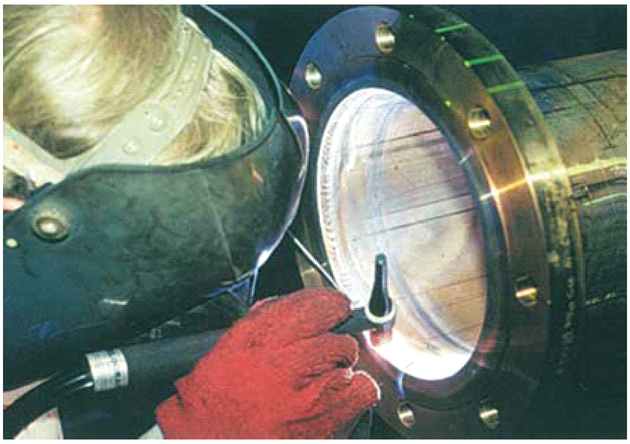


Fig.: Welding with 90:10 consumable

Fig.: Welding with 70:30 welding consumable

Applications:

Cupronickel have strong resilience and excellent tolerance to degradation in a broad variety of temperatures and conditions such as seawater, sulphuric acid and more. The nickel-chromium alloy has excellent oxidation resistance and is considered the best metal alloys to help products withstand high temperatures and environmental conditions. Notable uses for cupronickel alloys are:
Petrochemicals, Refineries and Chemical Plants, Transportation, Food Processing, Textile Plants and Paper Mills, Marine engineering, Desalination plants, Cryogenic Applications and many others. Cu-Ni alloy pipe is widely used in piping systems for shipboard services, coastal installations, desalination plants and offshore oil production. Small diameter pipes, 50 mm. (2") and under are often socket weld joints. The preferred procedure for larger diameter pipes is a GTAW root pass with the option of GTAW, GMAW or SMAW fill welding. Most consistent quality and higher productivity are obtained when the pipe can be rotated for down hand welding. The GTAW root pass may be made by manual welding using either the hand-fed filler metal technique or consumable inserts or by using automatic orbital pipe welding. The pipe interior should be purged with argon using the standard practices for other alloys such as stainless steel and nickel alloys. The manual root pass procedures for Cu-Ni are basically the same as for other alloy piping, but the welders may notice the weld a V-bevel with a nil root face and root opening. The filler metal is ERCuNi, and the torch shielding gas is argon.ConclusionCopper-nickel alloys or cupronickel has been known to man for over a thousand years. It was originally known as white copper to the Chinese as far back as the third century BCE. The alloy is white even though it has a high content of copper. The 70-30 alloy was widely used before the 1950's, however with the accumulated years of its use, and the scientific method used in the modern ear, a 90-10 alloy was found to be better suited for seawater purposes.Copper-nickel alloys are welded today in much the same way they welded 50 years ago. Fluxes and machinery have advanced in technological diversity, but the alloy and its applications remain the same.Copper-nickel alloy is a very useful kind of alloy that has found application in different industries and areas of our life.As with every different alloy and metal, welders have to undergo training to be effective in working with this alloy. Due to its abundance of oil rig platform cladding as well as underwater piping, hyperbaric welding is commonly used as a form of welding deep underwater. Understanding the nature of the metal in every environment is an important factor in successful welding, and great welders can be found working in the most bizarre locations. For availability of all the grades contact:
sales@weldwell.com.

Evaporator shell	90-10 Cu-Ni solid or clad	Tubing	
Tube Plates	90-10 Cu-Ni solid or clad steel	- *Heat Rejection*	Cu-Ni30-Fe2-Mn2
Water boxes and flash chamber linings	90-10 Cu-Ni clad steel	- *Heat Recovery*	70-30 and 90-10 Cu-Ni
Piping	90-10 Cu-Ni	- *Brine Heater*	70-30 Cu-Ni, Cu-Ni30-Fe2-Mn2

Table: Typical applications for Copper-Nickel Alloys in Desalination plant

MONEL – FIRST NICKEL ALLOY DEVELOPED

In 1906, a nickel-copper (Ni-Cu) alloy, developed by International Nickel Company (INCO) was patented. This now is a group of nickel alloys that contain two-thirds nickel & one-third copper & is known as MONEL®. Its appearance is like chrome-molybdenum steel, but is a precipitation hardened nonferrous alloy of nickel and copper. In addition, Monel alloys also contain small amounts of iron, manganese, carbon, silicon, sulphur, aluminium, and titanium. The specific composition of a Monel alloy depends on its desired properties and applications The three main Monel alloys, each of which has several variations, are as below:

- Monel R-400 alloy has approximately 27 to 34% Copper and 63% min. Nickel
  Monel R-405 alloys have increased sulphur content
- Monel K-500 alloying elements aluminium (approx.3.15%) and (0.8%) titanium, but very low sulphur, to improve hardness and strength from precipitation hardening heat treatments.

Characteristics: In general, Monel alloys are known for their high strength and resistance to corrosion in both fresh and saltwater while also having excellent high and low-temperature resistance and with some unique properties. They can be fabricated readily by both hotand cold working, machining and welding. Ni-Cu alloys also possess excellent resistance to oxidation (burning) in high oxygen environments, excellent mechanical properties both at sub-zero temperatures and up to 5550C. Ni-Cu alloys can be fabricated readily by hot and cold working, however, in 1924, the addition of aluminium and titanium produced an age-hardening version with higher strength, known as K-500 (N05500). By means of the precipitation of gamma prime particles, yield strength in excess of 690 Mpa (100 ksi), about three times higher than alloy 400 (N04400) is achieved.

