Integration and Commercialisation of Tube Measuring Devices

A thesis presented in partial fulfilment of the requirements for the degree of

Master of Engineering

in

Mechatronics

At Massey University, Manawatu, New Zealand

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2016

Abstract

Failure of plant equipment in the hydrocarbon processing industry can lead to significant financial, environmental, and health and safety consequences. Therefore, the equipment is subject to ongoing routine inspections, which often involve significant labour and financial resources.

Methanex is a methanol producing company operating plants at six sites globally, including in New Zealand. The production of methanol involves the use of steam-methane reformers, which house hundreds of process-carrying vertically hung reformer tubes in a large gas fired furnace box. The heat and pressure of the process places the metal used for the tubes under high stresses, which results in the creep strain phenomenon exhibited as diametric growth in the tube. As the growth increases, the tube becomes weaker, and eventually fails. Methanex has developed a device for inspecting the reformer tubes and detecting this growth, called the Economole, thus helping to predict remaining tube life. However, the Economole device is not capable of inspecting the other part of the reformer, also at risk of creep strain, the pigtail collection pipes. These pipes are used to collect the gas at the bottom of the reformer tubes, and are smaller in diameter. Normal practice is to manually externally inspect these pipes, costing in excess of 100 000 NZD for Methanex New Zealand’s three reformers.

The research performed during this thesis was initiated to address the gap in internal, automated, reformer inspection at Methanex, by integrating the field proven Economole tube measuring device, with a laboratory tested prototype, the Minimole. Commercialisation of the Minimole concept was carried out, to provide a fit for purpose device, and integration of mechanical, electrical, communication and control systems was subsequently completed.

The final outcome of the project was the MXmole device. It consists of an improved Economole system, integrated with the Minimole system.. The MXmole is able to measure the full reformer tube, as well the top section of the reformer pigtail, during one inspection. Real time feedback is provided on the condition of the pigtail, with instantaneous critical warnings, indicating near end of life of the pigtail. This feedback can initiate immediate necessary replacement. Inspection coverage for Methanex’s reformer equipment has increased as a result of this research. This increase has provided them with additional data necessary to assess the life expectancy of their reformer equipment, including pigtails, without the need for costly and laborious manual external inspection. The outcome of this research may be adapted to other plants and processes in industry, allowing further economical inspection of equipment vulnerable to creep strain, and the overall safer and more reliable operation of high pressure and temperature plant equipment in industry.

Acknowledgements

I would like to thank Dr Liqiong Tang and Peter Tait for the opportunity to undertake the project, and for their guidance and assistance in the completion of the work detailed in this thesis.

I would like to give thanks...

To the staff at Methanex who facilitated my workshop and laboratory requirements, specifically Leith Warren, instrumentation workshop supervisor, and Sam Tait, reliability engineer.

To the machinists and staff at Cambrian Engineering Company Ltd., Energyworks Group, and Pace Engineering Ltd., for their willingness and skill in the manufacture of a large number of bespoke parts. Specifically to Tom Drew, of Tom Drew Ltd., for his skill and expertise in machining and for guidance in the practicalities of manufacture.

To the electronics workshop staff at Massey University, Anthony Wade and Morio Fukoaka, for being extremely helpful and flexible in assisting me throughout the project, including weekend work, and to Ken Mercer for helping me to remember some of the valuable information he imparted in my under graduate studies.

To my supervisor and managers and WorleyParsons New Zealand Ltd., for their flexibility in giving me the time off to complete this project, and keeping a job for me to go back to.

Finally, to my family, and my girlfriend, for encouraging me to take the opportunity, and for tirelessly supporting me throughout. Thank you Mum, Tom, Berit, Daniel, and Caitlin.

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