University of Victoria | Graduate Studies

Notice of the Final Oral Examination
for the Degree of Master of Applied Science

of

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BASc (University of Ottawa, 2015)

"Fiber Bragg Gratings for Temperature Monitoring in Methanol and Methane Steam Reformers"

Department of Mechanical Engineering

Tuesday, September 5, 2017
2:00 P.M.
Engineering Office Wing
Room 106

Supervisory Committee:
Dr. Peter Wild, Department of Mechanical Engineering, University of Victoria (Supervisor)
Dr. Ned Djilali, Department of Mechanical Engineering, UVic (Member)

External Examiner:
Dr. David Harrington, Department of Chemistry, University of Victoria

Chair of Oral Examination:
Dr. Charlotte Loppie, School of Public Health and Social Policy, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

Steam reforming of methanol and hydrocarbon are currently the processes of choice to produce hydrogen. Due to the endothermic nature of these reactions, zones of low temperature are commonly found in reformers. These zones can potentially damage the reformer through thermal stresses. Moreover, the response time and size of a reformer are controlled by the heat available to the reaction. The objective of this thesis is to demonstrate the feasibility of using fiber Bragg gratings as an alternative solution for temperature monitoring in methanol and methane steam reformers. To meet this objective, a sensor array containing seven gratings is placed in a metal-plate test reformer. First, temperature monitoring during steam reforming is conducted in 12 different sets of conditions. The resulting profile of the temperature change along the length of the catalyst capture the zones of low temperature caused by the endothermic nature of the reaction. Several nuances in the temperature profile caused by increasing temperature and/or flow rates were captured demonstrating the ability to use these gratings in methanol steam reforming. Similar experimental work was conducted to validate the possibility of using gratings as temperature sensors in methane reforming. Using a regenerated grating array, data was collected for 13 operating conditions. The conclusions arising from this work are identical to those drawn from the methanol steam reforming work. The regenerated FBGs exhibited behaviour that has not been reported in the literature which is referred to in this thesis as secondary erasure. This behaviour caused some instability in the grating signal and erroneous readings for some operating conditions. Despite this, the grating measurements captured the zones of low temperatures in the reformer and the nuances brought about by increasing the reforming temperature and lowering the steam to carbon ratio.