



GREEN CHEMISTRY: A REVIEW

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Article Received on 20/03/2017

Article Revised on 10/04/2017

Article Accepted on 01/05/2017

ABSTRACT

In day to day life, due to emerging industrialization in various fields, the use of chemicals and requirement of energy is increasing and due to this the various toxic chemicals, gases (CFC, CO, CO₂ etc.) and harmful wastes leads to environmental disruption (Depletion of Ozone Layer, Acid Rain). To avoid this, there is need to use eco-friendly advanced techniques and green chemicals.

KEYWORDS: In day to day advanced techniques and green chemicals.

INTRODUCTION

The concept of Green chemistry was proposed by Paul Anastas (America) in year 1994. The Knowledge and practices in chemistry in last few decades have given large number of chemical products to mankind e.g. medicines, dyes, fabrics, rubbers, fertilizers, insecticides etc. Such products are manufactured on large scale for the service to man.

Over 5,000 crore tons of chemical waste is produced from the chemical industries per year in the world, hampering the life and environment. An account of \$ 30,000 crores is spent on treatment, control and disposal of the waste. These facts have emphasized the need for designing the chemical processes in a new way to protect life and environment of our globe.

The chemical reaction involved in the production, are associated with certain by products, which are harmful for the environment. Hence, to minimize the problems of environmental pollution and hazardous waste, it is necessary to review and modify the chemical processes for the manufacture of chemical products.

The design of harmless processes has emerged as the new branch of chemistry, called as "Green Chemistry" or "Clean Chemistry".

Green Chemistry is defined as "use of chemistry for designing of chemical products and processes that are more environments friendly and helps in reduction or elimination of generated hazardous by-products". Now a Days Green Chemistry is become popular due to better chemical processes and different chemical technologies which help in prevention of pollution and improvement of quality of life. Use of Green Chemistry is highly effective approach for prevention of pollution, as it

provides scientific solutions to the problems associated with chemical processes.^[1]

NEED OF GREEN CHEMISTRY

Before the concept of Green Chemistry came in existence, the chemical production processes were carried out without caring the environment, human beings. There was no thinking about is there something wrong during production? The waste by-products produced during chemical processes have bad effects on environment and ecosystem, the production of chemicals were not necessarily less energy consuming, there were hazardous and toxic waste releases.

Green chemistry has proposed the philosophy for safety and well-being of man and environment. Green chemistry principles are most important for chemical productions which are hazardous, which produce products of higher costs.

Various organizations and countries in the world have deliberate on norms for chemical production and promulgated laws, monitor and execute them and keep the environment proper for the future generations.^[2,3]

GOALS OF GREEN CHEMISTRY

- 1) To reduce adverse environmental impacts.
- 2) To develop processes based on renewable feed.
- 3) To minimize by products (by higher % atom economy).
- 4) To develop reactions involving less toxic materials.
- 5) To develop hazards free processes.
- 6) To use environment friendly solvents and extractants rather than organic solvents.
- 7) To improve energy efficiency by developing low temperature, low pressure processes using improved catalysts.

8) To develop reliable methods to monitor and control processes.^[2,4]

SIGNIFICANCE OF GREEN CHEMISTRY

Chemical Industries releases over 5,000 crore tons of chemical waste every year and expenditure over \$ 30,000 for treatment, control and disposal of the chemical waste. These facts give challenge to chemist or chemical engineers to review and modify chemical reaction pathways and chemical technology for improvement or changes in design, manufacture, and use of chemical products.

Laws/rules have been made by many countries and implementation of these laws is strict to reduce impact of chemical waste on environment but still this cannot be adequate. Industries have to install a variety of waste handling, treatment and disposal systems which will increase the price of consumer goods.

- Hence, **Green Chemistry** provides the green pathways for chemical reactions and chemical products manufacture.

- Some countries have started to levy taxes on industries towards the environmental impact caused by their operations. Therefore, industries have undertaken steps to lower the hazardous waste formation by following the principles of **Green Chemistry**.

- Green chemistry provides the knowledge and technology to develop new techniques and methods of chemical manufacture to minimize the environmental impact and the funds to pay for environmental tax, are being diverted to research and development efforts^[5,6,7].

