Measuring Technologies in Remanufacture

The Weir Group PLC & University of Strathclyde

A Remanufacturing Case Study

Project Summary

Utilising faster, more accurate and effective in-situ measuring technologies which are transportable to customer sites has the potential to save Weir Engineering Services over £275,000 per annum in labour and parts in the overhaul of valves.

The improved measuring techniques also have the potential to reduce the company's annual waste to landfill *by 10kg per year.*

Innovation in Overhaul Methods

Weir Engineering Services (Weir) Ltd (part of The Weir Group PLC) overhaul a range of industrial valves, predominantly for the UK power markets. The majority of valve overhauls are conducted in-situ on customer sites.

Weir recognised an opportunity to reduce costs through the introduction of innovative repair techniques that will add value for the customer.

Two projects looking at ways to improve the measurement techniques used to determine requirements for overhaul were carried out with researchers from the University of Strathclyde.

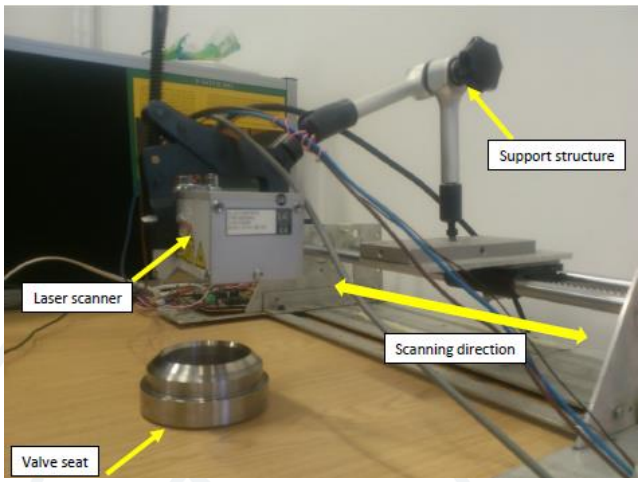
Digital Measurement of Valve Taper

The valve seats within safety valves have critical dimensions and high precision machining tolerances that influence the performance of the valve. The current method for measuring these dimensions is difficult to do consistently due to the shape and design of the valve seat which lead to unstable reference for the measuring tool to fit to.

The project investigated alternative methods for accurate mobile measuring devices. Three measurement technologies were considered by the research team but the difficulties in access and accuracy led the project to focus on a non-contact laser based technology.

Testing was carried out on a new valve seat supplied by the Weir Flow Control facility in Alloa to give an accurate sample to test the technology against.

Several considerations were taken into account when designing the measurement set-up including reference geometry for larger valve seats and the necessity for the valve seat to remain flat whilst being scanned. The final measurement set-up is illustrated below.



Measurement Setup

The measurement set-up utilised open source software and produced graphical results of measurements.

Results

This study found that it was feasible to accurately and quickly measure valve seat dimensions with the laser scanner but there were some limitations to be considered in future work.

- The rigidity of the measurement rig needs to be increased, the current set up allows the reading to change as a result of any external contact which is likely as the rig will be used in-situ.
- Methodology to eliminate any human error when the scanner has to be moved on site should be developed.

Any future work will focus on design of a robust scanner handling device that could be made transportable for on-site use.

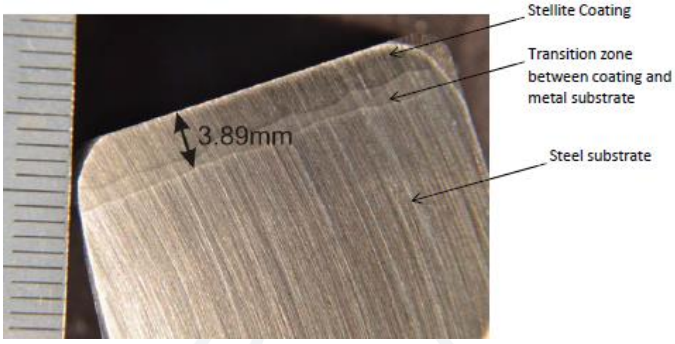
Stellite Coating Thickness

Valves used in severe environments, have a stellite clad valve seat to improve the wear performance. However, the remaining life of the coating is not currently measured and is routinely placed during the refurbishment process at Weir Engineering Services. If an effective method of measuring and assessing the remaining thickness could be found, parts could potentially be reused without rework, increasing efficiency and reducing the repair cycle lead-time.

Researchers analysed the accuracy of various commercial coating thickness measurement technologies by comparing them to the thickness measurements from an optical microscope. After initial tests it was concluded that ultrasonic measuring technology produced consistently less accurate measurements than the measurement made with eddy current meters and therefore the study should focus on the testing of this technology.

By measuring a sample taken from valve discs with different degrees of wear, optical microscope readings determined that there was significant variation in the stellite thickness across each valve seat and there is a certain amount of ambiguity as to where the coating ends and the underlying substrate starts.

Used valve disc



Sample from new valve disc

Comparison of the optical microscope and eddy current meter measurements found that the eddy current meter provided a consistent under-measurement of the remaining coating thickness and therefore could be used in the refurbishment process.

The study tested two different eddy current meters and found one to be more reliable than the other and concluded that the meter used in-situ should be carefully selected to ensure it can handle the required depth measurement.

Follow on work will strive to create and test a robust process for assessing the thickness of stellite cladding, involving multiple measurements to overcome the variation in coating across used valves. Deploying this new process will result in a faster refurbishment time saving £225,000 annually in labour time alone, with an estimated increase of market share of 10%.

Conclusion

There is considerable scope within Weir Engineering Services to improve efficiency and reduce costs by implementation of advanced measurement technologies in the valve refurbishment process. By increasing the volume of parts that are reused the company will reduce their waste to landfill and improve their throughput leading to an increased market share and a faster turnaround time for customers.