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# GREEN CHEMISTRY FOR SUSTAINABLE DEVELOPMENT

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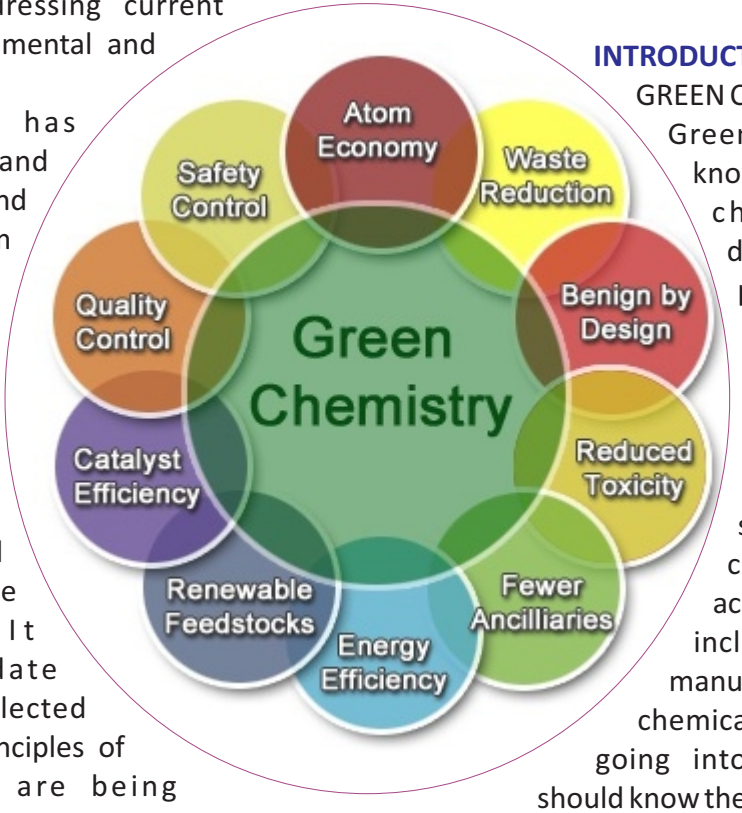
**ABSTRACT:**

In this paper an effort has been made to throw some light that green chemistry plays a major role in sustainable development. Green chemistry, also known as sustainable chemistry, also known as sustainable chemistry, is the design of chemical products and processes that reduce or eliminate use or generation of hazardous substance. Eminent international experts present research on and the application of green chemistry and engineering in addressing current issues of an environmental and social nature.

Green chemistry has brought relatively and positive paradigm and positive paradigm shift in the overall use and management of natural resource raw materials the development of social with subtle promise to cause for less pronounced harm to the environment. It provides up-to-date information on selected fields where the principles of green chemistry are being embraced for safeguarding and improving the quality of the environment. Chemistry students need to encouraged to consider the principles of green chemistry when designing processes of green chemistry when designing processes and choosing reagent Green chemistry can be the next social movement that will set aside all the world's differences and allow for the creation of an environmentally commendable civilization and will be a great help in sustainable development.

**KEY WORDS:** Green chemistry, sustainable chemistry, hazardous substances, environmentally commendable socialization.




## INTRODUCTION:

GREEN CHEMISTRY

Green chemistry, also known as sustainable chemistry, is the design of chemical products and processes that reduce eliminate the use or generation of hazardous substances. Green chemistry applies across the life cycle, including the design, manufacture, and use of a chemical product. Before going into the details one should know the famous quote.

"The significant problems we face today cannot solved at the same level of thinking we were at when we created them." Albert Einstein

On one side Green 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 whereas on the other side environmental chemistry focuses on the effects of polluting chemicals on nature, green chemistry focuses on technological approaches to preventing pollution and reducing consumption of non-renewable resource.

## GOALS OF GREEN CHEMISTRY

The overarching goals of green chemistry

- More resource-efficient.
- Inherently safer design of molecules, materials, products, and processes.

## ORIGIN OF GREEN CHEMISTRY

The idea of green chemistry was initially developed as a response to the pollution prevention Act of 1990, which declared that U.S. national policyshould 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) is known as a regulatory agency, it moved away from the "command and control" or end of pipe" approach in implementing what would eventually be called its "green chemistry" program.

By 199111, the EPA Office of Pollution prevention and toxics had launched a research grant program encouraging redesign of existing chemical products and processes to reduce impacts on human health and environment. The EPA, in partnership with the U.S National Science Foundation (NSF), then proceeded to fund basic research in green chemistry in the early 1990s.

The introduction of the annual presidential Green Chemistry Challenge Awards in 1996 drew attention to both academic and industrial green chemistry success stories.

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 where published in 1998, providing the new field with a clear set of guidelines further development. In 1999, the Royal Society of chemistry lunched its journal Green chemistry.

