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STUDIES AND RESEARCHES REGARDING THE FRICTION WELDING OF PIECES MADE OF CAST IRON

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ABSTRACT: In to this work we presented few general ideas about friction weldig.after this,we followed the determination of displacements and von mises tensions into the contact area of pieces wich are subjected to the welding.friction couples which we chosed are made from grey cast iron and they had different constructive structures. Like a result at tensions he analisis with finite element we reached the conclusion that the shape of pices doesn't influence asseverate the value of displacements and von mises tensions into the contact area.

KEY WORDS: displacements, von Mises tensions, welding, cast iron

1. INTRODUCTION

Friction welding is an ecological procedure that allows a quality joining of the hard or very hard welding materials using classical methods.

This welding procedure requires a lower consumption in comparison with the classical procedures through electric or chemical arc, allows a quality welding at a more superior range a materials to those procedures, in the conditions of obtaining more important power consumption saving, as well as materials and manual labour saving.

Regarding the shape and dimensions of the pieces that can be joined, it is a procedure that requires special processing in some cases (**Fig.1.h**), therefore it is less applicable.

This welding procedure allows joining cylindrical products (**Fig. 1.a**), tubular ones (**Fig. 1b**), cylindrical and tubular ones (**Fig.1c**), plane and cylindrical ones (**Fig. 1 d**), plane and tubular ones (**Fig. 1 e**), as well as plane pieces (**Fig. 1 g**).

The applicability range of the friction welding is rather restricted, but the most suited fields are the vehicles industry and the machine industry. This welding procedure is suited only with complete automation.

In the machine industry, friction welding is used for making cutting tools from two pieces (drills, mills, screw taps), therefore obtaining a lower cost, engine shafts and turbine shafts, gear wheels, valves, crank axels elements, injection pumps axes, water or gas supply, welding different pipes and power supply conductors, from copper and aluminum.In order to accomplish the welding friction a relative movement of the joint pieces and an F force that would act upon them perpendicularly to the joining surface are required (**Fig. 2**).

The material range that may be joint by welding friction is very diversified, therefore different properties materials may be joint.

Because of the specific way of local heating of the welding heads, different materials may be welded from the point of view of chemical composition and melting temperature.

Friction welding is based upon atomic diffusion phenomenon.

The main friction welding procedures are:

A. Commune friction welding. In this case the joint components are pressed one against the other with an axial force, one of them spinning with a constant speed over a period of time in order to provide the necessary plasticity conditions for welding formation.

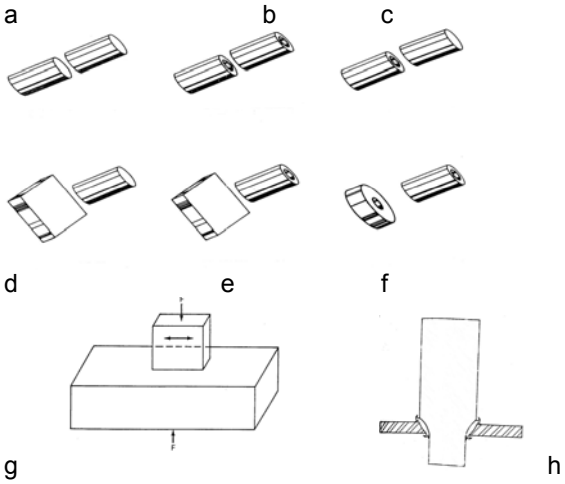


Fig1. Bar strips and friction welded pieces

a- full cylindrical pieces, b- tubular pieces, c- cylindrical pieces with tubular pieces, d- prismatic piece and full cylindrical piece; e- prismatic piece with tubular piece, f- cylindrical piece with tubular piece.

Fig. 2. The condition for accomplishing pressure welding joints

B. Stored energy friction welding. This welding type may be accomplished through friction with a flywheel or through inertia. Within this procedure the energy necessary for welding is stored in a flywheel and the energy release is done through coupling or uncoupling a clutch. Big components with short period of the welding cycle may be welded in this way.

C. HUP friction welding (heat under power) is similar with the continuous friction welding after which the cycle is continued with an inertial stop.

