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Green Synthetic Approaches in Organic Synthesis: A Short Review

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Abstract: The Green Chemistry principles were first detailed by Paul T. Anastas and John Warner and from that point forward various logical scientific disclosures and innovations have climbed through "Green Chemistry". The twelve green chemistry principles have given an unprecedented ladder for the production of new research in the zone of green chemistry. Green chemistry capably utilizes reasonable crude materials, lessens waste and avoids the use of hurtful and also hazardous reagents and solvents for the combination and use of synthetic products. Importantly, these twelve principles emphasize environmentally benign ideas from the planning of the desired product to its preparation, working, investigation, and its disposal after its use. New methodologies that are prepared for reducing the usage of perilous substances are the prime objective of green chemistry. Over the range of the most recent years, new approaches are developed that are less risky to human prosperity and the earth. This new procedure has gotten wide thought. This short review covers green synthetic methodologies which are developed in the recent two years.

Keywords: Green Chemistry, Organic synthesis, Nanoparticles, PEG-400, Water

I. INTRODUCTION

Green chemistry is the need of present and future research considering the present scenario and polluting factors. Paul T. Anastas and John Warner proposed the twelve green chemistry principles that principally focused on minimization of waste. These 12 principles (Fig. 1) guide us to use take necessary environmentally friendly actions to synthesize synthetic products [1]. These standards have given an answer for a few issues, for example, forestalling the utilization of unstable and harmful solvents, i.e. less dangerous chemical reactions, the amount and reusability of the catalyst and reagents utilized i.e. stoichiometric reagents, atom-economy synthetic strategies, energy-efficient, and benign reaction conditions, and prevent the chemical waste produced. With expanding attention towards green chemistry in organic synthesis the modification of old methods is the prime need. By considering these vital aspects of green chemistry researchers are continuously focussing on the development of green synthetic approaches for the synthesis of variety organic compounds.

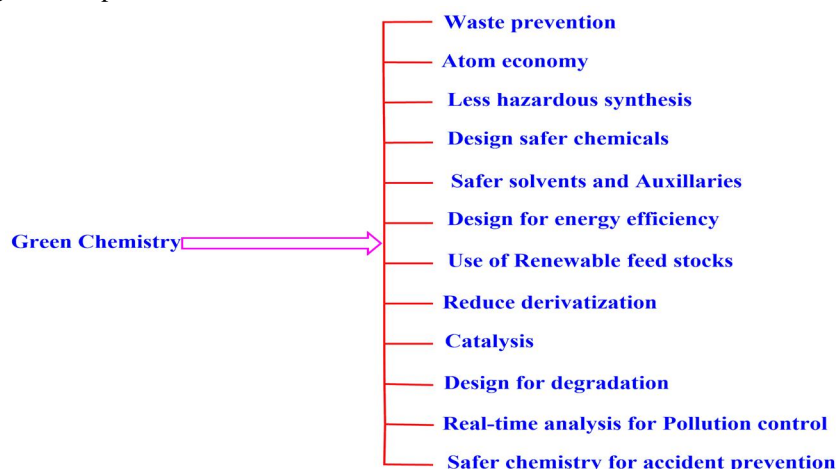


Fig. 1 12 Green chemistry principles

A. Waste Prevention

The potential of chemists to redesign chemical adjustments to limit the generation of dangerous waste is a crucial first step in pollutants prevention. With the aid of preventing waste generation, we decrease hazards associated with waste storage, transportation and remedy.

B. Atom Economy

Synthetic methods should be designed to maximize the incorporation of all materials used in the process into the final product. Atom economy is a ratio of the total mass of atoms in the desired product to the total mass of atoms in the reactants. One way to minimize waste is to design chemical transformations that maximize the incorporation of all materials used in the process into the final product, resulting in few if any wasted atoms. Pericyclic reactions are best to illustrate the concept of atom economy.

C. Lee Hazardous Synthesis

Whenever practicable, synthetic methodologies should be designed to use and generate substances that possess little or no toxicity to human health and the environment. The aim is to use much less dangerous reagents on every occasion possible and design approaches that do not produce dangerous byproducts.

D. Design Safer Chemicals

Chemical products should be designed to preserve the efficacy of the function while reducing toxicity. New products may be designed which can be inherently more secure, at the same time as rather effective for the goal utility. In academic labs, this precept needs to impact the design of artificial objectives and new merchandise.

E. Safer Solvents And Auxiliaries

The use of auxiliary substances (solvents, separation agents, etc.) should be made unnecessary whenever possible and, when used, innocuous. Solvent use leads to major waste. In cases wherein the solvent is wanted, much less dangerous replacements should be hired. Purification steps also generate large sums of solvent and different waste. Keep away from purifications when feasible and minimize the use of auxiliary substances whenever possible.

