P: ISSN NO.: 2394-0344 RNI No.UPBIL/2016/67980 VOL-3* ISSUE-4* July- 2018
E: ISSN NO.: 2455-0817 *Remarking An Analisation*

Green Chemistry and Environment

Abstract

Green Chemistry is defined as the type of chemistry that seeks to curb pollution, conserve energy and promote environmentally friendly production. Green chemistry is the utilization of a set of principles that reduces or eliminates the use or generation of hazardous substances in the design, manufacture and application of chemical product. This advance branch of chemistry has come a long way since its birth in 1991, growing from a small grassroots idea in to a new approach to scientifically based environmental protection. The purpose of green chemistry is to discover new way to make the best chemical products and processes that need less reagents, smaller amounts of solvent and fewer energy to make, also being safer, producing less waste and increasing productivity. There are 12 basic principles of green chemistry. Under these principles waste is avoided by intelligently by design a synthetic process that decreases pollution before it happens, limiting the environmental impact by going through fewer intermediates or by using chemically benign reagents rather than chemicals hazardous to humans and the environment.

Keywords: Pollution Prevention, Eco-Friendly, Sustainable Design, Green Chemicals, Benign Products.

Veena
Associate Professor,
Deptt.of Chemistry,
S.N.D.B. Govt P.G. College,
Nohar

Introduction

Green chemistry is the utilization of a set of principles that reduces or eliminates the use of hazardous substances in the design, manufacture and application of chemical products. Green chemistry aims not only for safer products, less hazardous consequences to the environment, saving energy and water, but includes broader issues which can promote in the end sustainable development. The term green chemistry was first used in 1991 by Paul T. Anastas the father of GC 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. EPA advanced the idea and applications of Green Chemistry from the beginning of the 1990s. in 1996 the organizing IUPAC. International union of applied and pure chemistry created a working group of scientist from the various fields for green chemistry. In 1997 the Green Chemistry Institute, was established by the biggest chemical society of the world, the American chemical society. The GCI is devoted to promote and advance Green Chemistry in chemical Industries, Universities, Research institutes and in the design and use of chemicals.

Two decades after the implementation of the EPA, The Pollution Prevention Act (1990) was created to enforce eco-friendly strategies. In 1991 the office of the pollution prevention and Toxics (OPPT) launched a model research grants programmers called “Alternative Synthetic pathway for Pollution Prevention.” This programmers includes pollution prevention in the design and synthesis of chemicals, eco-friendly solvents and safer chemicals. The first international conference on Green Chemistry was held in Washington DC in 1997, sponsored by IPUAC and the ACS. The first book and journals on the subject of green chemistry were introduced in 1990, including the journal of clean processes and Green Chemistry, sponsored by the Royal society of chemistry. The Green Chemistry is also known as environmentally benign chemistry or Benign to design chemistry.

Review of Literature

Anastas and Zimmerman et al *Innovations in Green Chemistry and Green Engineering (2013)* focused the processes that meet the objectives of Green Chemistry and Chemical Engineering minimize waste and energy use and eliminate toxic by products and utilize green energy (Solar thermal, Solar Electric, Wind and geothermal etc) that is known fossil fuel. Fossil fuel have their own waste and toxicity problems even through usually remote from the site of chemical production. The modern day chemical industry relies mostly on fossil fuel such as petroleum, natural gas and coal

based feedstock. The author explained the sustainable alternatives to conventional technologies includes [(a)] developing greener process technologies based on existing feedstock [(b)] replacement of fossil fuel based feedstock with renewable ones such as those designed from biomass [(c)] replacement of the target product itself with alternative renewable feedstock. Suresh et al *Green Chemical Engineering An introduction to Catalysis, Kinetics and Chemical Processes (2014)* explain the basic concepts of Green Engineering and reacting design fundamentals and provides key knowledge. It covers the basic principal various types of chemical, reactors, analysis of rate equation for different type of reaction and highlights the development of a green catalytic process and the application of a green catalyst in the treatment of industrial effluent. Stefanidis G et al *Alternative Energy Sources for Green Chemistry (2016)* the author focused on the use of alternative energy forms and transfer mechanisms is one of the key approaches of process intensification and on the application of the alternative energy forms and transfer mechanisms of the intensification of the chemical reaction by the use of plasma, electric and magnetic fields, electromagnetic and ultrasound waves and other high gravity fields. Summerton L et al *Green and Sustainable Medicinal Chemistry (2016)*, explain about CHEM21 (Chemical manufacturing methods for the 21st Century pharmaceutical Industries) that is Europe's largest public private partnership dedicated to the development of the manufacturing sustainable pharmaceuticals. The over all aim of the CHEM21 is to develop a broad based portfolio of sustainable technologies for Green Chemical intermediate manufacture aimed at identifying reactions and methodologies that address current bottlenecks in the sustainability of processes.

Aim of the Study

Aim of the study is to promote environment friendly production through eco-friendly solvents and safer chemicals. In this paper I go through all the related literature, articles and conclude that green chemistry can contribute to make pollution free environment and sustainable development.

