

# Green Chemistry- Ultimate Necessity (Review)

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**Abstract**—In today's era green chemistry is a vexed issue. The aim of this study is to aware people about eco-friendly environment and minimizing the use and generation of hazardous substances. From feedstock's to solvents to synthesis and processing green chemistry actively seeks ways to produce materials in a way that is safer to human health and the environment. The current emphasis on green chemistry reflects a shift away from the historic "command and control" approach to environmental problems that mandated waste treatment, control and clean up through regulations.

**Keywords:** Condensed principles, Ibuprofen, The triple bottom line, Process safety, Scope and Green chemistry into crowded chemistry curriculum

## 1. INTRODUCTION

There is increasing pressure from both society and governments for chemistry-based industries to become more sustainable through development of eco-friendly products and processes that both reduce waste and prevent toxic substances from entering the environment. The chemical industry is vitally important to world economy; however the success of the industry has led to some environmental damage and a low perception of the industry. The synthesis of molecules having diverse uses in medicines, agrochemicals and biomolecules are dealt with in organic chemistry. The basic concern of the industries producing such chemicals is the type of reaction involved and the percentage of yield so that the synthesis becomes cost effective giving special attention to ensure that there is no environmental pollution. All these considerations form the basis of green chemistry.

Green Chemistry is about the area of chemistry and chemical engineering focused on designing of products and processes that minimizes the use and generation of hazardous substances. It is an open field for innovation, new ideas and revolutionary progress. Tool not only for minimizing the negative impact of procedures but aimed at optimizing efficiency. It has its roots in the environmental movement of the 1960s. It embodies two components: minimization of waste and avoiding the use of toxic substances. Green Chemistry is about reducing waste, material, hazard, risk, energy and cost.

**Table 1: Full Form of Green Chemistry**

Global	Community
Rivers	Health
Environment	Environment
Education	Medicine
Network	Industry
	Sciences
	Teaching
	Research
	You

**Table 2: The twelve general principles of green chemistry are:**

P	Prevent wastes
R	Renewable materials
O	Omit derivatization steps
D	Degradable chemical products
U	Use safe synthetic methods
C	Catalytic reagents
T	Temperature, pressure ambient
I	In-process monitoring
V	Very few auxiliary substances
E	E-factor, maximize feed in product
L	Low toxicity of chemical products
Y	Yes, it is safe

## 2. LITERATURE

A study on *Ibuprofen* occur which was synthesized in 1960 by pharmaceutical company Boot and sold under the commercial name Aspro, Panadol and Nurofen. Synthesis was performed in six steps with the production of secondary byproducts and wastes. Main problem in synthesis was "poor atom economy"

$\% \text{ atom economy} = 100 * (\text{molecular weights of all atoms utilized}) / (\text{molecular weights of all reactants/ reactants used})$

These six steps of the synthetic route was consuming chemicals and energy while lowering the yield of the final product while in 1980 the BHC discovered a new synthetic route with only three steps and increased efficiency. The atoms of starting chemicals are incorporated into the products of reaction and waste is minimized. In both steps starting

chemical are 2-methylpropylbenzene and raney nickel was used which decreases substantially the steps of synthesis. In the greener method of three steps the final yield is 77% whereas in older only 40%. Raney nickel can be recycled and reused while aluminium chloride had to be thrown away as waste. Energy requirement of second method were much lower than first.

Large amounts of adipic acid [ $\text{HOOC}(\text{CH}_2)_4\text{COOH}$ ] are used each year for the production of nylon, polyurethanes, lubricants and plasticizers. Benzene – a compound with convinced carcinogenic properties-is a standard substrate for the production of this acid. Chemists from State University of Michigan developed green synthesis of adipic acid using a less toxic substrate. The natural source of this raw material-glucose- is almost inexhaustible. The glucose can be converted into adipic acid by an enzyme discovered in genetically modified bacteria. Production of this acid guards workers and the environment from exposure to hazardous chemical compounds.

