

Forgeability Study of Medium Carbon Micro-Alloyed Forging Steel

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Abstract : Micro-alloyed steel components are used in automotive industry for the necessity to make the manufacturing process cycles shorter when compared to conventional steel by eliminating heat treatment cycles, so an important saving of costs and energy can be reached by reducing the number of operations. Micro-alloying elements like vanadium, niobium or titanium have been added to medium carbon steels to achieve grain refinement with or without precipitation strengthening along with uniform microstructure throughout the matrix. Present study reports the applicability of medium carbon vanadium micro-alloyed steel in hot forging. Forgeability has been determined with respect to different cooling rates, after forging in a hydraulic press at 50% diameter reduction in temperature range of 900-1100°C. Final microstructures, hardness, tensile strength, and impact strength have been evaluated. The friction coefficients of different lubricating conditions, viz., graphite in hydraulic oil, graphite in furnace oil, DF 150 (Graphite, Water-Based) die lubricant and dry or without any lubrication were obtained from the ring compression test for the above micro-alloyed steel. Results of ring compression tests indicate that graphite in hydraulic oil lubricant is preferred for free forging and dry lubricant is preferred for die forging operation. Exceptionally good forgeability and high resistance to fracture, especially for faster cooling rate has been observed for fine equiaxed ferrite-pearlite grains, some amount of bainite and fine precipitates of vanadium carbides and carbonitrides. The results indicated that the cooling rate has a remarkable effect on the microstructure and mechanical properties at room temperature.

Keywords : cooling rate, hot forging, micro-alloyed, ring compression

Conference Title : ICMMME 2015 : International Conference on Mining, Material and Metallurgical Engineering

Conference Location : Singapore, Singapore

Conference Dates : March 29-30, 2015