Twelve Principles of Green Chemistry

The 12 Principles of Green Chemistry provid a framework for chemists to use when designing or improving materials, products processes and systems. The principles focus on sustainable design and have been the backbone for a wide range of innovative solutions created over the past decade in chemical processes, in manufacturing of various products, in designing less toxic materials, recycling and producing eco-friendly equipment.

Prevention

It is better to -prevent waste at the outset than to treat or clean it up.

Atom Economy

Chemical reactions should be designed so as many of the atoms as possible that are present in the starting materials, end up in the product rather than in the waste stream.

Less Hazardous-Chemical Syntheses

Synthetic-production methods should be designed to contain little or no toxic materials hazardous to human health and the environment.

Designing Safer Chemicals

Chemical products should be designed for safety as well as per forming their intended function.

Safer Solvents and Auxiliaries

Benign solvent systems, solvent-free methods, or biphasic systems should be used for reactions that integrate preparation and product recovery.

Design for Energy Efficiency

Energy requirements for chemical processes should be minimised, using ambient pressure and temperature where possible.

Use of Renewable Feedstocks

Raw materials should be sourced from renewable feedstocks wherever technically and economically practicable.

Reduce Derivatives

Unnecessary derivisation should be avoided, to reduce waste products.

Catalyas

Catalysts should be used to lower the activation energy barrier of a reaction and thereby use less energy.

Design for Degradation

Chemical products should be designed to decompose into benign substances at the end of their functional life, to prevent persistence in the environment.

Real-time Analysis for Pollution Prevention

Real-time, in-process monitoring and control should be allowed for in a chemical process, to avoid the formation of hazardous substances.

Inherently Safer Chemistry for Accident Prevention

The type and form of a substance used in a chemical process should be chosen to minimise the potential for chemical accidents, including releases, explosions, and fires.

Practical Applications of Green Chemistry

The areas under the green chemistry principles were selected with emphasis on economic considerations and for their future contribution to sustainable development and eco-friendly environment.

Use of Alternative Feedstock's

The emphasis on renewable raw materials and a shift from fossil fuels is very desirable for sustainability. The starting materials for the chemical industry must be renewable and less toxic for workers and the environment.

Use of Less Hazardous Reagents

Chemists and technologists divert their efforts to use less dangerous materials and reagents for the synthetic routes of the production of chemical products, choose less toxic substances and change their technologies accordingly, for example using catalysts and new synthetic techniques.

Use of Natural Processes, Like Biocatalytic Techniques

Biosynthetic methods are more selective, use less energy, lower temperatures, higher yields and demand raw materials which are less toxic.

Use of Alternative Solvents

Many solvents, especially polychlorinated and aromatic solvents were used for extraction techniques in synthetic organic chemistry. Some of these solvents e.g. carbon tetrachloride were banned and some others are restricted. Chemists use now less toxic solvents and their waste can be recycled or decomposed at high temperatures. Green Chemistry principles, in new solvents which are less toxic to workers and can disintegrate more easily under environmental conditions.

Design of Safer Chemicals and Products

Many new developments in methodology and toxicological tests improved our understanding of the toxicity and their mechanisms of new chemicals and products. Green Chemistry principles and applications synthesised chemical products with very low toxicity and are more benign to the environment.

Developing Alternative Reaction Conditions

Greener reaction techniques improving substantially, the product yield, saving energy, minimize waste, Photochemical reactions, microwave and ultrasound assisted organic synthetic techniques, reactions using water as solvent, catalytic reactions, etc are some of the new techniques in synthesizing chemicals.

Minimizing Energy Consumption

This is a very important goal considering the energy savings and the climatic change which has become a global environmental problem. The chemical industry has invested enough resources to reduce energy demands with innovations and changes in synthetic reactions.

Advantages of Green Chemistry and Environment Surroundings

1. Many chemicals end up in the environment by intentional release during use (e.g., pesticides), by unintended releases (including emissions during manufacturing), or by disposal. Green chemicals either degrade to innocuous products or are recovered for further Use.
2. Plants and animals suffer less harm from toxic chemicals in the environment.
3. Lower potential for global warming, ozone depletion, and smog formation.
4. Less chemical disruption of ecosystems.
5. Less use of landfills, especially hazardous waste landfills.

Human Being and Health

1. Cleaner air: Less release of hazardous chemicals to air leading to less damage to lungs.
2. Cleaner water: less release of hazardous chemical wastes to water leading to cleaner drinking and recreational water.
3. Increased safety for workers in the chemical industry; less use of toxic materials; less personal protective equipment required; less potential for accidents.
4. Safer consumer products of all types: new, safer products will become available for purchase; some products (e.g., drugs) will be made with less waste; some products (i.e., pesticides, cleaning products) will be replacements for less safe products.
5. Safer food: elimination of persistent toxic chemicals that can enter the food chain; safer pesticides that are toxic only to specific pests and degrade rapidly after use.
6. Less exposure to such toxic chemicals as endocrine disruptors.

