GREEN CHEMISTRY

What is Green Chemistry?

We can say "Doing chemistry with personal safety and the Environment in mind" is green chemistry.

Definition:

❖ Green chemistry is the design of chemical products and processes that reduce or eliminate the use or generation of hazardous substances. ❖ Green chemistry applies across the life cycle of a chemical product, including its design, manufacture, use, and ultimate disposal. Green chemistry is also known as sustainable chemistry

Green chemistry and Sustainable development:

- ❖ The UN defines sustainable development as 'meeting the needs of present without compromising the ability of future generation.
- ❖ Green chemistry focuses on how to achieve sustainability through science and technology.
- ❖ To better understand and solve the issue of environmental pollution, many approaches and models have been developed for environmental impact assessments.

❖ Some of these approaches and models have been successful in predicting impacts for selected chemicals in selected environmental settings. ❖ These models have joined air and water quality aspects to point and nonpoint sources and have been very useful for the development of emission control and compliance strategies.

- ❖ However, some of the approaches and models were aimed primarily at evaluating the quantity of pollutants that could be discharged into the environment with acceptable impact, but failed to focus on pollution prevention.

WHY DO WE NEED GREEN CHEMISTRY?

- Chemistry is undeniably a very prominent part of our daily lives.
- Chemical developments bring new environmental problems and harmful unexpected side effects, which result in the need for **'greener' chemical products. Eg.** DDT.
- **Green chemistry looks at pollution prevention on the molecular scale**

It is an extremely important area of Chemistry due to the importance of Chemistry in our world today and the implications it can show on our environment.

- The **Green Chemistry program supports the invention of more environmentally friendly chemical processes which reduce or even eliminate the generation of hazardous substances.**

The Benefits of Green Chemistry

- Economical
- Energy efficient
- Lowers cost of production and regulation
- Less wastes
- Fewer accidents
- Safer products
- Healthier workplaces and communities
- Protects human health and the environment

12 Principles of Green Chemistry

1. **Prevention.** It is better to prevent waste than to treat or clean up waste after it is formed.

2. **Atom Economy.** Synthetic methods should be designed to maximize the incorporation of all materials used in the process into the final product.

3. **Less Hazardous Chemical Synthesis.** Whenever practicable, synthetic methodologies should be designed to use and generate substances that possess little or no toxicity to human health and the environment.

4. **Designing Safer Chemicals.** Chemical products should be designed to preserve efficacy of the function while reducing toxicity.

5. **Safer Solvents and Auxiliaries.** The use of auxiliary substances (solvents, separation agents, etc.) should be made unnecessary whenever possible and, when used, innocuous (harmless)

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6. **Design for Energy Efficiency.** Energy requirements should be recognized for their environmental and economic impacts and should be minimized. Synthetic methods should be conducted at ambient temperature and pressure.

7. **Use of Renewable Feedstocks.** A raw material or feedstock should be renewable rather than depleting whenever technically and economically practical.

8. **Reduce Derivatives.** Unnecessary derivatization (blocking group, protection/deprotection, temporary modification of physical/chemical processes) should be avoided whenever possible .

9. **Catalysis.** Catalytic reagents (as selective as possible) are superior to stoichiometric reagents.

10. **Design for Degradation.** Chemical products should be designed so that at the end of their function they do not persist in the environment and instead break down into innocuous degradation products.

11. **Real-time Analysis for Pollution Prevention.** Analytical methodologies need to be further developed to allow for real-time in-process monitoring and control prior to the formation of hazardous substances.

12. **Inherently Safer Chemistry for Accident Prevention.** Substance and the form of a substance used in a chemical process should be chosen so as to minimize the potential for chemical accidents, including releases, explosions, and fires.

Examples of Green Chemistry

- New syntheses of Ibuprofen and Zoloft.
- Integrated circuit production.
- Removing Arsenic and Chromate from pressure treated wood.
- Many new pesticides.
- New oxidants for bleaching paper and disinfecting water.
- Getting the lead out of automobile paints.
- Recyclable carpeting.
- Replacing VOCs and chlorinated solvents.
- Biodegradable polymers from renewable resources.

Green methods

- solvent selected not cause any environmental pollution and health hazard.
- the reaction should be carried out in aqueous phase
- the reaction should be carried out without the use a of solvent (solventless reactions).
- The use of liquid or supercritical liquid CO_2 should be explored.
- A better method is to carry out reactions in the solid phase
- immobilised solvents can be used

- The immobilised solvent maintains the solvency of the material, but it is non-volatile and does not expose humans or the environment to the hazards of that substance.

In the end we can say that Green chemistry is Not a solution to all environmental problems But the most fundamental approach to preventing pollution