HVMC Forge welding capability

Process Summary

Forge welding process is a solid state joining technique that involves application of very high pressing forces at the interface (mating surface) between the two separate metal parts to create an instant diffusion bond. The two separate metal parts can be of similar or dissimilar type. The surfaces of the two separate parts are appropriately machined to enable a flat and continuous mating surface between the two. A conventional arc weld, LASER weld or electron beam weld (EBW) can be used to create a seal weld between the two parts to keep them intact during subsequent handling for hot forging process. The two part assembly, joined with a seal weld, is then placed into a furnace at appropriate high temperature, relevant to type of metal, suitable for forging. Depending on the size of the two part assembly heating time in furnace can vary from 30 minutes to 2 hours. Once the assembly is at uniform temperature, it is placed onto a lower die of any suitable forging machine (e.g. screw press, hydraulic press, drop hammer) to provide very high pressing force to create an instant diffusion bond at the interface between the two metal parts. Figures 1 to 3 show images of a case study project carried out by HVM CATAPULT centres AFRC, NAMRC and MTC showing forge welding process of two dissimilar steel rings to manufacture connectors for nuclear reactor plant applications.

Process Advantages

- Similar or dissimilar metals (most combinations) can be readily joined together with this process. The process provides a sound solid state joint.
- Large components of up to 1.5 metres in diameter can be joined using this process depending upon the size of the forging machine available.
- Hollow and bulk components can be readily welded.
- Since the joining occurs at a uniform high temperature followed by air cooling, the weld produced by this method doesn't exhibit any heat affected zone. The weld doesn't suffer from high residual stress such as in case of the conventional arc welding processes.
- Mechanical and microstructure properties of forge welded components are equal or better than the parent metal with uniform properties across the weld cross section.
- This process has a high potential for commercialisation to produce parts for a wide range of engineering sectors.

Typical Applications

- Dissimilar metal connectors are crucial in O&G, chemical processing and nuclear plant applications.
- Wide range of engineering manufacturing sector can benefit from hollow and solid dissimilar metal component joining using forge welding.
- Other applications include automotive drive line, hybrid components with hard rim and soft core for tailored properties and cladding application on small components.

Catapult capabilities

Equipment	HVM Catapult Capability	Typical Applications
Hydraulic press	500T hydraulic press - 6mm/second maximum speed https://www.strath.ac.uk/research/advancedformingresearchcentre/ourwork/ourequipment/hotforgingforming/	Joining similar or dissimilar metals using hot forging process - Cladding applications, Forging complex shapes from dissimilar metals through closed die forging.
Screw press	2100T screw press with 140 kJ energy - With 400mm total stroke. https://www.strath.ac.uk/research/advancedformingresearchcentre/ourwork/ourequipment/hotforgingforming/	Joining similar or dissimilar metals using hot forging process - Cladding applications, Forging complex shapes from dissimilar metals through closed die forging.

Table1: Hot forging presses available at AFRC for Forge welding process.

