GREEN CHEMISTRY: A NEW APPROACH TO REDUCTION OF HAZARDOUS SUBSTANCES EMISSIONS

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ABSTRACT
The term “Green” involves, it refers to the environment friendly objects. Green Chemistry may be defined as environment-friendly chemical synthesis or the alternative synthetic pathways through which it reduces or eliminates the generation of hazardous substances.

Source Reduction → Green Chemistry
Recycling → Green Building
Reuse → Green Product
Recover → Green Energy

The four process of Integrated Waste Management are reducing, recycling, reuse and recover: Green building refers to the use of recycled content materials and products in new construction. Green product refers to the use of same waste material with some modification to get zero waste products. Green Energy is the energy obtained from the waste material without producing any toxic waste materials.

KEY WORDS - Hazard, Exposure, Green Energy

INTRODUCTION
The Pollution Prevention Act of 1990 was the first Act to focus on preventing the formation of pollutants. Maximum pollution to the environment is contributed by numerous chemical industries and other industry where many chemicals and chemical synthesis are involved. Therefore, attempts have been made in terms of Green Chemistry to follow environment - friendly chemical synthesis thorough alternative methods. Science and advance technologies have also contributed to alternative pathways of synthesis to reduce or eliminate pollutants.

BASIC PRINCIPLE OF GREEN CHEMISTRY - Atmosphere and hydrosphere (Particularly Oceans and Seas) are the largest sink for air pollutants and water pollutants believing that “Dilution is the best solution to
pollution”. By diluting the pollutants the risk factors related to health may be reduced, substantially for a particular species, but it may be hazardous to other species. The risk associated with various chemicals is a function of both hazard and exposure as - \[ \text{Risk} = f(\text{hazard}, \text{exposure}) \]

The green Chemistry believes on the principle that an environment-friendly substance or product poses no risk to any species regardless of exposure even if for a longer period. Thus, green chemistry believes on the theory that prevention is better than cure. Green chemistry is an approach dealing with the environmental pollution prevention for safer and habitable environment.

TOOLS OF GREEN CHEMISTRY- THE TOOLS ARE

- Green Starting materials.
- Green reagent
- Green reactions
- Green Chemicals Products
- Green Methodologies / Analysis

GREEN STARTING MATERIALS - Starting material for any chemical synthesis purpose is said to be green only when its use or overuse will not deplete the natural resources and degrade the environmental quality. For example; natural polymers or biopolymers are more preferable because they produce little waste products and these waste products are easily biodegradable. Therefore, it gives environment friendly product and it is also a renewable source. Substances like polysaccharides which are renewable natural (biological) resources for many polymer synthesis activities because it produces no hazard chemicals and waste products are easily biodegraded.

GREEN REGENTS - The reagent for any chemical synthesis or manufacture processes are said to be green when they satisfy the following conditions:

(a) These reagents must be incorporated maximum into the final products without producing any hazardous waste by-products.

(b) They must increase the efficiency of the concerned reaction process.

(c) These reagents must be readily available preferably natural renewable sources.

If there are any waste by-products they must be nontoxic and easily biodegradable. For example: phosgene was used to prepare polyurethanes which are very toxic to humans. Monsanto Company has developed a method to prepare the same product without using phosgene like,

R'OH
RNH₂ + CO₂ → RNCO + H₂O → RNHCOOR'

Amine Isocyanate Urethane

Earlier it was
RNH₂ + COCl₂ → RNCO + 2HCl → RNHCOOR'

Amine Phosgene Isocyanate Urethane **Green Reactions** - A particular reaction is said to be green only when almost all the reactants are incorporated to the end product without producing any toxic or hazardous by-products. For example, Diels-Alder reaction and Aldol condensation reaction are good examples of green reactions as they produce little or no by-products.

**Green Methodologies / Analysis** - To save the environment from toxic pollutants, in many organic synthesis processes Biocatalysts are used as enzymes. Bio catalytic reactions generally carried out in aqueous phases and it involves only one or two steps. Protection of selective group in biocatalytic reaction is not necessary. Biocatalysts are also readily available and it saves energy.

Another example of green methodologies is the method in which the chemical reactions are carried out in aqueous phase rather than using any other chemical solvents. For example, Diels - Alder reaction in water. It was found that the rates of reaction and selectivity can be increased in an aqueous system. This methodology has found a number of applications in chemical and Pharmaceutical industries like, heterocyclic compounds with nitrogen or oxygen-containing dienophiles are synthised from a hetero Diels-Alder reaction. **Green Chemical Products** - Since green reagents, green reactions, green starting materials and green methodology is applied for a chemical synthesis then its product obviously will be green product, for example: The product Poly Acrylic Acid (PAC) is used in many industrial applications but these polymers are non-biodegradable. Instead of PAC, Thermal Poly Aspartate (TPA) is used to improve the performance characteristics of the reaction. It is also biodegradable and nontoxic.

**CONCLUSION**

It gives the advantage that natural biological products are biodegradable; therefore, these waste products generally not create any environmental problem. Even by using the biological system, biopolymers and bioplastics can be prepared which are environment friendly products.

Biodiesel is a renewable source of energy which can replace the non-renewable fossil fuel. Biodiesel does not emit sulphur and carbon dioxide (CO₂) on its burning which is environment - friendly. Biodiesel can be prepared from vegetable oil.
REFERENCES


