USE OF VANADIUM IN FLAT PRODUCTS (PLATE AND STRIP)

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VANITEC SEMINAR ON VANADIUM STEELS
GUILIN, NOVEMBER 6-7,2000

Vanadium is used in the following flat products:
1) Heat-treated (quenched and tempered) plate
2) Normalized plate
3) Heavy thickness plate
4) Conventionally hot-rolled plate
5) Recrystallization controlled rolled plate (RCR)
6) High strength (350 to 600 Mpa YS) 4 to 15mm thick strip
7) Thin (less than 2mm) high strength strip
8) High strength strip made by thin slab technology

1 Interaction of Vanadium with Nitrogen

Because of high affinity of vanadium for nitrogen and cubic crystal structure of VN, the kinetics of VN precipitation in ferrite is rapid.

When added to steel, vanadium fulfills a dual role: (a) removes nitrogen from solid solution in ferrite by forming VN and makes the steel non-aging; and (b) by nucleating numerous fine VN particles increases the effectiveness of precipitation strengthening. Vanadium converts nitrogen from an "impurity" into a cost effective alloy. Nitrogen, by forming small VN particles, increases the strengthening contribution of vanadium.

In steel containing both vanadium and aluminum, on cooling from hot-rolling temperature, nitrogen combines preferentially with vanadium because of more rapid precipitation kinetics.

When reheating (normalizing) steels containing V and Al, part of V(C,N) precipitates will dissolve and N will form more stable aluminum nitrides, Al N.

2 Processing of V-Steels by RCR

Recrystallization controlled rolling represents deformation of steel in the high temperature regime, i.e. above the recrystallization - stop temperature.

The evolution of austenite micro-structure follows three steps.

1) flattening (pancaking) of grain

2) recovery and recrystallization; the size of the recrystallized grain depends on temperature, initial grain size and — most importantly — on the amount of deformation.

3) Grain growth of recrystallized grains during the time interval between passes.