HIGHLIGHT # 3 – RSA OLEFINS PROGRAMME

The relevance of catalysis to the South African economy and the opportunity of catalysis for the South African economy are briefly described below.

The c*change scientific programme is made up of three distinct research programmes, viz.

1. The Synthesis Gas (SYN) Programme (cf. Highlight # 1)
2. The Paraffin Activation (PAR) Programme (cf. Highlight # 2)
3. The RSA Olefins (OLE) Programme

South African Context

A second major product fraction from the Fischer-Tropsch reaction (cf. Highlights 2 and 3) concerns linear alpha-olefins, which are industrially important in the manufacture of various products (co-monomers, polymers, lubricants, detergent alcohols, etc.). Much of the global alpha-olefin supply is derived via ethylene polymerization, resulting in even-numbered alpha-olefins. The product slate of the Fischer-Tropsch synthesis contains not only even-numbered but also odd-numbered alpha-olefins. The odd-numbered alpha-olefins (especially C_5, C_7 and C_9) cannot readily be sold to consumer manufacturers who are reluctant to be dependent on a single supplier. The primary objective of the RSA Olefins Programme is therefore to add value to the relatively low-value RSA olefins (especially C_5 – C_9) feed stocks to higher value detergent range olefins (C_{10} – C_{18} olefins and functionalized analogues) through catalytic manipulation.

Impact of the RSA Olefins Programme

This work is geared towards adding value to the RSA chemical product pool (see below).

Significant contributions have been made in the following areas:

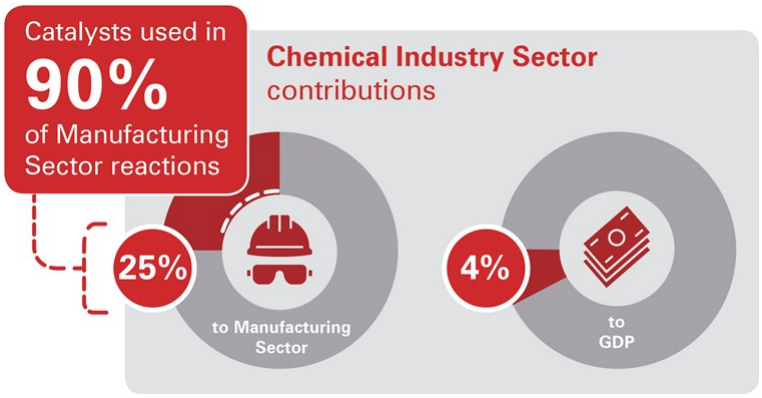
- C_5-C_9 alkenes have been converted to Guerbet-type surfactants containing a unique C_{10}-C_{18} tail component and novel head-tail combinations;
- recyclable homogeneous precatalysts with suitable activity and regioselectivity and reasonable catalytic lifetime have been developed for hydroformylation using metallopolymers and metallodendrimers in biphasic processes;
- organic solvent nanofiltration has been implemented successfully to separate catalyst species from metathesis and hydroformylation reaction mixtures in active form;
- a techno-economic model for the catalytic processes, i.e. metathesis and hydroformylation, has been developed.

These outcomes contribute towards viable process development options for transforming South Africa's odd-numbered linear alpha-olefins into higher-value detergent range chemicals.

Relevance of Catalysis to the South African Economy

By its very nature the field of catalysis is environmentally friendly, insofar that catalysis inherently aims to improve the selectivity and yield towards the formation of the desired product(s), thereby reducing the formation of the undesired by-product(s). Moreover, relatively small changes in the desired product yield from a catalytic process (± 1%) may translate into substantial economic benefits for an industrial chemical process. Consequently, there is great potential for indirect economic benefit from the research, in that the research supports the South African Chemical Process Industry (SACPI) by studying more efficient chemical transformations, resulting in economically more competitive chemical processes.

Catalysis lies at the heart of the many chemical transformation processes, because approximately 90% of all chemical reactions carried out in commercial chemical industries make use of a catalyst. The purpose of a catalyst is typically to (i) speed up the rate at which the desired product is formed, (ii) form the desired product more selectively, and/or (iii) lower the operating conditions for the reaction. All three of these aforementioned reasons result in improvements of the chemical process and, consequently, in the overall financial performance of the company.



The RSA chemical industry sector contributes about 25% to the RSA manufacturing sector, and this contributes about 4% to GDP.

Opportunity of Catalysis for the South African Economy

South Africa is a nett importer of chemical products. The opportunity for the South African Chemical Process Industry is therefore to reduce the trade deficit by (i) increasing the volume of locally manufactured chemical products and reducing imports, or (ii) by adding value to the locally manufactured chemical products, particularly those that are exported.

The c*change research portfolio is geared heavily towards supporting the South African Chemical Process Industry in achieving those objectives.