Hiden Analytical Ltd.
420 Europa Boulevard
Warrington WA5 7UN
England

T +44 [0] 1925 445 225
F +44 [0] 1925 416 518
E info@hiden.co.uk
W www.HidenAnalytical.com

H_2S purification from biogas by direct selective oxidation to sulphur on V_2O_5–CeO_2 structured catalysts

Our research project concerns the H_2S purification from a biogas stream by direct and selective oxidation to sulphur and water at low temperature.

Biogas is a renewable energy source that can be produced from biomass, agricultural and industrial waste and sewage sludge. Its main components are CH_4, CO_2 but unfortunately sulphur based compounds such as H_2S, COS are also present.

The main limitation of the biogas utilization as fuel in Molten Carbonate Fuel Cells is due to the presence of sulphur compounds such as H_2S that can poison the main components of the fuel cell.

The partial H_2S oxidation reaction is carried out in presence of vanadium-based catalysts that are active and very selective toward Sulphur formation.

The aim of the work is to study the preparation procedure of V_2O_5/CeO_2 structured catalysts from the washcoating with CeO_2–ZrO_2 to the deposition of the active phase (V_2O_5) for the abatement of H_2S at 150–200°C.

The catalytic tests were carried out in a fixed bed flow reactor, made of a steel tube 21 cm long and a 14 mm of internal diameter. The reactor is inserted in an electrical furnace equipped with a PID electronic temperature controller. A thermocouple is inserted in a steel sheath concentric to the reactor. The catalytic tests were carried out in the temperature range 150– 250 °C, with a GHSV of 180,000 h^{-1}, by feeding 500 ppm of H_2S, 250 ppm of O_2 and N_2 to balance.

In Figure 1, the scheme of the laboratory plant is shown.

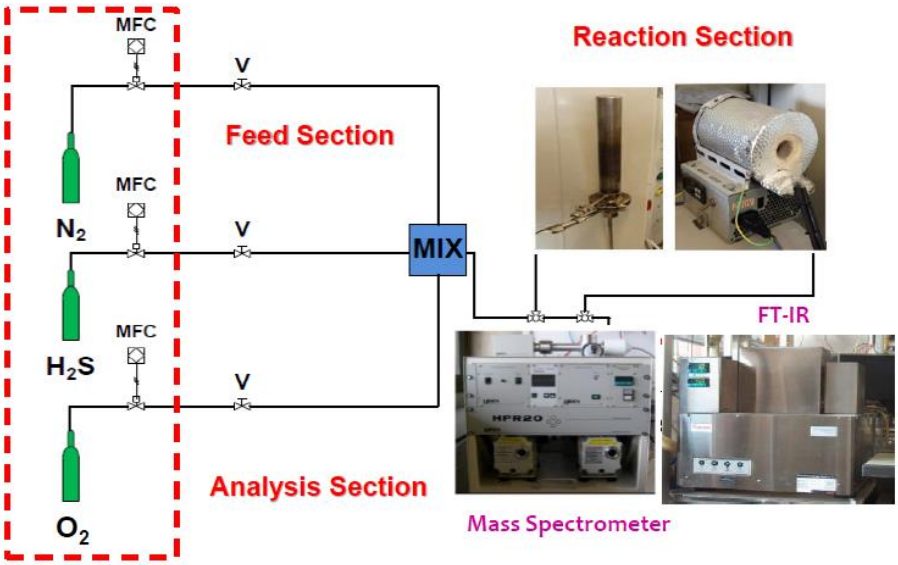

Fig. 1. *Laboratory plant for the catalytic tests*

The exhaust stream (H_2S, O_2, H_2O) was analyzed by a quadruple filter mass spectrometer (**Hiden HPR-20 QIC R&D**). It was equipped with a sulphur trap to prevent that the sulphur causes the occlusion of the capillary and damage to the fundamental parts of the analyzer.

