Erection of a water wall in a coal -fired thermal power plant.

SEAMLESS METAL CORED WIRE IMPROVING WELDING SPEED FOR SUBMERGED ARC WELDING OF WATER WALL STEELS FOR THERMAL POWER UTILITY STEAM GENERATOR

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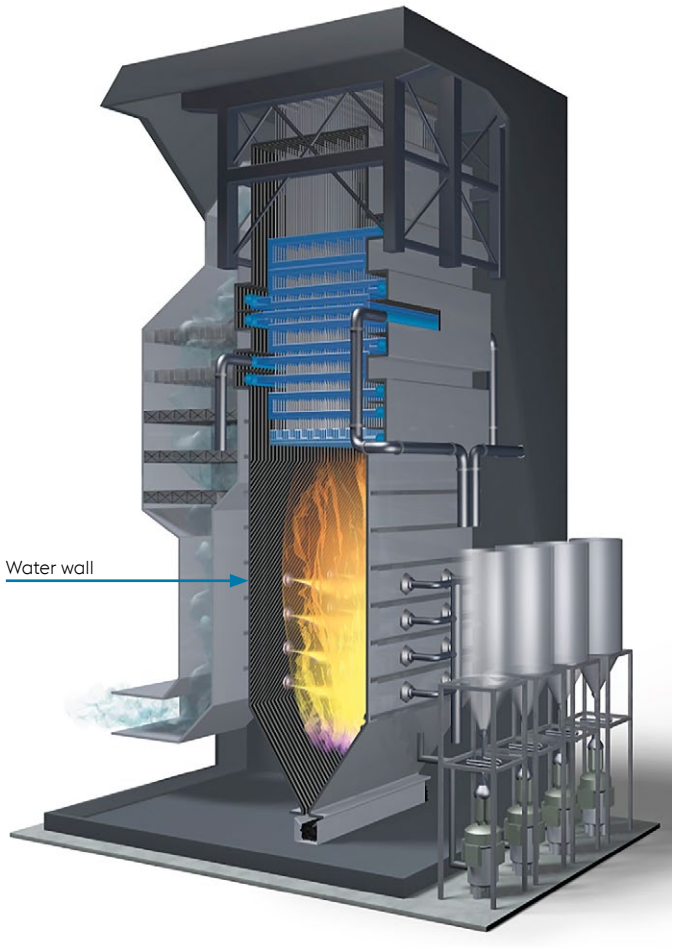
In a conventional thermal power plant water is heated up until it turns into steam. The steam spins a steam turbine which drives an electrical generator. Depending on the heat source thermal power plants differ in fossil fueled (gas, oil and coal), nuclear, solar, waste incineration and biomass power plants. The water wall is part of the fossil fuel steam and waste incineration steam generator. It encloses the rectangular boiler furnace (approximately 10-15 m on each side and 30-40 m in height). Water walls are usually configured as evaporators. Water walls are fabricated from carbon steels like SA 106 Grade B to advanced low alloy grades like T 1 (16Mo3), T 12 (13CrMo4-5), T 22 (10CrMo9-10), T 23 (7CrWVMoNb9-6) or T 24 (7CrMoVTiB10-10) depending on the boiler design and steam parameter. These steels do not require post-weld heat treatment which is an essential factor for the fabrication of these complex components. For the next generation of thermal power plants with mean steam temperature of 700° C or even above (Advanced Ultra-Supercritical Power Plant) creep resistant martensitic steels like T 91 and T 92 which must be heat treated after welding as well as austenitic steels like HR6W or nickel alloys like Alloy 617B are potential candidates.



Boiler house of a fossil-fired thermal power plant.
The water wall is highlighted by an arrow.

