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Design Future Perspective of Green Chemistry

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ABSTRACT

Green chemistry is an eco friendly and rapid emerging field of chemistry which offers green alternative to conventional chemistry practices. It indicates the creation of chemical products and procedures that reduces the use and production of harmful materials. The goals of green chemistry for protecting the environment can be achieved by various method some of them are biocatalysts, biomass, microwave activation as well as to new photo catalytic reaction. The green chemistry movement is part of a larger movement that leads to sustainable development, sustainable economics and sustainable living practices. Sustainable chemistry is a scientific concept that seeks to improve the efficiency with which natural resources are used to meet human needs for chemical products and services. Process chemistry and engineers can apply green chemistry principles to redesign traditional process and they are also in the privileged position to design, develop and implement manufacturing processes for new pharmaceutical products and pipeline molecules. The ultimately aim of green chemistry is to entirely cut down the stream of chemical pouring into the environment and raise awareness on the fundamental aspects, necessities and benefits of green chemistry. We are focusing in this review a huge future scope and discuss advantage & disadvantage of green chemistry.

Key words: Sustainable, Conventional, Photocatalytic, Pharmaceutical, Chemistry

INTRODUCTION

The term "GREEN CHEMISTRY" was coined by Professor Paul Anastas, who is known as the father of green chemistry, at US Environmental Protection Agency Green Chemistry is the effort of reducing or eliminating the use of or generation of hazardous substances in the Design, manufacture and application of chemical products.Green Chemistry is defined as environmentally benign chemical synthesis (1). It is science Based, non regulatory and economically driven approach to achieving the goals of Environmental protection. The ultimate value of green chemistry lies in its applicability for the new millennium. So the challenge to reduce the waste, the toxicity of chemical and the Amount of energy used, while still providing the goods that society needs, is overcome Through green chemistry.

The Green Chemistry revolution provides an enormous number of opportunity to discover and apply new synthetic approaches using alternative feedstock; Eco friendly reaction conditions, energy minimization and thedesign of less toxic and inherently safer chemicals. The origin and basis of Green Chemistry for achieving environmental and economic prosperity is inherent in a sustainable world (2). One important element of sustainable chemistry is commonly defined as the chemical research aiming at the optimization of chemical processes and products with respect to energy and material consumption, inherent safety, toxicity, environmental degradability, and so on. Green Chemistry is the utilization of set of principles that reduces or eliminates the use of generation of hazardous substances in design, manufacture and application of chemical products. Consequently, there have been efforts to achieve environmentally benign synthesis and various acts have been passed to control and treat pollution, in an endeavour to encourage industries and academics to devise novel technologies, processes and educational materials, discouraging the formation or use of hazardous substances. Green Chemistry is not different from traditional chemistry in as much as it embraces the same creativity and innovation than has always been central to classical chemistry (3). Since the types of chemicals and the types of transformations are much varied, so are the Green Chemistry solutions that have been proposed. Developed 'The twelve Principles of Green Chemistry' that serve as guidelines for practicing chemists in developing and assessing how green a synthesis, compound, process or technology .

Sustainability and Cleaner Production:

To combine the technological progress with environmental safety is one of the key challenges of the millennium. Cleaner technology is new dimension that is emerging rapidly at both national and international level. Cleaner production has been in identified as a key method for reconciling environment and economic development (4). The basic idea of cleaner production is to increase production efficiency while at the same time eliminate at least

minimize wastes and emissions at their source rather than treat them at the end of pipe after they have been generated. The concept of cleaner production, pollution prevention or waste reduction is still relatively young, although the concepts involved are much older. Both cleaner production and sustainability came into focus with the publication of 'our common future'. This report provided a focused definition for the concept of sustainable development: "A process of change in which the exploitation of resources, the direction of investment, the orientation of the technological development and instituted change are all in harmony and enhance both current and future potential to meet human need and aspiration"(5). According to the World Commission on Environment and Development, Brundtland Commission on Environment and Development, Brundtland commission 1987, Sustainable development is "Development that meets the needs of the present without compromising the ability of future Generations to meet their own needs."(6) Sustainable development demands change, requires doing more with lesser resource input and less waste generation. Instead of end-of-pipe technology, it requires pollution prevention philosophy, which is: "First and foremost, reduce waste at the origin-through improved housekeeping and maintenance, and modification in product design, processing and raw material selection. Finally, if there is no prevention option possible, treat and safely dispose of the waste.

