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Green Chemistry: Sustainable Future to Science and Technology

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Abstract – Green chemistry for chemical synthesis addresses our future challenges in working with chemical processes and products by inventing novel reactions that can maximize the desired products and minimize by seeking greener solvents and environmentally benign. The emerging area of Green chemistry is a need in the design and attainment of sustainable development. Green chemistry is the utilization of a set of principles that will help reduce the use and generation of hazardous substances during the manufacture and application of chemical products. In this review, a brief some industrial applications are discussed.

Keywords: Green Chemistry, Environment Friendly, Sustainable, Development, Safer Chemistry.

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INTRODUCTION

Green Chemistry:

Sustainable and green chemistry thinking about how chemistry and chemical engineering can be done. Over the years different principles have been proposed that can be used when thinking about the design, development and implementation of the principles enable scientists and engineers to protect and benefit the economy, people and the planet by finding creative and innovative ways to reduce waste, conserve energy, and discover replacements for hazardous substances. The scope of green chemistry and engineering principles go over hazards from chemical toxicity and include and life cycle considerations such as the use of stocks and designing for end of life or the final disposition of the product. The effect of industrial pollution on the environment has led the industry and research communities to focus on green chemistry that is concerned with developing processes and products to reduce or eliminate hazardous substances or conditions. Green chemistry, also called sustainable chemistry, is a philosophy of chemical research and engineering that encourages the design of products and processes with minimum use and generation of hazardous pollutants.

One of the primary goals of green chemistry is to prevent pollution at its source, as opposed to dealing with pollution, after it has occurred. Accordingly, utilization of nontoxic chemicals, environmentally benign solvents and renewable materials are some of the key factors in green chemistry strategy. The key elements of green chemistry are:

- Design of processes to maximize the amount of raw material that ends up in the product
- Use of safe, environment-benign substances, including solvents, whenever possible;
- Design of energy efficient processes;
- Design of the chemical products in such a way that at the end of their function they do not persist in the environment and break down into innocuous degradation products;
- Development of analytical methodologies to allow for real-time, in-process
- Monitoring and control prior to the formation of hazardous substances;
- Use the ideal waste disposal strategy i.e. not to generate waste in the first place.

Green chemistry is increasingly seen as a powerful tool that researchers must use to evaluate the environmental impact of the processes being developed. Now a days, attempts are being made not only to quantify the greenness of the chemical process but also to factor in other variables, such as, chemical yield, cost of reaction components, safety in handling chemicals, hardware demands, energy profile and ease of product workup and purification. Green chemistry thus combines important elements of

environmental improvement, economic performance, and social responsibility to address environmental problems as well as industry competitiveness. Green chemistry developments are likely to have an impact on the global trade of chemical industry in future.

PRINCIPLES OF GREEN CHEMISTRY

There are total of twelve principles contributing the green chemistry. These are elaborated 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 Syntheses:** 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 (e.g., 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

CONCLUSION:

Green Chemistry is 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. Great efforts are still undertaken to design an ideal process that start from non-polluting materials. It is clear that the challenge for the future chemical industry is based on safer products and processes designed by utilizing new ideas in fundamental research. Furthermore, the success of green chemistry depends on the training and education of a new generation of chemists. Students at all levels have to be introduced to the philosophy and practice of green chemistry.

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