International Journal of ChemTech Research
CODEN (USA): IJCRGG, ISSN: 0974-4290, ISSN(Online):2455-9555
Vol.11 No.10, pp 293-297, 2018

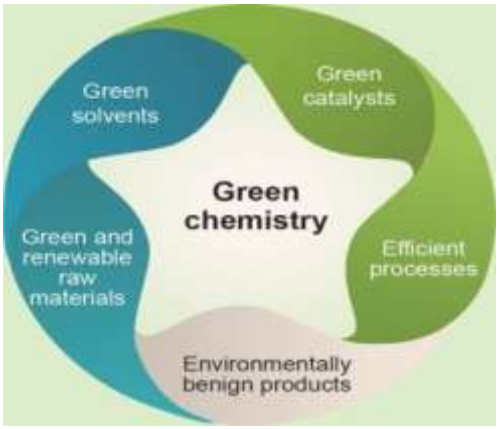
Environmental pollution control through Green Chemistry

S. Ravichandran

Associate Professor in Chemistry, Lovely Professional University, Phagwara, Punjab-144411, India

Abstract : Chemistry is really very helpful to us as its applications are used worldwide for several purposes. We cannot really imagine a world without chemistry and its applications such as medicines. However, several reactions taught in Pharmaceutical and medicinal chemistry laboratory today are hazardous to environment and hence needs to be modified. With an impetus from Pollution control act, Green Chemistry; a relatively newer branch has originated. 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. Chemistry is really very helpful to us as its applications are used worldwide for several purposes. We cannot really imagine a world without chemistry. However, we should now concentrate on green chemistry, or sustainable chemistry, which refers to reducing or stopping the damage done to the environment around us. Hence, green chemistry could include anything from reducing waste to even disposing of waste in the correct manner. All chemical wastes should be disposed off in the best possible manner without causing any damage to the environment and living beings. This article presents a brief description on implementation of various green chemistry principles and their applications to basic and applied research. Green Chemistry is a multidisciplinary field and covers areas such as synthesis, solvents, catalysis and efficient processes, as shown in the following figure.

Keywords: Green chemistry, Environmental pollution control.



S. Ravichandran /International Journal of ChemTech Research, 2018,11(10): 293-297.

DOI= http://dx.doi.org/10.20902/IJCTR.2018.111036

Introduction to Green Chemistry

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 approach[1-7]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
- Cleanchemistry

The term **Green Chemistry** was coined in 1991 by **Paul T. Anastas**. The purpose is to design chemicals and chemical processes that will be less harmful to human health and environment. Green chemistry protects the environment, not by cleaning up, but by inventing new chemical processes that do not pollute. The 12 principles of Green chemistry[3] and their applications to basic and applied research is briefly described below:

1. Prevention

It is better to prevent waste than to treat or clean up waste after it is formed. The ability of chemists to redesign chemical transformations to minimize the generation of hazardous waste is an important first step in pollution prevention. It goes back to the old saying "prevention is better than cure". It is better to prevent waste than clean it up after the fact.

2. Atomeconomy

This principle gets into the actual chemistry of how products are made. This principle states that it is best to use all the atoms in a process. And, those atoms that are not used end up as waste. Choosing transformations that incorporate most of the starting materials into the product are more efficient and minimize waste.

3. Less hazardous chemical synthesis

The goal is to reduce the hazard of the chemicals that are used to make a product. Chemists have traditionally used whatever means necessary. Today we are finding that less hazardous reagents and chemicals can be used in a process to make products. Synthetic methodologies should be designed to use and generate substances that possess little or no toxicity to human health and environment. Some toxic chemicals are replaced by safer ones for a green technology. For example, in the manufacture of polystyrene foam sheet packing material, chlorofluorocarbons which contribute to O_3 depletion and global warming, have now been replaced by CO_2.