DIRECTORS: Ian D. Neale B.Sc., Peter J. Hatton B.A., Robert W. Blacas ACA, ATII., Paul A. Jones B.Sc.
Registered in England 1596907. WEEE Producer Reference No. WEE/HK0067TX
VAT Registration Number : GB 373 3169 48

nqa. ISO 9001 Registered Quality Management Certificate 6738

The concentration of SO_2, which may be present at a very low concentration in the stream leaving the reactor is also monitored by an analyzer FT-IR Multi-gas continually.

In Figure 2 we have shown the typical behaviour of a catalytic activity test carried out by using a catalyst with the highest vanadium loading (19 wt%V_2O_5).

It is worth noting that when the feed stream is sent to the reactor, an immediate and strong decrease of the H_2S concentration and O_2 signal is verified, while a very low SO_2 concentration (10 ppm) is produced. The formation of the water, that remains stable and constant during the test, is indicated by the signal m/z = 18. During this test (2h), no deactivation phenomena were observed. The final H_2S conversion value was higher than 90%.

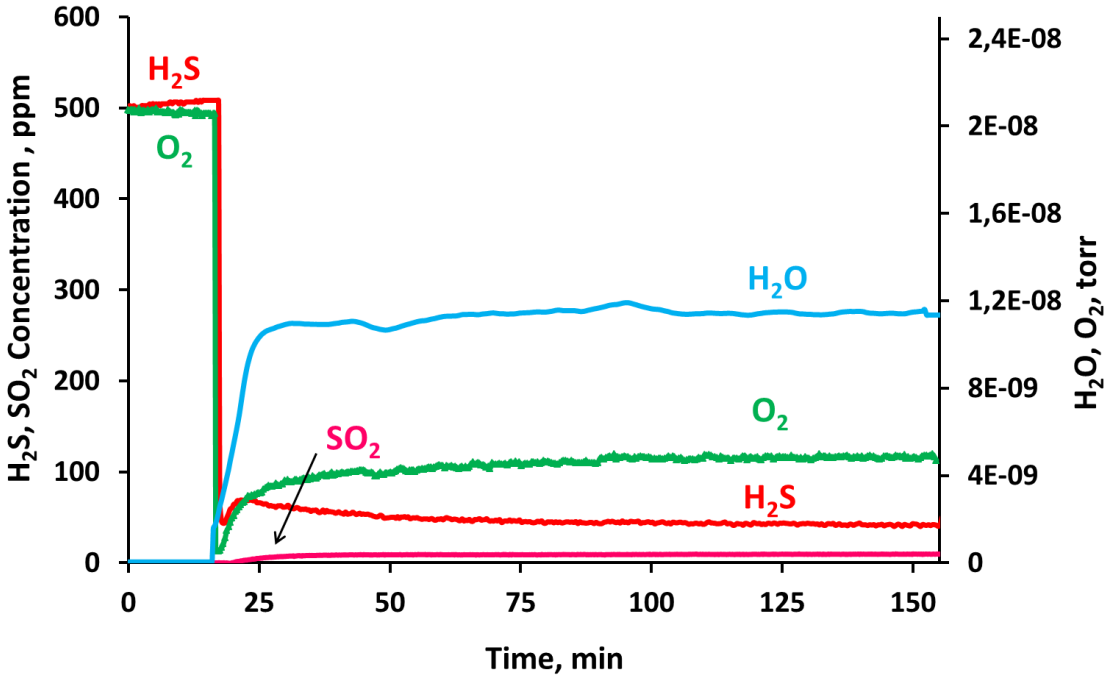

Fig.2. *Catalytic activity test of structured catalyst at T = 200°C*

Finally, the structured catalysts can be considered, based on these results, promising and innovative catalytic systems for the H_2S partial oxidation at low temperatures, having shown good catalytic performances with results very similar to those showed by powder catalysts.

Project summary by:
Vincenzo Palma and Daniela Barba
Department of Industrial Engineering
University of Salerno
Via Giovanni Paolo II
132, Fisciano, SA, Italy

Paper Reference:

V. Palma & D. Barba (2014) "H_2S purification from biogas by direct selective oxidation to sulphur on V_2O_5–CeO_2 structured catalysts" *Fuel* **135,** 99-104

Hiden Product:

[HPR-20 QIC R&D]