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The Advantages of Cold Pilgering compared to Cold Drawing

Summary

These processes are commonly used in the Tube Industry when reducing the outside diameter and wall thickness of tubes down from a relatively uncontrolled and often hot worked product or large diameter welded tube. The final resulting tubes will have much tighter dimensional tolerances and will have controlled micro-structures and properties.

During the process the tube properties will evolve to meet the demanded requirements of specified for tensile strength and ductility and there may have been significant reductions in the depth of any surface imperfections . The defect depth, surface roughness and micro structure will meet the desired specifications.

Sometimes both processes are used in a reduction sequence to maximise productivity whilst at other times the processes might be used on their own to make use of fundamental advantages. For instance, the material being pilgered can have relatively low ductility but still be subject to large elongations, whereas the drawing process is very good for imparting measured amounts of cold work to meet properties. The drawing process can also be good for producing very smooth inside surfaces and there is a point at which small diameter thick wall tubes will tend to be finished by the drawing process without any inside support.

From a stress analysis point of view the essential difference between the processes is that the stresses in the cold drawing process are essentially tensile as the tube is pulled through a die in a single pass whereas the stress in pilgering is compressive as the tube is rolled between two circular rolls containing a tapered groove. The tube follows the groove dimensions as it progresses incrementally through the rolls. The rolls being moved forward and backward for each incremental movement forward.

Both processes usually employ mandrels in the tube bores and these are located on the ends of long rods stretching from the start of the machine bed and extending to the work area so that they can resist deformation forces from the drawing dies or pilger rolls. Hence wall thickness reduction is possible at the same time as the outside diameter is reduced.

The tube wall reduction being achieved while the diameter reduction occurs can be expressed as a ratio. This is defined as the wall strain divided by the mean diameter strain and is often designated as the ‘Q’ factor. For tube makers this factor in very important and its control can have many influences on cost and quality.

For information the ‘Q’ factor is best calculated as follows:
‘Q’ = Ln (Wall strain) divided by Ln(mean diameter strain)
Ln means natural logarithm
Wall strain = Ln (Wall thickness at the start of draw/ Wall thickness at end of draw)
Mean diameter = The average tube diameter or the diameter taken at a point half way through the wall thickness or the diameter less one wall thickness.
Therefore, the mean diameter strain = Ln (mean diameter at start of draw/mean diameter at end of draw)

The use of spreadsheets has made the ‘Q’ factor very easy to calculate. Technicians who make decisions on what reductions to use need to be careful when deciding on reductions with a ‘Q’ factor of less than 1. This can lead to undesirable stress distributions in the reduced tube – especially to a value called the strain disparity.

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