Welding Challenges: As an alloy made primarily of nonferrous metals, oxyacetylene and other fuel gas welding techniques are not applicable to Monel. Joining Monel is best accomplished through electric arc welding. All types of arc welding provide a way to shield the molten metal and prevent the weld from being contaminated. While all types of arc welding can be used on Monel alloys, some welding processes are known to work better than others. It has relatively low fluidity when melting and the result is a "sticky" molten puddle and more difficulty maintaining penetration in the joint. Another unique characteristic of Monel is that each of the metals that combine to form this alloy has a slightly different melting and cooling point, which can cause separation when melted. This tendency for the constituent metals of Monel to separate increases the stress on the weld as it cools, meaning that Monel welds tend to be more prone to cracking and lack-of-fusion (LOF). Monel is also very corrosion resistant. This is due to its tenacious oxide coating, and while this is a desirable material trait, the oxide makes the material more challenging to weld.

Welding Consumables:

1) Monel can be welded with SMAW using a high-nickel electrode and direct current. However, creating a smooth interior surface for the weld requires the use of a backing plate since SMAW offers no internal shielding of the molten metal. Monel is also especially vulnerable to cracking due to uneven heat, and SMAW welding inputs more heat than gas shielded methods of arc welding. Cracking is especially likely with open-groove welding that requires multiple passes using wide-ranging weave patterns to fill the joint. Monel also becomes contaminated if the molten weld pool is exposed to the atmosphere, and without inert shielding, contamination is harder to avoid.

Brand Name	Monel WE 190	Monel WE 187
AWS	A5.11 ENiCu-7	A5.6 ECuNi
Limiting Ni+Co	62.0-68.0	29.0 min
Carbon	0.15 max.	0.05 max
Manganese	4.0 max	1.0 - 2.5
Iron Fe	2.5 max.	0.40 – 0,70
Sulphur	0.015 max	0.015 max
Silicon	1.0 max	0.50 max.
Phosphorus P	0.02 max.	0.020 max
Titanium Ti	1.0 max	0.50 max
Aluminium Al	0.75 max	----
Others	0.50 max	0,50 max
Copper Cu	Remainder	Remainder

Table1: Chemistry of Welding Electrodes

(b) Gas shielded methods of arc welding have several characteristics that make them preferred for use with Monel. Gas coverage is critical when welding Monel. The best way to weld Monel, as widely agreed, is gas tungsten arc welding (GTAW). It provides the ability to keep arc lengths very short, to guide the weld puddle precisely, and to reduce the build-up of heat in the metal. However, even with this precision control, it still takes detailed welding procedure specifications (WPS), a high level of engineering expertise, and a highly skilled welder with experience dealing with this alloy in order to create reliable welds. Ultimately, welding Monel comes down to the ability of the welder to control a molten puddle that has very little ability to flow without putting excessive heat on a single point. Welding Filler Metals.

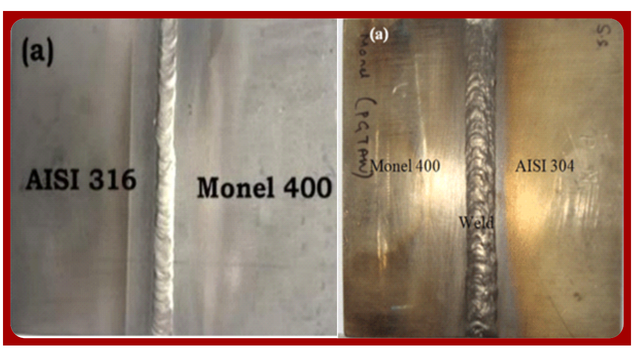
Brand Name	Monel FM 60	Monel FM 67
AWS	A5.14ERNiCu-7	A5.7 ERCuNi
Limiting Ni+Co	62.0 - 69.0	29.0 - 32.0
Carbon	0.15 max	0.04 max
Manganese	4.0 max	1.0 max
Iron Fe	2.5 max.	0.40-0.75
Sulphur	0.015 max	0.01 max
Silicon	1,25 max.	0.25 max
Phosphorus P	0.020 max	0.02 max.
Titanium Ti	1.5 – 3.0	0.20-0.50
Aluminium Al	1.25 max.	----
Others	0.50 max	0.50 max.
Copper Cu	Remainder	Remainder
Lead Pb	------	0.02 max.

Table2: Chemistry of Filler Wires

GTAW offers the most control over both heat and the molten puddle. The tungsten electrode at the centre of GTAW welding keeps the arc very focused and the heat localized to the weld. Since tungsten electrodes are non-consumable, the welder has a great deal of control over the arc length, arc pressure, and the flow of shielding gas over the weld. A skilled TIG welder can adjust each of these elements as the weld progresses to keep the molten puddle moving, the heat even, and the weld within acceptable parameters.

Dissimilar Welding of Monel:

Dissimilar combinations of Monel 400 and austenitic stainless steel AISI 316 are widely used in the petrochemical, nuclear industries, where the weldments are usually subjected to hot corrosion. When stainless steel is joined to Monel, the first run is usually with stainless steel consumables. This technique consists of depositing a layer of filler alloy on stainless steel surface followed by filling on Monel and complete the joint is commonly known as 'buttering.'.



