P.G.SEMESTER-III
CC-XII
Environmental Chemistry and Green Chemistry

Unit-IV Green Chemistry : Def. & Obj.

Topic- Principles of Green Chemistry

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INTRODUCTION

- Green Chemistry is also known as environmentally benign chemistry or sustainable chemistry.
- Chemical developments also bring new environmental problems and harmful unexpected side effects, which result in the need for 'greener' chemical products.
- Green chemistry looks at pollution prevention on the molecular scale and 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.

Def:

Design of chemical products and processes

WHY?

Reduce and eliminate the use or generation of hazardous substances

Paul Anastas and Warner formulated the twelve principles of green chemistry in 1998.

These serve as guidelines for chemists seeking to lower the ecological footprint of the chemicals they produce and the processes by which such chemicals are made

Future!


12 Principles
GREEN CHEMISTRY
1. Waste prevention
2. Atom economy
3. Less Hazardous chemical synthesis
4. Designing Safer Chemicals
5. Safer solvents
6. Design for energy efficiency
7. Use of renewable feedstock
8. Reduce derivatives
9. Catalysis
10. Design for degradation
11. Real time pollution prevention
12. Safer chemistry for accident prevention

Principles of Green chemistry

1. Waste Prevention

Aims at reduction in waste generated rather than cleaning of waste after generation.

"Less Waste is directly proportional to Less Pollution".

Case Study: **In the Redesign of Sertraline process**

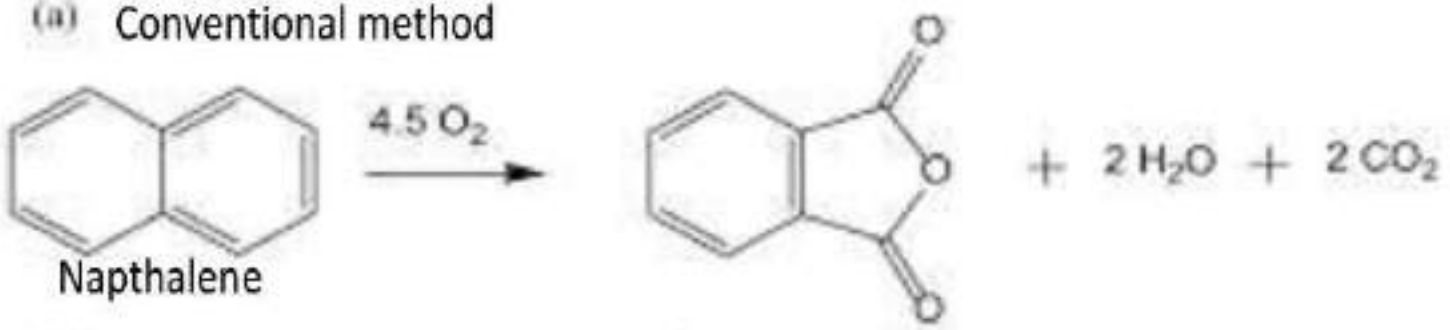
Conventional method	**Green method**
→ Multi step synthesis	→ Single step synthesis
→ Formation of half of unused diastereomer product	→ Formation of chirally pure sertraline
→ Four solvents were used	→ Ethanol for combine process

2. Atom economy

Design to maximize the incorporation of all material used in the process into the final product

