Abstract

This study is concerned with the mechanical properties and fatigue behavior of nanobainite steel. The specimens were divided into five groups according to heat treatment. The first group is in the direct quenched and tempered condition (tempered martensite at 300ºC). The remaining four groups were isothermally hardened and isothermally hardened with tempered at three different temperatures (350ºC, 550ºC and 650 ºC). The results of all properties are compared with those of the direct quenched and tempered condition. The static mechanical tests included hardness, tensile and impact. Fatigue tests were of the rotating bending type with a constant stress ratio of (R= -1) in laboratory environment.

The results have shown that the hardness of untempered nanobainite is similar to the hardness of tempered martensite, 655 HV and 631 HV, respectively. The hardness of nanobainite decreases with increasing tempering temperature by about 2.5% to 38%. However, the effect of tempering was only significant at temperatures higher than 500ºC.

The ultimate tensile and yield strengths of untempered nanobainite are higher than tempered martensite, (2285 MPa and 2010 MPa) and (1900 MPa and 1750 MPa), respectively. The ultimate tensile and yield strengths decrease with increasing tempering temperature by about (6.5% to 27%) and (10% to 33%), respectively.

The percentage elongation and reduction in area of untempered nanobainite are higher than tempered martensite, (8.25% and 5.561%) and (5.838% and 5.088%), respectively. The percentage elongation and reduction in area increase with increasing tempering temperature by about (10.625% to 15%) and (6.059% to 9.99%), respectively.

The impact energy of untempered nanobainite is much higher than tempered martensite, 170 J and 40 J, respectively. The impact energy

decreases linearly with tempering temperature by approximately 12.5 J per 100ºC.

The fatigue strength of untempered nanobainite is higher than tempered martensite; the fatigue limit is 1320 MPa and 1100 MPa, respectively. The fatigue limit decreases with increasing tempering temperature by 7% to 28%.