

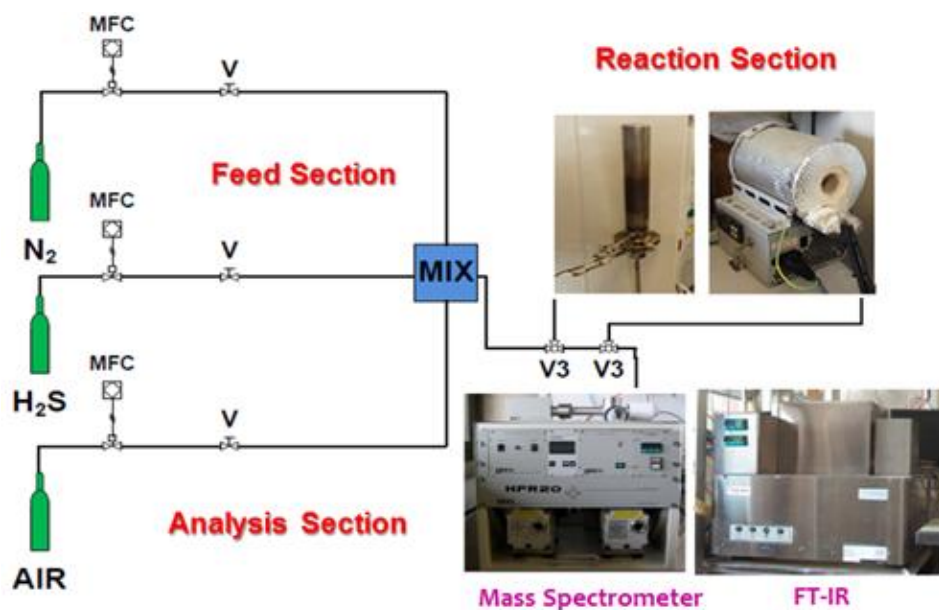
## Low temperature catalytic oxidation of H<sub>2</sub>S over V<sub>2</sub>O<sub>5</sub>/CeO<sub>2</sub> catalysts

**Our research project concerns the abatement of H<sub>2</sub>S from a biogas stream by partial and selective oxidation to sulphur and water.**

Hydrogen sulfide (H<sub>2</sub>S) is one of the most toxic compounds usually present in fuels, oil and gas refinery processes. In particular, it's also present in little amount in biogas which is a renewable energy carrier obtained from the anaerobic digestion of organic substrates. The main compounds are CH<sub>4</sub>, CO<sub>2</sub> but there are also sulfur compounds present. Next to the traditional catalytic oxidation processes such as the Claus process used for the abatement of H<sub>2</sub>S, an interesting one-step solution for the clean-up of biogas from H<sub>2</sub>S could be, for small plants, selective catalytic H<sub>2</sub>S oxidation to sulfur at low temperatures.

The partial H<sub>2</sub>S oxidation reaction is carried out in presence of vanadium-based catalysts that were identified, from a previous screening of catalysts, to be very active and selective to sulphur.

The catalytic tests were carried out in a fixed bed flow reactor, inserted in an electrical furnace equipped with a PID electronic temperature controller. A thermocouple is inserted in a steel sheath of inner diameter of 6 mm concentric to the reactor. The catalytic tests were performed at atmospheric pressure with a contact time of 20 ms, at temperatures between 150 and 250 °C, by feeding 200 ppm of H<sub>2</sub>S, 100 ppm of O<sub>2</sub> and N<sub>2</sub> to balance. The scheme of the laboratory plant is shown in Figure 1 (Fig.1).



