Thesis Title	The Relationship between Decarburization and Mechanical Properties of Carbon and Low Alloy Steel
Thesis Credit	15
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Degree of Study	Master of Engineering
Department	Materials Technology
Academic Year	2001

Abstract

Carbon and Cr-Mo low alloy steel tubes are widely used in boiler and heater furnace for heat exchanging between flue gas and liquid at high temperature. External surfaces of the tubes are in contact with flue gas and may subject to surface decarburization by reaction with certain kind of elements in flue gas if proper combustion condition cannot be maintained. Loss of carbon at surface will alter the mechanical properties and service life of the tubes.

The purpose of this research is to study the effect of decarburization on the mechanical properties of such steel tubes by using carbon steel with 0.1% C and low alloy steel with 0.13%C 0.75%Cr and 0.42%Mo. The specimens were prepared at various depth of decarburization by heat treating in CO_2 and N_2 atmosphere at 800°C for 1 to 36 hours.

The specimens were decarburized to the depth of 0.4 to 3.1 mm and 0.3 t0 2.5 mm for carbon steel and low alloy steel respectively. The specimens with soaking time 12 hours and longer were found to exhibit substantial grain growth.

Decarburization altered the mechanical properties of carbon steel specimen (5 mm thick) per 1 mm of total decarburization depth (D_{total}) as follows: yield strength (YS) was reduced by 38 MPa, tensile strength (TS) by 29 MPa and %elongation (%EL) increased by 2.3%. At 450°C, YS was reduced by 13 MPa , TS by 13 MPa and no change of %EL with wide data scattering. The hardness values were decreased to 104-118 HV on decarburized surface as compared to 132-144 HV for normal value of carbon steel specimen.

For low alloy steel specimens (5 mm thick), decarburization also altered the mechanical properties of the specimens. For 1 mm of total decarburization depth (D_{total}), YS was reduced by 16 MPa, TS by 55 MPa and %EL increased by 2.2%. At 450°C, YS was reduced by 24 MPa ,

TS by 38 Mpa and a slight decreased of %EL by 0.8%. The hardness values were decreased to 112-124 HV on decarburized surface as compared to 179-189 HV for normal value of low alloy steel specimen.

The influence of decarburization on the fracture of tensile specimen in that the fracture was unsymmetrical after breaking and the fracture surface showed the greater dimples depth. Decarburization also shortened the stress rupture specimens life. Decarburized carbon steel specimen was found to be oxidized at 800°C at the greater rate, 50-60% faster than normal. Opposite result was found for low alloy steel which exhibited a reduced oxidation rate of 11%.