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OVERVIEW OF GREEN CHEMISTRY

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ABSTRACT

The present review work focuses on the importance and economic devlopment of green chemistry. It is new branch in chemistry dealing with reduction of harmful and toxic chemicals in the synthesis and replacing it with ecofriendly methods. The principle of green chemistry with various benefits have been discussed to understand the basic requirement for replacement of conventional synthetic method with green chemistry synthesis. To describe it the synthetic approach for the synthesis of acetanilide has been discussed and compared.

Processes without adverse effects its impact on the environment. It is based on twelve principles that can be used to first create and re-create molecules, materials, reactions and processes are better for human health and the environment. Green chemical processes the materials developed so far cover almost all areas of chemistry, organic, inorganic, biochemistry, polymer, toxicology, environment, physics, technology, etc. Through some well-known trends in environmental conservation, for example. Reduction, biocatalysis and alternative applications: renewable raw materials (biomass), reaction media (water, ionized water and supercritical fluid), reaction method (microwave irradiation) and new synthesis method (photocatalytic reaction), both objectives – environmental protection and possible economic benefits. This article provides examples of popular features Green chemistry reduces the environmental impact of chemical processes and technologies.

Keyword: Green Chemistry, Ecofriendly, Environment.

I. INTRODUCTION

The accelerated progress of science and technology in the second half of the 20th century has led to significant economic development and an increase in living standards in developed parts of the world. However, this economic development has also led to significant environmental damage, such as the expansion of climate change, the appearance of ozone holes, and the accumulation of non-destructive organic pollutants in all parts of the biosphere.

The newly emerged situation required the search for solutions that balance the use of natural resources, economic growth, and environmental protection. As a result of these considerations, the last two decades have seen an increased awareness of the need for environmental protection, and much attention has been paid to so-called "green and future-proof technologies." New laws and regulations aim to protect ecosystems from harmful chemicals, while the chemical community is directed towards the development of new compounds and processes that pose less risk to human health and the environment through the processes of green chemistry. Green chemistry or sustainable chemistry is a term that refers to the development of chemical products and processes that reduce or eliminate the use and production of hazardous substances.

As a new branch of chemistry with an ecological approach, it involves reducing or eliminating the use of hazardous substances in chemical processes, as well as reducing harmful and toxic intermediates and products. To be considered "green", all reactions must contain three green elements (solvents, reagents/catalysts, and energy consumption).

Environment, and the processes of green chemistry developed to date include mainly all areas of chemistry, including Organic, inorganic, biochemical, polymeric, toxicological, environmental, physical, technological, etc. Basic principles of green chemistry cover a wide spectrum of synthetic organic synthesis: designing processes in organic synthesis to reduce byproduct/waste generation, reduce the use of hazardous chemicals/raw materials and enhance the use of safer or more environmentally-safe solvents and (bio) catalysts, renewable raw materials and how Would improve energy efficiency. In addition, green chemistry is interested in the best form of waste disposal and designing the process of degradation of chemical products after use, all in accordance with pollution prevention and sustainable development measures. The goals of green chemistry in environmental protection and economic profit are achieved through several dominant directions such as catalysis, biocatalysis, the use of alternative renewable raw materials (biomass), alternative reaction media (water, ionic liquids, supercritical fluids), alternative reaction conditions (microwave activation Mechanochemistry and ultrasound) as well as new photocatalytic reactions.

Fig 1: Green Chemistry

PRINCIPLE:

1. The 12 principles of green chemistry were developed by Paul Anastas and John Warner of the EPA, who explained its importance in practice in their 1998 book, Green Chemistry Theory and Practice. The principles of green chemistry describe the reduction or elimination of hazardous or harmful substances from the synthesis, production, and application of chemical products, in other words, the use of substances that are appropriate for the chemical product's purpose.
2. Human health and the environment is reduced or eliminated. When designing a green chemistry process, it is impossible to meet the requirements of all twelve principles of the Process at the same time, but it attempts to apply as many principles as possible during certain.

Fig 2: Green Chemistry in Solution

PRINCIPLES:

1. Prevention.
2. Atom Economy.
3. Less Hazardous Chemical Syntheses.
4. Designing Safer Chemicals.
5. Safer Solvents and Auxiliaries.
6. Design for Energy Efficiency.
7. Use of Renewable Feedstocks.
8. Reduce Derivatives.
9. Catalysis.
10. Design for Degradation.
11. Real-time Analysis for Pollution Prevention.

Inherently Safer Chemistry for Accident Prevention.

