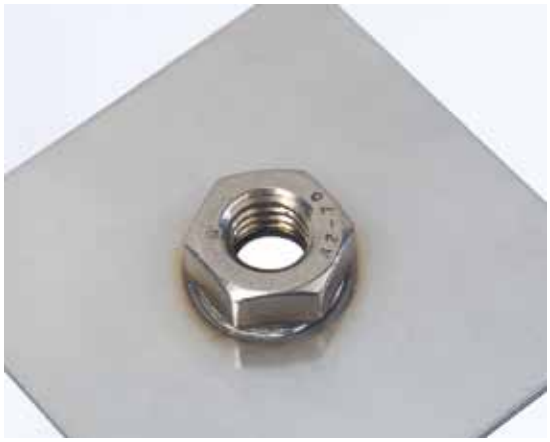
Refractory Fibre's CNC wire bending machine manufacturing stainless steel anchors for a rotary cement kiln.

Miles Simpson, director of Refractory Fibre and Anchor Systems.

Stud welding and anchor systems

Refractory Fibre and Anchor Systems, a division of the Dickinson Group, manufactures and installs stainless steel refractory anchors for furnace applications throughout southern Africa and is the agent for stud welding equipment from both Taylor (UK) and Soyer (Germany). *African Fusion* takes a tour of the company's Vereeniging facilities and talks to its director, Miles Simpson.



Refractory Fibre has now perfected a technique for stud welding a nut around a punched hole using the new Soyer magnetic field process.

The drawn arc stud welding process results in welds on base metals that are stronger than the surrounding metal and have maximum weld penetration without marring the other side.

Refractory Fibre and Anchor Systems manufactures and installs anchor systems for all types of monolithic, ceramic fibre and brick refractory linings, systems that are essential for retaining the refractory material and enhancing the life and lining performance of furnaces and kilns. "Furnace linings can be anywhere between 35 mm to 400 mm thick, sometimes with a single layer and sometimes with several – ceramic paper at the bottom, an insulating castable lining above that and a hot castable lining at the surface. Our anchors hold all of these layers in place against the steel shell," Simpson explains.

The division is also the African agent for a drawn arc and capacitor discharge range of stud welding equipment from Taylor Stud Welding Systems (UK) and steel fibre reinforcement products from Yixunda (China). "We have sold in excess of 15 million capacitor discharge studs and almost 200 stud welding machines, manufactured and supplied in excess of 45 000 kg of refractory anchoring systems this year and 400 000 kg of melt extract fibres, which are added to monolithic linings to strengthen the refractories," says Simpson.

For the past four years, Refractory Fibre has also been the agent for Soyer Stud welding, the German pioneer of the use of magnetic field technology to contain stud welding arcs. "The Germans are very well advanced and have come up with new technology over the last three years or so," Simpson says.

He takes us into the factory, where stainless steel anchors, or hangers, are being manufactured using a CNC wire bender. "This machine makes anchors for all kinds of furnaces. It bends and cuts the wire to the exact shape and size," he explains. "These are for a rotary cement kiln. The anchors get welded onto the shell, which then gets covered in a heat resistant refractory, monolithic cement. We bring in all our stainless wire from overseas because Columbus Steel doesn't do wire and the CNC machine only works to tight wire tolerances," he adds.

Alongside the machine, he shows

the production process of a smaller anchor. "These have been bent on the CNC machine. We drill into the anchoring end and place an aluminium ball inside the hole. This takes the oxygen out of the weld metal at the time of welding, to prevent porosity," says Simpson. "These are for a furnace at Scaw metals, to be attached to the base of the furnace to hold the refractory in place.

"Once we started doing stud welding, the range just got bigger and bigger. Today, studs are used in places that you would never know about, the new public card phone booths, for example – there are 12 studs behind each of the silver panels – and there are four studs holding the locks in place of post boxes," he informs *African Fusion*.

