

the influence of the mechanical stresses on the flattening of the welded tubes.

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Abstract.

The process of destructive and non-destructive testing of the manufacture of high frequency induction welded steel tubes has always give better results at the Labiod-tèbessa Algeria tube construction plant such as tensile testing, folding, flaring and also the flattening tests whose limits of use were given by the experimental methods which have known deficiencies in measures in particular of the parameter of the height H which is given by the equation and that this difficulty is noted between the calculated and measured height levels. For these reasons it is necessary to find a numerical model of simulation which obviously replaces the experimental process to give reliable results with cheaper conditions in terms of cost and time which has been respected which allowed us to collect data. Results and compare the different heights calculated and measure and often confirm the experimental tests.

Keywords; steel tubes, flattening, traction, removal, simulation, E24-2, H

Introduction

The interest of this work of research is motivated by the concern to detect anomalies related to the welding (operation which consists in reuniting the constituent parts of an assembly, so as to ensure the continuity of the matter between these parts), and to scientifically analyze this problem in order to be able to propose solutions that ensure a quality seal.

The definition of the weld ability of these steels is complex because it is a qualitative property assessed using different criteria according to the envisaged achievements; it brings into play many parameters, steel being only one of them. [1] .

During the 1930s, broken bridges involved welded structures, particularly in Germany and Belgium, then during the Second World War occurred in breaks Liberty Ships built using the welding technique. Later, other catastrophic ruptures affected pressure vessels[2]

2. Experimental

The flattening of a specimen (between the trays of a machine), taken from the end of a tube or cut from a tube in the longitudinal axis direction perpendicular to the of this tube, continues until the distance between the trays under load in the direction of flattening reaches the value specified in the relevant product standard (see Figure 1a and 1b); on the other hand in the case of flattening said block the inner surfaces of the test piece must come into contact with each other over at least half the width b of the flattened test piece (see Figure 1.c). The machine used for this test must be capable of flattening the specimen at the height H prescribed between these two parallel and rigid [3] symbols and their designations are shown in the table 1.

Table 1. : Symbols and designations.

<i>symbol</i>	<i>description</i>	<i>Unit</i>
<i>D</i>	<i>Outside diameter of the tube</i>	<i>mm</i>
<i>e</i>	<i>the Wall thickness of the tube</i>	<i>mm</i>
<i>b</i>	<i>Internal width of the test piece flattened</i>	<i>mm</i>
<i>L</i>	<i>Length of the test piece</i>	<i>mm</i>
<i>H</i>	<i>Distance between plates measured under load</i>	<i>mm</i>

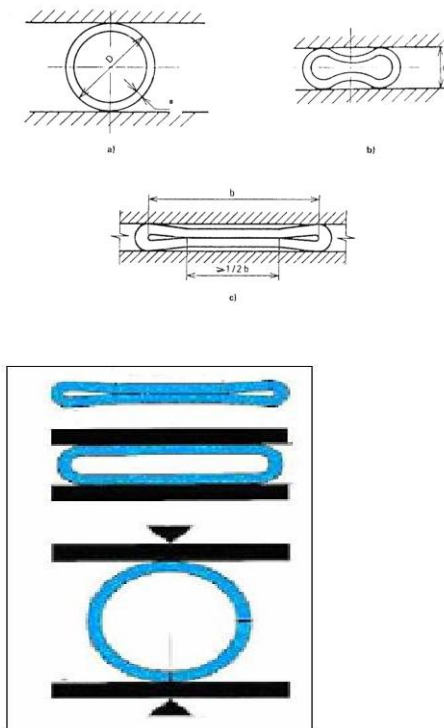
$$\left[\frac{1 + K}{K + \frac{e}{D}} \right] \cdot e \quad (1)$$

E24-2 Value of k = 0.09

Lower limit of H = 4.

The results of the flattening test (for different diameters and thicknesses of the welded blanks) are grouped in the table 2.

Table 2. Results of the flattening test carried on specimens welded blanks



<i>Dimension (mm)</i>		<i>flattening</i>		<i>bservation</i>
<i>(mm)</i>	<i>(mm)</i>	<i>calcule (mm)</i>	<i>measure s (mm)</i>	
0.7	.50	1.73	1.0	<i>g ood</i>
0.7	.2	9.79	8.4	<i>good</i>
4	.50	2.75	2.0	<i>good</i>
20.0	.10	9.17	0.0	<i>ruptur</i>
10	.50	4.17	0.80	<i>crack</i>
14	.50	4.34	4.0	<i>ruptur</i>

Fig.1. a, b and c: flattening test. [4]

The flattening is conducted until the distance H (distance between plates, measured under load), reaches the upper limit value calculated by the following formula (1):

The geometric features are shown in the figure 2:

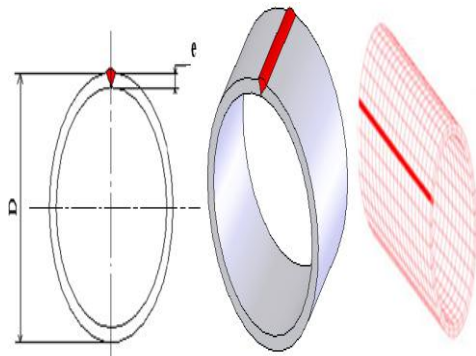


Fig.2.the geometric features
 Cylinder of: - outer diameter (D) ranging from 33.7 to 84 mm
 -thickness (e) taking both values: 2.2 and 2.5 mm

And whose set of hardware parameters introduced in the simulation code are listed in the following table 4.

