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不锈钢热连轧机粗轧支持辊剥落影响因素的有限元分析

*曹建国1，王燕萍1，孔 宁1，杨连宏2，侯安全2，王泽斌2

(1. 北京科技大学机械工程学院，北京 100083；2. 山西太钢不锈钢股份有限公司，山西，太原 034207)

FINITE ELEMENT ANALYSIS ON AFFECTING FACTORS OF SPALLING OF THE BACKUP ROLL OF A ROUGHING MILL FOR STAINLESS STEEL

*CAO Jian-guo1 , WANG Yan-ping1 , KONG Ning1 , YANG Lian-hong2 , HOU An-quan2 , WANG Ze-bin2

(1. School of Mechanical Engineering, University of Science and Technology Beijing, Beijing 100083, China; 2. Shanxi Taigang Stainless Steel Corporation Limited, Taiyuan, Shanxi 034207, China)

- 摘要
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摘要 该文分析某2250不锈钢热连轧粗轧机频繁发生支持辊严重边部剥落难题的影响因素。通过理论及实际剥落断口形貌分析，指出世界上不锈钢产量最大的该生产线复杂轧制工艺条件和服役期内辊系力学行为引起的不均匀辊间接触压应力分布是该轧机轧制过程中轧辊剥落的主要原因。根据现场跟踪实测数据，采用大型通用有限元软件建立了四辊轧机辊系三维有限元模型，仿真分析了带钢宽度、轧制力、轧辊磨损对辊间接触压应力峰值和位置的影响。结果表明：随着带钢宽度和轧制力的增大，辊间接触压力峰值增幅明显，辊间接触压力分布不均匀度系数基本不变；在不同磨损阶段，当工作辊和支持辊都处于服役后期时，压力峰值、不均匀度系数显著增大，均在距轧辊辊身边部附近存在接触压应力尖峰，且此位置与实际剥落位置一致。研究结果为成功研制的新支持辊形技术投入长期稳定工业应用累计轧制600万t以上未再发生剥落提供了理论依据。

关键词： 热轧 轧辊 磨损 剥落 有限元建模

Abstract： The objective of the paper is to analyze the affecting factors of spalling, which is one of the typical damage that occurs on the backup rolls of a roughing mill during stainless steel rolling process of 2250mm hot strip mill. Based on the theoretical study and fracture analysis on spall, the peak value of the uneven contact pressure between the work roll and the backup roll is found to be the key factor for the spalling accident during rolling process, which is caused by arduous operating conditions of the largest stainless steel production lines in the world. The three-dimensional finite element models of 4-high roll stacks are developed with measured work and backup roll contours configurations in service. The analysis based on the models demonstrates that the peak value of contact pressure and the location of the peak are influenced by strip width, unit width rolling force and work & backup roll wear contours in different service period. The simulation results show: (1) the peak value of the contact pressure between rolls increases sharply with the increasing of the strip width and unit width rolling force; (2) the peak and the dissymmetry of the roll contact pressure become larger when the work rolls and backup rolls are at the end of the service; (3) the location of the peak shows good agreement with the actual position of spall at the edge of backup rolls. The developed backup rolls have been successfully applied to the production mill without spalling by strip rolling of 6 millions tonnage and more.

Key words： hot rolling roll wear spalling finite element modeling

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