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UDC: 621.311.21 : 621.181.004

Effect of Enhanced Mechanical Properties of Weld Metal and Heat Affected Zone on the Strength of the Welded Joint

ABSTRACT

Selection of steel, dimensions and fabrication technology for the welded structure are all parts of the design process, because they are in close connection with the function of the structural whole under certain conditions of exploitation for the predicted service life. Quality of welded joints in the process of production of the welded structure is being defined by properties that the structure has to possess in order to fulfill certain requirements, which is being accomplished by the selection of the adequate welding procedure and welding parameters, implementation of inspection programs for all technological operations, as well as by performing mechanical and technological tests in order to determine the magnitude of strength and deformation of base material and welded joints. Constituent parts of a welded joint are base material, heat affected zone and weld metal. Heat affected zone of structural steels is being characterized by the fusion zone, overheating zone, zone of complete normalization and zone of incomplete normalization.

In this paper the effect of change in hardness of weld metal and heat-affected zone on mechanical properties of welded joints when base material is quenched and tempered steel C45 (DIN EN 10083) is being considered. Test results showed that the application of welded structures made of quenched and tempered steels with hardness HV10 > 400 and tensile strength UTS > 600 MPa is useful only when the stress concentration is low ($\alpha_s \leq 2$) and when there are no residual stresses due to welding.

Keywords: quenched and tempered steel, mechanical properties, hardness of the welded joint, heat affected zone

UTICAJ POVIŠENIH MEHANIČKIH SVOJSTAVA METALA ŠAVA I ZONE UTICAJA TOPLOTE NA ČVRSTOĆU ZAVAREN OG SPOJA

REZIME

Izbor čelika, dimenzija i tehnologije izrade zavarene konstrukcije je deo procesa konstruisanja, jer je u uskoj vezi sa funkcijom konstrukcijske celine u određenim uslovima eksploatacije za predviđeni vek trajanja. Kvalitet zavarenih spojeva u procesu izrade zavarene konstrukcije definiše se karakteristikama koje konstrukcija mora posedovati da bi zadovoljila određene zahteve, što se postiže izborom odgovarajućeg postupka i parametara zavarivanja, sprovođenjem programa kontrole svih tehnoloških operacija u njihovoj izradi i mehaničkim i tehnološkim ispitivanjima čvrstoće i deformacija osnovnog materijala i zavarenih spojeva. Konstitutivni delovi zavarenih spojeve su osnovni materijal, zona uticaja toplote i metal šava. Zonu uticaja toplote konstrukcijskih čelika karakterišu zona stapanja, zona pregrevanja, zona potpune i zona nepotpune normalizacije.

U radu je razmotren uticaj promene tvrdoće metala šava i zone uticaja toplote na mehanička svojstva zavarenih spojeva čelika za poboljšanje Č. 1530 (C45 prema DIN EN 10083). Rezultati ispitivanja su pokazali da primena zavarenih konstrukcija od čelika za poboljšanje sa tvrdoćom HV10 > 400 i zateznom čvrstoćom većom od 600 MPa je svrsishodna samo za konstrukcije sa niskom koncentracijom napona ($\alpha_s \leq 2$) i kada nema zaostalih napona usled zavarivanja.

Ključne reči: čelik za poboljšanje, mehaničke osobine, tvrdoća zavarenog spoja, zona uticaja toplote

