

ON-LINE OVERLAP MEASUREMENT SYSTEM FOR THE JOINING PART OF ENDLESS ROLLING

MyoungKoo Kang*, YongSoo Kim**

Instrumentation and Measurement Group in POSCO Research Lab,
Pohang, Korea, (email: pmang@posco.com*, nangakim@posco.com**)

Abstract: The on-line Overlap Measurement System is developed for measuring the length of overlap just before joining in the Endless Rolling Mill in POSCO (Pohang Iron and Steel Company). Because the joining mechanism of POSCO is different from the other ones, overlap measurement system is necessary to check if joining is possible. If overlap length is not in the appropriate range, joining process would not be done successfully. For the successful joining process, proper overlap must be prepared before joining and the overlap length is to be known before joining. First overlap measurement system had been realized at laboratory, and then was installed at the Joining Machine to show its good performance and reliability. Copyright © 2008 IFAC

1. Introduction

POSCO has introduced endless rolling technology into hot rolling mill of Pohang works. To activate the endless hot rolling technology, new solid-state joining process has been developed for on-line joining of sheet bars. This joining process employs a unique concept of solid-state joining that utilizes the pendulum-shearing action, and consists of four steps; partial descaling – overlapping – joining – crop removing.

1.1 Overlapping and Joining.

Endless rolling process is shown in Fig. 1., and the Joining Machine is located in the middle of the process.



Fig. 1. Endless rolling process

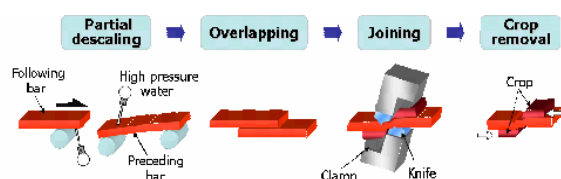


Fig. 2. Solid-state joining steps

The joining process consists of four steps as shown in Fig. 2. During partial descaling, the preceding and following bars move in parallel. On overlapping following bar is controlled to overcome the distance between preceding and following ones. After overlapping the overlap amount is controlled to be kept constant. Overlap measurement must be done just after overlap completion and before joining. The distance between overlap completion and joining point is about 3 m. The reasonable overlap range is from 150mm to 600mm. If overlap is too small

Joining Machine can not join, and if it is too large overlap crops cannot be removed.

1.2 Monitoring Overlap

After overlapping, overlap moves along the path line inside the frame of joining machine. Monitoring side-view of overlap is very difficult because the installation space for monitoring system is too small and the steam is too heavy and hot. If the side-view was available, dimension and shape of overlapped part would be computed more quickly and easily.

2. Radioactive Thickness Gauge

2.1 Measuring Overlap.

The overlap consists of upper tail of a preceding bar and lower top of a following one. Because side-view of overlap is not available in this situation, another recommended method would be detection of upper head and lower tail end each. But there is not enough space for installation of detection systems for the both. Even if installation space does not matter, the cooling water flowing down the bar and vibration of the target's surface are the biggest obstacles to overcome.

2.2 Radioactive source and detector.

Thickness gauge using radioactive source and detector has many advantages over the other measurement methods. It is robust to the radiated heat from hot surface, high ambient temperature, cooling water and vibration. And more it is very reliable and needs low maintenance.

The continuous thickness gauge operates according to the physical law of attenuation of gamma radiation. On thickness being measured as the bar is passing by, an overlap part makes change to radiation signal.

3. Simulation

As measurement time available is only one second or less after overlapping completion, the response time of detector is the shorter the better. Radiation source is Cs-137 80mCi and the detector is Sz-5 of Berthold Co. The dimensional scale of simulation configuration is about 1:6 and it is shown in Fig. 3.

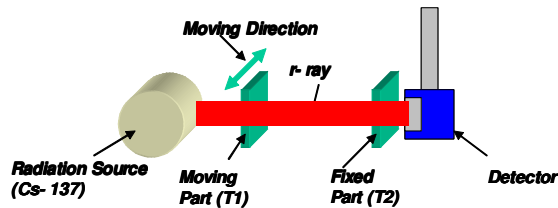


Fig. 3. Simulation configuration

Overlap is simulated by using fixed and moving specimens. If moving part is not in the path of r-ray, it looks like a preceding bar. If moving part comes to overlap the fixed part, it looks like an overlapped one to detector. The result shows that measurement error is less than 10mm.

4. Application and Result

To apply for real Joining Machine, radiation source must be protected from cooling water. Steel scales falling down from the bar surface must be removed not to build up on the source's housing. Considering these disturbances and the distance between the source and detector, the source activity should be 4Ci or more.

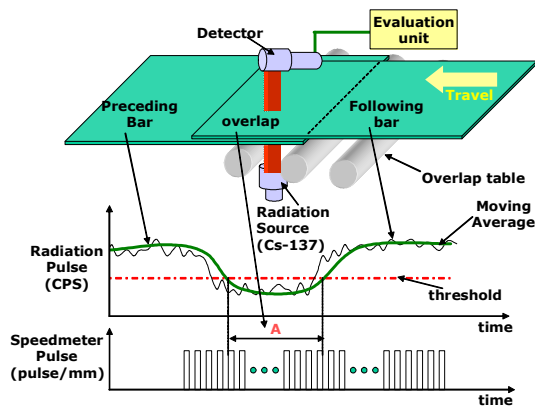


Fig. 4. Applied installation configuration

Radiation signal has big noise, so it is necessary to use moving average of the radiation pulse signal to prevent wrong decision. To find out top and tail of each bar, threshold value is used. To compute the length while overlap running over the radiation source, the speed meter pulse of preceding bar is accumulated over 'A' as shown in Fig. 4. The response time delays of detector and speed meter are compensated.

During 6 month application period, no maintenance was done. Real measurement after joining and crop removal was performed 6 times. The result shows that the measurement error of the system is less than 30mm.

5. Conclusion

We have shown that radioactive thickness gauge can be used to detect overlap part and to compute the overlap length using speed meter. And more the system showed robustness to cooling water and hot ambient temperature, vibration, etc. Radioactive system is especially useful in harsh environment and small installation space.

REFERENCES

<http://www.berthold.com>
 J. S. Lee, Introduction of Endless Hot Rolling at Pohang Works of POSCO, Current Advance in Materials and Process, p.987, Vol.20, No.4, 2007.