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Review Article

APPLICATIONS OF GREEN CHEMISTRY PRINCIPLES IN EVERY DAY LIFE

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ABSTRACT

Green chemistry is the new and rapid emerging branch of chemistry. The beginning of green chemistry is considered as a response to the need to reduce the damage of the environment by man-made materials and the processes used to produce them. Green chemistry could include anything from reducing waste to even disposing of waste in the correct manner. All chemical wastes should be disposed of in the best possible manner without causing any damage to the environment and living beings. This article presents selected examples of implementation of green chemistry principles in everyday life.

Keywords: Green chemistry, Environment, Sustainability.

INTRODUCTION

The term green chemistry[1] was first used in 1991 by Poul T. Anastas 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. In 1995 the annual US Presidential green chemistry challenge was announced. Similar awards were soon established in European countries. In 1996 the working party on green chemistry was created, acting within the framework of International Union of Pure and Applied Chemistry. One year later the Green Chemistry Institute (GCI) was formed with chapters in 20 countries to facilitate contact between governmental agencies and industrial corporations with universities and research institutes to design and implement new technologies. The firs conference highlighting green chemistry was held in Washington in 1997. Since that time other scientific conferences have been soon held on a regular basis. 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 concept of green chemistry incorporates a new approach[2-7] to the synthesis, processing and application of chemical substances in such manner as to reduce threats to health and environment. This new approach is also known as:

- Environmentally benign chemistry
- Clean chemistry
- Atom economy
- Benign-by-design chemistry

Green Chemistry is commonly presented as a set of twelve principles proposed by Anastas and Warner[1]. The principles comprise instructions for professional chemists to implement new chemical compound, and new synthesis and technological processes.

BASIC PRINCIPLES OF GREEN CHEMISTRY

1. Prevention

It is 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 Synthesis

Whenever 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 toxicity.

5. Safer Solvents and Auxiliary

The use of auxiliary substances should be made unnecessary wherever possible.

6. Design for Energy Efficiency

Energy requirements of chemical processes should be recognized for their environmental and at low temperature and pressure.

7. Use of Renewable Feedstocks

A raw material or feedstock should be renewable rather than depleting whenever technically and practicable.

8. Reduce Derivatives

Unnecessary derivatization (use of blocking groups, protection, deprotection) should be avoided whenever possible.

9. Catalysis

Catalytic reagents (as selective as possible) are superior 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.

These principles can motivate chemistry at all levels: research, 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 atom economy, toxicity, solvent and other media using consumption of energy, application of raw materials from renewable sources and degradation of chemical products to simple, nontoxic substances that are friendly for the environment.

GREEN CHEMISTRY IN DAY-TO-DAY LIFE

1. Green Dry Cleaning of Clothes

Perchloroethylene (PERC), $Cl_2C{=}CCl_2$ is commonly being used as a solvent for dry cleaning. It is now known that PERC contaminates ground water 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[8] has also evolved a metal cleaning system that uses CO_2 and a surfactant thereby eliminating the need of halogenated solvents[9].

2. Versatile Bleaching Agents

It is common knowledge that paper is manufactured from wood (which contains about 70% polysaccharides and about 30% lignin). For good quality paper, the lignin must be completely removed. Initially, lignin is removed by placing small chipped pieces wood into a bath of sodium hydroxide (NaOH) and sodium sulphide (Na_2S). By this process about 80-90% of lignin is decomposed. The remaining lignin was so far removed through reaction with chlorine gas (Cl_2). The use of chlorine removes all the lignin (to give good quality white paper) but causes environmental problems. Chlorine also reacts with aromatic rings of the lignin to produce dioxins, such as 2,3,4-tetrachloro-pdioxin and chlorinated furans. These compounds are potential carcinogens and cause other health problems.

These halogenated products find their way into the food chain and finally into products, pork, beef and fish. In view of this, use of chlorine has been discouraged. Subsequently, chlorine dioxide was used. Other bleaching agents like hydrogen per oxide (H_2O_2), ozone(O_3) or oxygen (O_2) also did not give this the desired results. A versatile agent has been developed by Terrence Collins of Camegie Mellon University. It involves the use of H_2O_2 as a bleaching agent in the presence of some activators known as TAML activators[10] that as catalysts which promote the conversion of H_2O_2 into hydroxyl radicals that are involved in oxidation (bleaching). The catalytic of TAML activators allow H_2O_2 to break down more lignin in a shorter time and at much lower temperature. These bleaching agents find use in laundry and results in lesser use of water.[11]

3. Green Solution to Turn Turbid Water Clear

Tamarind seed kernel powder, discarded as agriculture waste, is an effective agent to make municipal and industrial waste water clear. The present practice is to use Al-salt to treat such water. It has been found that alum increases toxic ions in treated water and could cause diseases like Alzheimer's. On the other hand kernel powder is not- toxic and is biodegradable and cost effective. For the study, four flocculants namely tamarind seed kernel powder, mix of the powder and starch, starch ad alum were employed. Flocculants with slurries were prepared by mixing measured amount of clay and water.

The result showed aggregation of the powder and suspended particles were more porous and allowed water to ooze out and become compact more easily and formed larger volume of clear water. Starch flocks on the other hand were found to be light weight and less porous and therefore didn't allow water to pass through it easily. The study establishes the powder's potential as an economic flocculants with performance close more established flocculants such as $K_2SO_4Al_2(SO_{4)3}.24H_2O$ (potash alum).

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.

REFERENCES

1. P.T. Anastas, J.C. Warner, Green Chem Theory and Practice, Oxford Univ. Press, New York (1998).
2. P.T. Anastas, I.T. Hovarsth, Innovations and Green Chemistry, Chem.Rev.107, 2169 (2007).
3. S. Ravichandran, Int. J. ChemTech Res., 2(4)2191 (2010).
4. B. M. Trost, Atom economy-A challenge for organic synthesis: Homogeneous catalysis leads the way. Angew Chem Int ., Ed., 34, 259 (1995).
5. R.A. Sheldon, Green solvents for sustainable organic synthesis: State of the art. Green Chem., 7, 267 (2005).
6. V.B. Bharati, Resonance, 1041 (2008).
7. V.K. Ahluwalia and M. Kidwai, New Trends in Green Chemistry, Anamaya Publisher, New Delhi (2004).
8. Micell Technology, Website: www.micell.com, accessed Dec. 1999.
9. P.T Anastas and T.C.Williamson, Green Chemistry: Frontiers in Benign chemical Synthesis and Processes. Oxford University Press, Oxford. (1998).
10. J.A. Hall, L.D. Vuocolo, I.D. Suckling, C.P. Horwitz, R.M.Allison, L.J. Wright, and T. Collins; Proceeding of 53rd APPITA Annual Conference, Rotorua, New Zealand. April 19-22, 1999.
11. P. Tundo and P.T. Anastas, Green Chemistry: Challenging Perspectives, Oxford University Press, Oxford. (1998).