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Integration and Commercialisation of Tube Measuring Devices

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## 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.

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