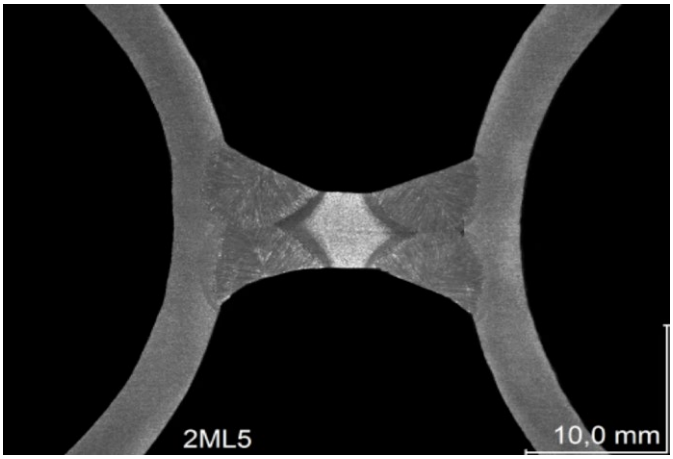
voestalpine Böhler Welding application engineer working on the qualification of Union MV Mo S / UV 305 for fabrication of water wall panels at customer site.

Water walls are gas-tight components fabricated from seamless tubes of approximately 22 m in length, 52 mm in diameter and 6.3 mm wall thickness which are connected to web plates of around 15 mm in width and 6 mm in thickness by fillet welds in PB position. These panels are pre-fabricated in the workshop commonly using submerged arc welding process. First tube twins, quads, etc. are welded from one side using multiple welding head equipment. Subsequently the panel is reversed and the backside is welded. Once the maximum width of the welding machine is achieved a manual SAW tractor is commonly used to join the water wall panels. To reach the full length of the water wall panel the tube to tube connections are welded by tungsten inert gas welding process. It is economically and technically not feasible to apply a post-weld heat treatment for these components during workshop fabrication due to the large dimensions of the water wall panel and during on-site erection due to the high thermal stresses which will be introduced by a local post-weld heat treatment.

For an 800 MW utility steam generator unit more than 100.000 m tube to fin connections has to be welded during water wall fabrication! In consequence a high speed welding process is necessary in order to obtain an economically feasible fabrication route. For submerged arc welding of water wall panels welding, speed of more than 1 m/min is required for the workshop fabrication. To realize this welding speed a high speed flux like UV 305 is mandatory. The aluminate-rutile flux is characterized by excellent slag detachability and high speed welding performance in combination with good mechanical properties giving the essential advantage for the water wall panel fabrication.

Although solid wires are predominantly used for the fabrication of water wall panels by submerged arc welding process some fabricators benefit from the advantage of a seamless metal cored wire. In comparison to the solid wire the wetting behavior, bead appearance and slag detachability is improved. All together, these advantages allow increasing the travel speed up to 1.5 m/min which is 20 % faster compared to solid wire application. The heat input is decreased as a consequence of the higher travel speed at constant amperage which can minimize residual welding stresses as well as distortion of the water wall panel. This leads to a reduction of extensive straightening work, thus increasing the productivity of the fabricator.

For the fabrication of grade 1 (16Mo3) water wall panels voestalpine Böhler Welding successfully qualified a welding procedure specification for submerged arc welding using Union MV Mo S / UV 305 seamless metal cored wire flux combination together with our customers and approved by the notified body (TÜV). Travel speed of 1.45 m/min has been realized using 2.0 mm wire for tandem DC/DC welding. Hardness level of less then 225 HV10 in the weld metal and heat affected zone has been achieved without preheating and post weld heat treatment. The requirements for the fabrication of water wall panels according to EN 12952-5 and VdTÜV-Merkblatt Dampfkessel 451-68/1 have been approved



Macro section of T 1 (16Mo3) water wall tube to fin connection welded with seamless metal cored wire flux combination Union MV Mo S / UV 305

SELECTION GUIDE FOR HIGH EFFICIENT WELDING OF WATER WALL PANEL STEELS

Alloy grade	Solid wire	Seamless metal cored wire	Flux
	Union S 2 Si		
SA 213 T1	Union S 2 Mo	Union MV Mo S	UV 305
SA 213 T12	Union S 2 CrMo	Union MV CrMo S	for all alloy grades
SA 213 T22	Union S 1 CrMo 2		
SA 213 T23	Union S P23		
SA 213 T24	Union S P24		

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