3.6 Results of stresses (Von Mises, σ_{xx} and σ_{yy}) and flattening (H)

The simulations are made with different geometrical dimensions of the cylinder ($e = 2.2$ and 2.5 mm, diameter $D = 33.7, 40, 70.7$ and 84 mm). We apply a progressive loading so that we can have all the values of stresses: σ_{xx} , σ_{yy} and Von Mises stresses, which allow us to identify the beginning of the plastification zone. This was found with the different simulations performed by taking for example the case: $e = 2.2$ mm; $D = 33.7$ mm (see Figure3, 4).

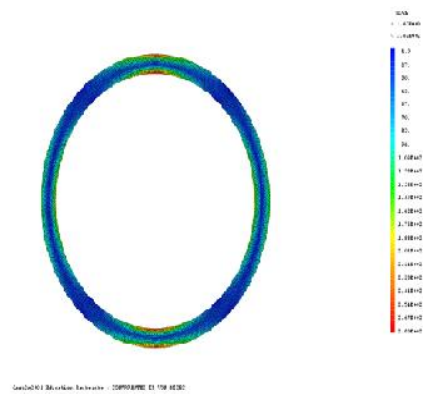


Fig.3. Distribution of the stresses of Von Mises

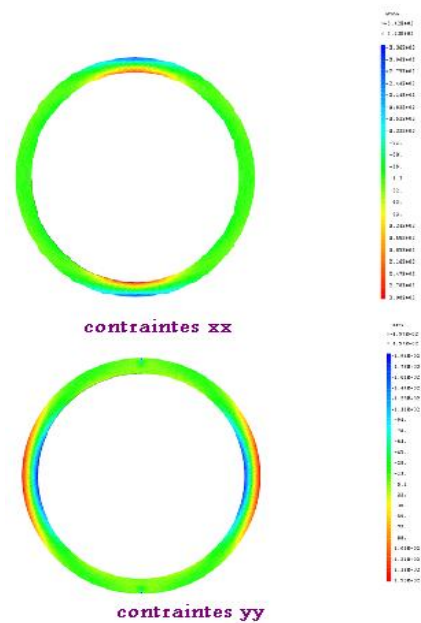


Fig.4.Distribution of stresses according to XX and YY

Note (1): We also noticed that the inner part of the cylinder is under the effect of a traction (Next σ_{xx}) and the outer part under the effect of a compression (following σ_{xx}). By against the opposite is found according to σ_{yy} (see Figure 5).

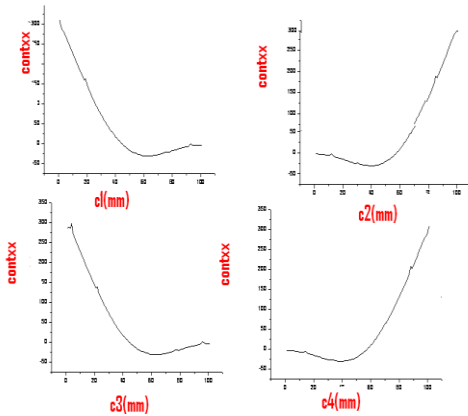


Fig.5. Evolution of the stresses (Contxx) according to the segments: C1, C2, C3, C4

Data	Value
Voluminal mass	$\gamma=78,5KN/m^3$
Young's modulus	$E=210KN/mm^2$
Poisson's ratio	$\nu = 0.3$
Elastic limit	$Re=240MPa$
Designation	Structure

In the case: $e = 2.2mm$, $D = 40mm$)

3.7 Interpretations of the results

Case of stresses:

The advantage of this simulation is that it gives us the distribution of stresses inside and outside the cylinder. Therefore according to figure 4.a and b, the maximum stress is on both sides points P1 and P3 inside and points P6 and P8 outside the cylinder with a distribution of constraints more extension (area where the weld seam is located, ie at 90° from the direction of the applied force). The stresses

(contxx and contyy) in these areas and at the points P3 and P6 are respectively: 280 and 135. (in the case: $e = 2.2 mm$ and $D = 33.7 mm$). As we also noted that the increase of the diameters outside these cylinders while keeping constant their thicknesses, causes the increase of the stresses (contxx and contyy) points P3 and P6 as shown in the following table, which groups the results of constraints extracted from Figures 5.

4. Conclusion

The adaptability and reliability of the mechanical characteristics of the steel used (E24-2) goes through a series of quality controls by developing destructive tests (CD) mainly comprising: traction, hardness, resilience, flaring and flattening; the latter apply mainly to specimens (flat and sections of the tube), on blank (non-laminated welded tube) and on finished product (hot rolled tube and regenerated by normalization annealing).

However flaring, flattening, are tests that load axially, all these tests give the steel the appearance of being able to withstand higher stresses; the character (Uniaxial of these tests actually limits their ability to detect certain types of weld problems.

On the other hand, to better understand some processes of induction welded tube checks we have tried to complete our work by a numerical simulation of the flattening of welded tubes by the finite element method using the castem 2001 software, and this to understand the different phenomena involved in this test, and especially to describe the evolution of flattening (H) depending on the load.

From the results obtained, we can say that: the variation of the thickness (e) of the cylinder has a very great

influence on the evolution of H and especially on the part of the curve which comes just after the landing

To conclude we will say whatever the nature of industrial applications induction heating has a number of intrinsic advantages that explain its growing development.

Accurate location of the thermal effect due to an inductor design and an operating frequency adapted to the room to be heated.

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