

7% Ni steel + Cu

Effect of Cu Addition on the Low Temperature Notch-Toughness of 7% Ni Steel

Tokushi Funakoshi, Yoshihiro Kajinaga, Noriaki Koshizuka

Abstract:

Ni-Cu steel, the low temperature notch-toughness of 7% Ni steel is known to be improved by the addition of Cu. To clarify this mechanism, the precipitation behavior of austenite and Cu and the changes in the sub-grain size were investigated on tempering of quenched 7% Ni and 7% Ni-2% Cu steels by electron microscopy and impact test. The results obtained are as follows: 1) The impact values of the Ni-Cu steel at -196 °C are higher than those of the Ni steel. The most suitable tempering temperature for the Ni-Cu steel (560 °C) was 30 °C lower than that for the Ni steel. 2) The austenite precipitated in the Ni-Cu steel on tempering exhibits smaller grain size and higher copper content than that in the Ni steel, resulting in better stability at low temperatures. 3) The growth of the sub-grains in the Ni-Cu steel on tempering at temperatures below 560 °C is prevented by the precipitating of Cu.

Synopsis:

The low temperature notch-toughness of 7% Ni steel is known to be improved by the addition of Cu. To clarify this mechanism, the precipitation behavior of austenite and Cu and the changes in the sub-grain size were investigated on tempering of quenched 7% Ni and 7% Ni-2% Cu steels by electron microscopy and impact test. The results obtained are as follows: 1) The impact values of the Ni-Cu steel at -196 °C are higher than those of the Ni steel. The most suitable tempering temperature for the Ni-Cu steel (560 °C) was 30 °C lower than that for the Ni steel. 2) The austenite precipitated in the Ni-Cu steel on tempering exhibits smaller grain size and higher copper content than that in the Ni steel, resulting in better stability at low temperatures. 3) The growth of the sub-grains in the Ni-Cu steel on tempering at temperatures below 560 °C is prevented by the precipitating of Cu.

(c)JFE Steel Corporation, 2003

7% Ni 鋼の低温靱性におよぼす Cu の影響

Effect of Cu Addition on the Low Temperature
Notch-Toughness of 7% Ni Steel

7%Ni鋼

0.03

0.15

0.35

0.004

0.013

7.06

0.04

0.021

●—7Ni-2Cu } 吸収エネルギー

15

7Ni-0.05Cu

20

7Ni-2Cu

ルテンサイトに変態したものをオーステナイトとして扱った。7% Ni鋼のオーステナイトの間隔は焼もどし温度の上昇とともに直線的に増加す

3-3 下部組織

る。7% Ni—2% Cu鋼のオーステナイトの間隔は500~560°Cの低温焼もどしでは7% Ni鋼にほぼ等しいが、560°C以上で一定値に近づき両鋼の差は大きくなる。

オーステナイトの間隔に差異が認められた590°Cにおいて等温焼もどしを行なった試料の衝撃試験結果と析出オーステナイトの大きさの変化を図5に示す。7% Ni鋼の脆性破面率は焼もどし

化があげられる。光学顕微鏡では針状組織である7% Ni—2% Cu鋼と7% Ni鋼の結晶粒の大きさを比較することは困難であるので、電子顕微鏡によるサブグレインの大きさを測定した。焼もどし温度によるサブグレインの平均大きさの変化を図6に示す。焼入れのままあるいは500°Cの焼も