Select the Right Filler Material

For welding Monel to stainless steel, a compatible filler material is crucial. Common choices include:

Monel 60: This filler is often used for welding Monel to stainless steel.

Inconel 625: This is another suitable filler that can be used, especially for higher strength requirements.

3) Welding Process TIG (GTAW): This is often the preferred method for welding dissimilar metals like Monel and stainless steel due to its precision and control.

MIG (GMAW): This can also be used but may require more skill to manage the heat input and prevent issues like cracking.

4) Parameters Heat Input: Control the heat input carefully. Too much heat can lead to distortion and cracking. Use a lower amperage setting. Travel Speed: Maintain a steady travel speed to ensure even heat distribution.

Interpass Temperature: Monitor interpass temperatures to avoid overheating the base metals.

Post-Weld.

Treatment Cleaning: After welding, clean the weld area to remove slag and any oxidation.

Passivation: For stainless steel, consider passivating the weld area to restore corrosion resistance. Testing-After welding, perform necessary inspections and tests to ensure the integrity of the weld, such as visual inspection or non-destructive testing (NDT).

Considerations Consult Specifications: Always refer to relevant welding specifications and standards for specific applications.

Preheat: Depending on the thickness of the materials and the specific alloy, preheating might be necessary to reduce the risk of cracking. By following these guidelines and using the appropriate techniques and materials, you can effectively weld Monel to SS 316. Always prioritize safety and ensure you are using the correct personal protective equipment (PPE) during the welding process.

Applications:

- Marine engineering - Monel's corrosion resistance makes it ideal for use in marine applications such as pipes, pump shafts, valves, anchor cables, and propellers.
- Aerospace engineering - Monel's ability to resist high temperatures makes it useful for jet aircraft coatings, locking wire, and other aerospace and aeronautical constructions.
- Petroleum - Monel is used in crude oil towers, extraction wells, valves, and other applications where it's exposed to high temperatures, sulphides, and hydrofluoric acid.
- Chemical processing - Monel's corrosion resistance makes it useful for pump and valve

Figure 1: Submarine Welding

components, doctor blades, and scrapers.

- Musical instruments - Monel is used in high-end instruments and their parts.
- Everyday objects - Monel is found in eyeglass frames, gas boiler parts, water tanks and heaters, and kitchen sinks.

Summary:

To summarize, Monel is a versatile alloy used across many industries, from marine applications to electronics. The issue for many Monel welding projects, however, is that qualified TIG welders who have experience working with Monel are rare. Moreover, the demanding industries that use Monel most often require a level of precision, reliability, and repeatability that is not attainable with manual welding. Automated orbital GTAW welding provides a solution. For all Monel welding consumables contact sales@weldwell.com

METAL ADDITIVE MANUFACTURING TECHNOLOGIES: AN OVERVIEW

Additive manufacturing of components, layer-by-layer, offers several advantages compared to conventional production technologies such as higher material utilization efficiency and increased geometric possibilities. It is revolutionizing industries.

Introduction: Additive manufacturing technologies are currently one of the fastest growing manufacturing processes. Often called 3D printing, it is a novel method of manufacturing parts directly from digital model by using layer by layer material build-up approach. Through this additive layer manufacturing concept any shaped 3-dimensional objects may be fabricated, which are light as well as strong components These innovative technologies provide engineers anew approach for design and manufacture of parts, which substantially reduce the amount of post-processing and improve product quality by producing parts with form the closest to computer model data. This tool-less manufacturing method can produce fully dense metallic parts in short time, with high precision.

Principle of 3D printing - In all the AM technologies, a digital model is exported from a CAD file to build components by adding layers of material until the finished product has been created. This digital model can be created using various 3D design software or can also can be created using 3D scanning or by a plain digital camera and photogrammetry software. The models created with CAD, result in reduced errors and can be corrected before printing, allowing verification in the design of the object before it is printed. Once the 3D model is created, it is then sliced into layers thereby converting the design into a file readable by 3D printer. 3D printer will then print this file layer by layer using the material given as input to the 3D printer.

The processing is done by four basic components: CNC controller; drive system; power supply; and a power system filler material. The entire 3D printing technology can be divided into 3 steps – (a) 3D Design (b) Slicing (c) 3D Printing. 3D digital model is the starting point for any 3D printing process. There are different approaches of additive manufacturing, which use different types of initial materials. Essentially these can be divided into two fundamental types: powder-based processes and wire-based processes. In is article, both metal powder based and wire based additive manufacturing is presented.

Powder–based Processes: Many early

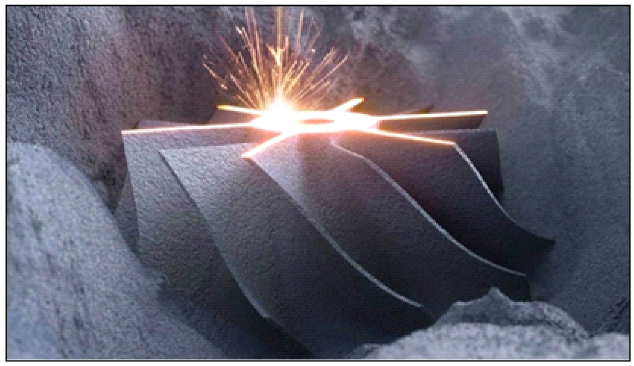


Fig. # 1 Additive Manufacturing with Metal Powder
Characteristics of the Metal powder

technologies, such as selective laser or electron beam melting, laser cladding, and binder jetting, use initial material in the powdered form. In Powder - based processes, the layers are built up using molten metal powder. They produce extremely precise results, but are somewhat slow in production. A majority of metal 3D printing technologies utilize unique features of the metal powder, which is considered as the backbone of metal 3D printing. The major differences between types of metal printers relate to how they fuse the powder into metal parts. These methods vary greatly, ranging from using high energy lasers to fuse loose powder to extruding bound metal powder filament.

