Green Chemistry

TOPICS COVERED

- Polylactic Acid
- Polymerisation
  - PEG
  - Green Chemistry in Sustainable development
  - Photocatalysis
  - Homogenous and Heterogenous System
- What is Green Chemistry?
- Benefits of Green Chemistry
- Need of Green Chemistry

Sustainability

- Meeting the needs of the present generation without compromising the needs of future generations

- **Green chemistry:** technologies of the invention, design and application of chemical products and processes to reduce or to eliminate the use and generation of hazardous substances ,and where possible utilize renewable raw materials

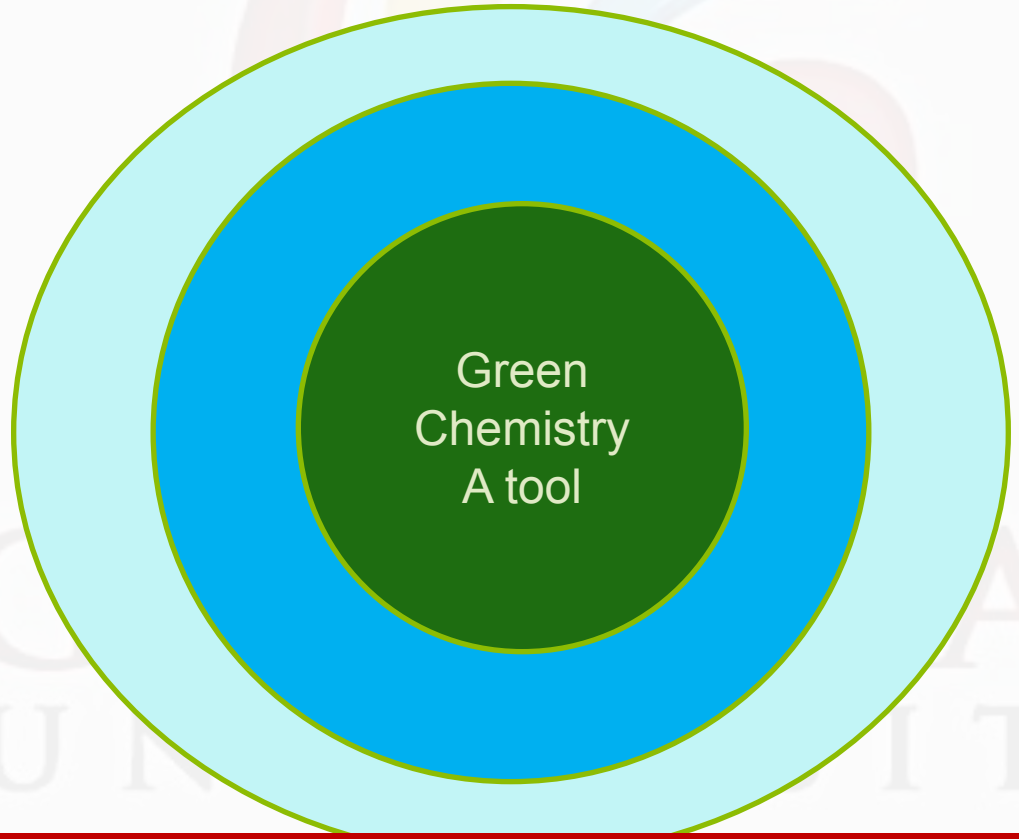
Primary pollution prevention not remediation

Use of chemistry for improved environmental performance

As human beings --- we are part of the environment

The way in which we interact with our environment influences the quality of our lives

Sustainable development
the goal



Industrial ecology

Principles of Green Chemistry

Prevent waste.

Design safer chemicals and products.

Design less hazardous chemical syntheses.

Use renewable feed stocks.

Use catalysts, not stoichiometric reagents: 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.

Avoid chemical derivatives: Avoid using blocking or protecting groups or any temporary modifications if possible. generate waste.

Maximize atom economy.

Use safer solvents and reaction conditions

Increase energy efficiency.

Design chemicals and products to degrade after use.

Analyze in real time to prevent pollution.

Minimize the potential for accidents.

Originally published by Paul Anastas and John Warner in **Green Chemistry: Theory and Practice** (Oxford University Press: New York, 1998).

O_3 or supercritical water oxidation

- If the chemical reaction of the type
- A + B P + W
- Find alternate A or B to avoid W
- Example 1:
- Disinfection of water by chlorination. Chlorine oxidizes the pathogens there by killing them, but at the same time forms harmful chlorinated compounds.
- A remedy is to use another oxidant, such as

Green Chemistry:

Preventing Pollution

Sustaining the Earth

- Green chemistry has come a long way since 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

Introduction of photocatalysis

- **photocatalysis is the acceleration of a photoreaction in the presence of a catalyst. In catalysed photolysis, light is absorbed by an adsorbed substrate. In photogenerated catalysis, the photocatalytic activity (PCA) depends on the ability of the catalyst to create electron–hole pairs, which generate free radicals (e.g. hydroxyl radicals: •OH) able to undergo secondary reactions. Its practical application was made possible by the discovery of water electrolysis by means of titanium dioxide (TiO_2).**
- **Homogeneous photocatalysis**
- In homogeneous photocatalysis, the reactants and the photocatalysts exist in the same phase. The most commonly used homogeneous photocatalysts include ozone and photo-Fenton systems (Fe^+ and Fe^+/H_2O_2). The reactive species is the •OH which is used for different purposes.
- the Fenton system produces hydroxyl radicals by the following mechanism
- $Fe^{2+} + H_2O_2 \rightarrow HO\bullet + Fe^{3+} + OH^- Fe^{3+} + H_2O_2 \rightarrow Fe^{2+} + HO\bullet 2 + H^+ Fe^{2+} + HO\bullet \rightarrow Fe^{3+} + OH^{-2}$

APPLICATIONS OF PHOTOCATALYSIS

- Use of TiO2 in self cleaning glass.
- Use of TiO2 in self sterilizing photocatalytic coatings .
- Decomposition of crude oil with TiO2 nanoparticles.
- Removal of unwanted fingerprint from sensitive electrical and optical components .
- Disinfection of water by supported TiO2 photocatalysts ,a form of solar water disinfection.

Reference :-

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Ryan, M.A. & Tinnesand, M. *Introduction to Green Chemistry*, American Chemical Society, Washington (2002).
Lancaster, M. *Green Chemistry: An Introductory Text* RSC Publishing, 2nd Edition, 2010.