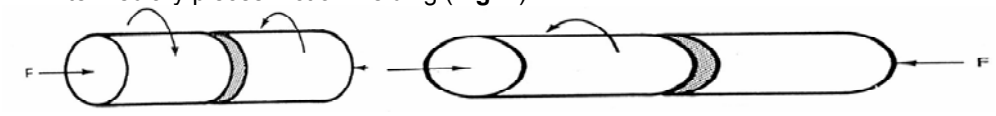
D. Impulse friction welding. The energy necessary for welding is introduced into the welding components under the form of impulses determined by centrifugal forces.

E. Orbital friction welding. The welding components of forms other than the circular one spin around their own axes, and the distanced axes spin around them and reciprocally the parallels spin on a radial orbit one against the other.

F. Friction welding through supplementary heating by induction of the welding components. A supplementary heating is made with inductors therefore reducing the welding time.

Depending on the friction kinetic energy there are two friction welding ways, namely:

- continuous friction welding (**Fig. 3**)
- intermediary pieces friction welding (**Fig. 4**)



a b

Fig 3. Continuous friction welding

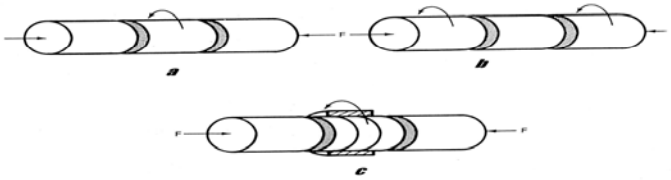


Fig 4. Continuous friction welding
a- with one piece spinning; b- with both pieces spinning
c-with the connection hub spinning

During the friction welding process there are a series of phenomena of which the less important are: plastic flows, surface wear, forming and destroying connections between joint pieces, cold-hardening, atomic diffusion.

2. INVESTIGATION EQUIPMENT AND MEANS

In order to determine the deformations and voltages that appear during the deformation period within the friction welding process a Pentium IV computer with a INTEL processor has been used.

For drawing the program SOLID WORKS 2005, has been used, and for establishing voltages and deformations the MSC visual Nastran 4D 2004 product has been used.

The two components, plate and cylinder, that will be friction jointed were made of grey cast iron whose features are displayed in **Fig 5**. The plate and cylinder's shape and dimensions are displayed in **Fig 6**.

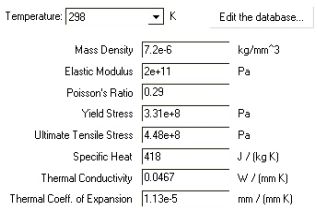


Fig 5 Grey cast iron features

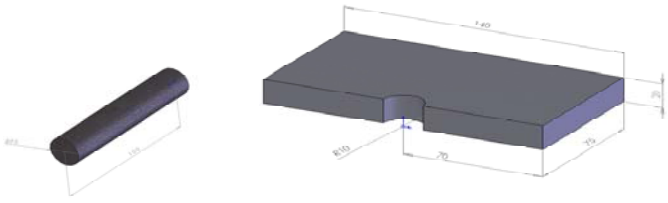


Fig 6 The plate and cylinder's dimensions

For the plate a digitization in 4612 joints and 2683 elements was done and for the cylinder 4402 joints and 2631 elements. A Mesh Size 8 was used for the plate and for the cylinder 4. a uniformly distributed force was applied on the plate and the cylinder received a speed revolutions around its own axis. The errors of the program used are below 10%.

3. EXPERIMENTAL RESULTS

As a consequence of the MSC visual Nastran 4D 2004 product for the plate-cylinder assembly a deformations variation was obtained (**Fig 7; Fig. 8;Fig.9;Fig 10**) and von Mises voltages (**Fig 11**) the following experimental results:

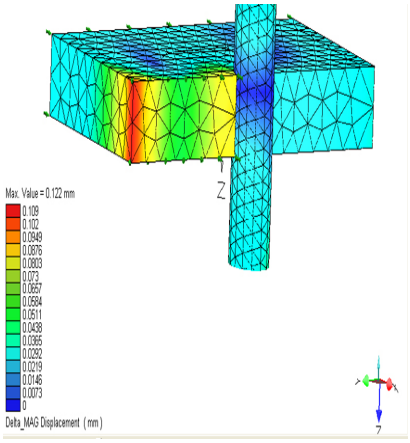


Fig 7.Total displacement

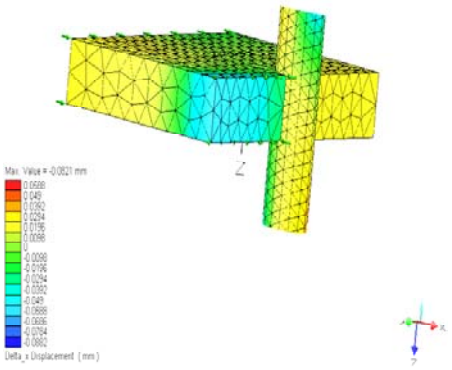


Fig 8. OX displacement

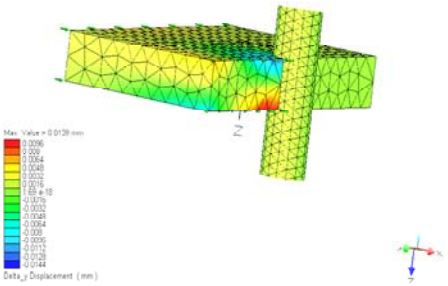


Fig. 9 OY displacement

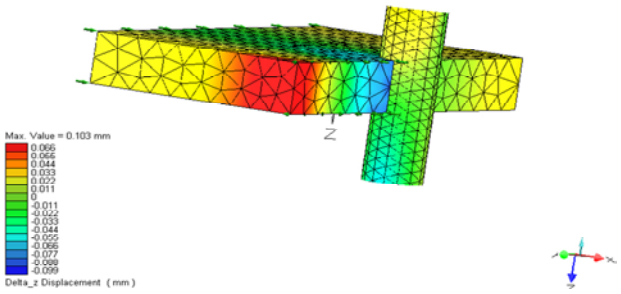


Fig 10 OZ displacement

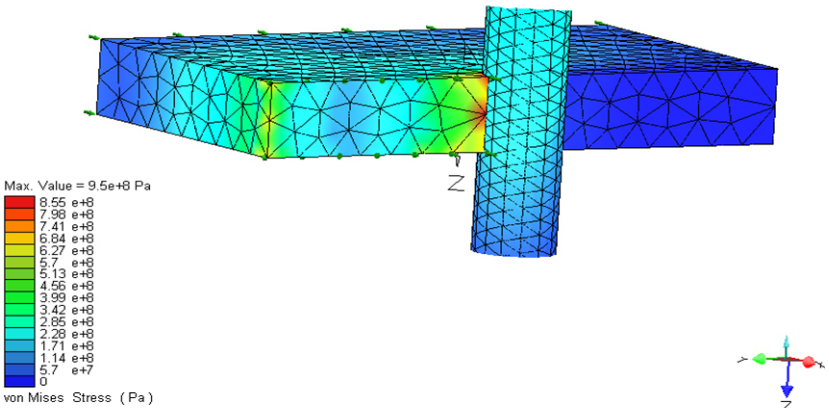


Fig 11. Von Mises tension

4. CONCLUSIONS

As a consequence of the analyses we can observe that there is a deformation on the cylindrical piece due to the plastic breaking phenomenon and the maximum deformation can be encountered on the most prismatic contact area with the cylindrical one at the beginning of the contact. Von Mises tension have maximum values in the central contact area of the two pieces.

5.BIBLIOGRAPHY

[1] BAESLACK I Inertia friction welding of rapidly solidified powdered metallurgi aluminium, Journal of Materials Science, vol 31,nr January,1996,230

[2] EBERHART BJ Friction weld ductily and toughness as influenced by inclusion morfology, Welding Journal,nr28, 1986,180

[3] ELLIS CRG Recent industrial developments in friction welding, Journal of Materials Science, vol 31,nr January,1996,146.

[4] GIRNICEANU Gh, The determination of displacements and von mises tension into the contact area ofpieces wich are subjected to the welding,Scientific Conference 10 th edition 2005 Tg Jiu,2005,

[5] KYUSOJIN A Study on mechanism of friction welding in carbon steel , Buletin of the JSME 1980.