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Green Chemistry

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ABSTRACT

Green chemistry is the new and rapid emerging branch of chemistry for the environment. It is really a philosophy and way of thinking that can help chemistry in research and production to develop more eco-friendly solutions. Green chemistry is a science based non-regulatory and economically driven approach to achieve the goals of environmental protection and sustainable development. All chemical wastes should be disposed of in the best possible manner without causing any damage to the environment and living beings. Another way to save the environment through sustainable chemistry is to make use of renewable food stocks. This article presents selected examples of implementation of green chemistry principles in everyday life, in industry and in domestic purpose.

Keywords : Green Chemistry. Eco-Friendly Solutions. Environmental Protection Agency, Geothermal Energy, PERC

I. INTRODUCTION

The idea of green chemistry was initially developed as a response to the Pollution Prevention Act of 1990, which declared that U.S. national policy should eliminate pollution by improved design (including cost-effective changes in products, processes, use of raw materials, and recycling) instead of treatment and disposal. Although the U.S. Environmental Protection Agency (EPA implemented green chemistry program. Paul T Anastas for the first time in 1991 coined term green chemistry**.**

The mid-to-late 1990s saw an increase in the number of international meetings devoted to green chemistry, such as the Gordon Research Conferences on Green Chemistry, and green chemistry networks developed in the United States, the United Kingdom, Spain, and Italy.

The 12 Principles of Green Chemistry were published in 1998, providing the new field with a clear set of guidelines for further development (1). In 1999, the Royal Society of Chemistry launched its journal Green Chemistry.

In 2005 Nobel Prize for Chemistry awarded to Chauvin, Grubbs, and Schrock, which commended their work as "a great step forward for Green Chemistry is the design of chemical products and processes that reduce or eliminate the use and generation of hazardous substances.

The green chemistry approach seeks to redesign the materials that make up the basis of our society and our economy including the materials that generate, store, and transport our energy—in ways that are benign for humans and the environment and possess intrinsic sustainability.

The concepts and practice of Green Chemistry have developed over nearly 20 years into a globe-spanning endeavor aimed at meeting the ''triple bottom line'' sustainability in economic, social, and environmental performance.

- **Definition:**

"Green chemistry, also called **sustainable chemistry**, is an area of chemistry and chemical engineering focused on the designing of products and processes that minimize the use and generation of hazardous substances."

- **Principle of green chemistry:**

1. Prevention: Prioritize the prevention of waste over clean-up and treatment once it's Created

2. Atom Economy: Synthesis methods are designed to maximize the incorporation of all Materials used in the process into the final product
3. Less Hazardous Chemical Synthesis: Design chemical reactions and synthetic routes to be as safe as possible for 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 whenever possible and innocuous when used
6. Design for Energy Efficiency: Choose the least energy-intensive chemical route. Avoid heating/cooling and Pressurized/vacuum conditions (i.e. ambient temperature & pressure are Optimal)
7. Use of Renewable Feedstock's: Use chemicals which are made from renewable (i.e. plant-based) sources rather than other, equivalent chemicals originating from petrochemical sources.
8. Reduce Derivatives: Minimize the use of temporary derivatives such as protecting groups. Avoid derivatives to reduce reaction steps, resources required, and waste created
9. Catalysis: Catalytic reagents (as selective as possible) are superior to stoichiometric reagents.
10. Design for Degradation: Products should be designed so that at the end of their function they break down into innocuous products and do not persist in the environment
11. Real Time Pollution Prevention: Monitor chemical reactions in real-time as they occur to prevent the formation and release of any potentially hazardous and polluting 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.

- **Application of green chemistry:**

Agriculture application:

Some industries co-operate to make better use of energy. For example, the production of ammonia generates both waste heat and carbon dioxide, both derived from fossil fuel. One UK manufacturer pipes these to large commercial tomato greenhouses, greatly extending the season during which the plants may be grown economically.

Geothermal Energy

In geothermal power stations super-heated steam generated deep underground when water comes into contact with heated rock or magma from the earth's mantle is extracted through a series of boreholes and piped into a turbine, where the steam is used to generate electricity.

Small amounts of carbon dioxide and other gases such as hydrogen sulphide are emitted from the geothermal areas. In one area in Iceland, the gases from a power plant are piped to an adjacent installation where carbon dioxide is separated from other non-condensable gases and used as an input to a process, where hydrogen and carbon dioxide are passed over a solid catalyst under high pressure to produce renewable methanol. The hydrogen is made by electrolysis of water using electricity from hydro and geothermal power sources. This green methanol can be blended directly with standard petrol or can be used in esterification of vegetable oil or animal fats to produce biodiesel (Fatty Acid Methyl Ester).

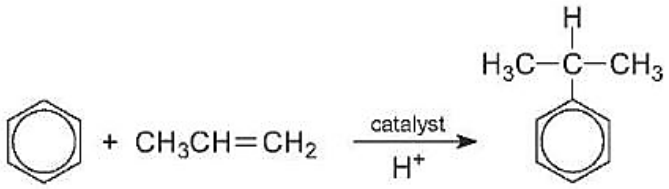
Green chemistry in day to day life:

Green Dry Cleaning of Clothes Perchloroethylene (PERC), Cl2C═CCl2 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 CO2 and a surfactant for dry cleaning clothes, thereby replacing PERC. Dry cleaning machines have now been developed using this technique. Micell Technology8has also evolved a metal cleaning system that uses CO2 and a surfactant thereby eliminating the need of halogenated solvents.

Catalysis

Aluminium chloride was used for many years in the production of alkylbenzene sulfonates, an active surfactant in many detergents. The aluminium chloride

was needed to effect the reaction between benzene and a long chain alkene. The aluminium chloride could not be recycled and became waste as aluminium hydroxide and oxide. Now a solid zeolite catalyst with acid groups is used and can be reused time and time again with no waste products. The zeolite is more environmentally friendly as the effluent is much cleaner and lower temperatures and pressures can be used.



II. 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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