Summer Research Program 2019/2020

**Project Title:** Combustion Reactivity of Coke and Bio-coke for the Regeneration of Deactivated Zeolitic Catalysts in Petroleum Refineries

**Supervisor(s):** Ms. Yu Qi, Dr Bai-qian Dai, A/Prof Lian Zhang

**Email:** Yu.Qi@monash.edu, bai-qian.dai@monash.edu; and lian.zhang@monash.edu

**Phone:** 990 52592

**Department:** Chemical Engineering

**Website:** [https://www.monash.edu/engineering/clean-solid-fuel-lab/home](https://www.monash.edu/engineering/clean-solid-fuel-lab/home)

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**Objective**

Fluid catalytic cracking (FCC) is one of the most important conversion processes used in petroleum refineries, to crack crude oil as it is or blended with renewable bio-oil. Since the cracking reactions produce cokes that deposit on the zeolite catalyst surface, the catalyst is deactivated and hence, has to be regenerated by combustion at high temperatures. The proposed project aims at clarifying the combustion reactivity of crude oil-derived coke and bio-coke in the lab-scale drop tube furnace under different conditions. Additionally, the speciation and occurrence of metals, including nickel, iron, and vanadium will be clarified. These metals are believed to cause the catalyst deactivation too.

**Description**

A drop-tube furnace (DTF) facility shown on the right will be employed to carry out coke combustion under a variety of catalyst particle residence times (2, 4, 6s), gas conditions (Air+N₂, steam+N₂) and temperatures (600–1000 °C), which are designed to simulate the regeneration conditions in the real industry process.

The residue derived from the abovementioned reactors will be subjected to element quantification using state-of-the-art analytical methods including inductively-coupled plasma optical emission spectrometry (ICP-OES), X-ray fluorescence (XRF) spectrometry, scanning electric microscopy coupled with energy dispersive spectroscopy (SEM-EDS), transmission electron microscopy (TEM) and Fourier Transformation Infrared Spectroscopy (FTIR). The thermochemical software FactSage will be used to perform thermodynamic modelling to predict
the transformation of metal elements, which will be compared with the experimental data. In addition, the different mathematical models will be used to interpret the experimentally measured data, so as to extract the kinetic parameters governing the combustion of coke and bio-coke.

**Prerequisites**

*Third-year Engineering students, preferably those who finished CHE3164*