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1. Prevention

Preventing waste is more effective than treating or disposing of it after it is generated. The first principle of green chemistry is that prevention, i.e. avoiding the generation of waste, is less costly for people and the environment. Finally, it is cheaper treating and destroying waste after it is generated. The justification for the introduction of this principle is confirmed by the fact that the United States annually discharges about 12 billion tons of waste, or about 300 million tons of waste harmful to human life. Health and the environment (so-called hazardous waste). Chemical Industry generates 70 percent of the total amount of hazardous waste and the highest proportion organic waste. Toxic waste (about 150,000 tons), mainly methanol and xylene. Waste disposal "consumes about 2.2 percent of the U.S. gross domestic product and costs continue to rise." Organic waste that is harmful to humans and the environment is mainly generated during certain synthesis stages, the so-called "dirty reactions", where toxic reactants and solvents are used and harmful by-products are generated in large quantities under harsh reaction conditions.

2. Atom Economy

Synthesis methods should be designed so that all materials used in the process are maximally incorporated into the final product. The principle of nuclear economy is logically related to the principle of waste reduction, since all raw materials used in production should be used or integrated into the final product in order to ultimately reduce the amount of waste. This means that chemical syntheses should be designed to maximize the use of raw materials in the final product, or synthetic products should be developed that use all of the materials used in the synthesis in the final product. The principle of atom utility was defined by Barry Trost of Stanford University in 1991. Trost believes that by introducing the concept of atom utility, we can essentially eliminate waste at the molecular level. Barry Trost's concept led to the redesign of existing synthetic reactions up to that point, "making things regardless of price". These changes are useful because they are generally expensive and lead to income. There are known advances in the synthesis of ibuprofen. The main problem with the old synthesis (the boot process) is the economic cost due to the use of raw materials used is only about 40%. In the 1990s, new "green" methods were introduced.

3. Less Hazardous Chemical Syntheses

Wherever practicable, synthetic methods should be designed to use and generate substances that possess little or no toxicity to human health and the environment. Most chemical synthesis reactions, which usually take place in multiple stages, use toxic reagents. Although the product does not contain these toxic substances, there is a risk of its contamination and redesigning these processes is a task of green chemistry. The Less Hazardous Chemical Synthesis advocates, wherever possible, the creation of synthetic methods for the use and creation of substances that are little or no toxic to human health and the environment. Replacing harmful chemicals with biological enzymes makes many industrial processes cleaner and cheaper. As an example, a new Asahi Kasei's polycarbamate synthesis (PC) process is conceptually simple, based on the substitution of toxic carbonyl dichloride (COC2) with CO2. This process also results in the removal of dichloromethane (CH2Cl2) as a solvent. The total reaction consists of ethylene oxide (CH2) 20, CO2 and bisphenol-A (C15H16O2) to give polycarbamate and ethylene glycol C2H6O2.

4. Designing Safer Chemicals

Chemical products should be designed to effect their desired function while minimizing their toxicity. Minimizing toxicity, while maintaining function and efficiency, can be one of the most challenging aspects of designing safer products and processes, and achieving that goal requires understanding not only chemistry but also the principles of toxicology and environmental science. Designing Safer Chemicals advocates the design of chemical products in a way that reduces their toxicity and maintains their effectiveness. The goal of producing safe chemicals (non-carcinogenic, mutagenic, neurotoxic) is the balance between optimal performance and chemical product function, ensuring that toxicity and risk are reduced to the lowest possible level. In other words, the use of toxic chemicals should be avoided and replaced inhospitable wherever possible, but should take account of their efficacy. This principle is used in the development of new insecticides and pesticides that are specific to target organisms, ie. they are toxic only to target organisms and decompose into environmentally harmless substances.

5. Safer solvent and Auxiliaries

The use of auxiliary materials (e.g. solvents, release agents, etc.) should be unnecessary as much as possible and should be harmless if used.

Chromatographic separations using large amounts of solvents are problematic due to environmental pollution. The most common organic solvents are toxic, flammable and corrosive. Energy-efficient distillation leads to high losses in recycling, so the development of environmentally friendly solvents is necessary.

"Safer Solvents and Auxiliaries" recommends reducing synthesis processes as much as possible and avoiding the use of chemical auxiliaries (e.g. solvents, release agents, etc.) wherever possible. They should be harmless if used. According to the principles of green chemistry, the selection of suitable alternatives to organic solvents is based on the aspects of occupational safety, process safety, environmental safety and process sustainability.

6. Design for Energy Efficiency

The energy requirements of chemical processes are minimized, taking into account their environmental and economic impact. Synthetic fibers should be used if possible the procedure is carried out at ambient temperature and pressure. The oil crisis of 1973 triggered a series of processes to consider energy saving, with the aim of saving every kJ of energy. Utilize the production process. According to the above principles Designing for energy efficiency too energy efficiency is called the basic requirement minimize energy consumption. Energy efficiency in the chemical industry.

7. Use of Renewable Feedstocks

If technically and economically feasible, raw materials or starting materials should be renewable and non-exhaustive. It is possible the seventh principle of green chemistry recommends using renewable raw materials as far as technically and technologically possible. This is economically justified: for example, it is more convenient to use renewable raw materials than various plastics. And dispose of waste materials.