Key metal powder characteristics for additive manufacturing are chemical composition, powder size distribution (PSD), morphology, and physical properties. Additional important points to consider when selecting metal powders for additive manufacturing processes are storage and aging of powders; reusability of powder after additive manufacturing cycles; and health, safety, and environmental issues.

Regarding the chemical composition, it is important to take into account interstitials, such as oxygen, nitrogen, carbon, and sulphur, as they may affect significantly material properties depending on alloys. Powders obtained by gas atomization process usually have a spherical or near to spherical shape and have particle sizes, which mostly can be used in additive technologies. It should be noted that particle size distribution has a strong dependence on the type of atomized alloy and used system. With the gas atomization process, all powder particles have the same chemical composition, but finer particles tend to have higher oxygen content due to the higher specific surface. the powder-based technologies can use special materials not available in the bulk form. This fact together with higher part geometrical accuracy leads to a wide application range of powder-based processes. There exist three main technologies for additive manufacturing from metal powders: powder bed fusion, directed energy deposition, and binder jetting. Each one of them has advantages and disadvantages. The main advantage of all types of additive manufacturing is a possibility to produce parts with design that impossible to manufacture by traditional technologies. Direct energy deposition uses metal feedstock and a laser to fabricate parts. Unlike powder bed fusion, the stock (which can be powder or wire) and the laser both sit on a single print head that dispenses and fuses material simultaneously. The resultant parts are very similar to Powder Bed Fusion, with a few key differences and opportunities.

Wire-based Process: Of all the number of developments since 3D printing was introduced, the more recent use of fusion welding as a deposition source has opened up wide ranging possibilities in manufacturing. This has led to the Wire Arc Additive Manufacturing Technology (WAAM), which combines traditional arc welding techniques with additive manufacturing principles. Unlike powder-based methods, WAAM uses metal wire, which is melted using an electric arc and deposited layer by layer to build parts directly from a CAD model.

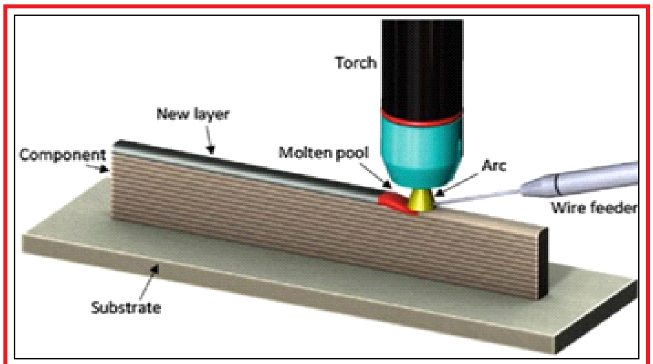


Fig.1: Illustration of WAAM.

Welding processes: A stable welding process and effective heat dissipation are essential for large-scale 3D metal printing. The welding process needs to be sufficiently low energy such that when a new layer is applied, the existing layers do not melt again. In other words, the process needs to be as "cold" as possible. Furthermore, the weld layers need to be continuous, spatter-free, and consistent. If any flaws were to occur, these would be replicated in each subsequent layer. The welding processes considered with foremost importance for WAAM depending upon the feasibility and cost benefits may be among Gas Metal Arc Welding (GMAW) process, Gas Tungsten Arc Welding (GTAW) process, and Plasma Arc Welding (PAW) process.

Several welding process variables exist for the different welding processes and these affect the final quality of components. Therefore, a key care to be taken for the selection of appropriate welding process as well as welding parameters. A few of the features are listed below:

Energy Source	Features	Deposition Rate
Conventional GTAW based	Non-consumable electrode; wire feed process ; Wire & Torch rotation are needed	1-2 Kg/hr
Conventional GMAW-based	Consumable Wire Electrode; Poor arc stability, spatter	3-4 Kg/hr
Cold Metal Transfer (CMT) GMAW - based	Reciprocating consumable wire electrode; Low heat input process with zero spatter; High process tolerance	2-3Kg/hr
Tandem GMAW	Two consumable wires electrode ; Easy mixing to control composition for Intermetallic materials manufacturing	6-8 Kg/hr
Plasma PAW - based	Non-consumable electrode; Separate wire feed process Wire & Torch rotation needed	2-4 Kg/hr

Table # 1

Automation Systems: Automation is the heart to deliver WAAM fabrication and welding. Cartesian coordinates (x, y & z axes), robotic arm, and manipulator like kinematic machines have been available for providing necessary motions to the weld-torch for attaining build shaped structure. The repeatability with accuracy in such motions will lead to achieve desired geometrical, physical properties of the weldment. The high volume of material may be needed to be post-processed, if the motion system is not accurate. This would detrimentally decide the cost of WAAM. CNC machine movements have been employed for WAAM and are believed to be cost-effective approach and would be a hybrid process as the motion for building components and machining to achieve the final component shall be done on the same machine at a stretch.