4. Designing safer chemicals

Everyone wants safe products. This principle is aimed at designing products that are safe, and non-toxic. Pharmaceutical products often consist of chiral molecules, and the difference between the two forms can be a matter of life and death – for example, racemic Thalidomide when administered during pregnancy, leads to horrible birth defects in many new borns. Evidence indicates that only one of the enantiomers has the curing effect while the other isomer is the cause of severe defects.

5. Safer solvents

We use solvents regularly in our daily lives (cleaning products, nail polish, cosmetics, etc.) and in the chemistry laboratory. Many chemical reactions are done in a solvent. And, traditionally organic solvents have been used that pose hazards and many are highly toxic. Solvents are extensively used in most of the syntheses. Widely used solvents in syntheses are toxic and volatile – alcohol, benzene (known carcinogenic), CCl_4, $CHCl_3$, perchloroethylene, CH_2Cl_2. Purification also utilize large amounts of solvents (e.g., Chromatography) which add to pollution and can be highly hazardous to human health. The development of Green Chemistry redefines the role of a solvent: An ideal desirable green solvent should be natural, nontoxic, cheap, and readily available. This principle focuses on creating products in such a way that they

use less hazardous solvents. It is obvious that water is the most inexpensive and environmentally benignsolvent.

6. Design for energy efficiency

Today there is a focus on renewable energy and energy conservation. We use energy for transportation purposes and to provide electricity to our homes and businesses. Traditional methods for generating energy have been found to contribute to global environmental problems such as Global Warming and the energy used can also be a significant cost. This principle focuses on creating products and materials in a highly efficient manner and reducing associated pollution and cost.

7. Use of renewable feed stocks

90-95% of the products we use in our everyday lives are made from petroleum. Our society not only depends on petroleum for transportation and energy, but also for making products. This principle seeks to shift our dependence on petroleum and to make products from renewable materials. Biodiesel is one example of this where researchers are trying to find alternative fuels that can be used for transportation. Another example is, bio-based plastics. Polylactic acid (**PLA**) is one plastic that is being made from renewable feedstocks such as corn and potato waste. Benzene used in the commercial sythesis of adipic acid which is required in the manufacture of nylon, placticizers and lubricants, has been replaced to some extent by the renewable and nontoxic glucose and the reaction is carried out inwater.

8. Reduce derivatives

Unnecessary derivatization (blocking group, protection/deprotection) should be avoided whenever possible, because such steps require additional reagents and can generate more waste.

9. Catalysis

In a chemical process catalysts are used in order to reduce energy requirements and to make reactions happen more efficiently. Another benefit of using a catalyst is that generally small amounts are required to have an effect. And, if the catalyst is truly a "green" catalyst it will have no toxicity in the process. Enzymes are wonderful examples of catalysts. Biocatalysed reactions are advantageous as they are performed in aqueous medium.

10. Design for degradation

Not only do we want materials and products to come from renewable resources, but we would also like them not to persist in the environment. Plastics do not degrade in our landfills and pharmaceutical drugs such as antibiotics build up in our water streams. This principle seeks to design products in such a way that they perform their intended function.

11. Pollution prevention

Everyone known that prevention is better than cure from this pollution is better than pollution control. Pollution prevention is using materials, process or practices that reduces or eliminate pollution or wastes at the source.

12. Safer Chemistry for Accident Prevention

This principle focuses on safety for the worker and the surrounding community where an industry resides. It is better to use materials and chemicals that will not explode, light on fire, ignite in air, etc. when making a product. There are many examples where safe chemicals were not used and the result was disaster. The most widely known and perhaps one of the most devastating disaster was that of Bhopal, India in 1984 where a chemical plant had an accidental release that resulted in thousands of lives lost and many more injuries. When creating products, it is best to avoid highly reactive chemicals that have potential to result in accidents. When explosions and fires happen in industry, the result is often devastating.

These principles can motivate chemistry at all levels: research, reduction to practice, education and public perception. The first principle describes the basic idea of green chemistry in protecting the environment from pollution. The remaining principles are focused on such issues as atom economy, toxicity, solvent and other media using consumptionof energy, application of raw materials from renewable sources and degradation of chemical products to simple, nontoxic substances that are friendly for theenvironment[8-10].

