Short Essay

Innovations in green chemistry towards sustainable development

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Abstract: In our current globalized world, green chemistry is becoming the strength leading towards sustainable development. It is evident that that many academic institutions and industries recognize the importance of innovations in green chemistry. It is imperative to teach the value of green chemistry to future generations. Chemistry and its application plays vital role in many industries such as medicine. Green chemistry is tool for innovation which includes business, education and economy to build a sustainable future. Hence, we should now concentrate on innovation in green chemistry to reduce the environmental damage and eliminate the use and generation of hazardous substances. There are various innovations in green chemistry such as renewable feed stocks, use of catalysts in experiments, proper disposal of waste, design of safer chemicals and auxiliaries, design for degradation and reactions with more efficient syntheses and high efficiency formulation. This conceptual paper addressing innovations in green chemistry and steps need to be taken by various industries to incorporate green chemistry for a sustainable development.

Keywords: Green chemistry, Innovations, Design of safer chemicals, High efficiency formulations, sustainable development

Introduction

Green chemistry is described as the movement towards more environmentally acceptable chemical product and processes (WCED, 1987). It comprises of research, education and commercial application of chemicals (DOE, 2004). Green chemistry can be applied through environment friendly old or new technologies (Bjorn Lamborg, 2001). Although nowadays green chemistry is accepted as a vital development in a way we practice chemistry and sustainable development but it is only applied in a small fraction of actual chemistry. It is also very important to understand that Green chemistry technologies is not only should be practice in development countries. In 1980s there was a research conducted by developed countries such as Japan, UK and France and later in 1990s when United States Environmental Protection Agency (US EPA) proposed the term “Green Chemistry”, there were various research in industrial field application among many countries including China and India (El-Agraa, 2004).This rapid field of science governed by twelve specific chemical principles which move processes and products towards an economy based on renewable feedstocks which prevent deliberation of toxicity at the molecular level. The chemical processes and products are designated to eliminate waste, minimize energy use, be less hazardous and degrade safely upon disposal.

In a short term, green chemistry has been focused heavily focused on developing new and environment friendly chemical processes using many technologies. Globalization era will demand increasing emphasis on product but it is important that the manufacturing should be through green chemistry methods. Green chemists and engineers employ biological systems and life cycle to create chemicals that lead to foundation of our economy. There are numerous application of Green Chemistry in industry such as plastics, renewable energy technologies, pesticides, textile manufacturing, water purification, pharmaceuticals and basic chemical feedstocks. It is believed that, overtime Green Chemistry will change a chemistry as a whole towards an economy based on sustainable renewable energy,

green jobs, bio-based productions. Hence, in this article, the researchers will start to explore the innovations behind the movement towards green and sustainable chemistry.

Replacing Chelates with GLDA

Chelates are widely used in many of industrial processes and cleaners. Reaction of Chelates complex with metal ion will increase the solubility of metal ions. Chelates are based on composition of sodium tri polyphosphates and ethylenediaminetetraacetic acid, EDTA).Since phosphates can cause pollution through eutrophication and EDTA is non-biodegradable, Chelates is often considered as an environmentally unfriendly Akzo Noble has developed a biodegradable chelating agent that is produced from a renewable feed stock. The newly manufactured chelating agent is called as tetra sodium L-glutamic acid, N, N-diacetic acid (GLDA) which will substitute the phosphates. GLDA is manufactured through waste free synthesis from the flavor enhancer monosodium glutamate (MSG) which was fermented through renewable materials such as corn sugars. In addition, GLDA also a bio-based agent compare to EDTA which fuel-based. Apart from that, GLDA also highly soluble with 30% highest concentration compare to EDTA will reduce the cost for the packaging and transportations of manufacturers. Significantly, GLDA is biodegradable substance will reduce the pollution towards sustainable development.

Replacing Spinosad with Natular

Spinosad is environment friendly pesticide used on crops. Spinosad absorb strongly into organic matter and soils which will lead to instability in water and degrades photo chemically at the site of applications. Although spinosad is excellent pesticide for use on land and environmentally safe pesticide but prevented its use in aqueous environments because can instability in water can cause uncontrollable mosquito larvae populations. In order to overcome this problem, Clarke invented Natular in December 2008, a spinasad based mosquito larvacide that provides stability in water. The Natular is 15 times less toxic than organophosphate, biodegradable and not toxic to wild life.