Green Chemistry in Education

Convincing chemists to think in an environmentally friendly manner begins with education. The idea of including Green Chemistry in chemistry education was first put forward in 1994 (7). Few Green chemistry textbooks have also been published. Graduates, post graduates, teachers and researchers will find these books of immense use. Both Environmental Protection Agency (EPA) and American Chemical Agency (ACS) have recognized the importance of bringing Green Chemistry to the class room and the laboratory(8). Together they have launched a significant campaign to develop Green Chemistry educational materials and to encourage the 'greening' of the chemistry curriculum. Student involvement in Green Chemistry principles and practices is essential to the integration the environmentally benign technologies in academia and industry. ACS Student Affiliate Chapters may be recognized as "green" chapters by engaging in at least three Green Chemistry activities during the academic year. Suggestions for these activities include: Hosting a Green Chemistry speaker ·

1. Organizing an interdisciplinary Green Chemistry workshop on campus ·
2. Working with a local company on a Green Chemistry project ·
3. Developing a Green Chemistry activity with a local school ·
4. Converting a current laboratory experiment into a greener one ·
5. Organizing a Green Chemistry poster sessions on campus ·
6. Distributing a Green Chemistry Newsletter to the local community ·
7. Designing a green Chemistry web page.

Green Chemistry Applications:

Green Chemistry has several uses in our daily lives. The following are some of the applications of green chemistry (9): It Is utilized in the coating process, consumer items, medications, preservatives, and so forth.

Dry cleaning- In the beginning, we utilized tetrachloroethylene as a solvent for dry cleaning. This substance is carcinogenic and pollutes groundwater. Dry cleaning is now done using liquid carbon dioxide and an appropriate detergent. As a by product, it produces liquid carbon dioxide, which is less toxic and hence creates less pollution.

Paper bleaching—originally, chlorine gas was used for this purpose, but it has since been replaced with hydrogen peroxide. Hydrogen peroxide is combined with a suitable catalyst to enhance its bleaching activity. It's also found in electronics and a variety of other electrical equipment. Green chemistry promotes a healthy environment for human civilization, and as responsible citizens, we shouldall eventually follow. A pollution-free world will enhance living circumstances and extend the lives of the planet's inhabitants.

Scope

The key to achieving the goal of reducing the generation of environmentally unfriendly waste and the use of toxic solvents and reagents is the widespread substitution of "solochiometric" Technologies by greener catalytic alternatives (10). The first two involve 100% atom efficiency while the latter is slightly less than perfect owing to the co-production of molecular water. The longer trend is towards the use of the simplest raw materials – H_2, O_2, H_2O, H_2O_2, NH_3, CO and CO_2 in catalytic low salt processes (11). For many years catalysis 33 sprouted life and led to evolution. Today catalysis is one of the powerful tools of the chemical industry. Similarly, the widespread substitution of classical mineral and lewis acids by recyclable solid acids, Such as zeolites and acidic clays, and the introduction of recyclable solid bases, such as Hydrolatcites (anionic clays) will result in a dramatic reduction of inorganic waste. Because Of the deleterious effects that many organic solvents have on the environment and/or health, media such as halogenated hydrocarbons (e.g. chloroform, dicholoromethane) are being phased out of use and benign replacements are being developed. A possible alternative for the use of organic solvents is the

extensive utilization of water as a solvent. Traditionally, water is not a popular reaction medium for organic reactions due to the limited solubility of many substrates and also to the fact that a variety of functional groups is reactive towards water(12). But recently, there has been a revival of interest in water as a solvent and chemistry in aqueous medium, as it offers many advantages for a clean green chemistry. The addition of surfactants can strongly modify the attitude of water to solubilize organic molecules.

