Science and technology of synergism.

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Abstract

The negative and positive effects of both synergistic and antagonistic effects can be directed to a certain purpose. The synergistic process can be used in some industrial areas as well as in some areas of health. A synergistic process can lead to new reactions or develop existing reactions leading to significant industrial development such as synergistic catalysis as a positive direction. On the other hand, this process brought about an increase in the negative direction. This behaviour was observed in the case of carbon tetrachloride and ethanol which are individually toxic to the liver, but the presence of them resulted in much more liver injury than the sum of their individual effects on the liver. So, we need to define what we want from the synergistic process? This can be achieved by determining our goal i.e., is it the negative or positive effect of both synergism and antagonism?

Keywords: Synergistic effect, Antagonistic effect

Accepted on November 20, 2017

Introduction

There are two possibilities for the effect of materials on each other [1]. One of these possibilities is their negative effect of materials on each other in the sense that the combined effect of two or more things is less than their individual effect. This effect can be called antagonism. The second effect is the positive effect, which is divided into three types, as follows: a) Additive Effect, in which the combined effect of materials is equal to the sum of the effect of each material given alone. b) Potentiation effect in which one substance that does not have any effect by itself but which does have the potential to greatly increase the effect of another substance. c) Synergistic effect in which the combined effect of materials is much greater than the sum of the effect of each material given alone. In other words, synergistic effect or synergism is an effect arising between two or more agents, entities, factors, or substances and produces a multiplicative effect greater than the sum of their individual effects. This effect was observed in the case of presence of carbon tetrachloride with ethanol in situ brought about much more liver injury (overall toxicity of them) than the sum of their individual effects (sum their toxicity) on the liver. On other hand, Synergism comes from the Greek word "synergos" meaning working together [1,2]. However, synergism technology is area of intense scientific research, due to a wide variety of potential applications in different fields such as health, pharmacology, drugs and catalysis…..etc. In fact, synergism is of great scientific interest as it is effectively a bridge between two or more processes.

The mechanisms of synergism can change from situation to situation depending upon nature of the investigated field. With synergism, the substance function could either be inhibited or accelerated in some directions depending on various factors. These factors can alter from field to another. In the field of catalysis, these factors involve the history of materials and their concentrations …etc. In this overview paper some key aspects of synergism involved in different fields.

Types of Synergism

The synergistic effects can be classified into physical and chemical synergisms. There are various examples including the physical and chemical synergisms. Occupational health and safety experts reported that the physical synergism was observed in enhancement of chemical substances associated with hearing loss due to noise exposure. In addition, the exposure to asbestos and radon daughters is much more hazardous to cigarette smokers than non-smokers due to chemical synergism.

Synergism Applications

Synergies exist in many industrial, environmental, agricultural, medical, biological, geological, electrical, magnetic and catalytic fields. Silva et al. display synergistic effect between carbon nanomaterial and metal oxide semiconductors for photo catalytic applications [3]. These authors claimed that the synergic effect induced by the presence of carbon materials in the hybrid photo catalysts is mainly attributed to the decrease of electron/hole recombination, band gap tuning and increase in the adsorptive active sites. Zhiani and Kamali reported to the synergistic effect of ceria on the structure and hydrogen evolution activity of nickel nanoparticles grown on reduced graphene oxide [4]. It was found that the Ni/ceria– reduced graphene oxide containing 50 wt. % ceria has a superior activity in the hydrogen evolution reaction. The presence of certain ceria content in the investigated solids inhibits the nickel grain growth, leading to a reduction in the Ni nanoparticle size, which can improve the catalytic activity. It also enhances the rate of hydrogen evolution reaction by facilitating H adsorption. Allen and MacMillan speculated that the synergistic interaction of two catalytic cycles brings about several benefits, specifically (i) introducing new, novel reactivity not attainable with a single

catalyst; (ii) improving existing reactions, often by suppressing side reactions; (iii) creating or improving stereo control through highly organized transition states [5]. Freitas et al. investigated the antibacterial activity and synergistic effect between watercress extracts, 2-phenylethyl isothiocyanate and antibiotics against 11 isolates of Escherichia coli from clinical and animal source [6]. Deraz studied the physicochemical, surface, and catalytic properties of pure and ceria-doped manganese/alumina catalysts [7]. The results showed that the doping with ceria brought about production of electron-mobility environment at the surface, which was necessary to enhance the redox pathway of the reaction. However, the author suggested an increase in the process of oxygen transfer between manganese and cerium oxides due to intimate contact of MnOx with CeO2 crystallites, favouring the formation of the Mn3O4 phase as a result of a synergistic effect [7]. Jinno et al. discussed synergistic effect of electrical and chemical factors on endocytosis in micro-discharge plasma gene transfection [8]. There are many great articles in the literatures illustrated various applications of synergistic effect in all fields.

Conclusion

Synergism is a technique of introducing combined effect into the overall action for characterization of the effect of two or more substance on each other. It is a fundamental effect or deriving force used in different fields such as medicine, biology, industry, agriculture, environment and catalysis. Synergistic catalysis is a powerful synthetic strategy for new reaction development. We conclude from this work that good investigations of the synergistic effect in all fields should be determined to avoid risks, as in the field of occupational health and safety, and to obtain the highest efficiency of materials as in the fields of industrial, environmental, agriculture and catalysis.

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