Use of Sawdust ash as fine aggregate replacement in concrete

A research conducted by Mageswari and Vidivelli (2009) discussed the possibility of using sawdust ash as a substitution in fine aggregate for a new concrete. Sawdust Ash (SDA) generated from rice mills usually delivered in landfills to disposal. The researchers was partially replaced 5%, 10%, 15%, 20%, 25% and 30% of SDA into the concrete and measure the compressive strength, tensile strength and flexural strength up to 180 days. The measurement was compared with concrete made with natural fine aggregates as a control group. Apart from that, the researchers also studied the specific gravity, moisture content, fitness modules, percentage void and porosity for both natural concrete and concrete containing sawdust ash. The result indicated that manufacture concrete containing sawdust ash has the same characteristics to those natural concrete with percentage of sawdust ash as fine aggregate is limited 10-20% respectively.

Carbon Dioxide Blowing Agent for Polystyrene Form Production

Polystyrene form is a material used in food transportation and packaging. The production process of polystyrene form involves chlorofluorocarbon (CFC) and other ozone depleting chemicals which is hazardous for the environment. In 1996, Dow chemical won the Greener Reaction 1996 award due to invention of use carbon dioxide blowing agent for polystyrene foam production. The Dow chemical invented the supercritical carbon dioxide woks same as blowing agent without the need for ozone depleting chemicals and allows the polystyrene to be easily recyclable. Apart from that, the carbon dioxide produced from this process will be recycle for other industries so that the net carbon released is zero.

Biodiesel made with Sugar Catalyst

Biodiesel production that uses sulphuric acid (H_2SO_4) involves energy, costly and chemically wasteful (Toda et al., 2005). It is known that recyclable chemicals such as Nafion make a better catalyst, expensive and their activity is lesser than liquid acids (Okuhara, 2002). A strategy of overcoming the problem of sulphonating incompletely carbonized natural organic materials to prepare more robust solid catalyst was devised. Sulphonation of natural products such as cellulose, starch and sugars would expected to generate a stable solid with high density of active sites with high performance and cheaper. Saccharides molecule are known to be suitable to be used as a replacement for liquid sulphuric acid in esterification reactions. In addition to biodiesel productions, this environmental friendly and natural products becoming alternative catalyst and should find application in a wide range of other acid-catalyzed reaction that lead towards sustainable development.

Green Chemistry: The challenges and Opportunities for Sustainable Development

As sustainable development has been accepted by the government, industries and the public, green chemistry plays a vital role in maintaining and improving the quality of life, the competitiveness of the chemical industry and the natural environment. The challenges faced by the chemist and others are basically concerned on societal, economic and environmental benefits. This requires a new approach that minimizes or eliminates harmful chemicals from environment, maximize the use of renewable resources, extend the durability and recyclability of products- which in a way increases industrial competitiveness (Clark, 1998).

Other than this, lack of awareness and training in school, universities and industries and the management perception that green chemistry is a cost without benefits becoming the major obstacles of green chemistry.
Although there are few challenges, but the rapid growing interest in green chemistry especially in industries and academic institution are being partly witnessed by the growth in relevant conferences that are regularly held in USA, Europe and Asia (Clark, 1998). This are good examples that shows the awareness about green chemistry begins to improve. In addition, marketing sustainability as a key strategy to enhance the awareness in green chemistry. The transition to green chemistry can be done by helping to create the demand for green chemistry among workers, managers, manufacturers, retailers, users, investors, consumers, students and public. This is because in some situation, this community may willingly to pay a premium price for green products and manufactures that do not uses green chemistry will be seen as unethical or environmental damaging factor (Meyer, 2001).

Conclusion

The goal of green chemistry is to create a better, safer and efficient environment by reducing waste and eliminate the hazardous materials in chemicals. Our future challenges in society, environmental, economic and resources demand for efficient and environmental-friendly chemical processes and products. Therefore, through our paper, we have addressed a few innovations, challenges, opportunities and step need to be taken for a sustainable development through green chemistry.

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