Innovative Process to Eliminate Ledeburite Network in Tool Steel

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Tool steels are a widely-used material with well-known heat treatment procedures for obtaining the desired mechanical properties. Their weakness is the presence of sharp-edged carbides which compromise the material's toughness. When produced by conventional metallurgical routes, high-alloy steels, such as X210Cr12 (1.2080) and X155CrVMo121, contain sharp-edged M7C3 carbides which remain stable even at high temperatures. As these carbides form as early as in the solidification stage, there is no practical conventional heat treatment for removing them or for converting them to more favourable carbide types. As a result, unconventional methods must be sought for these steels. One of them combines short-time conversion to semi-solid state and subsequent thermomechanical treatment. This method was used with both tool steels named above, with a great emphasis on the choice of the heating temperature. The results showed that at an appropriate heating temperature and deformation magnitude, very fine structure can be obtained in which the matrix consists of grains of the M-A constituent and carbide precipitates. In X210Cr12 steel, hardness values of up to 862 HV10 were achieved. In X155CrVMo121, the hardness level was 859 HV10.

Keywords: semi-solid treatment, tool steels, X210Cr12, chromium carbides, thermo-mechanical treatment, refinement of carbides

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