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Growth of the Fe_2B layer on SAE 1020 steel employed a boron source of H_3BO_3 during the powder-pack boriding method

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Key Words: Boriding, Boric Acid, Thermal Analysis, Growth Kinetics, Regression Analysis, Adhesion Test

Abstract

In this study, an alternative powder-pack boriding mixture containing H_3BO_3 as boron source was prepared and used for boriding of SAE 1020 steel. The boriding treatment was carried out in the temperature range of 850-950^oC for a treatment time ranging from 4 to 12 h. The generated boride layers were characterized by different experimental techniques such as optical microscope, SEM, XRD analysis and the Daimler-Benz Rockwell C indentation test. The powder-pack boriding mixture was analyzed by TGA and DTA methods and the possible chemical reactions that may be occurred during boriding were investigated. Furthermore, the growth kinetics of the boride layer forming on SAE 1020 steel substrates was investigated. A regression model based on a full factorial design was used to estimate the boride layers' thicknesses as a function of the boriding parameters. A single phase boride layer with saw-tooth morphology was formed on the steel samples. The value of boron activation energy for SAE 1020 steel was estimated as 183.15 kJ/mol. The comparisons were made between the empirical values of the boride layers' thicknesses with estimated ones. The contour diagrams were plotted for estimating the thickness of boride layer as a function of the temperature and time.