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An investigation of pulsed eddy currents for the development of a profile gauging system suitable for aluminium hot rolling mills.

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Abstract

This study investigates the Pulsed Eddy Current (PEC) technique, as an alternative method, to establish its performance in a profile gauging system for aluminium hot rolling mills. Radiation gauges are the popular choice for profile gauging. However, they present poor accuracy ($\pm 0.1\%$), are not safe, require frequent maintenance and are very expensive. A PEC system model, was developed using analytical methods in order to allow for specimen conditions that could not be easily emulated, to be investigated thus giving a complete assessment of the PEC system. The model was validated against experimental data. The coil probe and specimen were characterised as lumped resistance and inductance and the characterisation gave a good fit between simulated results and results from experiments and was therefore useful to the investigation. Results from experiments and simulations reveal that changes in specimen temperature show a point of crossing in the received signal agreeing with findings made by other researchers, for other parameters. Furthermore, results indicate that relative motion between a small probe and a massive specimen does not affect the signal at the probes and a quasi-static approximation was assumed for the model.

The developed characterisation of the aluminium specimen used in conjunction with the developed system model indicate that differences in thickness of up to 4 microns at the minimum nominal thickness of 2 mm required for the finishing mill could be gauged. The signal processing method described in the study indicates that at a crown and wedge definition of 0.2%, accuracies of $\pm 0.04\%$ were achieved, showing PEC to have better accuracy than radiation gauges. Temperature changes in the specimen were successfully eliminated from the profile measurement.This was achieved by using the relationship observed between the temperature point of crossing (TOC) and specimen thickness for

different specimen temperatures. A method for harnessing profile measurements from the PEC signal was also developed. PEC system could therefore have potential in profile gauging systems for aluminiunm hot rolling mills.