Diagnosing Cold Mill Chatter Through Mill Stand Hydraulic Monitoring and Roll Shop Grinder Testing

This project won the AIST Maintenance Processes Operating Committee's Silver Reliability Achievement Award, which recognizes iron and steel producing companies for reliability improvements and achievements.

On Sept. 24, 2003, a chatter reduction team was formed in order to determine why USS-POSCO Industries' (UPI) tandem cold mill (TCM) was experiencing an abnormally high incidence of delays (roll changes) due to what had been termed "bearing chatter." Figure 1 indicates that the number of roll changes due to bearing chatter could be as high as approximately three roll changes a week plus or minus two roll changes. The average number of roll changes was unacceptable, and the variability was too great, denoting a process out of control.

USS-POSCO's tandem cold mill had begun to experience an increased number of roll changes due to mill chatter. Through several innovative means, root causes were identified and chatter was reduced by 50 percent.

Table 1

Key Definitions

Discrete peak	Vibration amplitude at a specific frequency. Figure 3 has a 3 psi discrete peak at 51,675 cpm.
Sidebands	Equidistant peaks located around a central peak.
Spectrum	A plot showing energy in terms of periodic behavior. The top plot in Figure 3 is a spectrum.
Natural frequency	The frequency of free vibration,[1] or the frequency at which a mechanical object lacks material stiffness.
Resonance	A condition when the input force frequency equals the natural frequency of the system.[2] The result of such a condition is instability of the system.
Chatter	A roll stack resonant condition seen in cold rolling mills.
Critical speed	Speed of a rotating system that corresponds to a resonant frequency of the system.[3]
Resonant frequency	Frequency at which resonance exists.[4]

Chatter is the result of a resonant response of the cold mill stack. This causes the stack to vibrate uncontrollably when excited by a periodic force. This force can be produced by a variety of things. While discussing the problem in further detail, operations personnel noted that the typical response to bearing chatter was a roll change. It was believed that once the bad bearings were out of the mill, then the resonance condition would go away. The only other fact made known to the team was that the physical effect of this type of cold mill chatter was a short cycle pattern across the width of the strip, visibly seen at the exit of the TCM. Figure 2 is an example of the pattern seen on the strip.

With this limited amount of data, the team decided, in keeping with UPI's current root cause methodology, that it would have to collect physical evidence first in order to further identify and define the problem. Since chatter could have a variety of sources, additional measurements would have to be taken to identify the specific cause. Only then could the team begin analyzing the problem. It was decided that physical samples of the strip surface and roll surface, along with mill and

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