

Influence of Hydrostatic Pressure on the Mechanical
Properties of Heat Treated Steel

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Abstract

The stress distribution of heat treated steel can be remarkably changed with the condition of heat treatment, while the similar phenomenon can be expected by pressure treatment, which means here in this paper to bring metals under isostatic high pressure environment after thermal preparations.

The purpose of this paper is to find the manner how the residual stress should be distributed in steel rod specimen after pressure treatment and concerns also to what mechanical properties should be brought as the results.

Two types of high pressure vessels were designed. The smaller one has the pressure chamber of $35\phi \times 150 \text{ mm}^3$ and the larger one consists of two chambers of lower and higher pressures respectively. In other words, the inner shell of higher pressure is enclosed by the annular outer cylinder and has the volume of $100\phi \times 200 \text{ mm}^3$ enough to set a certain heating device within. But the present paper is only limited to the pressure treatment at room temperature.

Change of residual stress distribution: Residual stress distribution is changed almost to the opposite sign. For example, in case of SCM 22 steel specimen (0.9 mm rod; 0.2 C, 1.1 Cr, 0.2 Mo), residual tensile stress of about 40 kg/mm takes place on the surface as oil-quenched, while this disappears after pressure treatment of 2000 kg/cm² and compressive stress of about 20 kg/mm² can be observed instead. In general, the stress distribution along principal axis of quenched steel rod is as following across the cross section; tensile stress at the central part, compressive stress at the middle annular part and tensile stress takes place again at the outer part, increasing larger towards the surface. But after pressure treatment this pattern is altered almost upside-down.