Study on the Potential Rupture Position of SUS304 Stainless Steel Welded Tubes under Hydroforming Conditions

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Abstract. The parts made of welded tubes have been widely used in the automotive industry, however, due to the initial wall thickness unevenness and surface defects of the welded tubes, the rupture position in tubes hydroforming (THF) is random. Therefore, the purpose of this research is to determine the randomness of potential rupture position of the marketed SUS304 stainless steel welded tubes under hydroforming conditions. In this research, firstly, the influence of the initial wall thickness and the surface morphology of the welded tubes was studied, as shown in Fig. 1 and Fig. 2. Secondly, the marketed SUS304 stainless steel welded tubes is subjected to multiple sets of hydroforming tests at two loading speeds and using the 3D digital speckle analysis system to record the image of the sample from initial bulging to breaking time in real time, as shown in Fig. 3. Afterwards, a new method is proposed in research that based on the Digital Image Correlation (DIC) to determine the potential rupture position by using the 3D digital speckle analysis system, as shown in Fig. 4, and analyzing the effect of the loading speeds on the rupture position of the welded tubes from the statistical point of view. The results have shown that the potential rupture position at low speed loading happened randomly in [3°, 26°] and occurs in [4°, 24°] at high speed loading, as shown in Fig. 5 and Fig. 7. And found the probability of rupture position of the welded tubes in different group is also certain differences by using a frequency distribution histogram, as shown in Fig. 6 and Fig. 8. The result through statistical analyzed was provided a certain reference value for predicting the rupture position of this type of welded tubes under different hydroforming conditions.

Keywords: Welded tubes; tubes hydroforming; rupture position; statistical

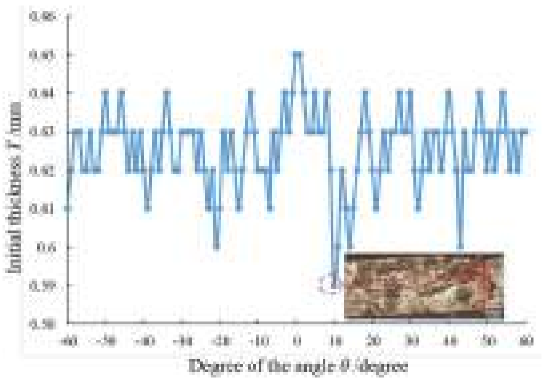

FIGURE 1. Initial thickness distribution of the SUS304 stainless steel welded tubes

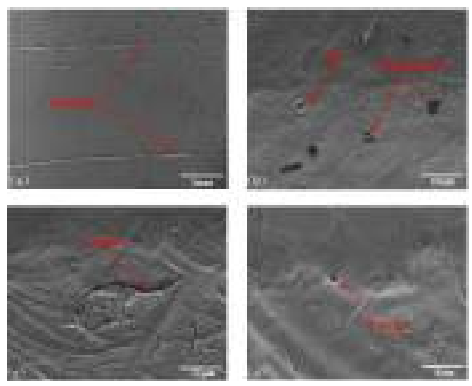

FIGURE 2. Surface defects of the SUS304 stainless steel welded tubes

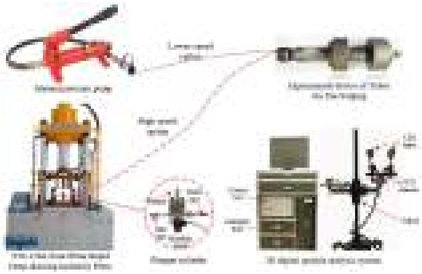

FIGURE 3. Test system of the tubes hydroforming

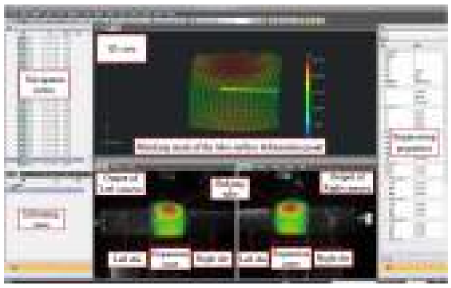

FIGURE 4. The main interface of the 3D digital speckle analysis system

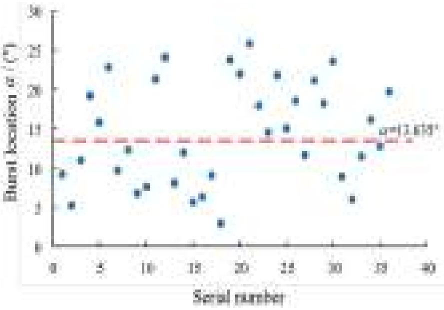

FIGURE 5. Burst location of the SUS304 stainless steel welded tubes at low speed loading

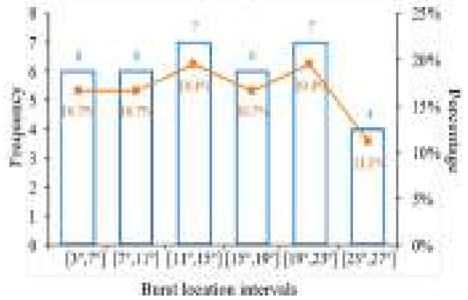

FIGURE 6. Interval distribution of burst location at low speed loading

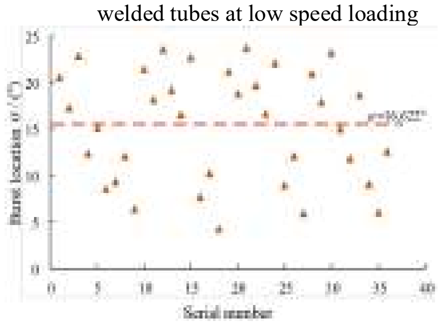

FIGURE 7. Burst location of the SUS304 stainless steel welded tubes at high speed loading

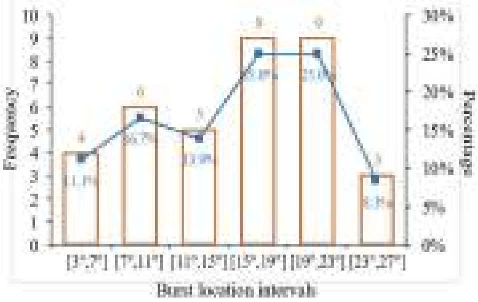

FIGURE 8. Interval distribution of rupture position at high speed loading

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