Sem VI DSE III

Q. Write down the twelve principles of Green chemistry

Ans → The twelve principle of green chemistry are as follows:-

1. Waste Prevention
2. Atom economy
3. Less Hazardous chemical synthesis
4. Designing safer chemicals
5. Safer solvents and auxiliaries
6. Design for energy efficiency
7. Use of renewable feedstock
8. Reduction of derivatives
9. Catalysis
10. Design for degradation
11. Real-time pollution prevention
12. Safer chemistry for accident prevention

1. Waste prevention → Priority should be given for the prevention of waste instead of cleaning up it and treating waste after it has been created. The plan should be made in such as way that in each step, waste is minimised.

2. Atom-economy →

Waste should be reduced at the molecular level by maximising the number of atom from all reagents. The efficiency of a reaction should be evaluated by using atom economy.

$$\% \text{ atom economy} = \frac{\text{Molecular mass of desired products}}{\text{Sum of molecular mass of all reagent}} \times 100$$

3. Less hazardous chemical synthesis →

The chemical reaction and synthesis result should be so designed that it must be safer one as far as possible. Hazardous nature of all the reagents used must be considered also the hazardous nature of waste must also be considered.

4. Designing safer chemicals →

For a particular synthesis toxicity should be minimised by possible change in molecular design. Throughout the designing process every aspects like physical properties, toxicity, impact of environment

should be considered

5. Safer solvent and auxillianies →

Safest available solvent should be choosen for any given step. Also the amount of solvent should be minimised. Also, the auxilliary substances should be minimised so that we can minimise the waste formed at last.

6. Design for energy efficiency →

Here the least energy requirement route is choosen. Heating and cooling process should be avoided as far as possible. Also, creation of vacuum condition or creation of high pressure condition should be avoided. An optimum condition of temperature and pressure should be used.

7. Use of renewable feedstock →

Such chemicals should be used which has been made from renewable item ie biodegradable substance eg plants or derivatives of plants. Substance derived from petrochemical derivative should be avoided

8. Reduction of derivatives → 4

Use of temporary derivative eg protecting group should be minimised. Also derivatives should be avoided to reduce reaction steps, resources required and waste created.

9. Use of Catalysis →

Catalytic steps should be used in-stead-of Stoichiometric reagents in reactions. Such catalysts are chosen which increase selectivity, minimise waste, reduce reaction time and energy requirement

10. Design for degradation →

Such chemical should be designed which are degradable (bio-degradable) or can be discarded easily. Here it should be noted that both chemicals as well as degradable products are non-toxic and environmental friendly.

11. Real-Time Pollution prevention →

It should be monitored that it chemical reaction occur in real time and formation as well as release of any hazardous substance should be prevented. Also no such such substance is formed which can pollute the environment.

E-factor gives a much truer reflection of greeness of a chemical reaction than atom economy

$$\text{E-factor} = \frac{\text{Amount of waste produced in the process/kg}}{\text{Amount of desired product(s) produced in the process/kg}}$$

Safer Chemistry for accident prevention →

The procedure is chosen such a way so that they are safer in each respect and risk of accident should be minimized. The various possible risk may be assessed and prevented as far as possible.

Q what is need of Green chemistry? 6

Ans → Since the world war II human society has enriched with various notable technologies which has helped the human being to simply their lives. During this process of advancement we have also got some side effects which are causing miseries in our lives Therefore, our society as well as government are putting pressure for chemistry based industries to become more sustainable through development of eco-friendly process and products which can reduce waste as well as pollutants (toxic) coming into the environment. Chemical industries has led a considerable damage to our environment, therefore a general perception towards chemical industries is not very good. In order to raise the acceptibility of public in general, we require a more greener and cleaner product design.

However, green techniques have come up but it is not sufficient to meet the requirement for such sustainable technology. European union is leading with the green product whereas third world countries are lacking behind.

Therefore we need a change to low carbon, bio-based economy, in simple we can say Green chemistry.

Q what are the goals of green chemistry?

Ans → Followings are the goals of green chemistry

1. Economical process → The entire process should be economical.

2. Energy efficient → The process should be such that it should consume low energy as far as possible.

3. Lowers cost of production → Green chemistry aims in designing the synthesis of desired product which must have lower cost of production than the conventional method.

4. Lesser amount of waste →
After the production of desired product the amount of waste produced must be minimum.

5. Fewer number of accident → During the production of desired product the chances of occuring accident must be avoided

Safer product → The product obtained should be safe to human being as well as safe for environment

Healthier work place and communities →
There should be healthy environment at the work place and also for near by communities.

Q Discuss the obstacles in persuing the goal of green chemistry

Ans → Followings are the obstacles in persuing the goal of green chemistry:

1. Non- Availability of green technology
2. Commercialisation
3. Connecting green chemistry solution provider to industry
4. Understanding the basics of green principle
5. Myth: Green chemistry is costly and not suitable for small and medium entrepreneures
6. Regulatory hurdles

1. Non- availability of green technology →

We still have not such viable green chemistry based solution for many processes like nitration, sulphonation, Friedel-Craft reaction etc. In absence of such solutions, still the industries adopt the conventional methods for producing huge quantities of acids, alkalis and other reagent. These processes are undesirable due to low conversion, poor selectivity, low yield and huge amount of waste but industries have no viable option.

This barrier can be overcome by making significant partnership between industries and academic institutions.

2. Commercialisation →

There are many innovations that have been developed by various research institutes and are potential solutions for such challenges but due to lack of commercialisation they have not come up for benefit of society. For this industries and academics should come at a common platform to resolve the issues.

3. Connecting green chemistry solution provider to industries →

After the challenging concept of green chemistry, there are many innovations which are available with research institutes (solution provider) but due to reluctancy of industries these innovation could not be commercialised simply because industries are not interested in adopting these new innovative practices as they do not want to quit their established practices.

4. Understanding the basics of green principle →

One of the very important obstacles in implementation of green chemistry is that our chemical engineers working on designing new processes have limited knowledge about the basic principle of green chemistry and engineering. It should be ensured that these teams must have workable knowledge about these principles. Green chemistry should be added in the curriculum so that our next generation

must aware of the change.

5. Myth: Green chemistry is costly and suitable for small and medium enterpreneures →

There are certain mythis in the implementation of theory of Green chemistry like green chemistry is good but practically it is not feasible, it is difficult and complex concept and not viable for small and medium enterpreneures, it requires huge resources and enough time taking

But actually this is not so. green chemistry based solution can be commercialised even for small and medium size chemical companies with low gestation period as low as 3 months.

However some project may take longer time and require big amount but it is not true in all cases.

6. Regulatory hurdles → Green chemistry based process which is replacing the conventional process, has to go through validation trial, approval from internal regulatory affair team, from external regulatory agencies like FDA, Changes in Drug master file (DMF) filing, in spite of it financial resources should be managed.

These process must be Amplified by goverment so that companies may be encourged.