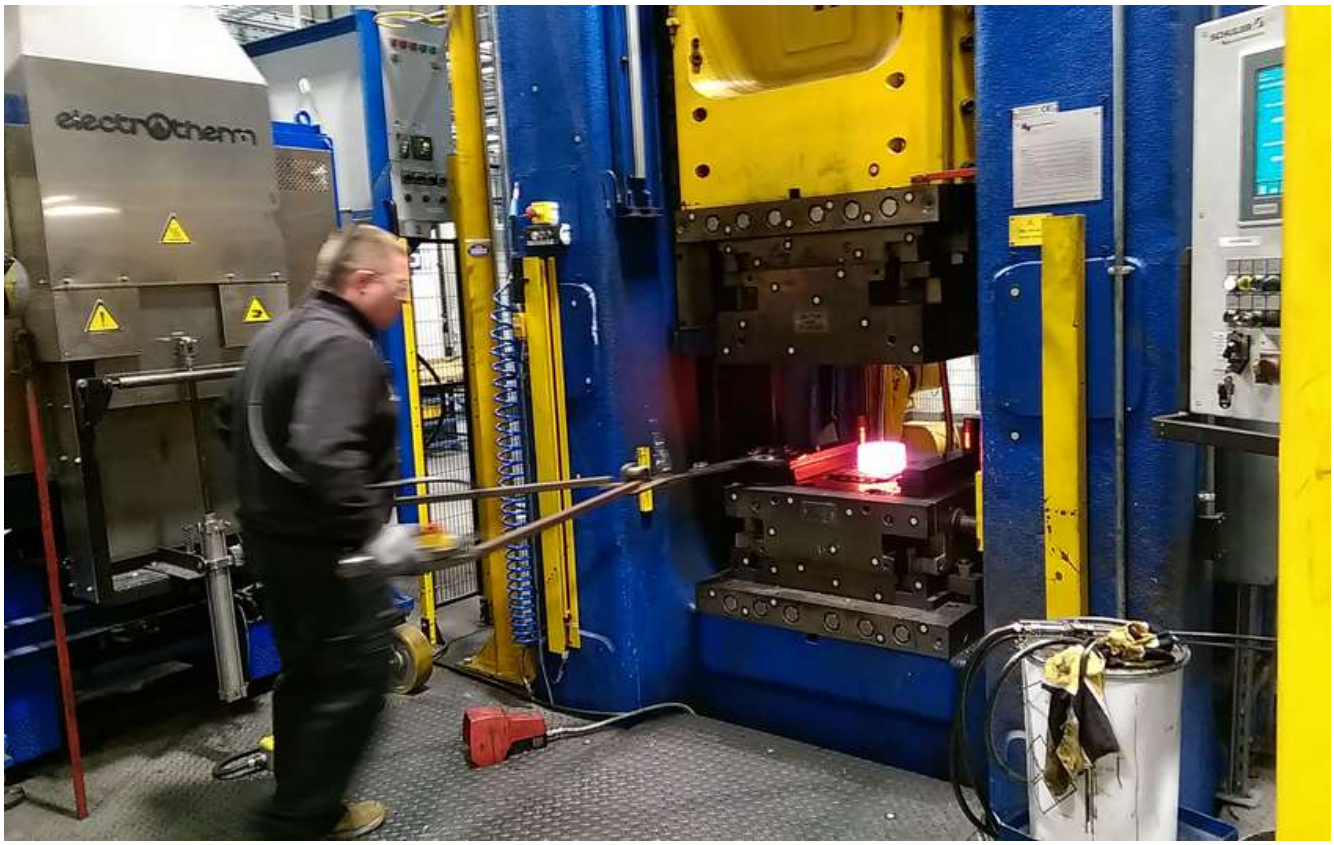

Figure1: Forge welding process on 2100T screw press at AFRC. (A dual ring preform made of two different steel grades has been transferred to the lower die of the screw press)

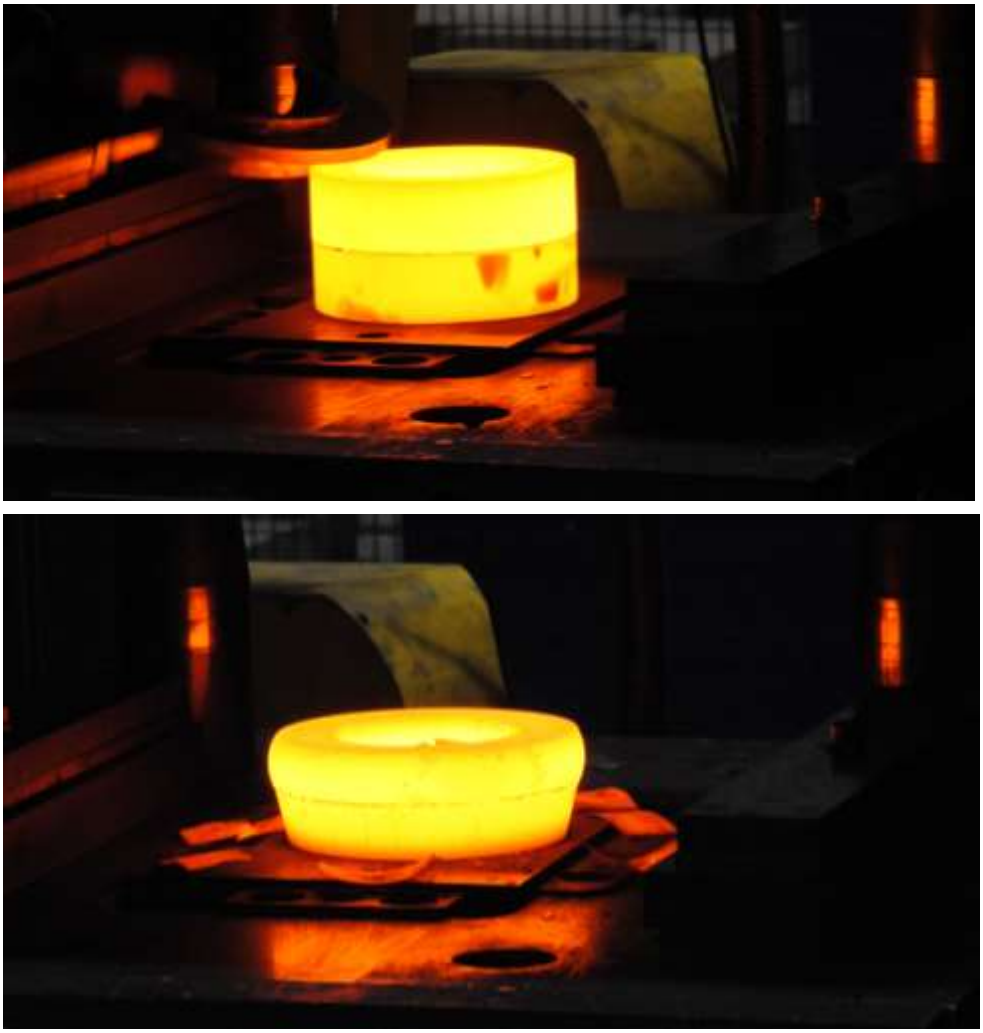

Figure2: Close up photograph of dual ring preform (top) at forging temperature and a photo after forging (bottom)

(a) **(b)** **(c)**

Figure3: (a) seal welded preforms made of two different steel grades, (b) Forge welded part after air cooling and (c) proof machined forge welded part in finished condition.

Contact Details

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