

Catalysis and chemical kinetics: Key drivers in chemical technology.

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Abstract

Catalysis and chemical kinetics are two key drivers in chemical technology, driving innovation and advancements in many industries, from pharmaceuticals to petroleum refining. In this article, we will explore the importance of these fields, their applications, and the ways in which they contribute to the development of new technologies and products. Catalysis is the process of increasing the rate of a chemical reaction by introducing a substance called a catalyst. Catalysts work by providing an alternative reaction pathway that has lower activation energy, meaning less energy is required to initiate the reaction. This allows reactions to occur more quickly, or at lower temperatures, making them more efficient and cost-effective. Catalysts are used in a wide range of applications, including the production of chemicals, fuels, and pharmaceuticals, as well as in environmental and energy-related processes.

Keywords: Catalysis, petroleum refining, pharmaceuticals, chemical kinetics.

Introduction

One of the most well-known examples of catalysis is the catalytic converter in automobile exhaust systems. This device uses a catalyst, typically platinum or palladium, to convert harmful pollutants such as carbon monoxide and nitrogen oxides into less harmful substances such as carbon dioxide and water. Without catalytic converters, automobile emissions would be significantly more harmful to the environment and human health. Chemical kinetics, on the other hand, is the study of how chemical reactions occur, and how their rates can be manipulated. Understanding chemical kinetics is essential for optimizing chemical reactions, as it allows scientists and engineers to predict how a reaction will proceed under certain conditions, and how those conditions can be altered to increase efficiency and yields. Chemical kinetics is particularly important in the field of pharmaceuticals, where optimizing reaction rates and yields can make the difference between a cost-effective drug and an unfeasible one. For example, the synthesis of the chemotherapy drug taxol was initially difficult and expensive, requiring over 40 steps and low yields. However, by studying the kinetics of the reaction and optimizing conditions, scientists were able to reduce the number of steps and increase the yield, making the production of taxol more efficient and cost-effective [1].

The combination of catalysis and chemical kinetics has led to many important developments in chemical technology. For example, the synthesis of ammonia, a key ingredient in fertilizer, is a highly exothermic reaction that requires high temperatures and pressures. However, by using a catalyst, such as iron, and optimizing reaction conditions, the reaction

can be carried out at lower temperatures and pressures, reducing energy requirements and costs. Another example is the production of ethylene oxide, a chemical used in the production of plastics, detergents, and other products. The synthesis of ethylene oxide is highly exothermic and can be dangerous if not controlled properly. However, by using a catalyst, such as silver, and optimizing reaction conditions, the reaction can be carried out more safely and efficiently, reducing the risk of accidents and increasing yields [2,3].

Catalysis and chemical kinetics are also essential in the production of renewable energy, such as biofuels and hydrogen. Biofuels are produced from biomass, such as corn and sugarcane, and require a series of chemical reactions to convert the biomass into usable fuel. Catalysts are used in these reactions to increase the efficiency and yield of the process. Similarly, hydrogen fuel cells, which convert hydrogen into electricity, rely on catalysts to speed up the reaction and reduce energy requirements. The development of new catalysts and optimization of chemical kinetics also play a key role in the search for new materials and technologies. For example, the development of new catalysts has led to the synthesis of new polymers and materials with unique properties, such as shape memory polymers and self-healing materials. These materials have potential applications in a wide range of fields, from biomedical implants to aerospace [4,5].

Conclusion

Catalysis and chemical kinetics are two fundamental concepts that are key drivers in chemical technology. They enable the production of new materials, pharmaceuticals, and other

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Received: 25-Feb-2023, Manuscript No. AACTA-23-90648; Editor assigned: 27-Feb-2023, PreQC No. AACTA-23-90648(PQ); Reviewed: 15-March-2023, QC No. AACTA-23-90648; Revised: 18-Mar-2023, Manuscript No. AACTA-23-90648(R); Published: 02-June-2023, DOI: 10.35841/aacta-6.2.138

essential products by providing an alternative reaction pathway and optimizing the reaction conditions. The applications of catalysis and chemical kinetics in chemical technology are vast and have contributed significantly to the development of new technologies that have transformed industries and improved our lives.

References

1. Cornils B. Catalysis. Concepts and Green Applications. Von Gadi Rothenberg. *Angew Chem.* 2008;120(30):5583-4.
2. Bond, Geoffrey C. Catalysis, science and technology. *Appl Catal.*1983;5:134.
3. Zhang X, Pei C, Chang X, et al. FeO₆ octahedral distortion activates lattice oxygen in perovskite ferrite for methane partial oxidation coupled with CO₂ splitting. *J Am Chem Soc.* 2020;142(26):11540-9.
4. Antzara A, Heracleous E, Lemonidou AA. Energy efficient sorption enhanced-chemical looping methane reforming process for high-purity H₂ production: Experimental proof-of-concept. *Appl Energy.* 2016;180:457-71.
5. Galvita VV, Poelman H, Marin GB. Combined chemical looping for energy storage and conversion. *J Power Sour.* 2015;286:362-70.