***Usage*:** A large number of metal AM research articles focus on the following three types of alloys: titanium, nickel and aluminum alloys. This process is highly efficient for producing large-scale metal components with complex geometries, making it suitable for industries such as aerospace, automotive, and marine engineering.

Conclusion: Powder-based printing is challenged by safety, high material costs, limits with powder re-usability, and additional post-processing steps. However, there are many applications that require higher resolutions than that are possible with wire-based printing. Powder-based printing remains the

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WIRESENSE: THE WIRE ELECTRODE THAT DOUBLES AS A SENSOR

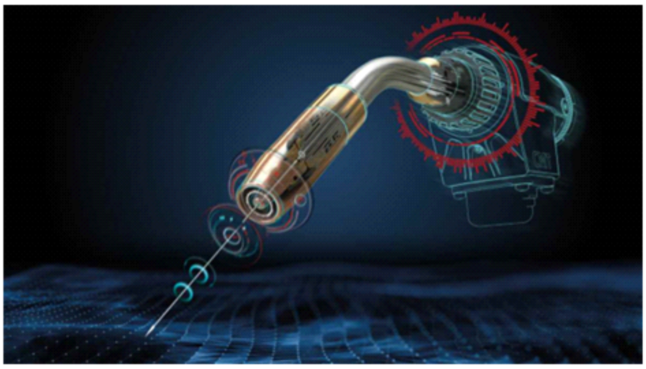
Introduction: Robot welding systems in industrial production are still, an area where inaccuracies are a recurring problem, despite the high levels of precision. Variations in the expected weld seam paths are commonplace and result in a range of problems and fusion errors in joining technology: Burn-through, inadequate a-dimensions, faulty or even missing joints between upper and lower sheets are just some of the possible scenarios. Ultimately, these result in costly rework, component waste and occasionally massive delays in cycle times.

The ideal solution in situations where the sheets being joined deviate excessively from the programmed welding position is to implement the correction before welding begins. To date, the usual approach has been to carry out a manual inspection or use optical measuring systems. The cameras in such cases are usually installed on the torch bodies. But it is precisely this that causes the problems: The angle and shape of the torch can restrict the welder's view of the welding seam. A more frequent problem, however, is that the cameras obstruct access to the component, as there is simply no space for optical measuring tools.

New In-built Solution:

WireSense is the assistance system from Fronius which makes robotic welding more efficient. The wire electrode is turned into a sensor that checks the component position before each weld. Manufacturing inaccuracies can be compensated for and perfect welding results achieved by reliably detecting actual sheet edge heights and positions. Rework and component rejects are largely eliminated, while additional optical measuring devices become unnecessary, resulting in significant time and cost savings.

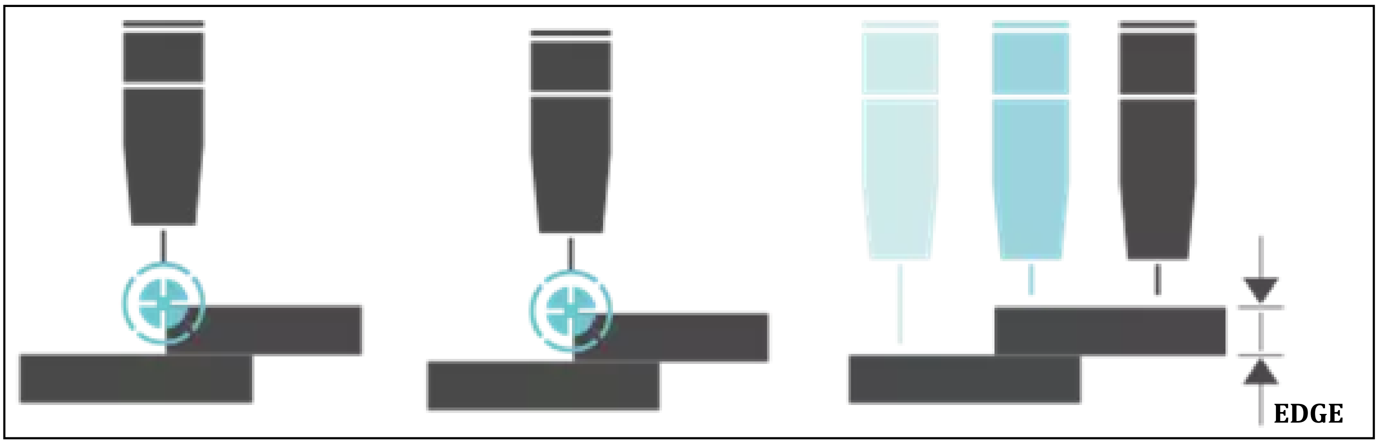
The Science behind WireSense: The welding torch scans the component with a reversing wire movement and the welding system sends the height information and the edge position to the robot. For example, if a lap joint is being welded, the edge position can be precisely defined, and the system can react to any deviations. The robot adjusts the weld seam process based on an application-specific program. By evaluating the height information, the robot can determine both the course of the edge and the actual edge height. It is also possible to determine the exact air gap between the sheets. Edges are detected from a height of 0.5 millimetres. WireSense can be used with steel, stainless steel, aluminum, and other alloys. It is with aluminum that



WireSense truly comes into its own, as reflective surfaces are frequently a major obstacle for optical measuring devices.