Fiscal

1. Higher yields for chemical reactions, consuming smaller amounts of feedstock to obtain the same amount of product.
2. Fewer synthetic steps, often allowing faster manufacturing of products, increasing plant capacity, and saving energy and water.
3. Reduced waste, eliminating costly remediation, hazardous waste disposal, and end-of-the-pipe treatments.
4. Allow replacement of a purchased feedstock by a waste product.
5. Better performance so that less product is needed to achieve the same function.
6. Reduced use of petroleum products, slowing their depletion and avoiding their hazards and price fluctuations.
7. Reduced manufacturing plant size or footprint through increased throughput.

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 make pollution free environment and 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 but are useful in evaluation of there effects on the Environment. Green Chemistry, through design and better synthetic routes focused on cleaner production techniques and less toxic consumer products. From pesticides, fertilizers, elastomers, plastics, medicines, analytical reagents, and other commercial products, the major industrial players now concentrating in the production of safer, healthier and more benign products for the environment.

References

1. *Anastas PT, Beach ES. Changing the Course of Chemistry. ACS Symposium Series vol.1011. Chapter 1, pp 1-18. American Chemical Society Publications, Washington DC, 2009.*
2. *Horvath IT, Anastas PT. Innovations and green chemistry. Chem Rev 107(6): 2169-2173, 2007.*
3. *Climent MJ, Corma A, Iborra S. Heterogeneous catalysts for the one-pot synthesis of chemicals and fine chemicals. Chem Rev 111(2):1072-1133, 2011.*
4. *Warner JC, Cannon AS, Dye KM. Green Chemistry. Environ Impact Assess Rev 24(7-8):775-799, 2004.*
5. *Manley JB, Anastas PT, Cue BW. Frontiers in green chemistry: meeting the grand challenges for sustainability in R & D and manufacturing. J Cleaner Product 2008.*
6. *Anastas PT. Green Chemistry principles and practice. Review. Chem Soc Rev 2010.*

7. *Dunn PJ, Wells AS, Williams MT (Eds). Green Chemistry in the Pharmaceutical Industry. Wiley-VCH-Verlag, Weinheim, 2010.*
8. *Clark JH, Macquarrie D (Eds). Handbook of Green Chemistry and Chemical Technology. Blackwell Science Ltd, Oxford, UK, 2007.*
9. *Anastas PT, Levy 1J, Parent KE (Eds). Green Chemistry Education. Changing the Course of Chemistry, ACS Publications, Washington DC, 2009.*
10. *Grossman E. Chasing Molecules: Poisonous Products, Human Health, and the Promise of Green Chemistry. Island Press, New York, 2009.*
11. *Sharma SK. Green Chemistry for Environmental Sustainability. Series: Advancing Sustainability Through Green Chemistry and Engineering. CRC Press, Boca Raton, FL, 2010.*
12. *Kerton FM, Marriott R. Alternative Solvents for Green Chemistry, 2nd ed. RSC publications, Green Chemistry Series No. 20, Cambridge , UK, 2013.*
13. *Albini A, Protti S. Paradigms in Green Chemistry and Technology. Springer, Springe Briefs in Green Chemistry for Sustainability, Heidelberg, 2016.*
14. *Webb J. BBC (www.bbc.co.uk) Science and Environment. Evolutionary engineer Frances Arnold wins €1m tech prize. 24 May 2016. [http://www.bbc.com news/science-environment-36344155] (Accessed June 2016).*
15. *Federsel H-J. En route to full implementation: driving the green chemistry agenda in the pharmaceutical industry. Green Chem 15.*
16. *Gupta P, Mahajan A. Green chemistry approaches as sustainable alternatives to conventional strategies in the pharmaceutical industry. Royal Soc Chem Adv 2015.*
17. *Kerton FM. Marriott R. Alternative Solvents for Green Chemistry. Royal Society of Chemistry, Green Chemistry Series, No. 20, 2nd edition, Cambridge, UK, 2013.*
18. *Gawande MB, Bonifacio VDB, Luque R, et al. Benign by design: catalyst-free in-water, on-water green chemical methodologies in organic synthesis. Chem Soc Rev.*
19. *Sharmin E, Zafar F, Akram D, et al. Recent advances in vegetable oils based environment friendly coatings: A review. Industrial Crops Prod 2015.*
20. *Boodhoo K, Harvey A (Eds). Process Intensification for Green Chemistry. Enginering Solution for Sustainable Chemical Processing. John Wiley & Sons, Chichester, W Sussex, UK, 2013.*
21. *Suresh S, Sundaramoorthy S. Green Chemical Engineering: An Introduction to Catalysis, Kinetics, and Chemical Processes. CRC Press, Boca Raton, FL, 2014.*
22. *Poux M, Cognet P, Gourdon C (Eds). Green Process Engineering: From Concepts to Industrial Applications. CRC Press, Boca Raton, FL, 2015.*
23. *Stefanidis G, Stankiewicz A (Eds). Alternative Energy Sources for Green Chemistry. Royal Society of Chemistry publication, Green Chemistry Series Cambridge, 2016.*
24. *Summerton L, Sneddon HF, Jones LC, Clark JH (Eds). Green and Sustainable Medicinal Chemistry: Methods, Tools and Strategies for the 21st Century Pharmaceutical Industry. Royal Society of Chemistry publications, Cambridge, 2016.*