

FINAL REPORT

THE IMPORTANCE OF NICKEL COMPOUNDS:

DETERGENTS

Prepared for

European Nickel Institute

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THE IMPORTANCE OF NICKEL COMPOUNDS: DETERGENTS

1. INTRODUCTION

The Detergents industry supplies a wide range of essential household, office, factory, and speciality cleaning products to consumers, business, and institutional customers. These products include fabric washing, dish cleaning, and hard surface cleaners for household markets and catering and food industry cleaners, building care products, technical cleaning products and laundry products for the industrial and institutional market.

Detergent products reduce disease and improve hygiene, choice and quality of life. They do this because their physical properties enable them to interact with stains and greases, dissolving or suspending them in water and hence removing them from fabrics, dishes and surfaces.

The most important ingredient present in every detergent formulation is the surfactant. It is the chemical structure and associated characteristics of the surfactant that enable the detergent to carry out its primary cleaning function. Organic molecules within the surfactant enable the cleansing solution to fully drench the surface, and then to loosen, emulsify and dissolve or suspend the stain from the material.

Nickel catalyst technology plays a critical role in the production of modern surfactants from both petrochemicals and oleochemicals (natural oils such as palm oil). Nickel compounds are important in the production of many catalysts used in the manufacture of surfactants.

2. NICKEL AND DETERGENTS

Surfactants used in detergents are made from petrochemicals derived from crude oil, natural gas or oleochemicals derived from fats and oils such as palm oil, palm kernel oil and coconut oil. Some types of surfactants can be made from either raw material source. Petrochemicals are often termed 'synthetic' materials, while oleochemicals are sometimes called 'natural.' Both have 'natural' sources, since crude oil is extracted from the earth and oleochemicals come from plants or animals. Whatever their source, surfactant raw materials have to be chemically converted, or synthesized, before they can become useful ingredients in cleaning products. Both processes use catalysts in the production of precursors to detergents. In its final form, a surfactant based on oleochemicals is similar to the same surfactant based on petrochemicals. This similarity enables manufacturers to use either or both types of surfactants in their cleaning products.

Catalysts used in the production of surfactants are known as hydrogenation catalysts. The hydrogenation process is comprised of three components: the unsaturated substrate, the hydrogen (or hydrogen source) and, invariably, a catalyst. The largest scale technological uses of H₂ are the hydrogenation and hydrogenolysis reactions associated with both heavy and fine chemicals industries. Hydrogenation and



hydrogenolysis reactions require metal catalysts, especially those based on nickel such as Raney and Urushibara nickel catalysts.

In addition, another process called the Shell Higher Olefin Process (SHOP) is used in the production of surfactants. The SHOP process uses an organometallic nickel catalyst in the production of surfactants. The specific nickel compound used in the SHOP process is a nickel hydride based catalyst. The SHOP process is one of the largest applications of homogeneous catalysis using nickel. The nickel based catalysis process is an effective one as it results in the production of valuable chemicals including precursors for surfactant production for use in detergents. The availability, cost, ease of formulation, and desired product form and characteristics are the deciding factors for the continued use of nickel based catalysts in such processes.

3. IMPORTANCE OF DETERGENTS FOR THE EU

3.1. Economic Impacts

The production, sale and use of modern detergent products creates substantial wealth and jobs in the EU.

The 'Household' detergent sector has sales of around Euro 19 billion per annum and gross value added of circa Euro 4 billion. It is estimated that nearly 60,000 people are employed directly in this part of the industry. The Industrial and Institutional Sector has further sales of around Euro 3 billion per annum, gross value added of Euro 0.75 Billion and around 12,000 associated jobs. Moreover, Europe has a large number of companies active in the detergents industry, ranging from SMEs to global multinationals such as Unilever (UK and The Netherlands), Henkel (Germany), McBrides (UK), and Reckitt Benckiser (UK and The Netherlands).

In addition to the direct industry, suppliers to the detergents industry also contribute gross value-added of around Euro 3 billion and a further 70,000 jobs. The downstream distribution and the retailing of detergents products add a further Euro 3 billion in gross value-added. Of the retail sectors employment approximately 75,000 jobs across the EU can be attributed to the detergents industry.

In total, the direct detergents industry, its suppliers, its retailers, and associated induced spending in the wider economy, contributes gross value-added of around Euro 13 billion and around 265,000 jobs in Europe. Moreover, a further downstream part of the value-chain – the commercial cleaning industry- depends on detergents for its own effectiveness and efficiency. This is a significant sector in the European economy, accounting for sales in excess of Euro 45 billion, gross value-added of Euro 32 billion, and over 3 million jobs. Over 80% of companies in the commercial cleaning sector have less than 50 employees: large companies include OCS (UK) and ISS (Denmark).



3.2. Other Impacts

The Detergents industry brings a number of other benefits to Europe in terms of innovation, efficiency, and sustainability.

Innovation – Innovation is one of the critical success factors for competitiveness in the highly competitive European Detergents sector. Surfactants, produced using nickel based catalysts, provide an important platform for innovation in detergent formulations. Different surfactants have differing performance characteristics and have been instrumental in enabling detergent manufacturers to improve the functional performance of their products. Examples include detergents with improved effectiveness against specific stains or in specific uses, detergents with better general soil removal, products that improve the life of the textiles they are washing, concentrated detergents that reduce dosage, and detergents that enable effective performance at lower washing temperatures.

Efficiency – Nickel-based catalyst technology improves the efficiency of the production process in the manufacture of surfactants, the key ingredient in all detergents. Moreover, the detergents industry has improved efficiency in the European economy through the performance of its products. The effectiveness and efficiency of detergents products today have significantly reduced the amount of time spent by people (often women) in performing laundry tasks and household cleaning activities. As a consequence this has enabled more women to contribute to the work force. Modern detergents also improve the longevity of clothes, reducing replacement expenditure. Detergents have also helped to improve commercial and industrial productivity, in terms of improved cleanliness, health benefits and the number of people needed to undertake cleaning activities.

Sustainability – The Detergents industry has invested significantly to reduce the environmental impact of detergents in terms of biodegradability, aquatic toxicity, and overall environmental impact. Life cycle analysis studies have shown, for example, that 75-80% of the total energy used during the manufacture, use and disposal of laundry detergents occurs during the household usage phase, particularly in the heating of water (circa 55%). The industry has therefore responded by significantly improving the effectiveness of laundry detergents in lower temperature washes.

4. CONCLUSIONS

Detergents, and the surfactants upon which they are based, bring significant socio-economic benefits to Europe in terms of the wealth created by the direct industry, its suppliers and its retailers. The commercial cleaning sector, which relies on detergent products, also brings significant benefits in terms of wealth and jobs, particularly in SMEs. But the detergents industry also brings other benefits to Europe. The industry invests significantly in innovation and has contributed to improvements in economic efficiency through improving productivity in commercial and industrial sectors and helping to free people from time-consuming household chores to participate in the labour market. The industry has also invested to reduce the environmental impact of



detergents. Surfactants, produced using nickel-based catalysts, have provided an important platform for these achievements. Nickel compounds play an important role in the production process for nickel catalysts used in the detergents industry.