How Wire Sense Works:

A very low sensor voltage is applied to the welding wire, reducing the current to a minimum. When the robot moves to the required position and starts the WireSense process, the welding wire touches the component and creates a short circuit. Due to the extremely low power levels, however, no welding is performed. The short circuit is then cleared by raising the wire. The change in the position of the welding wire at the instant the short circuit is created is analysed by the intelligent TPS/i power source using special evaluation algorithms and presented as a height measurement signal for later use – for example by the robot controller. Importantly, WireSense delivers height information, which allows component contours and air gaps to be measured. During commissioning, welding parameters for different air gap sizes can be defined and saved. The WireSense assistance system therefore enables the robot to determine the actual component conditions in order to call up the suitable welding parameters. In anticipation of possible air gaps and other deviations that could lead to lack of fusion, without the use of sensors the welder often has to work at a reduced speed, in order to ensure a high weld seam quality. Thanks to the precise detection of such anomalies in advance, the robot can now join materials fully automatically at the optimal speed, which contributes to additional cycle time optimization. In this way, the new WireSense technology ensures that welding is always performed at the exact weld seam position with optimized parameters. Final visual inspections, rework and component rejects can be significantly reduced resulting in time savings and serious cost reductions.



Advantages:

(I) Detection of the edge position for optimal positioning of the welding start point and end point

(ii) WireSense technology does not require any additional sensor hardware components, such as optical measuring devices, instead the wire electrode is used as a sensor.

(iii) Unlike Optical Sensors, this technique does not disrupt the movements of the robotic arm or place any other restriction

(iv) High-precision withexcellent component accessibility(v) Detection of sheet thicknesses between 0.5 and 20 mm, both for steel and stainless steel as well as aluminum and unwanted air gap

(vii) Economical, as No wear, No Maintenance & No Cleaning Costs

Conclusion:

WireSense – A Step Towards Autonomous Production

WireSense can be used with any TPS/i welding system from Fronius that is configured for the use of the CMT welding process. The precise wire movement of the Robacta Drive CMT wire feeder, which sits directly on the torch body, is crucially important. Retrofitting of existing welding systems is possible at any time due to their flexibility.

WireSense works with all standard CMT welding equipment using any of the popular filler metals.

Continued from Page # 9

best solution for small, complex parts with fine internal features, but these designs must create enough business value to justify the associated process risks and costs.* WAAM is recognized for its efficiency in reducing material waste and energy consumption. It can achieve deposition rates significantly higher than other additive manufacturing methods, which makes it ideal for producing large components, such as aerospace structures and heavy machinery partsThe key advantages of WAAM technology include high material utilization, reduced waste, cost-effectiveness, and the ability to create large-scale parts.* Wire-based metal additive manufacturing processes are simpler, faster, safer, and lower cost than those using powder. While wire-based printing sacrifices resolution in achieving these advantages, the net production benefits are clear.* Arc-based additive manufacturing processes have the additional advantage of an almost unlimited assembly space, higher deposition rates, and an improved utilization factor of raw materials. For larger, near-net-shape applications where wire-based processes can meet requirements, it is almost always the better solution. WAAMis at the forefront for large scale parts. However, wire-based additive manufacturing (AM) is not ideal for complex parts or parts with a fine surface finish, as, parts made from wire often require post-processing. For availability of Metal Additive Manufacturing Powders and WAAM Wires contact: sales@weldwell.com or thermalspray@weldwell.com'.

Resource: 'Technical insights for metal AM deployment'–Published in Inside Metal

Event : 13TH ASEAN SHINYO KAI MEETING

Mr. Kapil Girotra, Director: Weldwell at the Inauguration Ceremony

Kobe Steel Limited, was founded in year 1905 and subsequently in 1946, the first electrode factory for civilian use was established in Japan. Kobe Steel and its welding business have presence in twenty-two countries with six manufacturing facilities spread all over. The south-east Asian countries viz, Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand and Viet Nam are member states of ASEAN (Association of South East Asian Nations) which is based in Jakarta, Indonesia. The ASEAN countries meet periodically, every four years under the banner"Shin-Yo-Kai".

THAI-SHINYOKAI	Colour Signification Purple- Good Red-"Innovation Traditional" Gold- "Prosperity"

KOBELCO, which has been doing business for decades in the South East Asia region and has continuously maintained its position as the No.1 is an active member. This year, the event was hosted by Thai Kobe Welding and held on August 7, 8-2024.Weldwell Speciality, were privileged to participate as part of Kobelco India team.

A total of one hundred and nine delegates from forty-one organizations from twelve countries were a part of the sales and distribution network. The event was to reconfirm mutual relationships, assess the distribution of KOBELCO products to users, and reflect upon the unity of the organization in its contribution to the development of the industries it serves with products and technical services.

Various cultural activities and a Golf tournament were staged to allow everyone to relax, interact and enjoy. During the meeting we got opportunity to meet many senior officials including Mr. Kazuyuki Suenaga San, Head of Welding Business at Kobelco steel Ltd, Japan. The cordial atmosphere was a pleasant experience to interact with different Kobe company heads. Weldwell is thankful to the Kobelco Management for this opportunity.

