Hot Deformation Behavior and Recrystallization Controlled Rolling of Ti-V-N Plate Steels

Sun Quanshe, Zhang Yongjia

Technology Center of Baoshan Iron and Steel Co. Ltd., Shanghai 201900, China.

Abstract: The static phase transformation points and CCT curves were measured of the different levels of V and N in Ti-V-N plate steels. The steels, processed by RCR and conventional CR, respectively, were taken to test the mechanical properties and impact toughness. The results show that, with the increasing of effective V and N, the A_{c1} and A_{c3} decrease. When cooling rate exceeds 4°C/s, the transformation of bainite begins, and at cooling rate over 9°C/s, the pearlite transformation will not occur. With the strain rate increasing and the strain temperature decreasing, the critical strain of the austenitic dynamic recrystallization goes up. Compared with CR, the plate steels by RCR+ACC process exhibit higher yield and tensile strengths, but lower elongation and toughness, and with the effective N increasing, the strengthening effect presents more remarkably.

Key words: Ti-V- N steel； hot deformation； RCR； CR； CCT curve

1 Introduction

V as a microalloying element has certain further advantages due to its greater solubility in austenite compared with Nb. It is demonstrated that the relatively large solubility of V(CN) and the much lower solubility of VN and VC makes V an eminent choice for strong and easily controllable precipitation strengthening [1]. Through introducing N into the V steel without Ti-treated, the ferrite grain size is refined and the strength increases [2]. The prevention of austenite grain growth between rolling passes and after the final pass can be achieved by a small addition of titanium which generates stable TiN particles, and accelerated cooling (ACC) increases the strength level via precipitation of VN [3]. In this report, Ti-V-N plate steels were processed to determine CCT curves, and the mechanical properties and impact toughness by RCR+ACC and CR processes.

2 Material and Experimental Process

The steel-making was processed in 50kg vacuum induction furnace, and the liquid steel was cast into an ingot 40kg weight. There are five different V/N levels in the steels, which contain almost the same amount of Ti. The final chemical compositions are listed in table 1.

Table 1 Chemical composition of steels

Steel	C	Si	Mn	P	S	Al	Ti	V	N	N_{eff}
1	0.09	0.29	1.40	0.011	0.004	0.018	0.016	0.041	0.0074	0.003
2	0.08	0.29	1.40	0.011	0.007	0.019	0.019	0.079	0.0076	0.002
3	0.08	0.34	1.43	0.008	0.005	0.014	0.018	0.077	0.0100	0.005
4	0.09	0.30	1.49	0.012	0.004	0.020	0.016	0.081	0.0140	0.009
5	0.08	0.30	1.40	0.009	0.006	0.023	0.016	0.120	0.0082	0.004