Fabrication of Friction Welding on Centre Lathe: A Case Study

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Abstract
This project is a model and a simplified version of friction welding on Centre Lathe Machine and has been made under the constraints of space, time and resources available. The friction welding has been fusion on to MS round metal pipe piece. The two MS round metal pipe pieces join into each other, while the two side parts remain intact with the two round metal face. Friction welding method is one of the most simple, economical and highly productive methods in joining similar and dissimilar metals. It is widely used in the automotive, aircraft and aerospace industrial applications. In the present work, a MS round metal pipe piece to be friction welded to another MS round metal pipe piece. On the hand, the MS round metal pipe pieces were machine down using a centre lathe machine to the dimension required. The diameters of the MS round metal pipe pieces were both 20 mm respectively. Rotational speeds for friction welding were between 700 to 900 rpm. A friction pressure was maintained at 7 MPa and friction time was kept constant.

Keywords
Friction Welding;Lathe Machine;MS Pipe; Braking System;

I. Introduction
Friction Welding is a solid-state joining process that uses a third body tool to join two faying surfaces. Heat is generated between the tool and material which leads to a very soft region near the Friction Welding. It then mechanically intermixes the two pieces of metal at the place of the join, then the softened metal (due to the elevated temperature) can be joined using mechanical pressure (which is applied by the feed), much like joining clay, or dough.

All welding methods can be investigated in one of the two main categories; melt and pressure welding. Friction welding is a type of pressurized welding method. Friction welding is a solid state process, where no electric or other power sources are used, mechanical energy produced by friction in the interface of parts to be welded are utilized. Using heat efficiently in the welding region is only possible by efficiently distributing heat on surfaces, to which welding will be applied. During the welding process, surfaces are under pressure and this period called the heating phase continues until plastic forming temperature is achieved. The temperature in the welding region for steels is between 900 and 13000C. Heated metal at the interface accumulates by increasing pressure after heating phase. Thus, a type of thermo mechanical treatment occurs in the welding region and this region has stable particle structure. Metals and alloys, which cannot be welded by other welding methods, can be welded using friction welding. In order to obtain welding connection between parts, untreated surfaces need to be contacted to one another. This contact is efficient because friction corrects contacting problems. The melting process does not normally occur on contacted surfaces. Even though, a small amount of melting may occur, accumulation caused by post-welding process makes it invisible.

One of the parts is stationary while the other one rotates. When the rotational speed rises to a certain value, axial pressure is applied and location heating occurs in parts at the interface. Then, rotation is stopped; heated material at the interface accumulates. This one day session at our headquarters in St. Charles is designed to help you understand the fundamentals of the two major frictional welding processes for thermoplastics:

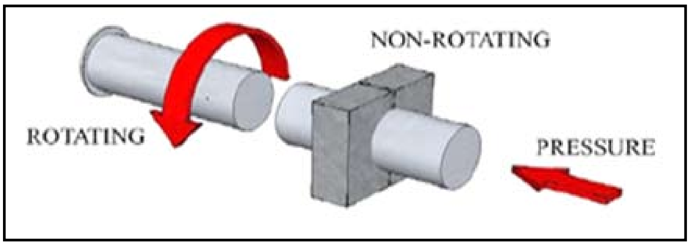
- Vibration Welding
- Spin Welding

Friction welding is a low temperature, solid state welding process producing repeatable, CNC controlled high quality weld joints. Interface temperature is raised to a plastic state level through friction by spinning one part against another, and then applying a forging forced force to bond the weldment.By producing a full cross-sectional surface forging, our process yields a very high strength, low stress weld with no porosity, and, in most cases, eliminates the need for costly pre-machining. Joint strength is equal to parent material strength. Another principal advantage of friction welding is that it allows for the joining of dissimilar materials such as steel to stainless steel, aluminium to steel or copper, and a host of other combinations using various materials that are not weld able through traditional methods. Unlike other methods, please note that our process is low temperature e (plastic state versus liquefied metal as per traditional welding) and has a very small heat-affected zone. Material micro-structure and most material properties are maintained as well. Only solid, internal material exists across the interface with no third alloy added. Many material combinations that are not consider weld able can be joined by our process, all without the use of fillers, or field gasses. Also, we are able to remove the flash (the plastic state material displaced during forging) while it is still soft and pliant during the process cycle even when harden able materials are used, thus eliminating costly grinding.

II. Case Study
In this experiment of fabrication of friction welding on centre lathe, firstly take two pieces of MS pipe. After cutting the pieces, facing and centering both pieces on lathe machine. After facing and centering the work pieces, one end of the MS pipe is fixed with the help of chuck and one end of the MS pipe is fixed with threw chuck of tail stock. Then the centre lathe machine started, the MS pipe attached to the chuck is rotated and the other pipe is pushed towards it by applying pressure manually. At a point fusion temperature is reached, then rotation is stopped with the help of braking device and welding is done.

In friction welding one component is rotated and one component is held stationary. The part that is rotated is brought into contact with the stationary component and when enough heat has been generated to bring the components to a plastic state and the desired burn off has been achieved, rotation is stopped. More axial force is then applied between the two components resulting in a solid state bond at the interface forming a friction welded joint.

A. Process
STEP 1:- The two components to be friction welded are held in axial alignment.



STEP 2:- One component that is held in chucking spindle of the machine is rotated and accelerated to the desired speed.
STEP 3:- The other component that is held in the movable clamp is moved forward to come into pressure contact with the rotating component.
STEP 4:- Pressure and rotation are maintained until the resulting high temp makes the component's metal plastic for welding with sufficient metal behind the interface becoming softened to permit the components to be forged together. During this period metal is slowly extruded from the weld region to form an upset

III. Material Selection

Two mild steel pipes of diameter 20mm are taken initially.
Dimensions:
- Mild Steel Pipe
- Diameter:-20mm
- Thickness:-2mm

IV. Experimental work

1. Centering of the work piece on Lathe machine.
2. Facing of each work piece.
3. Work pieces are then fitted on chuck and threw chuck.
4. Friction welding process starts by rotating the chuck.
5. Braking applied on chuck at red hot conditions for immediate stopping of chuck to make joint.

Fig. 1: Fitting of Work Pieces on Chuck and Threw Chuck

Fig. 2: Friction Welding Joint

Fig. 3: Braking System

V. Result & Conclusion

Friction welding technology brings substantial advantage to the area of joining of MS round metal pipe mild steel series. In the form of light and soften friction weld as per the light and soften required load, the centre lathe machine is much better and less expensive than the Friction Welding Machine.
Availability of data required for design of Friction Welding technology processes in open literature is limited but provides sufficient base to estimate roughly possible benefits of the usage of the technology. Information about basic welding parameters is sufficient to be used as starting values for optimization process on the real construction, materials and tools. This causes higher financial requirements for new adopters of the technology.
Production of the stringer-reinforced panel using technology of Friction Welding provides possibility of improvement of mechanical properties of the panel, reducing weight of the plane construction, introduction of fully automated production into the manufacturing process and raising its efficiency. Further investigation is needed, however, to determine fatigue properties of friction welds in order to allow certification of the structure.

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