If chemists are to fully embrace all facets of sustainable chemical processes, an exemplary shift in the way chemistry and engineering are taught and practised is required. Many challenges still lie ahead and the solutions will be found not only in the discipline of chemistry but also at its interfaces with engineering, physics and biology. More attention needs to be given to the whole manufacturing process and life cycle of both products and wastes(13). Only by combining the best ideas from the areas of science and technology the desired aim can be accomplished. Concepts such as renewable feedstock, atom economy, energy efficient reactions and eco-friendly solvents should be more prominent in basic chemistry education and there shouldbe less emphasis on the very concept of immediate product yield and end-of-pipe cleaning mind set. Obviously, there are plentiful future challenges to research in achieving green chemistry principles. In a nut shell, some of the challenges are:

1. Use of water as an efficient source of energy.
2. Improvement of environmentally benign solvent systems.
3. Development of a synthetic methodology “toolbox” that is both atom economical and gentle to human health and our environment.
4. Introduction of plastics and polymers properly designed for safe degradation through the use of additives-free design.
5. Materials designed for recyclable/reusable/recoverable decisions based on implanted life cycle.
6. Expansion of “preventative toxicology” where escalating knowledge of biology and environmental sciencesact together continuously for designing new chemical produce.
7. Enlargement of non-combustion, non-material intensive energy resources.
8. Consumptive utilization of CO_2 and other greenhouse gases with value-addition at high volume.
9. Refinement of organic methodologies targeting diminished use of functional group protection/deprotection.
10. Development of materials and especially, their surfaces, that are long-lasting, robust and do not require coatings/paints and cleaners.

Future Trends in Green Chemistry

Future Trends in Green Chemistry includes oxidation reagent and catalysis comprised of toxic substances such as heavy metals showing substantial negative effect on human health and environment which can be changed by the use of benign substances, Non covalent derivatization , Supramolecular chemistry research is currently on going to develop reactions which can proceed in the solid state without the use of solvents, Biometric multifunctional reagents, Combinatorial green chemistry is the chemistry of being able to make large numbers of chemical compounds rapidly on a small scale using reaction matrices, Proliferation of solvent less reactions helps in development of product isolation, separation and purification that will be solvent-less as well in order to maximize the benefits(14).

a. Green Nanochemistry
b. Supramolecular Chemistry
c. Oxidation Reagents and Catalysts
d. Biometric Multifunctional Reagents
e. Combinatorial Green Chemistry
f. Non Covalent Derivatization Techniques

Green chemistry’s Advantages and Disadvantages (15)Advantages:

a. Toxic substances in the environment cause less harm to plants and animals.
b. Reduced risk of global warming,
c. Reduced Smog production and ozone depletion
d. Ecosystems are less chemically disrupted.
e. Less reliance on landfills, particularly hazardous waste dumps.

Disadvantages

While environmentally friendly living is a desirable goal, there are several potential drawbacks to Green processes and technology, including:

a. High implementation
b. Costs a lack of information
c. No known alternative chemical or raw material inputs
d. No known alternative process technology, and uncertainty about performance.

CONCLUSION

In coming days, expansion of green chemistry needs to increase at an accelerated pace if molecular science isto meet challenges of sustainability. We need the relevant scientific, engineering educational and other communities to work together for sustainable future through green chemistry. In fact, the practice of a new kind of human ethics and the practice of green chemistry are virtually inseparable. It is commonly said that the revolution of one day becomes the new convention of the next. If the twelve principles of green chemistry are successfully incorporated as an integral part of everyday chemistry, there will no longer be a need for focusing, highlighting and renaming of green chemistry (16). And when that day comes, the challenges that chemistry will meet cannot be imagined. Furthermore, the success of green chemistry depends on the training and education of a new generation of chemists. Student at all levels have to be introduced to the philosophy and practice of green chemistry. Regarding the role of education in green chemistry, it is evident that the biggest challenge of green chemistry isto implement its rules in practice. In this context we can recall the famous saying of Albert Einstein "The significant problems we face today cannot be solved at the same level of thinking we were at when we created them".

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