Characterizations of joints HDPE welded by FSW

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Abstract: The aim of this work is the characterization of high density polyethylene (HDPE) joints welded by the Friction Stir Welding (FSW) technique. The characterization is done by destructive testing (mechanical tensile tests) for welded joints.
To do this work, a series of experimental tests were made by taking in account of several parameters: - the geometry of the welding tool (pin), the axial force Fz applied to the tool along its axis of rotation, to compensate for the pressure formed in the weld zone, the speed of rotation of the tool, the speed of advance of the tool,
in this work, we only take in account of the last two parameters.
The results obtained were satisfactory and show the influence of these parameters on the quality of the joint.

Keywords: polymers, HDPE, welding, FSW.

1. Introduction

The main advantage of the friction stir welding (FSW) technique is its ability to be welded in the solid state metal alloys which are generally difficult to weld by conventional welding processes. The assembly of two parts by FSW is the production of heat due mainly to the shoulder and kneading the material with the pin. The shoulder and the pin are the main welding tool elements. The heat is mainly generated by friction between the tool and the plates to be welded and by the plastic dissipation[1].
The tool consists of a shoulder and a pin, the length of the pin is therefore critical, it should be about 20-30% less than the thickness of the sheet.
The rotating pin immersed in the material by heating until the shoulder comes into contact with the sheets. The pressure must be sufficient so that the heat produced by friction between the shoulder and the plate, can soften without reaching the melting point. Fig 1[2]

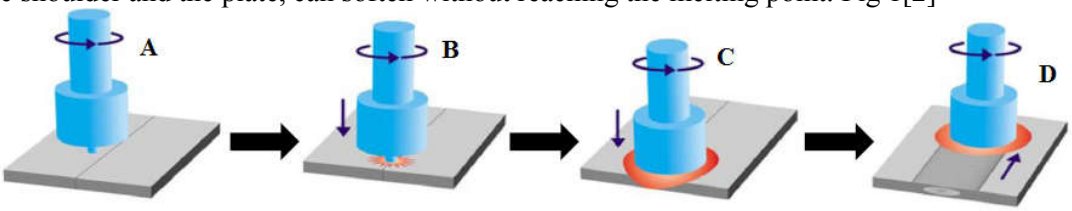

Fig .1. The four stages of the FSW process: (A) The tool is rotated, (B) penetrations, (C) shoulder is brought into contact with the surface of the parts to be assembled, and (D) Welding phase.

2. Experimental work

2.1The welding tool

SHOULDER		PIN	
Role	• Confining the material around the pawn, • Contribute to the heating and mixing of the material, • Forging of matter	Role	• Mix, • Allow plastic deformation by rotation and in advance • Extrusion of the material
Contact	At the surface of the parts to be assembled	Contact	At the interface level, penetrates the material of the parts to be assembled

A

B

Fig. 2 .A The welding tool, B pehd welded samples

2.2. Choice of welding parameters

The main driving parameters of the welding phase are:

- the geometry of the welding tool (pin),
- the axial force Fz applied to the tool along its axis of rotation, to compensate for the pressure formed in the weld zone,
- the speed of rotation of the tool (N),
- the speed of advance of the tool (Va),

In this work, we only take in account of the last two parameters.These parameters are to be adjusted according to the material, the welded thickness and the geometry of the tool. The assembly conditions the energy input, the flow of material, the formation of the bead, the mechanical properties of the assembly and the efforts generated [3]. The choice of these parameters is therefore essential. Table 1 resumes these parameters and welding quality.

sample	Advance Va (mm/min)	Rotation N (Tr/min)	Welding quality
01	10	2000	Fusion of the welded area
	16	2000	bad
02	40	2000	bad
	32	2000	good
	25	2000	bad
03	16	1200	Very good welding

Table .1. Selection of welding parameters.

3. Conclusions

The study of high density polyethylene (HDPE) weldability has confirmed the possibility of obtaining joints soldered by the friction-stir welding process.

Among all the cases that have given good results is the 2nd and 3rd sample, namely a rotation speed of 2000rpm and 1200 rpm respectively an advance speed of 32 mm / min and16 mm / min respectively, which is the most interesting interface, penetrates into the raw material of parts to assemble

The analysis of these results has allowed us to better understand the influence of this parameters at welding of the HDPE by FSW

References

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