

Modeling of Nitrogen Solubility in Stainless Steel

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Abstract : Scale-resistant austenitic stainless steel, X45CrNiW 18-9, has been developed, and modified steels produced through partial and total nickel replacement by nitrogen. These modified steels were produced in a 10 kg induction furnace under different nitrogen pressures and were cast into ingots. The produced modified stainless steels were forged, followed by air cooling. The phases of modified stainless steels have been investigated using the Schaeffler diagram, dilatometer, and microstructure observations. Both partial and total replacement of nickel using 0.33-0.50% nitrogen are effective in producing fully austenitic stainless steels. The nitrogen contents were determined and compared with those calculated using the Institute of Metal Science (IMS) equation. The results showed great deviations between the actual nitrogen contents and predicted values through IMS equation. So, an equation has been derived based on chemical composition, pressure, and temperature at 1600°C. $[N\%] = 0.0078 + 0.0406 * X$, where X is a function of chemical composition and nitrogen pressure. The derived equation has been used to calculate the nitrogen content of different steels using published data. The results reveal the difficulty of deriving a general equation for the prediction of nitrogen content covering different steel compositions. So, it is necessary to use a narrow composition range.

Keywords : solubility, nitrogen, stainless steel, Schaeffler

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