Corrosion resistance at weld overlay cladding

The boom in offshore oil and gas will ensure steady demand for high-performance alloys for years to come. But these alloys are expensive, so the need for cladding as a means to reduce alloy use is bound to intensify. This article looks at a special type of cladding, weld overlay cladding (WOC), which is gaining ground in offshore oil & gas and other industries. It requires great expertise combined with advanced equipment.

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reduced cost:

Weld overlay cladding is being used increasingly in offshore oil and gas installations.
**Issues**

Corrosion costs industry several billions of dollars every year. Especially in the oil & gas industry, mild stainless steels have repeatedly failed, necessitating expensive upgrades. What is more, conditions in the process and energy industries are becoming yet more severe, as acidity, pressure and extreme temperatures increase. For example in the offshore oil and gas industry, equipment is increasingly exposed to higher pressures and sour conditions caused by the presence of hydrogen sulphide, dissolved carbon dioxide and chlorides. In the energy industry, alloys are required that can withstand increasingly high temperatures. So demand for better performing alloys can only increase. For example in the offshore oil and gas industry, equipment is increasingly exposed to higher pressures and sour conditions caused by the presence of hydrogen sulphide, dissolved carbon dioxide and chlorides. In the energy industry, alloys are required that can withstand increasingly high temperatures. So demand for better performing alloys can only increase.

**Brief definition**

Weld overlay cladding (WOC) – also known as weld cladding or weld overlay – is a welding process in which a thin layer of metal is deposited over a base metal to improve its properties. This thin surface metal (the clad metal) has superior properties to the base metal and protects it from various types of deterioration (e.g. corrosion, wear, abrasion, heat impact).

The usual purpose of WOC is to protect against corrosion and erosion. But other reasons for its use can be to regain the required dimensions after depletion due to corrosion or erosion (build-up), or to expand the material on a new component until it has acquired the specified dimensions. Here, an alloy is deposited which has similar properties to the base metal in order to extend the material’s life.

**Materials used**

Base metals typically include carbon steels, alloy steels, mildly corrosion-resistant austenitic stainless steels, and occasionally duplex. In general WOC is indicated only for heavy wall thicknesses, and is less appropriate if the base metal has a thickness of less than 30mm. The most common cladding material is Inconel 625, a nickel-chromium-molybdenum alloy with addition of niobium that combines high strength with corrosion resistance. Other grades used are Inconel types 725 and 825; Monel; Hastalloy types B3, C22 and C276; Stellite 21 and Stellite 6; and other stainless steels and CRAs.

In addition, stainless steels such as duplex, super duplex, 304L, 316L, 317L and 410 are used. The cladding material is normally between 2mm and 20mm thick, but thicknesses can go down to 1.5mm.

As an example of the various combinations possible, Renown Oil and Gas offers the following combinations:
Welding processes

In theory, the welding processes used can be manual. In practice, however, an automated process is a much more efficient way to weld-overlay a complex surface. Apart from economics, other factors that determine the weld process include access, weld position and the alloy applied. Methods used include Gas Metal Arc welding (GMAW) and hot or cold wire Gas Tungsten Arc Welding (GTAW). GTAW is considered the most suitable for small bores or difficult area access. Also used are submerged arc welding (SAW), flux cored arc welding (FCAW), plasma transferred arc welding (PTAW) and laser deposition.

The German WOC specialist Uhlig Rohrbogen discontinued manual TIG welding when it acquired a digitally controlled Fronius TimeTwin welding system, which allows welding of thin strip in a single pass. Uhlig is typical of many fabricators who have acquired sufficient expertise of welding parameters to take advantage of the productivity gains that computer-guided automatic and robotic welding can offer. Fronius also offers an ETR [Endless Torch Rotation] cladding system with a capacity for parts weighing up to five tonnes. It is designed for use on valves and blow-out preventers.

After overlaying, heat treatment may be required if the heat affected zone (HAZ) hardness of the backing steel exceeds specified limits. After the weld is finished, various tests are carried out, including ultrasound, dye penetrant inspection and positive material identification using a handheld device to analyze the material’s chemistry.

References: