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Short Communication

Benefits of green chemistry

R M Madhumitha Sri¹, S Ravichandran^{2,*}, T B Suneetha³

¹Dept. of Pharmaceutical Technology, Anna University, Chennai, Tamil Nadu, India

²Dept. of Chemistry, Lovely Professional University, Phagwara, Punjab, India

³Dept. of Biotechnology, Acharya Institute of Technology, Bengaluru, Karnataka, India



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ABSTRACT

Our living standard rose after the industrial revolution. Chemistry has brought about medical revolution in the middle of 20th century in which drugs and antibiotics might have discovered. The world's food supply also increased enormously due to the discovery of new hybrid varieties, improved methods of farming, better and quality seeds, use of insecticides, herbicides and fertilizers. The quality of life on earth became much better due to the discovery of dyes, plastics, cosmetics and medicines. Soon, the ill effects of chemistry also became pronounced, main among them being the pollution of land, water and atmosphere. This is caused mainly due to the effects of byproducts of chemical industries, which are being discharged into the air, water and land. The use of toxic reactants and reagents also make the situation worse. Chemical industry developed many products that facilitate life, to extend human life. Industrial revolution has brought increased production but also waste material made to be consumed rapidly. As on today, maximum pollution to the environment is caused by numerous chemical industries. Therefore, attempts have been made to design synthesis for manufacturing processes in such a way that the waste products are minimum, Sustainability has spread in waves with the slogan in the end of 20th century. Chemical industry using the principles of green chemistry began to take measures relating to sustainability and the environment. For a continually growing population and restricted resources in a sustainable future in a world where the idea of development in the 21st century is one of the biggest challenges of green chemistry. Our scientific research must work for the welfare of our people. One of the best ways is to increase the direct interface of science with society. We need to strengthen our policies, regulations, investments and management to achieve our sustainable goals. In order to attain Sustainable Development, we have to bridge our traditional knowledge and Modern Science. It is significant to understand the principles of green chemistry to leave a livable world for future generations. Green chemistry represents the pillars that hold up our sustainable future. It is clear that many industries and research of many academics recognize the significance of green chemistry. The Green Chemistry is making us all to build a more sustainable, safer, progressive and prosperous mother planet for all humanity.

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1. Introduction

Chemistry has become very important in our everyday life during last few centuries. Although chemistry is helping enormously to the quality of life, negative effect of some chemicals are not exactly known to the human health and environment, even though they have been in use for several

decades. One of the biggest problems of today's world is facing environmental pollution. Environmental pollution is the major causes of nature thrown chemicals, toxic gases drained from factory chimneys, water, mixed organic solvents. Displays on the rapidly growing environmental pollution by the most responsible as chemicals, chemists and chemical engineers began looking at alternative solutions. The most significant of alternative ways to reach a sustainable improvement in a world with a

* Corresponding author.

E-mail address: ravichandran.23324@lpu.co.in (S. Ravichandran).

continually growing population and restricted resources is green chemistry. The term green chemistry¹ was first used in 1991 by Prof. Paul T. Anastas to implement sustainable development²⁻⁵ in chemistry and chemical technology by industry, academia and government. Green chemistry embodies two main components. First, it addresses the problem of efficient utilisation of raw materials and the concomitant elimination of waste. Second, it deals with the health, safety and environmental issues associated with the manufacture, use and disposal or reuse of chemicals. Green chemistry incorporates a new approach⁵⁻⁷ to the synthesis, processing and application of chemical substances in such a manner as to reduce threats to health and the environment. Green chemistry is commonly presented as a set of twelve principles proposed by Anastas and Warner. These principles are:

1. It is better to prevent waste than treat or clean up waste after is formed.
2. Synthetic methods should be designed to maximize the incorporation of all materials used in the process into the final product.
3. Wherever practicable, synthetic methodologies should be designed to use and generate substances that possess little or no toxicity to human health and the environment.
4. Chemical products should be designed to reduce toxicity
5. The use of solvents should be made unnecessary wherever possible.
6. Energy requirements should be minimized. Synthetic methods should be conducted at low temperature and pressure.
7. Raw material or feedstock should be renewable.
8. Unnecessary derivatization (blocking group, protection/deprotection) should be avoided whenever possible
9. Catalytic reagents (as selective as possible) are superior to stoichiometric reagents.
10. Chemical products should be designed so that at the end of their function they do not persist in the environment and break down into degradation products.
11. Analytical methodologies need to be further developed to control the formation of hazardous substances.
12. Substances and the form of a substance used in a chemical process should be chosen so as to minimize the potential for chemical accidents, including releases, explosions, and fires.

2. Benefits of Green Chemistry

Green Chemistry provides less waste formation. In fact Green Chemistry is a new approach to ensure preservation of human health and the environment. Energy conservation

and consumption has long been known to produce a major environmental effect. Microwave irradiation in the solid state⁸ is a technique that is being utilized to affect chemical transformations rapidly, in contrast to those that have classically been conducted in liquid solutions. Solvent-free microwave assisted reactions⁹⁻¹¹ provide an opportunity to work with open vessels and thus, avoiding the risk of high pressure and increasing the potential for scale up of such reactions. The practical feasibility of microwave assisted solvent free synthesis has been demonstrated in various useful transformations and in the synthesis of heterocyclic systems.⁸⁻¹¹

3. Significance of Green Chemistry

Green chemistry is multidisciplinary research area which involves knowledge from various disciplines like chemistry, chemical technology, biotechnology, molecular biology, ecology, toxicology. The inputs from the various disciplines can help while developing new and innovative technologies and green synthetic routes for chemical production. The greenness of a chemical synthesis can be evaluated quantitatively and qualitatively. As we are all aware that, Perchloroethylene (PERC), $\text{Cl}_2\text{C}=\text{CCl}_2$ is commonly being used as a solvent for dry cleaning. It is now known that PERC contaminates groundwater and is a suspected carcinogen. A technology, Known as Micell Technology developed by Joseph De Simons, Timothy Romark, and James McClain made use of liquid CO_2 and a surfactant for dry cleaning clothes, thereby replacing PERC. Dry cleaning machines have now been developed using this technique. Micell Technology has also evolved a metal cleaning system that uses CO_2 and a surfactant, thereby eliminating the need of halogenated solvents.

4. Conclusion

Green chemistry aims to develop new practice of chemistry with rules which provides resolutions to problems that human is facing today such as climate changes. Green Chemistry is a science that aims to emphasize the development of chemical methods and substances to protect the environment. It is significant to understand the principles of green chemistry for future generations. Most importantly we need the relevant scientific, engineering, educational and other communities to work together for sustainable future through Green Chemistry. Many inorganic and organic materials cause harmful effects to human, ecosystem and environment. But Green chemistry plays a key role in sustainable development through green synthesis and energy efficient process of production, recyclable and reusable materials. Various international organizations working on principles of green chemistry i.e. prevention of wastage, incorporation all material used in the process, designing less hazardous synthetic methods, safer

chemicals, biodegradable materials, using of renewable feed stock, more energy efficient process, catalytic process, use of green solvents etc.

5. Source of Funding

None.

6. Conflict of Interest

The authors declare that there is no conflict of interest.

References

- Anastas PT, Warner JC. Green Chemistry, Theory and Practice. vol. 148. First edition ed. Oxford, UK: Oxford University Press; 1998.
- Lancaster M. Green Chemistry: An Introductory Text. First edition ed. Cambridge, England: Royal Society of Chemistry; 2002.
- Anastas PT, Lankey RL. Sustainability through green chemistry and engineering. *ACS Symp Series*. 2002;823:1–11. doi:10.1021/bk-2002-0823.ch001.
- Wardencki W, Curyo J, Namieoenik J. Green Chemistry- Current and Future Issues. *Pol J Environ Stud*. 2005;14(4):389–95.
- Badami BV. Concept of green chemistry. *Resonance*. 2008;13(11):1041–8. doi:10.1007/s12045-008-0124-8.
- Ravichandran S. Green Chemistry-A potential tool for chemicalsynthesis. *Int J Chem Tech*. 2010;2(4):2188–91.
- Ravichandran S. Green Chemistry for Sustainable Development Asian. *J Biochem Pharm Res*. 2011;1(2):129–35.
- Csiba M, Cleophax J, Loupy A, Malthête J, Gero SD. Liquid crystalline 5,6-O-acetals of L-galactono-1,4-lactone prepared by a microwave irradiation on montmorillonite. *Tetrahedron Lett*. 1993;34(11):1787–90. doi:10.1016/s0040-4039(00)60779-7.
- Kidwai M, Mohan R, Saxena S. Solid-supported Hantzsch—Biginelli reaction for syntheses of pyrimidine derivatives. *Russian Chem Bull*. 2003;52(11):2457–60. doi:10.1023/b:rucb.0000012370.16259.4f.
- Singh A, Sharma R, Anand KM, Khan SP, Sachan N. Food- drug interaction. *Int J Pharm Chem Sci*. 2012;1(1):264–79.
- Yadav JS, Reddy KB, Raj KS, Prasad AR. Perkin Transaction. *J Chem Soc*. 2000;1:1939–41.

Author biography

R M Madhumitha Sri, Student

S Ravichandran, Associate Professor

T B Suneetha, Professor

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