Glimpse of participants of the Event

Trivia – NICKEL New Facts

Shape Memory Alloys Developed:

Shape Memory, the ability of nitinol to undergo deformation at one temperature, stay in its deformed shape when the external force is removed, then recover its original, undeformed shape upon heating above its transformation temperature. Two of the alloys that possess these two unique properties are: Super elasticity, is the ability for the metal to undergo elastic deformations and immediately return to its undeformed upon removal of the external load.

- NITINOL (Nickel alloyed with Titanium) where both the elements are present in approximately equal atomic percentages. Different alloys are named according to the weight percentage of nickel, e.g. Nitinol 55 & Nitinol 60.

- Cupro Aluminium Nickel(Cu13Al14Ni) is another alloy that demonstrates the Pseudo-Elasticity and Shape Memory effect.These unusual properties are being applied to a wide assortment of applications in a number of different fields including the medical and aerospace fields.Compared to Ni-Ti (Nitinol) alloys, the CuAlNi alloys are much cheaper to make as they use cheaper raw materials and do not require sophisticated processing. CuAlNi alloys are popular due to their wide range of useful transformation temperatures and small hysteresis. They are also the only SMA's that can be used at temperatures over 100°C.

Special Cupro-Nickel Alloy:

A special alloy of 55% Copper and 45 % Nickel, referred as 'Constantan' or 'Eureka' is commonly used for its stable electrical resistance across a wide range of temperatures. It can be processed for self-temperature compensation to match a wide range of test material coefficients of thermal expansion. It is commonly used in a variety of applications, including Thermocouples; Electrical Instruments; Shunt Resistors; Heating Cables; Aerospace and Automotive Sensors.

Super Alloy Foam:

Nickel foam is a metal foam with a complex network of connected cells that has many industrial uses. It has a large surface area, high porosity, and is highly absorbent. This new nickel superalloy foam has been developed to reduce the roar of aircraft engines. A team at A*STAR has shown how regular polymer foams can be used as a template to create heat-resistant, sound-suppressing superalloy metallic foams. The researchers coated a polymer foam with a slurry of the nickel-based superalloy, then burnt off the polymer to leave behind an open-cell metallic foam with the same structure as the original polymer. Testing the acoustic properties of these metallic foams, they found the smaller the pores, the longer and more difficult the sound wave's path will be through the material, and the more time the material has to damp sound energy by converting it to heat — a phenomenon known as the thermo-viscous effect.

Gold & Nickel Alloy

Scientists from the Tokyo Institute of Technology have developed a micrometre-wide thermometer consisting of a Gold and Nickel thermocouple on a silicon nitride membrane. The electrodes measured 2.5 micro metres while thickness of silicon membrane was just 30 nanometres. It's able to measure the smallest temperature changes in real time. The device is a breakthrough for many important applications within nano- technology.

Practical Education: SIMPLE WAYS TO IDENTIFY STAINLESS STEEL

In various procurement scenarios, we often need to determine the authenticity of stainless steel. Identifying the grade of stainless steel, you're working with is an important step in any project involving this versatile material. By using methods like visual inspection and testing with magnets, you can quickly determine if your material is ferritic, austenitic or martensitic without having to resort to costly laboratory tests every time. With these methods at your disposal, you'll be able to confidently choose the right material for your project every time! Some of these are detailed below.

Visual Identification - Different grades of stainless steel have distinct colours and finishes that can be used as an indicator of what grade they are. For example, Grade 304 stainless steel has a dull grey colour, while Grade 316L has a bright silver finish. Direct visual identification is less reliable, because the difference in appearance of various types of stainless steel is difficult to observe. Therefore, this method needs to be combined with other methods.

Chemical Qualitative Identification - This is the easiest and quickest way of chemical identification. A stainless-steel identification agent is available on the market and will display different colours under different steels. The discriminators can quickly distinguish the stainless-steel grades by comparing their display colours to the corresponding colour cards. Another mainstream method is the use of $CuSO_4$. The discriminator needs to remove the oxide layer on the steel, put a drop of water, and rub it with $CuSO_4$. If it does not change colour after rubbing, it is generally stainless steel; if it turns purple red: non-magnetic is high manganese steel, and magnetic is generally ordinary steel or low alloy steel.

Nitric Acid Reaction - On placing a drop of strong nitric acid on the steel surface, if it is a non-stainless steel then they are affected by nitric reaction, a pungent brown fume is generated. Stainless steels, however, remain unaffected. Thus, SS can be identified.

Spark Test - The identification by grinding is to put the stainless steel on the machine and grind it, usually on a grinder and watch the shape and colour of spark. If the spark is streamlined and has more dense forks, it is high manganese or manganese nitrogen steel with higher manganese content; if there is no fork, it is chrome steel or chrome nickel stainless steel.

Magnetic Response - Identifying the grade of stainless steel is determining if it is ferritic, austenitic, or martensitic. Ferritic and martensitic grades will stick to a magnet, while austenitic grades will not. If it doesn't stick to a magnet, then it's most likely an austenitic grade (which is generally non-magnetic). This method can easily distinguish between the two. Other methods can be combined to further distinguish some stainless steels, such as the above chemical identification, or to identify chromium-nickel stainless steel by annealing test.