From the point view of green chemistry, combustion of fuels obtained from renewable feedstock is more preferable than combustion of fossil fuels from depleting finite sources. Many vehicles around the world are fueled with diesel oil but biodiesel is also an alternative in coming future. Biodiesel oil is produced from cultivated plants oil, example- soya beans. It is synthesized from fats embedded in plant oils by removing the glycerin molecule. The combustion of biodiesel does not generate sulfur compounds and generally does not increase the amount of carbon dioxide in the atmosphere.

Room-temperature ionic liquids are considered to be environmentally benign reaction media because they are low-viscosity liquids with no measurable vapor pressure. The lack of sustainable techniques for the removal of products from the room-temperature ionic liquids has limited its application. Professors Brennecke and Beckman have shown that environmentally benign carbon dioxide is used extensively both for commercially and in research for the extraction of heavy organic solutes.

### 3. THE TRIPLE BOTTOM LINE

During the 1990s many industries began to earnestly adopt green chemistry and other sustainable practices. Forward looking companies realized that the practice of green chemistry not only leads to environmental benefits, but also economic and social benefits. The combination of these three benefits is known as the “triple bottom line” and it provides strong encouragement for businesses to develop sustainable products and processes. This phrase is introduced in 1994 by John Elkington and later used in his 1997 book “Cannibals with Forks”.

Patagonia does not use any chemicals in their production processes and often use recycled, organic or environmentally sound materials. They are providing that outdoor equipment

and clothing can be made for all types of environment without causing any harm to the environment. Patagonia is also vocal and financial advocate for environmental initiatives.

DHL is a very large consumer of oil and gasoline as it is a shipping company. It is taking shipping back-to-the-basics, enacting a revolutionary delivery program so that shipping can be more efficient. They now use couriers on bicycles in many European countries. DHL estimates that this change alone will reduce their carbon dioxide emissions by 152 metric tons per year.

## 4. PROCESS SAFETY

Even by adapting an approach based on the principles of green chemistry and engineering it is not possible to design out all risk associated with the manufacture of chemicals. Process safety is a blend of engineering and management skills focused on preventing catastrophic accidents and near misses, particularly structural collapse, fires and toxic releases of chemicals.

To ensure processes are running safely companies should have:

- Have a board Champion for process safety, with the board reviewing process safety indicators and performance on a frequent basis.
- Have a clear and visible policy and expectations that is communicated throughout the workforce.
- A set of relevant leading and lagging indicators are in place and used to monitor performance.
- A continuous improvement plan, based on the indicators should be in place and used to monitor performance.
- Incidents should be reviewed from across the industry as well as other sectors and programmes to implement lessons learned.

## 5. BRINGING GREEN CHEMISTRY INTO AN ALREADY CROWDED CHEMISTRY CURRICULUM

### CHALLENGES

- Overcoming the misconception that green chemistry is less rigorous.
- Finding experiments that illustrate green chemistry concepts and are effective in the teaching labs
- Involving students in the process of greening the curriculum
- Building a community to support the development and use of curriculum

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**STRATEGIES**

- Replace rather than add course material
- Modernize the curriculum using the latest green chemistry developments. Ensure quality through testing.
- Provide a wide range of choices
- Help others learn from experience

**SCOPE**

- It reduces the environmental impact of chemical substances and fuels by developing alternative technologies.
- Improved production methods, formulations and solvents.
- Environmentally-friendly process engineering
- Higher yields for chemical reactions, consuming amount of feedstock to obtain same product.
- Elimination of persistent toxic chemicals that enter food chain so safer food

**6. CONCLUSION**

Green Chemistry is not just a definite solution but an ultimate necessity. It is scientifically sound, cost effective and leads towards a sustainable civilization. Great efforts are still undertaken to design an ideal process that starts from polluting initial materials, leads to no secondary products and requires no solvents to carry out chemical conversion. Furthermore, the success of green chemistry depends upon the training and collection of new generation of chemists. A good flow of knowledge between the industries and research institutions/universities undergoing such types of research topics will not only enable us to expand our knowledge but it would also help to protect the environment.

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