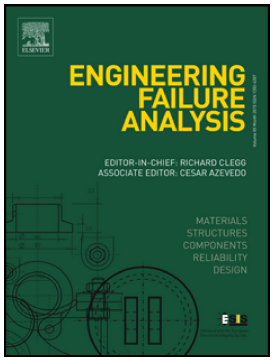

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Failure analysis of shock absorber tubes

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Abstract

The leakproofness of shock absorber tubes is one of the most important parameters determining the quality of these types of automotive parts. The technological parameters of forming their bottoms, as well as material properties strongly influence shock absorber leakproofness. This work focused on analysing the cause bottom cracking of shock absorber cylindrical tubes produced by the "hot bottom forming" method. The investigations showed that the cracks mainly resulted from improper parameters of the manufacturing technology.

Keywords: shock absorber; hot bottom forming; deformation bands

1. Introduction

The shock absorber steel tube is most often formed by closing the bottom of the pipe at one end by means of the so called hot bottom forming or hot spinning operation. This type of forming process allows the production of hollow, mainly axisymmetric components. These components are widely used in the aviation, aerospace, weapons and automobile industries [1]. Other methods of production may involve welding, i.e. the end cap (manufactured through deep drawing, which involves the pressing of a punch on a circular blank located over a cylindrical die) is welded to the tubular body of the shock absorber [2-4]. As another example, aluminium alloy shock-absorber tubes used in motorcycles are formed by means of liquid extrusion [5, 6]. The schematic view of the steel tube hot bottom forming process (also referred to as hot spinning process) is shown in Fig. 1. The steel tube end is induction heated (the induction heater is not shown in Fig. 1) up to the temperature of 1200°C, into the austenite region (manufacturers of tube hot bottom forming machines recommend a minimum temperature of 1000°C for hypoeutectoid steels), and then closed by one or more forming roller passes. Some industry manufacturers use continuous heating with a gas burner during hot bottom forming after induction heating, especially when making bigger tubes like CNG cylinders. This work analysed the case of forming in which the roller performs only one pass and with only induction heating being used.

Fig. 1. The scheme of hot bottom forming process: (a) start of forming, (b) end of forming

In the initial production stage, the manufacturer observed a large percentage of manufacturing defects in the products, in the form of cracks in the centre of the bottom, as shown in Fig. 2. Production engineers suspected that the occurrence of cracks was caused by the oxidation of the tube end during preliminary induction heating. Therefore, attempts were made mostly to reduce the possibility of oxide formation by intensive blowing of inert gas during the induction heating. These efforts, however, did not bring the expected result. Similarly, attempts to change the temperature and time of induction heating were not successful either.