

BENDING OF THIN WALLED PIPES USING THE HEAT REALISED BY FRICTION

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ABSTRACT

This paper considers appliance of heat generated by friction to relieve deformation of light metals, having as example of bending thin walled copper pipes. Based on numerous, primarily experiment analysis the conclusions have been applied for designing a machine for bending of thin walled copper pipes having small bend radius.

The machine's design is relatively simple, but it provides realisation of needed temperatures within required narrow area. Large number of tests has shown the reliability of suggested methodology.

KEYWORDS: Bending of thin walled pipes, heat, friction, copper arc.

1. INTRODUCTION

Friction welding has been in use since 1960's. This technology became irreplaceable in many branches of industry thanks to its very good characteristics [3, 4, 7]. That period of time signifies treating heat generated by friction from very negative aspect.

Thanks to the new point of view for heat generated by friction, researches that followed, had resulted not just by expansion in field of use of materials assembling technology, but also by a tendency for using heat effects of friction in material processing. According to the literature sources researches in this field are going in multiple directions. In late 70's there was a method of a stitch forming that has been used for creating a shroud on ends of solid cylinder parts. The results in domain of forming front hatch on bar and board parts were received as well. Now heat generated by friction has the most practical appliance in operations on tightening and widening ends of the pipes and forming (welding) ends of the pipes and solid profiles [5]. Even if this procedure has been already called "thermo friction processing", it may be said that this field is practically in its starting phase.

One thing that is characteristic in heat effects of friction appliance in all those applications is that there is a small number of papers dealing with theoretical review of this problem. Experiments anticipate the theoretical researches in most cases. This points out the complex process and the impossibility of placing reliable dependences between quantity of released heat and obtained temperature in function of input parameters of process itself (speed, pressure, friction modules etc.

Authors' research in this field is primarily

oriented to review possible expansion in field of practical appliance for the heat generated by friction. Theoretical analysis was performed in a smaller extent. The interest has been given to input of the process. The amount of heat and the intensity of the heat development can be controlled by this input [1, 8, 9]. A large number of experiments has been carried out in intention to review a possibility of appliance for the heat generated by friction to bending thin walled pipes. There was no research in this field according to accessible literature. A thin walled copper pipes bending machine was realised as a result of a large number of experiments. It works according to the concept of heating critical bending zone using the heat generated by friction. It has been showed that the heat and its intensity, generated by friction, can be relatively easy managed in a wide range in this type of forming. Over 100,000 high quality product units have been manufactured using the realised machine. It was practically showed that operation of forming (bending pipes) based on principle of heat generated by friction has also extremely convenience applying economic effects.

The machine for straightening and enlarging pipe ends has been realized together with the machine for thin walled pipes bending. Researches associated to this problem will not be represented here in consideration that the straightening of bended pipe is, in most part, implied to the bending procedure.

2. BASIC THEORETICAL POSTULATES OF THE PROCESS

Pipe bending is a particular and specific type of bending [2, 6]. During the bending process pipes are