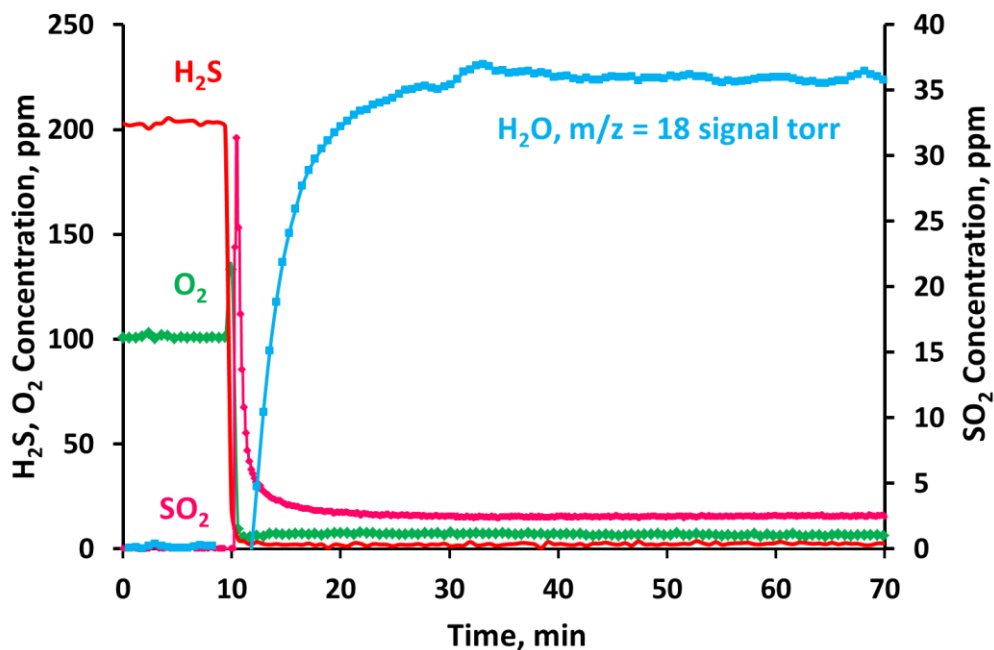
**Fig. 1.** Schematic diagram of the experimental apparatus

The exhaust stream (H<sub>2</sub>S, O<sub>2</sub>, H<sub>2</sub>O) was analyzed by a quadrupole mass spectrometer (Hidden HPR-20 QIC). It was equipped with a sulfur trap to prevent sulfur causing the occlusion of the capillary and damage to the fundamental parts of the analyzer. The concentration of SO<sub>2</sub>, which may be present at a very low concentration level in the stream

leaving the reactor was monitored by an analyzer FT-IR Multi-gas in continuous, consisting of the spectrophotometer Nicolet Antaris IGS Thermo Electron, with a specific cell for gas.

In Figure 2 (Fig.2), the typical behavior of a catalytic test performed at 150 °C on the 20 wt% V<sub>2</sub>O<sub>5</sub>/CeO<sub>2</sub> sample is shown, by plotting the concentration profiles of the reactants (H<sub>2</sub>S, O<sub>2</sub>) and the products (SO<sub>2</sub>, H<sub>2</sub>O) during the test.

After 10 minutes, the feed stream was sent to the reactor after which it is possible to see a significant decrease of the H<sub>2</sub>S, O<sub>2</sub> concentration with SO<sub>2</sub> and water production.



**Fig.2.** Catalytic activity test for the catalyst 20 wt% V<sub>2</sub>O<sub>5</sub>/CeO<sub>2</sub> at 150°C.

The concentration values of H<sub>2</sub>S, O<sub>2</sub> and SO<sub>2</sub> reached a stationary value after 10 min on stream. The final H<sub>2</sub>S and O<sub>2</sub> conversion values were 98% and 94% respectively, with a very low SO<sub>2</sub> selectivity (1.5%).

The water formation, indicated by the behavior of the signal m/z =18, after the initial transient time of about 20 min, was stable during the overall test time.

The catalyst has shown a good catalytic activity without evident deactivation phenomena during the test time.

#### Project summary by:

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#### Paper Reference:

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#### Hidden Product:

**[HPR-20 QIC R&D](#) Real-time gas analyser**