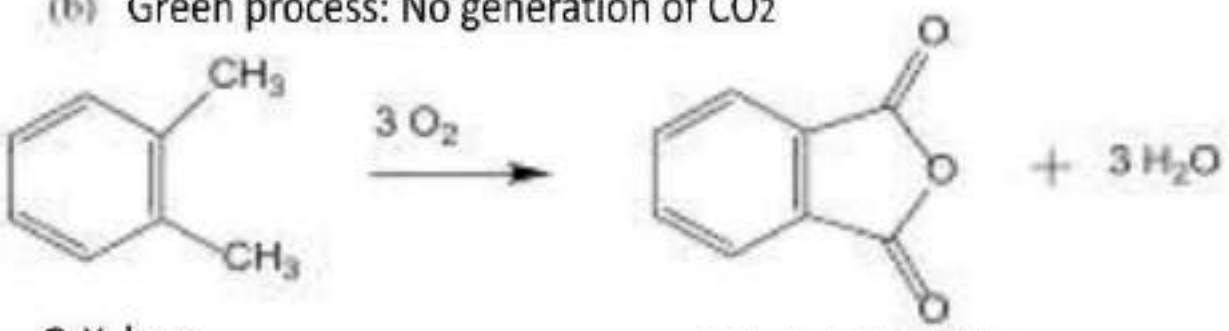
Synthesis of Pthalic Anhydride

(a) Conventional method



Napthalene

(b) Green process: No generation of CO_2



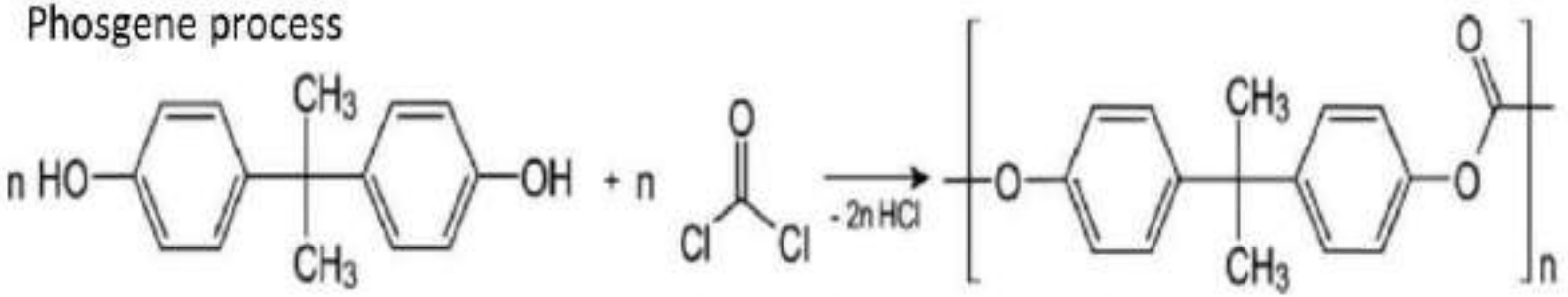
O-Xylene

Pthalic Anhydride

3. Less Hazardous chemical synthesis

Polycarbonate Synthesis

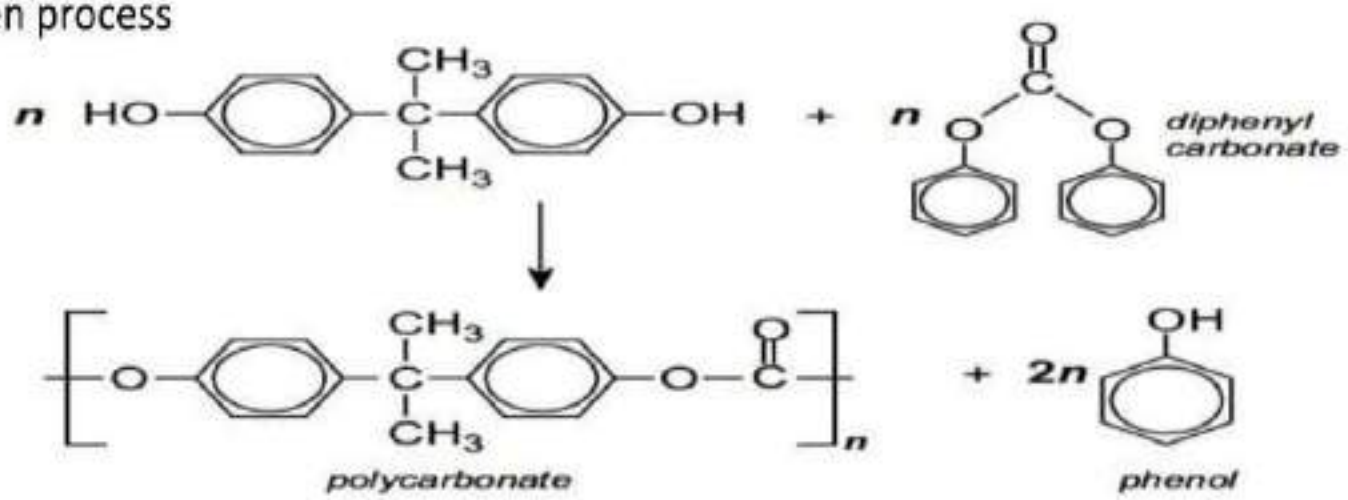
Phosgene process



Bisphenol-A

Phosgene(Toxic corrosive)

Green process



4. Designing safer chemical

Designed to preserve the efficiency of the function with less or no toxicity .

Example:

→1st generation antihistaminic drug replaced by 2nd generation.

Diphenhydramine causes sedation, it is replaced by levocetrizine having very low sedative effect.

5. Safer solvents

Undesired solvent	Alternative
Pentane, Hexane	Heptane
Diethyl ether, dimethoxy ethane	2 Me THF or tert-butyl methyl ether
Chloroform, Dichloro ethane, CCl4	Dichloromethane
Pyridine	Triethyl amine
Benzene	Toluene

6. Design for energy efficiency

Energy requirements sould be recognised for their environmental and economic impacts and should be minimized

Example: 1. Use of renewable sources of energy.

2. Minimizing impurities in final product to avoid numbers of purification technique.
3. Microwave heating is more efficient then conventional heating.

7. Use of renewable feedstock

Feedstock or raw material should be renewable rather than depleting wherever technically and economically practicable.

Example:

Ethene from bioethanol which is used to make polyethene and methane gas are considered as renewable starting material.

8. Reduce derivatives

→ Unneccessary derivatization(blocking groups, protection/deprotection) should be avoided whenever possible.

→ Adopt most suitable alternative pathways.

9. Catalysis

Catalytical reagents are superior to stochiometric reagents

→ Reduce energy

→ Increases efficiency

→ Reduces by product formation

10. Design for degradation

Chemical product at the end of their function they do not persist in the environment and break down into degraded product

Example:

→ Biodegradable polymer like polypropylene carbonate.

11. Real time 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. Safer chemistry for accidental prevention

→Principle Substances 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.

Ex: Replace of Na metal with Zn/Na_2CO_3 for elemental detector of N,S,Cl. As Na is highly reactive with H_2O.

The students are requested to keep studying and stay tuned till further updates regarding the content .

THANK YOU !

You can mail your subject related queries on…

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