Green chemistry is about,

- Reducing Waste
- Reducing Materials
- Reducing Hazards
- Reducing Risk
- Reducing Energy
- Reducing Environmental impact
- Reducing Cost

PRINCIPLES OF GREEN CHEMISTRY

There are twelve principles of Green Chemistry on which green chemistry is depended and by following these principles the environmental pollution load can be minimized. The principles are as

1. Pollution 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 products.

3. Less Hazardous Chemical Synthesis: Whenever practicable, useful methods should be design to use and

generate substances that possess little or nontoxic material for human or environment.

4. Designing Safer Chemicals: The chemical products should be designed such that they effects desired functions while minimizing toxicity.

5. Safer Solvents and Auxiliaries: Use of auxiliary substances (solvents and separation agents, etc.) should be made unnecessary whenever possible and innocuous when used.

6. Design for Energy Efficiency: Energy required for the chemical reaction or synthesis should be recognize and find way to minimize energy requirements. If possible, chemical reactions or synthetic methods should be conducted at ambient temperature and pressure.

7. Use of Renewable Feed stocks: A raw material used in the synthetic reaction should be renewable and rather than depleting whenever technically and economically practicable.

8. Reduce Derivatives production: Unnecessary derivatization of the chemical components should be avoided to reduce chemicals wastage.

9. Catalysis: Catalytic reagents should be used as possible as more and are superior to stoichiometric reagents.

10. Design for Degradation: Design of the experiment is such that after completion of the reaction the product do not persist in environment instead conversion into innocuous product.

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: Substance and the form of substance used in a chemical process should be chosen so as to minimize the potential for chemical accidents, including releases, explosions, and fires.^[2,3,4]

EXAMPLES AND APPLICATIONS OF GREEN CHEMISTRY

The wide range of application of Green Chemistry includes useful in pharmaceutical industry, as well as new approaches to minimize or avoid the use of solvents or to render them safer and more efficient. Green chemistry also plays important role in alternative energy science, and the production of new ways to make solar cells, fuel cells, and batteries for storing energy.^[7]

GREEN CHEMISTRY IN DAY-TO-DAY LIFE

1. Green Dry Cleaning of Clothes: For Dry Cleaning of clothes, commonly used solvent is Perchloroethylene

(PERC). But now it is found that Perchloroethylene contaminates ground water and is suspected as Carcinogen. Hence a new technology namely "Micell Technology" developed by Joseph De Simons, Timothy Romark and James McClain, for dry cleaning of clothes by using liquid CO₂ and a surfactant there by replacing PERC. By using this technique, Dry Cleaning Machines have now been developed.

2. Versatile Bleaching Agents: It is commonly known that Paper is made up of wood (which contains about 70% polysaccharides and 30% of lignin). For manufacture of good quality paper, lignin must be completely removed. Initially for removal of lignin use of chipped pieces of wood into a bath of Sodium Hydroxide (NaOH) and Sodium Sulphide (Na₂S). But by this method 80% to 90% lignin were removed, for complete removal of lignin again use of chlorine gas (Cl₂) takes place. But use of Chlorine causes some environmental problems and health related problems as Chlorine reacts with lignin to produce Dioxins which are potential carcinogens. To overcome this problem, a versatile agent has been developed by Terrence Chollins of Camegie Mellon University. It involves use of H₂O₂ as bleaching agent in presence of some activators which are known as TAML (Tetra-amido Macrocylic ligand) activators. These activators act as catalysts and promotes the conversion of H₂O₂ into hydroxyl radicals that are take part in the oxidation (bleaching).

3. Green Solution to turn Turbid Water Clear: Tamarind seed kernel powder is an effective agent and can used to make municipal and industrial waste water clear. In current scenario Al-salts are used to treat such water, but it is found that alum increases toxic ions in water and could cause diseases like Alzheimer's, while kernel power is non-toxic and biodegradable and economical.

3. As Starting Material

Polysaccharide Polymers: Polymers are important class of compounds and have broad applications and wide array of compounds can be exploited. Polymers have their hazardous effects. In order to use polymer as starting material for chemical process, we must use environmental friendly polysaccharides as the feed stock. These are biological feed stock and having the advantage of renewable in contrast with the compounds which are of petroleum origin. Also these have no chronic toxicity to human health and environment.^[8,9,10]

CONCLUSION

The ultimate aim of green chemistry is to entirely cut down the stream of chemicals pouring into the environment. This aim seems unattainable at present, but progress in the green chemical research areas and their application through successive approaches will certainly provide safer specialty chemicals and much more satisfactory processes for the chemical industry. By use of safe techniques, can prevent environmental disruption.

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