International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 02 Issue 11
November 2015

Green Chemistry-Trends & Principles

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ABSTRACT- Green chemistry has always been a lively research field. In the time period, the emphasis of catalysis research has significantly shifted and spread from traditional applications in green chemistry. Abstract The beginning of green chemistry is frequently considered as a response to the need to reduce the damage of the environment by man-made materials and the processes used to produce them. A quick view of green chemistry issues in the past decade demonstrates many methodologies that protect human health and the environment in an economically beneficial manner. This study presents selected examples of the implementation of green chemistry principles in everyday life in industry, the laboratory and in education. A brief history of green chemistry and future trends are also mentioned in this paper.

KEYWORDS: Green Chemistry, Environment, Human Health, Sustainable Chemsitry.

INTRODUCTION:

History- The term green chemistry was first used in 1991 by P. T. Anastas in a special program launched by the US Environmental Protection Agency (EPA) to implement sustainable development in chemistry and chemical technology by industry, academia and government. In 1995 the annual US Presidential Green Chemistry Challenge was announced. Similar awards were soon established in European countries. In 1996 the Working Party on Green Chemistry was created, acting within the framework of International Union of Applied and Pure Chemistry. One year later, the Green Chemistry Institute (GCI) was formed with chapters in 20 countries to facilitate contact between governmental agencies and industrial corporations with universities and research institutes to design and implement new technologies. The first conference highlighting green chemistry was held in Washington in 1997. Since that time other similar scientific conferences have soon held on a regular basis. The first books and

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journals on the subject of green chemistry were introduced in the 1990s, including the Journal of Clean Processes and Products (Springer-Verlag) . Green Chemistryis a New trend or buzz word to design safer chemicals and processes. It minimizes the negative impact of chemicals on the environment and helps in achieving sustainability in the chemical production. The desire of chemists to make products that are effective and economical expanded the scope of Green Chemistry.

The Idea of Green Chemistry The concept of green chemistry has appeared in the United States as a common research program resulting from interdisciplinary cooperation of university teams, independent research groups, industry, scientific societies and governmental agencies, which each have their own programs devoted to decreasing pollution. Green chemistry incorporates a new approach to the synthesis, processing and application of chemical substances in such a manner as to reduce threats to health and the environment. This new approach is also known as:

• Environmentally benign chemistry

• Clean chemistry

• Atom economy

• Benign-by-design chemistry

Green chemistry is commonly presented as a set of twelve principles proposed by Anastas and Warner. The principles comprise instructions for professional chemists to implement new chemical compounds, new syntheses and new technological processes. The first principle describes the basic idea of green chemistry — protecting the environment from pollution. The remaining principles are focused on such issues as atom economy, toxicity, solvent and other media using consumption of energy, application of raw materials from renewable sources and degradation of chemical products to simple, nontoxic substances that are friendly for the environment.

Green Chemistry-Green' in chemistry is used to promote use of reagents/chemicals/processes that are eco-friendly, reusable, recyclable, minimum waste production and avoid using toxic /hazardous material as reagents. 'Catalyst' is defined simply as a substance that increases the rate of a chemical reaction without itself undergoing any permanent chemical change. The green chemistry revolution is providing an enormous number of challenges to those who practice chemistry in industry, education and research. With these challenges however, there are an equal number of opportunities to discover and apply new chemistry, to improve the economics of chemical manufacturing and to enhance the much-tarnished image of chemistry.

TRENDS IN GREEN CHEMISTRY:

Environmental Chemistry is the discipline which includes the environmental impact of pollutants, the reduction of contamination and management of the environment. It is thus the study of the behaviour of pollutants with respect to their environmental fate and effects on the environment. Environmental Chemistry may be broken down into two main focus areas viz. the measurement of pollutant levels and the study of pollutant behaviour.

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. Sustainable chemistry encompasses the design, manufacture and use of efficient, effective, safe and more environmentally benign chemical products and processes. It can ensure eco-efficiency in everything we do, both individually and as a society. Sustainable chemistry also means protecting and extending employment, expertise and quality of life.

Agricultural Chemistry is the study of chemistry and biochemistry in their relation to agriculture, especially agricultural production, the utilization of agricultural products, and environmental matters.

Astrochemistry is the study of the chemical elements found in outer space, generally on larger scales than the Solar System, particularly in molecular gas clouds, and the study of their formation, interaction and destruction. As such, it represents an overlap of the disciplines of astronomy and chemistry. It involves the use of telescopes to measure various aspects of bodies in space, such as their temperature and composition.

Microwave Chemistry involves the use of microwave irradiation in carrying out chemical reactions. The approach can be used to efficiently heat a chemical reaction, which can accelerate reaction rates and improve chemical yields. The technique can also be used to selectively heat substances.

Analytical Chemistry is the science of obtaining, processing, and communicating information about the composition and

e-ISSN: 2348-6848
p-ISSN: 2348-795X
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structure of matter. Analytical chemists use their knowledge of chemistry, instrumentation, computers, and statistics to solve problems in almost all areas of chemistry and for all kinds of industries.

Phytoremediation is the direct use of green plants and their associated microorganisms to stabilize or reduce contamination in soils, sludges, sediments, surface water, or ground water. Sites with low concentrations of contaminants over large cleanup areas and at shallow depths present especially favorable conditions for phytoremediation. It is an alternative technology that can be used along with or in place of mechanical conventional clean-up technologies that often require high capital inputs and are energy intensive.