In the last few years, national networks have proliferated, special devoted to green chemistry have appeared in major journals, and green chemistry concepts have continued to gain traction. A clear sign of was provided by the citation for the 2005 Noble prize for chemistry awarded to Chauvin, Grubbs, and Schrock, which commended their work as "a great step forward for green chemistry"

## GREEN CHEMISTRY IS ABOUT

- Waste minimization at source
- Using Non-Toxic Resources
- Improved Atom Efficiency
- Use of Solvent Free or Recycle Environmentally Benign solvent systems

## WHY DO WE NEED GREEN CHEMISTRY?

- Chemistry is undeniably a very prominent part of our daily lives.
- Chemical developments also bring new environmental problems and harmful unexpected side effects, which result in the need for 'greener' chemical products.

• A famous example is the pesticide DDT.
• The Green Chemistryprogram supports the invention of more environmentally friendly chemical processes which reduce or even eliminate the generation of hazardous substances.
• This program works very closely with the twelve principles of green chemistry.

## PRINCIPLES OF GREEN CHEMISTRY

In 1998, Paul Anastas (who then directed the green chemistry program at the US EPA) and John C. Warner (then of Polaroid Corporation) published a set of principles to guide the practice of green chemistry. The twelve principles address a range of ways to reduce the environmental and health impacts of chemical production, and indicate research priorities for the development of green chemistry technologies.

## THE PRINCIPLES OF GREEN CHEMISTRY ARE AS FOLLOWS

1. Maximize atom economy: Design syntheses so that the final product contains the maximum proportion of the starting materials. There should be few, any wasted atoms.
2. Use safer solvents and reaction conditions: avoid using solvents, separation agents, or other auxiliary chemical. If these chemicals are necessary, use innocuous chemicals.
3. Increase energy efficiency: Run chemical reaction s at ambient temperature and pressure whenever possible.
4. Design chemicals and products to degrade after use: Design chemical products to break down to innocuous substances use so that they do not accumulate in the environment.
5. Analyze in real time to prevent pollution: include in-process real-time monitoring and control during syntheses to minimize or eliminate the formation of by-products.
6. Minimize the potential for accidents: Design chemicals and their forms (solid, liquid, or gas) to minimize the potential for chemical accidents including explosions, fires, and releases to the environment.
7. Prevent waste: Design chemical syntheses to prevent waste, leaving no waste to treat or clean up.
8. Design safer chemicals and products: Design chemical products to be fully effective, yet have little or no toxicity.
9. Design less hazardous chemical syntheses: Design syntheses to use and generate substances with little or toxicity to humans and the environment.
10. Use renewable feed stocks:Use raw materials and feedstock that are renewable rather than depleting. Renewable feedstocks are often made from agricultural products or are the wastes of other processes; depleting feedstocks are made from fossil fuels (petroleum, natural gas, or coal) or are mined.
11. Use catalysts, not stoichiometric reagents: minimize waste by using catalytic reactions, catalysts are used in small amounts and can carry out a single reaction many times. They are preferable to stoichiometric reagents, which are used in excess and work only once.
12. Avoid chemical derivatives: Avoid using blocking or protecting groups or any temporary modifications if possible. Derivatives use additional reagents and generate waste.

Attempts are being made not only to quantify the greenness of a chemical process but also to factor in other variable such chemical yield the price of reaction components, safety in handling chemicals, energy profile and ease of product workup and purification.

Green chemistry is increasingly seen as powerful tool that researchers must use to evaluate the environmental and human health impacts of both the products themselves and the processes to make

them, must be considered to ensure their long-term economic viability.

As human beings ---- we are part of the environment; the way which we interact with our environment influences the quality of our lives.

In 1999EPA Green chemistry Award for non-competitive for treating epilepsy and neuro degenerative disease was given to Lilly Research Labs for Producing Talampanol.

Pfizer, Inc, 2002 for while doing the SERTRALINE process made the following changes which resulted into saving energy, waste minimization and Greene Technology.

During this products following things were eliminated
Use of 140 metric tons / year of titanium tetrachloride
Generation of 440 metric tons / year of solid titanium dioxide waste
150 metric tons / year of 35% HCI waste
Need for 100 metric tons / year of 50% NaOH
Some aqueous washes

**Dramatically reduced:** the number and volume of solvents used and made it green technology.

Therefore, we say that green chemistry is not a solution to all environmental problems but the fundamental approach to preventing pollution.

In 2005 noble prize committee recognized the importance of green chemistry and since then, this relatively new science came into its own. Although no concerted agreements has been reached to yet about the exact content and limits of this interdisciplinary discipline, there seems to embodied in environmental topics that are based on the chemistry embodied in this subject. Linking green chemistry practice to environmental sustainability, Green chemistry for Environmental Sustainability illustrates the efforts being made to remediate a scathed environment into a pristine one.

## Links Green Chemistry practice to Environmental Sustainability

Eminent international experts present research on and application of green chemistry and engineering in addressing current issues of an environmental and social nature.