8. Reduce Derivatives

Unnecessary derivatization (use of blocking groups, protection/deprotection,temporay modification physical/chemical processes) should be minimized or avoided if possible, because they require additional steps requiring reagents and potentially generating waste.

One of the most important principles of green chemistry is avoiding the use of chemicals in the synthesis of the target molecule. Derivatives (reduce derivatives). Advocates of the principle avoid physicochemical ones whenever possible. Processes where blocking and deprotection groups are more appropriate are used during synthesis, i.e. whenever possible, biological processes should be in the synthesis.

9. Catalysis

Catalytic reagents (as selective as possible) are superior to stoichiometric reagents. To protect the environment, the catalytic principle promotes the use of biodegradable catalysts, which result in reduced energy consumption, avoidance of organochlorine compounds, reduced water consumption and wastewater.

Like all catalysts, enzymes work by lowering the activation energy of a single reaction, accelerating the reaction up to millions of times. Enzymes remain unchanged throughout the reaction they act on and completely unchanged at the end of the reaction. In addition, enzymes do not affect the relative energies between reactants and products or the associated reactions. However, what makes enzymes different from all other catalysts is their uniqueness in terms of stereochemistry, chemical selectivity, and specificity. Compared to non-biotic catalysts, biocatalysts have significant advantages in terms of reaction rate, catalytic specificity, low cost, etc., but they are less heat- sensitive and less stable.

10. Design for Degradation

Chemical products must be designed so that, once their function has ended, they break down into harmless decomposition products and do not remain in the environment. The principle of creating or designing to decompose degradable chemicals and products requires the creation of chemical products, which must be able to be transformed into products that are harmless to the environment after their activity has ceased. This requirement can be met by changing the technological parameters of the process control and by changing the so-called auxiliary materials that are added at certain stages of the production process.

11. Pollution Prevention:

Fig 3: Pollution Prevention

II. CONCLUSION

Green Chemistry is a novel approach that, by putting the principles of green chemistry into practice and expanding on them, has the potential to contribute to sustainable development. It is abundantly clear that the challenge facing the chemical industry in the future lies in developing processes and safer products that make use of innovative concepts from fundamental research. The education of the upcoming generation of chemists is essential to the success of green chemistry. There is an exciting opportunity for every challenge posed by the green chemistry revolution. Utilizing the principles of green chemistry, pharmaceutical companies and ContractResearch and Manufacturing Services (CRAMS) providers have begun developing atom-efficient routes that minimize waste and excess solvents. Technologies like bio- or chemocatalysis, for example.

III. REFERENCE

[1] Ahuwalia V.K, Kidvai M., New Trends In Green Chemistry, Anamayapublisher New Delhi, 2nd edition, 2007; 5-18.

[2] Ahluwalia V.K, Green chemistry Enviromentally Benign Reactions, published by India books, 2nd EDITION, 2006; 1-10.

[3] Vojvodic V. Enviromental Protection :Green Manufacturing in the pharmaceutical industry and cost reduction, KenInd, 2009; 58(1): 32-33.

[4] Anastas. P.T, Warner J.C, Green chemistry Theory and Practice, OxfordUniversity, Press, New York, 1998.

[5] Anastas P.T, Hovarsth I.T, Innovations and Green Chemistry, Chemistry review, 2007; 107.

[6] Ravichandaran S., International Journal, 2010; 2(4): 2191

[7] Trost B.M, Atom economy- A challenge for organic synthesis:Hompgeneous catalysis leads the way, 1995; 34: 259.

[8] Sheldon R.A, Green solvents for sustainable organic synthesis: State of art, 2005; 7: 267.

[9] Anastas P.T, Heine L.G, Williamson T.V, Green Chemical Synthesis and Processes, American Chemical Soceity, Washington DC, 2000.

[10] Gujral. S.S, Sheela. M.A, Khattri S., Singhla R.K. A Focus and Review on the Advancement of Green Chemsitry, Indo Global Journal of Pharmaceutical Science, 2012; 2(4): 397-408.

[11] Singhal. M, Singh A., Khan S.P, Green Chemistry Potential for Past, Present and Future Perspectives, International Research Journal of Pharmacy, 2012; 3(4).

[12] Ivankovic. A., Dronjic A., Review of 12 Principles of Green Chemistry in Practice, International Journal of Sustainable and Green Energy, 2017; 6(3): 39-48.

[13] Anastas P.T. Hovarsth LT. Innovations and Green Chemistry. Chemistry review, 2007; 107. https://doi.org/10.1021/cr078380v.

[14] Green Chemistry definition/American Chemical Society, www.acs.org.

[15] Ahluwalia V.K and Kidwai M., New Trends in Green Chemistry, Anamaya Publisher,New Delhi, 2004.