Refractory anchors are usually welded using the drawn arc process. Simpson explains how this works: "The process uses a DC power supply to create the arc." A stud is loaded into the stud welder's chuck and a ferrule (a disposable ceramic shield that contains the molten pool of metal) is placed over the end. The stud is placed in contact with the metal workpiece and, as soon as the current begins to flow, the stud is drawn back, creating an arc which melts both the stud and the workpiece. After a preset time, the stud is plunged into the molten pool to form the joint.

The process results in strong one-sided welds on base metals with maximum weld penetration without marring the other side. It provides highly reliable fastening for a wide variety of applications and allows almost any size or configuration of stud to be welded very quickly. "Drawn arc welds form a bond that is stronger than the surrounding metal," he adds.

The basic variants of stud welding are:

- Capacitor Discharge (CD) stud welding used on thin sheet metal.
- A drawn arc stud weld method used with a ferrule to contain the molten pool.
- The short-cycle drawn arc process, which does not use a flux or a ferrule and offers the shortest welding time of all the stud welding options.
- Gas arc stud welding, which uses an insert shielding gas to protect weld metal. This variant is easier to automate but it provides less fillet control and less depth of penetration in comparison with the other techniques.

The new radially symmetrical magnetic field process (SRM) from Soyer is the latest stud welding variant. The process has been developed by combining the advantages of capacitor discharge welding with those of short-cycle drawn arc welding. The new SRM technology uses a magnetically impelled arc to support the weld pool when welding with a one-sided or unbalanced earth connection. This innovation can be easily automated and is extremely cost-effective.

"The SRM stud welding gun develops a rotating magnetic field that controls the arc during the welding process," Simpson explains. This allows the system to control the fillet during the welding process. Larger diameter weld studs can be welded onto thin sheet metal with the short cycle drawn arc process. The fillet is uniform around the base of the weld stud, without the use of ceramic ferrules and the gun incorporates a shielding gas into the process to ensure weld integrity. "This system allows you to weld much bigger studs onto thinner plate. We have also now perfected a technique for stud welding a nut around a punched hole using the new Soyer magnetic field process," he claims. "You can't do this with conventional stud welding."

Capacitor discharge (CD) stud welding uses a very short weld time and allows small-diameter studs to be welded to thin, lightweight materials. The weld cycle can be completed in 0,01 seconds on material as thin as 0,5 mm. These fast weld times minimise heat build-up, resulting in welds with very little distortion, discoloration, or burning. The process is often used when appearance is a critical product feature.

The CD stud welding method, used mainly for welding mild steel, stainless steel, and aluminium studs, includes two primary techniques: contact and gap. Both require a specially designed stud with a projection, or ignition tip, on the weld end. This tip provides accurate welding time control with precise repeatability. The stud is loaded into the weld tool and positioned in contact with the workpiece. Energy is then discharged from capacitors through the stud tip. Since the size of the ignition tip cannot handle the current density of the discharge, it vaporises, creating a gap that allows an arc to be formed. As the arc begins to melt the stud and workpiece, the two pieces are forced together and a weld is produced. This process creates high-integrity welds on thin gauge materials. It also allows the welding of dissimilar metals because the weld penetration is so slight that metallurgical problems can be prevented.

"We bring in the copper coated mild steel, stainless, aluminium and brass studs for the smaller stud welding machines from the east where they are made very cheaply but with excellent quality. We have sold over 15-million studs for our CD-machines," says Simpson.

We ask about the future outlook: "We are currently tendering on a lot of new business," he responds. "The new hex mesh product from Causeway Steel Products (UK), which is also used for refractory linings, is ideal for cyclones and Fluid Catalytic Cracking Units (FCCUs) in the petrochemical industry, where abrasion resistant refractory linings are needed to overcome a combination of abrasion and heat. "The Coega smelter will also be a huge project , double the size of SAPREF," he concludes.

Stud welding test samples: "Studs are used in places that you would never know about," says Simpson.