Green chemistry has brought a relatively prompt and positive paradigm shit in the overall use and management of natural resources and raw material for the development of society with a subtle promise to cause for less pronounced harm to the environment. It provides up-to-date information on selected field's where the principles of green chemistry are being embraced for safeguarding and improving the quality of the environment.

In January, 2007 a workshop on Green chemistry was held in Johannesburg. John Warner and Amy Cannon (University of Massachusetts, Lowell) were the "guiding sprits" for this effort, funding came from the South African paper and pulp Industry (SAPPI).

At this meeting Professor Paul Ndalut from Daniel ArapMoi University wisely observed. "Green chemistry is a good idea. But Africa has many burdens, including poverty, war and the epidemic of HIV, malaria and tuberculosis. Green chemistry is a priority only if it helps address these issues."

The requirements that we make of green chemistry are to enable substantial progress towards equitable standards of living in a manner that is sustainable for future China/India) risky. Some exciting examples of green sustainable activity are being generated within Africa. He restricted his remaining comments on green chemical production to the making medicines.

## SUSTAINABLE DEVELOPMENT

Development that meet the need of the present without compromising the ability of future generation to meet their own needs.Sustainable developments cannot be achieved by technological solutions, political regulation or financial instruments alone. We need to change the way we think and act. This requires quality education and learning for sustainable development at all levels and all social contexts.

Education for sustainable Development (ESD) is about enabling us to constructively and creatively address present and global challenges and create more sustainable and resilient societies.

## GREEN CHEMISTRY AND SUSTAINBLE DEVELOPMENTS

Green chemistry is tool in achieving suitability. It's not a solution to all environmental problems. It's Fundamental approach to pollution prevention.

### Chemistry's unique contribution to sustainability is

- Primary pollution prevention not remediation
- Use of chemistry for improved environmental performance

Green chemistry education: a key to sustain the development of educational materials.
Now, how can deal with green chemistry at our practical life
Just we need to change our mind set and apply the concept in

- Classrooms
- Laboratory
- Manufacture
- Finally reaction of type
- A+B → P+W
- Find alternate A or B avoid W
- **Example 1:**

o Disinfection of water by chlorination. Chlorine oxidizes pathogens there by killing them, but at use another
o A remedy is to use another oxidant, such as O3 or supercritical water oxidation

- **Example 2:**

o Production of alcohol CH2=CHCH2OH
o Traditional route: Alkaline hydrolysis of allyl chloride, which generates the product and hydrochloric acid by a by-product.
o Greener route, to avoid chlorine: two step using propylene (CH2=CHCH3), acetic acid (CH3COOH)and oxygen (O2)
o Added benefit: The acetic acid produced in the 2nd reaction can be recovered and used again for the 1st reaction, leaving unwanted by product.

- **Example 3:**

o Production of styrene (=benzene ring)
o Traditional rote: Two-step method starting with benzene which is carcinogenic) and ethylene to form ethyl benzene, followed by dehydrogenation to obtain styrene.
o Greener route : To avoid benzene, stat with xylene (cheapest source of aromatics)
o Another option, still under development, is start with toluene (benzene ring with CH3 tail).

## GREEN CHEMISTRY EDUCATION

- Chemistry students need to be encouraged to consider the principles of green chemistry when designing processes and choosing reagents.
- Interactive Teaching Unit (ITU) have been developed specifically to introduce undergraduate students to study green chemistry.
- There are numerous scholarships and grants available for researcher and young scholars who are furthering the goals of green chemistry.

## CONCLUSION

The concern for nature and natural resources is not at all a new concept for Indians. Admiration for nature and the urge to concern and protect it has always been a part of our civilization. We must remember that by our habit of ignoring environmental issues, the issues will not end rather they will cost tremendous harm to the next generation. In order to save the environment, everyone should show his or her responsibility towards environment. Common people, non-go environmental organizations, voluntary agencies as well as government have made several efforts for environmental conservation. Thus, there is an urgent need to create environmental awareness among all human being so as to conserve, protect and nurture our environment resources.

It is a fact that because of lack of proper awareness, man has become too harsh to nature and we are paying for the consequences. Environmental protection starts by creating awareness among the people so that it becomes part of their lifestyle. Environmental awareness is the first step to trigger the students' involvement in environmental movements. Thus, it becomes necessary to develop awareness and positive attitude in people since their childhood. As responsible citizens of tomorrow, students need to have a sound knowledge and proper understanding of contemporary issues and problems of the environmental education.

The needs and aspirations of society are reflected in the education. In this education of green chemistry will also play an important role.

## Green chemistry: Preventing Pollution, Sustaining the Earth

• Green chemistry has come a long way since its birth its birth in 1991, growing from a small grassroots idea into a new approach to scientifically-based environmental protection.

• All over the world, governments and industries are working with "green" chemists to transform the economy into a sustainable enterprise.

• Who knows? Green chemistry may be the next social movement that will set aside all the world's differences and allow for the creation of an environmentally commendable civilization and will be a great help in sustainable development.

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