Bioremediation involves degradation of organic contaminants (such as chemicals, heavy metals, oil) in the soil or water, by the action of cultured microorganisms selected for their ability to metabolize the specific contaminants. In a process called bioaugmentation, these microorganisms are introduced into the contaminated environment usually as a liquid, with a proper nutrient mix to stimulate and foster their growth.

Green Computing is the study and practice of designing, manufacturing, using, and disposing of computers, servers, and associated subsystems such as monitors, printers, storage devices, and networking and communications systems efficiently and effectively with minimal or no impact on the environment.

Renewable Energy is any energy resource that is naturally regenerated over a short time scale and derived directly or indirectly from the sun or from other natural movements and mechanisms of the environment. Renewable energy does not include energy resources derived from fossil fuels, waste products from fossil sources, or waste products from inorganic sources.

Biosynthesis is the process in your body that turns simple structures into more complex structures. It can happen within a single cell (or within a single organelle within a cell), or across multiple cells. Sometimes all that is required for biosynthesis is for two substances to physically join together to make a new physical substance, which is called a macromolecule.

Biocatalysis is the use of natural catalysts, such as protein enzymes, to perform chemical transformations on organic compounds. Both enzymes that have been more or less isolated and enzymes still residing inside living cells are employed for this task.

Phytoextraction is a sub process of phytoremediation in which plants remove dangerous elements or compounds from soil or water, most usually heavy metals, metals that have a high density and may be toxic to organisms even at relatively low concentrations.

Degradable Products are the waste products, packaging materials, etc capable of being decomposed chemically or biologically. If the materials are decomposed by microorganisms called as biodegradable materials. Always bio degradable products are preferable because they can't pollute the environment.

Green chemistry also named as sustainable chemistry is defined as the practice of chemical science and manufacturing in a manner that is sustainable, safe, and non-polluting and that consumes minimum amounts of materials and energy while producing little or no waste material (Sheldon et al. 2007). Anastas and Warner also defined Green Chemistry as "The invention, design and application of chemical products and processes to reduce or to eliminate the use and generation of hazardous substances" (Anastas and Warner 1998). The design of environmentally benign chemicals and processes are guided by the 12 Principles of Green Chemistry developed by Anastas and Warner.

These 12 principles of green chemistry can be described in detail as follows:

1. Prevention- It is better to prevent waste than to treat or clean up waste after it has been created.

2. Atom Economy -Synthetic methods should be designed to maximize the incorporation of all materials used in the process into the final product.

3. Less Hazardous Chemical Synthesis- Wherever practicable, synthetic methods should be designed to use and generate substances that possess little or no toxicity to human health and the environment.

4. Designing Safer Chemicals- Chemical products should be designed to affect their desired function while minimizing their toxicity.

5. Safer Solvents and Auxiliaries The use of auxiliary substances (solvents, separation

agents, etc.) should be made unnecessary wherever possible and innocuous when used.

6. Design for Energy Efficiency- Energy requirements of chemical processes should be recognized for their environmental and economic impacts and should be minimized. If possible, synthetic methods should be conducted at ambient temperature and pressure.

7. Use of Renewable Feed stocks- A raw material or feedstock should be renewable rather than depleting whenever technically and economically practicable.

8.Reduce Derivatives-Unnecessary derivatization (use of blocking groups, protection/deprotection, temporary modification of physical/chemical processes) should be minimized or avoided if possible, because such steps require additional reagents and can generate waste.

9. Catalysis- Catalytic reagents (as selective as possible) are superior to stoichiometric reagents. 10. Design for Degradation- Chemical products should be designed so that at the end of their function they break down into innocuous degradation products and do not persist in the environment.

11. Real-Time analysis for Pollution Prevention- Analytical methodologies need to be further developed to allow for real-time, in-process monitoring and control prior to the formation of hazardous substances.

12. Inherently Safer Chemistry for Accident Prevention Substances and the form of a substance used in a chemical process should be chosen to minimize the potential for chemical accidents, including releases, explosions, and fires.

EXAMPLES:

Green solvents' Synthetic techniques, Carbon dioxide as blowing agent, Hydrazine, Lactide

Carpet tile backings Transesterification of fat ,Bio-succinic acid Laboratory chemicals

CONCLUSION:

Green chemistry is not a new branch of science. It is a new philosophical approach that through application and extension of the principles of green chemistry can contribute to sustainable development. Presently it is easy to find in the literature many interesting examples of the use of green chemistry rules. They are applied not only in synthesis, processing and using of chemical compounds. Many new analytical methodologies are also described which are realized according to green chemistry rules. They are useful in conducting chemical processes and in evaluation of their effects on the environment. The application of proper sample preparation techniques, (e.g. SPME, SPE, ASE) allows us to obtain precise and accurate results of analysis. Great efforts are still undertaken to design an ideal process that starts from non-polluting initial materials, leads to no secondary products and requires no solvents to carry out the chemical conversion or to isolate and purify the product. However, more environmentally friendly technologies at the research stage do not guarantee that they will be implemented on an industrial scale. Adoption of environmentally benign methods may be facilitated by higher flexibility in regulations, new programs to facilitate technology transfer among academic institutions, government and industry and tax incentives for implementing cleaner technologies. 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. Finally, regarding the role of education in green chemistry:

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