# Application of VN Alloy in 400 MPa Reinforced Bar

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**Abstract**: The paper presents the comparison test results of producing 400MPa V-bearing reinforced bar (20 MnSiV III reinforced bar) with VN alloyed steel and FeV alloyed steel in Pangang, studies the effects of V and N on the performance and structure of the reinforced bar, discusses the strengthening mechanism of VN and compares the production cost of using these two kinds of alloy.

**Key Words**: 400MPa reinforced bar, VN alloying, precipitation strengthening, cost

## 1 Preface

Currently, a variety of deformed bars about 20 million tons have been produced and consumed annually in China, in which 20MnSi II reinforced bar has amounted for about 95%, far behind the technical levels of the developed industrial countries, which normally use over 400MPa reinforced bar in construction projects. In new standard GB1499-98 in conformity with the international practice, 25MnSi reinforced bar has been eliminated from the list and C content will be controlled less than 0.25% (C equilibration less than 0.54%) in order to ensure good performance in ductility, toughness and weldability of the reinforced bar. In China, high priority has been put on promoting the application of 400MPa V-bearing reinforced bar in an attempt to speed up using new generation reinforced bars instead of the old one.

Up to now, microalloying elements like V, Ni and Ti etc., that can produce fine grain and precipitation strengthening through the generated carbon nitride, are mainly used to produce the reinforced bar with improved strength over 400MPa. As the adverse effect on the ductility and toughness, which are generally unchanged or improved later on, from the precipitation strengthening is offset in part due to the finer grain.

20MnSi III reinforced bar are produced, based on 20MnSi II, by adding FeV alloy or VN alloy for alloying treatment to increase its strength from 335MPa to 400MPa. Considering taking full advantage of using abundant resources of V and Ti in Panzhihua , Pangang used to produce to 400MPa reinforced bar with FeV alloy in general (80% FeV with 80%V are produced by Pangang). In 1998, Pangang began to produce 2000 tons of 400MPa reinforced bar in small amounts with VN alloy from USA and VN12 produced by Pangang with 80% V and 12%N, and meanwhile the comparison test on the technical economic index between VN12 and 80%FeV was made. The result showed that with the improved strengthening, VN12 alloyed reinforced bar had better performance in strength, ductility, toughness and weldability, together with non-strain age and higher V recovery rate. To be more, the required alloy amount is decreased and the production cost reduced.

## 2 Process flow

Melting in the converter with the capacity of 120 tons → aluminium feeding for deoxidisation after melting → argon purging → moulding about 9,421 tons of ingot → ingot heating → bloomed and rolled to $100mm^2$ billets → billet scarfing → billet heating → rolled to reinforced bar with diameter of 10-36mm → inspection, weighing and storage.