Metallurgist, Vol. 57, Nos. 3–4, July, 2013 (Russian Original Nos. 3–4, March–April, 2013)

USE OF SUPERPLASTIC DEFORMATION AND DIFFUSION WELDING TO FORM A TEE DESIGNED WITH A COMPLEX SET OF INTERNAL STIFFENING ELEMENTS

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UDC 621.7.04

A method is described for making a tee designed with a complex set of internal stiffening elements. The article describes the main stages of the modern process of pneumothermal forming in the superplastic regime with the use of diffusion welding. The production of a tee by superplastic pneumothermal forming after diffusion welding is modeled and the calculated results are presented.

Keywords: *pneumothermal forming of sheet parts, superplastic effect, tube parts made from sheets.*

The complexity of gas-distribution systems and oil-conditioning systems that separate out liquids requires the use of complicated tubular parts which separate different flows with the use of internal design elements. Parts of this type can take the place of a collection of tubular parts which do not have flow-separation elements. In this investigation, we examine one method of making tubular parts designed with a complex set of internal stiffening elements. As an example, we will examine a tee in which the large tube has a diameter of 30 mm and the branch has a diameter of 25 mm (Fig. 1).

Such a part is distinguished by the complexity and uniqueness of its design and cannot be made by the usual method. We will examine a variant for making the part which uses both pneumothermal forming in the superplastic regime and diffusion welding.

The *first step* is the zonal application of an anti-welding coating to the location where diffusion welding will take place.

In the *next step*, the sheets that make up the part are arranged from top to bottom in the order shown in Fig. 2 and are welded together at their ends. The resulting semifinished product is placed in the fixture of a hydraulic press to perform the operation of pneumothermal forming in the superplastic regime. The operation is carried out at a temperature of 910°C and a pressure on the order of 1 MPa. It results in diffusion welding of the sheets.

We modeled superplastic pneumothermal forming in the software package PAM-STAMP 2G, which was developed by the French company the ESI Group. The calculations were performed using a material model in which the stresses depend directly on the strain rate [1]:

$$\sigma = K\dot{\varepsilon}^m,$$

where K is a proportionality factor; $\dot{\varepsilon}$ is the strain rate; m is the strain-hardening modulus; and σ is the stress.

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Translated from Metallurg, No. 3, pp. 24–27, March, 2013. Original article submitted March 11, 2013.

0026-0894/13/0304-0172