Welder-driven fabrication quality

African Fusion visits the fabrication facilities of engineering, manufacturing, fabrication, machining, welding and refurbishment specialist, Turnmill Proquip Engineering and talks to the company's welding engineer, Renko Huisamen about current and recent fabrication successes.

Turnmill Engineering is a medium to heavy specialist engineering company in Vanderbijlpark. The company was founded in 1980 by Carel Pienaar and was acquired in 2008 by Level 1 B-BBEE company, The Structa Group.

The company's commitment to customer service, high standards of workmanship and quality, service and on time delivery, and its competitive cost structures have enabled Turnmill to build sound long-term partnerships with blue-chip clients.

"We manufacture a wide range of equipment in materials varying from boiler plate to stainless steel, duplex stainless steel and more exotic alloys. Being part of the Structa Group, Turnmill Proquip Engineering also has access to the Group's engineers and design packages, including FEA design facilities through our sister the subsidiary, Structa Konsult," says Huisamen

Originally founded in Vereeniging to service growing needs of the local petrochemical industry for heat exchangers and process vessels, Turnmill's core capability remains in medium to heavy fabrication projects.

Huisamen first cites ongoing work on four giant uranium leach vessels destined for use by a mine in Rustenberg. "These are huge constructions – 40 m long by 6.0 m wide and 5.0 m high – that look like massive versions of the vessels used for the D-day landings during the Second World War," he tells *African Fusion*.

Due to the size of these structures, manipulation for a more favourable welding position becomes impossible. "All the welding has to be done in position, which means there are lot of vertical and overhead seams. For these we have chosen to use a BOHLER Ti 71-T1M flux-cored wire, because the fast freezing slag enables the welders to control the weld bead shape without having to slow down the deposition rates," he explains.

Turnmill Engineering uses use Air Liquide's Arcal Force argon/CO_2 gas mixture for this process as it contains more CO_2 than solid wire gas mixtures such as Arcal Speed. This results in a tight arc that gives excellent fusion.

One of four giant uranium leach vessels being manufactured at Turnmill Engineering for use by a mine in Rustenberg.

"The gas and flux-cored wire combination is very competitive with respect to cost and allows us to use our conventional MIG/MAG welding equipment. We did look at solid wire pulsed-MIG welding for the job, but this would have involved new equipment investments and would not have been as fast," he reveals.

Describing his experience with flux-cored welding, he says that a few years ago a flux-cored wire was used with CO_2. "But we had to use heated regulators, which was a real hassle. When 100% CO_2 exits the gas cylinder, it starts to freeze up the regulator so we had to use heated versions that required mains power. We found this to be a real nuisance," he explains. "The introduction of Arcal Force instead of CO_2 has enabled us to bring the flux-cored process back into the workshop, with much better results and simpler technology."

Along with the fabrication of four of these leach vessels, there is a substantial amount of structural steelwork required to upgrade the mine's capacity. "We work together with CIS, a sister company that is fabricating the structural sections: cutting, drilling and preparing beams and welding on the end plates, for example," Huisamen reveals.

Where possible, he says that the semi-automatic MIG/MAG process with solid wire is preferred for down-hand welding of structural sections, "but we still use stick welding consumables, which clients often specify".

Solid wire processes can be exceptionally clean, he says. The consumable wire is inexpensive and the welding speeds are excellent. "For out of position welding, client permitting, we now prefer to use the flux-cored process and, if not permitted, we have to turn to sticks."

A 3.0 m can for the Mwadingusha pump storage refurbishment project being prepared for submerged arc welding.

The steam drum for the SO_2 converter project completed and ready for shipping to site.

Also currently in the workshop is a significant piping contract for the Mwadingusha pump storage refurbishment project in the DRC. Three of the six turbine-generators are being modernised at the hydropower plant to increase generation capacity.

"We have set up a mass production style setup to manufacture the three feed pipes linking the reservoir at the top to turbines at the bottom. These 70 m long and 2.5 m diameter pipes are called penstocks and we are required to fabricate and deliver a total of 48 twelve metre sections ready for weld assembly onsite," Huisamen explains.

"Starting with 12 mm flat plate, we first roll 3.0 m cans before inserting a seam joint, starting from the inside at ground level with a solid wire GMAW root pass onto a backing plate. This is followed by a GMAW hot pass and we then fill the inside seam using a submerged arc welding setup on a boom manipulator. The can is then rotated to give access to the seam at the top. We backgrind the root and then cap the outside of the seam with a final submerged arc bead."

By the time the contract is completed, 192 of these cans will have been fabricated. "We join four of these cans together to give us the 12 m delivery length for shipping to site," Huisamen tells *African Fusion*.

While not particularly complicated in terms of fabrication, there are some complex requirements that have to be met. "The specification is very strict with respect to welding quality and non-destructive examination requirements, for both the welds and the corrosion resistant epoxy paint specification," Huisamen explains.

"We have a 100% UT requirement for all the welds and for plate laminations – and if any indications are detected, then radiographic testing is required on the entire weld seam. We also have to meet hardness requirements and to perform magnetic testing on final welds and on the end bevel preparations, for which we have never seen a flaw," he informs us.

In addition, very strict visual testing requirements have to be met. "Cap weld heights cannot exceed 2.0 mm, with no undercut whatsoever. With respect to bead profiles, the bead to plate entrance angle can't be sharper than 160°. None of this can be achieved without excellent fit-up and very careful attention by our welders and our sandblasting and paint technicians," he says.

With respect to higher complexity fabrication, Turnmill Engineering is currently completing the delivery of a giant SO_2 converter and several peripheral components for an SO_2 abatement plant for a Polokwane smelter. The plant will use wet gas sulphuric acid technology to remove SO_2 from the furnace off-gas to comply with benchmark emissions standards.

"As well as the converter itself, we are fabricating the steam drum, a spray cooler in 100% 316 stainless steel and the acid storage tank, which is mostly made in carbon steel – which is suitable because of the very high (over 98%) acid concentration – with some exotics used on the nozzles and other critical areas.

"The converter itself is being manufactured in six modules, due to transport limitations, and consists of several different materials: carbon steel 516 Grade 70 boiler plate for the base and top section, 304 L stainless steel for the mid-top section and for the high-temperature centre, creep resistant 16Mo3 and SA204 Grade B plate is specified," Huisamen says.

The converter stands 40 m high and has a 7.5 m diameter. Internally, catalytic converter beds, heat exchangers and diffusers are used to efficiently convert the SO_2 offgas into SO_3, which then has to be cooled, reacted with H_2O and condensed into concentrated sulphuric acid (H_2SO_4).

"The technology is from Haldor Topsoe in Denmark, a global leader in catalysis and process technology – and the SO_2 converter unit will be the largest ever built," he adds.

Citing the welding of the steam drum for this project, Huisamen says that this very thick section pressure vessel had to be welded using mostly stick electrodes. "When the welding was independently inspected, the inspector sent me a photo saying he had never seen such beautiful stick welding," he notes.

"We rely on old-school welding practices here. We have a collection of 30 or so extraordinary welders and skilled operators who produce incredible quality. It is tough for new welders to join our team, because we cannot tolerate any inattentiveness at all. But for those that survive the first few weeks with us, they have access to one of the best support teams in the country," Huisamen concludes.