Ultrasonic Removal of Mill Scale from Continuous Strip

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This work was carried out as an undergraduate student project, as the intent of the funding was to promote education of engineers to work in the iron and steel industry.

The removal of scale is important step in the galvanizing process. In order to obtain adherence of zinc to the steel, the oxide scale and lubricants must be eliminated. Steel pickling is the most common process of the removal of mill scale. It is often considered an environmental problem due to acid sludge. The elimination of the acids would reduce air and water emissions. The fundamental purpose of the research was to remove scale without the use of pickling. The alternative methods tested were ultrasonic, and electrolytic. Polishing with a wire brush, periodic reversal of the polarity of the electrolytic cell, mechanical treatments of the surface of the steel and thermal treatment were performed to improve ultrasonic and electrolytic processes.

Of the many trials performed, the most effective was a four step process consisting of bending, a thermal shock treatment, electrolytic treatment, and concluding with an ultrasound treatment. The amount removed was comparable to 3 minutes of acid with a mass removal per area of 8.16 g/m^2 and a standard deviation of +/- 0.953 g/m^2. Thermal shock treatment consisted of immersing the sample in liquid nitrogen, which was convenient for laboratory use but may not be suitable for industrial use. Other methods to cause thermal shock should be explored.

This process offers potential for the elimination of acid pickling. An opportunity for greater mass removal per area lies in the addition of new scale breaking techniques. If a stronger scale breaking technique could be developed, the scale would remove much easier. It should be noted that error could occur in the experimentation due to the temperature and age of the steel and scale. Our experiments were run on steel obtained from a hardware store. Removal results could be different while attempting to remove scale in process.