F. Energy For Energy Efficiency

Energy requirements should be recognized for their environmental and economic impacts and should be minimized. Synthetic methods should be conducted at ambient temperature and pressure

G. Use Of Renewable Feed Stocks

A raw material or feedstock should be renewable rather than deplete whenever technically and economically practical. Examples of renewable feed stocks consist of agricultural merchandise or the wastes of different tactics. Renewable resources can be made increasingly viable technologically and economically through green chemistry. Biomass, Nanosciences and technology, Solar, Carbon dioxide, Waste utilization are great examples.

H. Reduce Derivatization

Unnecessary derivatization (blocking group, protection/deprotection, and temporary modification of physical/chemical processes) should be avoided whenever possible. Synthetic conversions that are more selective will eliminate or minimize the use of protecting groups. Moreover, alternative synthetic sequences may eliminate the need to transform functional groups in the presence of other sensitive functionality.

I. Catalysis

Catalytic reagents (as selective as possible) are superior to stoichiometric reagents. A catalyst may participate in multiple chemical transformations. Catalyzed reactions have a lower activation energy (rate-limiting free energy of activation) than the corresponding uncatalyzed reaction, resulting in a higher reaction rate at the same temperature and for the same reactant concentrations. Catalysts can perform several roles during a transformation. They can increase the selectivity of a reaction, reduce the temperature of a transformation, enhance the extent of conversion to products and reduce reagent-based waste.

J. 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.

K. Real-time Analysis for Pollution Control

It is always important to monitor the progress of a reaction to knowing when the reaction is complete or to detect the emergence of any unwanted by-products. Therefore, analytical methodologies need to be further developed to allow for real-time, in-process monitoring and control prior to the formation of hazardous substances.

L. Safer Chemistry for Accident Prevention

Substances and the form of a substance used in a chemical process should be chosen so as to minimize the potential for chemical accidents, including releases, explosions, and fires. Risks associated with these types of accidents can sometimes be reduced by altering the form (solid, liquid or gas) or composition of the reagents. One very dangerous incident where thousands were killed is Bhopal accident. Therefore to avoid such accidents it is very important to use safer processes for biosafety.

II. GREEN SYNTHETIC STRATEGIES

A. Organic Reactions In Water

Water has versatile blessings as a solvent. Water is the nature's favourite solvent and exhibit strong hydrogen bonding ability. High dielectric constant, Low viscosity, high surface tension, and high specific heat, are some notable characteristics of water which makes it adequate in terms of safety and synthetic capability. Some promising examples of water as a solvent in organic synthesis are synthesis of 2-arylidine indanones [2], Diels-Alder Reactions [3], and Claisen rearrangement [4].

B. Organic Reactions In Polyethylene Glycol

PEG-400 is considered used as a green reaction media in many organic reactions. It has principal properties like low cost, recyclability, safe nature, catalytic property etc. Researchers have utilized the synthetic potential of PEG in many reactions. Some noteworthy examples are synthesis of thiazoles and pyrimidines [5, 6], Heck reaction [7], Michael reaction [8], Biginelli reaction [9], etc.

C. Organic Reactions Over Metal Oxide Nanoparticles

Metal oxide nanoparticles can catalyse much organic reactions on their surface area and cavities. Advancement in their morphology and structures by imparting various ions could result in the formation of catalyst that is adequate in terms of high surface area and porosity. Metal oxide nanoparticles are taken into attention to be more selective as well as reactive as a catalyst since it provides high surface area that is easily accessible to the substrate molecules and that lead to high catalytic activity. Dihydropyrimidinones synthesis [10], thiazole synthesis [11], oxazole [12] synthesis are some examples involving nanoparticles as catalyst.

D. Microwave and Ultrasound Irradiation

Many microwave and Ultrasound methods have been reported in the last two years with enhancement in the rate of reaction [13-15]. These methods are adequate in terms of yield, time, efficiency, separation etc.

III. CONCLUSION

This review covers some green strategies such as water mediated reactions, PEG mediated reactions, nanoparticles' catalyzed organic reactions, ultrasound and microwave irradiation methods. More attention is needed to create new safer methodologies and meet the goals of renewability. The volume of the research on green chemistry is going to expand and grow rapidly over the coming years. There is a tremendous and alarming need to change or modify the conventional methods which are not environment-friendly, utilize hazardous solvents, not adhered atom economy in the sense that does not according to green chemistry principles. This could be useful for the safe being of students and is also environment-friendly. In summary, green chemistry is all about creating new strategies that drive environmental change and improve the environments health.

IV. CONFLICT OF INTEREST

Authors declare that they have no conflicting interest.

V. ACKNOWLEDGEMENT

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