The Top Submerged Lance TSL furnace technology has been widely adopted by industry for new processing plants, and some of the primary issues experienced by plant operators are refractory wear, lance tip wear and bending of the lance body. This is the first body of work undertaken to study the lance bending mechanism, with a view to improving understanding of the issue so that a design solution may be found.

Measurements of bent lances were collected from an operating TSL furnace in order to provide a real-world foundation for the present work. The results of the measurements indicated that all lances were bending in a consistent direction - away from the feed port opening.

Analytical modelling is used to explore the thermal impact of the slag layer thickness, and numerical modelling is used to explore the impact of uneven slag layer formation. An experimental investigation at the laboratory scale is used to confirm that key predictions from the numerical models for the full scale lances can be replicated.

Overall the site data, analysis, and experimentation provided insight into the lance bending mechanism, and several potential design solutions are proposed for further investigation.

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