Introduction to Green Chemistry: Principles and Goals

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Received: 29-May-2024; Manuscript No: tochem-24-142544; **Editor assigned:** 31-May-2024; PreQC No: tochem-24-142544 (PQ); **Reviewed:** 14-June-2024; QC No: tochem-24-142544; **Revised:** 19-June-2024; Manuscript No: tochem-24-142544 (R); **Published:** 26-June-2024

Introduction

Green chemistry, also known as sustainable chemistry, is a scientific approach focused on designing products and processes that minimize the use and generation of hazardous substances. This discipline aims to reduce the environmental and health impacts of chemical production and usage, promoting sustainability and safety in the chemical industry. Green chemistry encompasses a set of principles and goals that guide chemists in creating eco-friendlier and efficient chemical processes. The principles of green chemistry were first outlined by Paul Anastasi and John Warner in their 1998 book "Green Chemistry: Theory and Practice." These twelve principles provide a framework for designing chemical products and processes that are environmentally benign. Here's a brief overview of each principle. It is better to prevent waste than to treat or clean up waste after it has been created. Synthetic methods should maximize the incorporation of all materials used in the process into the final product, minimizing waste. Wherever practicable, synthetic methods should be designed to use and generate substances that are non-toxic or less toxic to human health and the environment.

Description

Chemical products should be designed to achieve their desired function while minimizing their toxicity. The use of auxiliary substances (solvents, separation agents, etc.) should be made unnecessary wherever possible and, when used, innocuous. Energy requirements of chemical processes should be recognized for their environmental and economic impacts and should be minimized. Synthetic methods should be conducted at ambient temperature and pressure whenever possible. A raw material or feedstock should be renewable rather than depleting whenever technically and economically practicable [1,2]. Unnecessary derivatization (use of blocking groups, protection/deportation, temporary modification of physical/chemical processes) should be minimized or avoided if possible. Catalytic reagents (as selective as possible) are superior to stoichiometric reagents. 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. Analytical methodologies need to be further developed to allow for real-time, in-process monitoring and control prior to the formation of hazardous substances. Substances and the form of a substance used in a chemical process should be chosen to minimize the potential for chemical accidents, including explosions, fires, and releases to the environment. The goals of green chemistry align with the principles outlined above, aiming to foster innovation and sustainability in the chemical industry. These goals include. One of the primary goals of green chemistry is to protect the environment by reducing pollution at its source. This involves designing chemical processes that produce less waste and use safer, non-toxic chemicals. By preventing pollution rather than managing it after its creation, green chemistry helps in preserving natural resources and reducing the burden on waste treatment facilities. Green chemistry can lead to significant cost savings for the chemical industry. By reducing waste and using more efficient processes, companies can lower their raw material and waste disposal costs. Additionally, safer chemicals and processes can reduce regulatory compliance costs and improve worker safety, leading to fewer accidents and lower insurance premiums. By focusing on the use and production of non-toxic chemicals, green chemistry enhances the safety and health of workers in the chemical industry and reduces the risk of harmful exposure to the general public. Safer chemicals also mean fewer accidents and lower risks of long-term health issues, contributing to overall public health improvements. Green chemistry encourages innovation by challenging chemists to develop new, sustainable methods and products [3,4].

Conclusion

This can lead to the discovery of novel materials and processes that offer competitive advantages in the market. Companies that adopt green chemistry principles can position themselves as leaders in sustainability, enhancing their brand reputation and appeal to environmentally conscious consumers. Green chemistry supports sustainable development by promoting the use of renewable resources and designing processes that minimize environmental impact. This aligns with global efforts to achieve sustainability goals and ensures that chemical production can continue to meet societal needs without compromising the ability of future generations to meet their own needs. Green chemistry represents a transformative approach to chemical production and usage, prioritizing environmental and human health while fostering innovation and economic benefits. By adhering to its principles and striving towards its goals, the chemical industry can significantly reduce its ecological footprint and contribute to a more sustainable future. As awareness and adoption of green chemistry practices grow, we



can look forward to a safer, cleaner, and more efficient world.

Acknowledgment

The Authors are very thankful and honoured to publish this article in the respective Journal and are also very great full to the reviewers for their positive response to this article publication.

Conflict of Interest

We have no conflict of interests to disclose and the manuscript has been read and approved by all named authors.

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