Measures to Control Air Pollution

Activated carbon is one of the most popular forms of air pollution control[8]. This type of control involves the use of apollution filter, carbon, to reduce the amount of pollutants that are allowed to escape into the air. When in use, thesefilters absorb pollutants helping to cleanse the air of any possible toxins.Bio-filtration is another effective type of air pollution control. It uses microorganisms, often bacteria and fungi, todissolve pollutants. Industries that employ bio-filtration systems include food and waste plants, pharmaceutical companies, and wastewater management facilities. While this method of air pollution control works rather well, alarge space is required in order to operate a bio-filtration system. Many industries do not have this amount of available space, so this method is often disregarded.Change in Fuel: This technique involves the use of less polluting fuel to reduce air pollution. Use of low sulfur fuelinstead of high sulfur fuel by electric utilities is an example of this method. Remember that low sulfur fuel is muchmore expensive than high sulfur fuel.The other choice for an electric utility can be the use of natural gas as a fuel. Fuel switching based on meteorologicalconditions or air pollution forecasts have been used to prevent air pollution problem in many areas. Use of oil withlow ash content or natural gas for a dryer at an asphalt plant to reduce particulate matter is another example of thismethod. Introduction of compressed natural gas, propane, ethanol and oxygenated fuels for automobiles have helpedin the reduction of air pollutants Nuclear power plants are relatively pollution free when compared to the coal firedpower plants. However, they have been subjects of controversy in their overall environmental impact.Improve Dispersion: This approach is based on the concept that dilution of air contaminants before they reachground will lower the concentrations to which the population is exposed. The use of this approach for industry is discouraged by the US EPA. The emissions from the plant are passed through a control device before releasing to atmosphere. The pollutants are removed, destroyed or transformed in the control device before discharging into ambient air.

Conclusions

Air pollution are basically the foreign material in the air which can be manmade or occur naturally, and areconcentrated where people are concentrated. Pollution is injurious to health and its prevention places an economicburden on the citizen. Air pollution has been a menace in recent years posingserious threats to environmental and social wellbeing. Government, authorities and industry have been at theforefront to tackle air pollution with the help of policy reformation and technological innovation. Green chemistry is a new philosophical approach that through application and extension of the principles of green chemistry can contribute to sustainable development. Great efforts are still undertaken to design an ideal process that starts from non- polluting materials. It is clear that the challenge for the future chemical industry is based on production of safer products and processes designed by utilizing new ideas in fundamental research.

References

1. P.T.Anastas,J.C.Warner, *Green Chem Theory and Practice, Oxford Univ.Press,NewYork,*1998.
2. P. T. Anastas, I. T. Horvath, *Innovations and Green Chemistry,Chem.Rev.*2007,107, 2169.
3. S. Ravichandran, Int.J. ChemTech Res., 2010, 2(4),2191.
4. B. M. Trost, *Atom economy—A challenge for organic synthesis: Homogeneous catalysis leads the way. Angew Chem Int Ed.*,1995, 34, 259.
5. R.A.Sheldon, *Green solvents for sustainable organic synthesis:State of theart.Green Chem.*,2005,7, 267.
6. V. B. Bharati, Resonance, 2008,1041.
7. V. K. Ahluwalia and M. Kidwai, *New Trends in Green Chemistry*, Anamaya Publishers, New Delhi,2004.
8. D.Vashi, P.D.Vashi, V.Deepika, V.Shah and K.B.Kurmi, ,*Advance in Applied Science Res.*, 2015,

6(5),118.
9. D. L. Hjeresen, D. L. Schutt, J. M. Bose, "Green chemistry and education", *J. Chem. Educ.*, 2000, 12,1543.
10. M. Lancaster, "Green Chemistry- An Introductory Text", Royal Society of Chemistry, Cambridge, 2002.

*****