Cold Working vs. Hot Working

A NOTE FROM OUR METALLURGIST

There are several methods by which seamless pipe may be produced. The two major categories, hot working and cold working, are differentiated by whether they are performed above or below the material's recrystallization temperature. Deformation below the recrystallization temperature results in cold hardening, and the resulting increase in strength is retained. When the deformation is performed above the recrystallization temperature, the strain relieves itself such that there isn't a resulting increase in strength. Cold working processes, including pilgering, drawing, and flow forming, are typically performed at room temperature, while hot forming processes, including extrusion, piercing, and rolling, are typically performed above 1900°F.

The advantages of cold working include superior dimensional control, better surface finish, and the ability to achieve high strength in alloys which cannot be achieved by heat treatment alone. Very high strengths can be achieved by cold hardening. However, the strength is lost if the material is subsequently exposed to high temperatures during fabrication, such as welding, or in service. The mechanical properties also tend to exhibit directionality, referred to as anisotropy. The degree of anisotropy depends upon the amount of cold work performed and the process used. With cold drawing, all of the deformation is in the axial direction, so the resulting anisotropy tends to be higher than with pilgering, where the strain distribution is more complex. Flow forming imparts torsional stress, which may be relieved during further processing or in service, resulting in distortion. Cold hardening may also reduce resistance to corrosion, in particular stress corrosion.

Cold working is often associated with higher costs because the rate of production is lower and the stresses required are much higher. However, hot working comes with additional heating costs and scrap loss, so the economics may be dictated by the volume of material being processed and the inherent alloy costs.