On-Line Monitoring System to Detect Anomaly of Rolls in Rolling Mills

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ABSTRACT

Rolling rolls are used under harsh conditions such as large loads and thermal stresses. If a roll spall occurs during rolling, it damages equipment and rolled materials severely, which leads to long and hard works to recovery. An on-line monitoring system has been developed to detect roll anomaly in a hot strip mill. The system calculates the roll eccentricity value for each roll and alerts the operators of a risk of roll spall when the value is largely changed. The presentation will show the actual results and discuss the basic ideas of the system.

Keywords: Roll monitoring, Roll Eccentricity Control, Anomaly detection, Rolling rolls

INTRODUCTION

It is necessary for steel suppliers to meet demands imposed by rolling high strength steels, in response to the recent rapid growth of customer’s requests. As a result, rolls in rolling mills now face tougher conditions - with harder materials to roll, higher roll forces and rapid increase/decrease of heat stresses. If rolls are damaged severely by roll spalling or breakage, not only is the rolled strip discarded, but mill equipment may be damaged, production is delayed, and a costly recovery is needed. Thus, it is very beneficial for steel rolling mills to be able to predict defects of roll condition.

It is well known that rolling mill rolls are often eccentric because of geometric asymmetry caused by an oil bearing structure, non-uniformity of revolution axis etc. Roll eccentricity does not cause fatal damage to mill rolls but it degrades product qualities such as strip thickness. Roll eccentricity control (REC) is usually used to improve thickness performance, because other automatic gauge controls cannot remove eccentricity. For hot strip mills (HSMs), REC is usually applied to the latter mill stands where the relative effect of eccentricity on thickness is higher. These stands have hydraulic screw-downs to respond to disturbances at high roll angular velocity. There are two ways to detect roll eccentricity in REC - by detecting measured roll force, and by detecting measured thickness deviation. The second method can only be applied to the stand with adjacent downstream X-ray thickness gauge [1], [2].

Some types of roll defect cause roll eccentricity anomalies, which can be detected by REC. In this paper we propose an online roll monitoring system for detecting roll anomaly by combining roll eccentricity detection and anomaly detection. REC is basically used for roll eccentricity detection. However, REC is characterized by divergent responses without control. Therefore, we also describe a roll eccentricity monitoring system (REM) that effectively detects roll eccentricity for rolling mills which do not have REC. We show the basic idea and effectiveness with simulation using actual HSM data.

CONTROL OBJECTIVES

Hot strip mill
The proposed online roll monitoring system can be applied to various rolls used in HSMs, cold rolling mills, plate mills etc. We have used a HSM for the online monitoring system to be applied. An example of mechanical configuration is shown in Figure 1. A slab is heated to about 1200°C in a furnace. It is rolled to the target thickness and width in roughing mill and finishing mill. After rolling in the finishing mill, the steel strip is cooled down by water on a run-out table (ROT) and coiled by a coiler.