Molybdenum (Mo) Spot Test - Stainless steels containing a significant amount of molybdenum (Mo) from the steels that are free of Mo can easily be sorted by this method e.g. Type 404 steels can also be sorted from type 316 steels. Some of the Mo grades, which provide a positive response to this test, include grade 316, grade 316L, grade 317, grade 317L, grade 444, grade 904L, grade 2205, "6-Mo" grades, grade 4565S and all "super duplex" grades.

Sulphur (S) Spot Test - Stainless and plain carbon steels having at least 0.1% of sulphur, i.e. free-machining gradescan be sorted from non-free-machining steels. SS 303 contains high sulphur content and, hence, it will initiate a positive reaction. However, the sulphur content of SS 304 and SS 316 is less than that of their standard equivalents and, hence, no positive reactions can be observed in these grades.

Summary -

In general, using a variety of methods can only identify certain stainless steels, but it is not yet possible to determine the elemental content of the steel. Therefore, the best method is to go to the production site, inspect and ask the manufacturer to show the relevant materials to determine the specific element content

NEWS

Lithium-ion Battery Powered Forklift Launched: Godrej & Boyce has introduced a lithium-ion battery operated forklift. These batteries offer up to 15% more run-time to 2&3 Ton forklifts and at least 4 times longer lasting than lead-acid batteries. Other advantages include less time charging, less energy consumption. The technology is scalable and plans to extend to other material handling equipment.

AM/NS India launches 'Optigal', a 'Premium Coated Steel:

Arcelor Mittal Nippon Steel India (AM/NS India) have commenced producing Optigal, a high-quality colour-coated steel, featuring an advanced Zinc-Aluminium-Magnesium (ZAM) coating. Optigal offers the longest warranty of any colour-coated steel in India, extending up to 25 years. It provides exceptional corrosion resistance and flexibility, making it suitable for various applications, including roofing, fencing, and architectural facades. This launch underscores AM/NS India's dedication to providing top-tier products for the domestic market and commitment to the 'Make in India' initiative.

India's significant leap in defence technology:

With the development of the new Kamikaze drones, India has made a major advancement in unmanned aerial vehicles (UAVs)). These indigenous, developed by the National Aerospace Laboratories (NAL) are powered by a 30-horsepower Wankel engine, enabling them to cover a range of up to 1,000 kilometres and fly at speeds of 180 kilometres per hour. Weighing around 120 kilograms, each drone can carry an explosive payload of 25 kilograms, making it a formidable asset in modern warfare. These drones are specifically designed for loitering munitions, allowing them to hover over target areas for extended periods, waiting for the command to strike. A notable feature of these drones is their ability to operate in GPS-denied environments, thanks to the Indian NAViC system. This capability ensures that the drones can navigate and execute missions even in areas where GPS signals are jammed or unavailable. This flexibility makes them ideal for a wide range of combat scenarios.

Titanium Developed:

MIDHANI's engineers have successfully formulated a special “space-age” titanium alloy named Titan6242S (Ti-6AL-2Sn-4zr-2Mo-0.08Si). Titan6242S is a 3D printed titanium alloy wherein titanium is infused with nearly 6.5% aluminum, 4.5% zirconium, 2.2% molybdenum, and other proportions of tin, silicon, and other residual materials. It is a type of alpha titanium alloy that provides high-grade mechanical strength, stability, and creep resistance up to 550-565 degrees Celsius. This newly developed titanium alloy Titan6242S', which will drive India's AMCA Program. Besides this, TITAN 26A and TITAN 29A have also been developed for high-temperature titanium applications in other strategic sectors of defence and space.

L&Ts Firm March in Nuclear Industry:

- After having successfully fabricated a 500Mwe Nuclear Power End-shield, a critical component for Nuclear Plants for the first time in India to be installed at the Tarapore Atomic Power Plant. They have also been regularly working closely with ongoing NPCIL nuclear power projects. Based on their capability NPCIL has chosen L&T to partner with them for future nuclear power projects. This is the first time that a private equity partner has been chosen in this highly sensitive area.
- In an attempt to provide clean energy, L&T is collaborating with US-based Clean Core Thorium Energy (CCTE). The patented ANEEEL fuel, made of Thorium and Enriched Uranium would be used in the PHWR and CANDU reactors and advanced nuclear reactors. This will thus promote clean energy, non-proliferation, enhanced safety and decarbonisation of hard-to- abate industries.

Breakthrough Development in Titanium:

Massachusetts Institute of Technology (MIT) researchers, in collaboration with ATI Specialty Materials, have developed new titanium alloys. By tailoring the chemical composition and lattice structure of the alloy and adjusting the processing techniques used, the team has developed alloys with exceptional combinations of strength and ductility.

This invention can provide new opportunities in a breakthrough in multiple industries including aerospace, where this property is useful.

India's Development of New Space Age Titanium:

The engineers of MIDHANI have successfully formulated a special titanium alloy named Titan 6242S. This alloy is 3D printed alloy wherein Titanium is infused with nearly 6.5% Al, 4.5% Zr, 2.2% Mo and suitable proportions of Sn, Si and other residual materials. It is a type of Alpha titanium alloy that provides high-grade mechanical strength, stability, and creep resistance up to 550-5650C.This newly developed titanium Titan 6242S alloy will drive India's AMCA Program. Besides this, TITAN 26A and TITAN 29A have also been developed for high temperature applications in many strategic sectors of defence and space.