

12/08/2021

Engineering Chemistry - IIGreen Chemistry - Tutorial 2

Q. 1.) Write an informative note on bio-diesel.

Ans 1) The conventional hydrocarbon based fuels are fast depleting therefore there is a need for alternative diesel fuels fulfilling the criteria of easy availability, economic viability, technical feasibility and environmental compatibility.

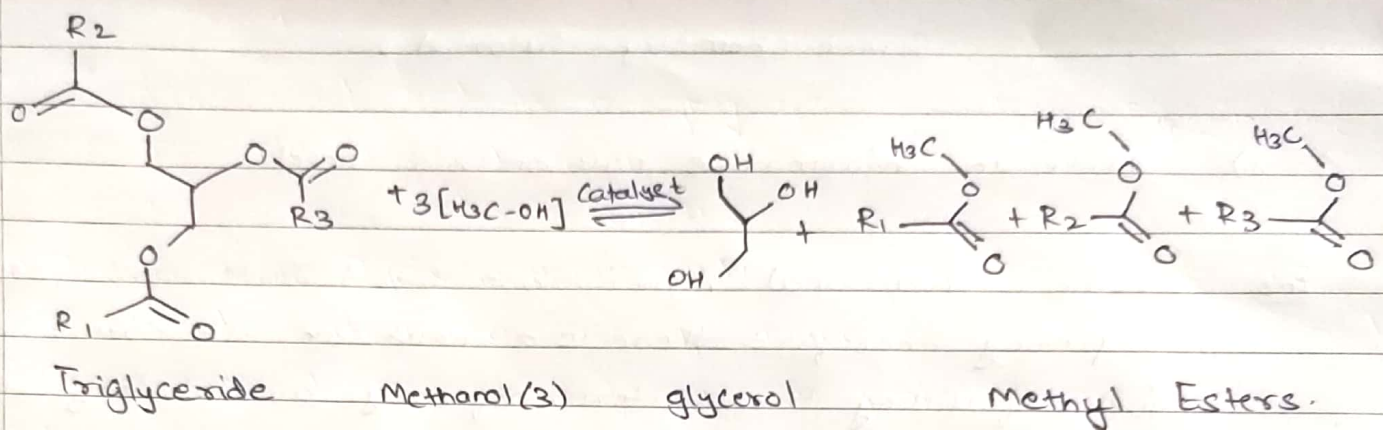
2) Bio-diesel from vegetable oil which comprise of 90-98% triglycerides with small quantities of mono and diglycerides, free fatty acids, phospholipids, carotenes, sulphur compound etc.

3) Biodiesel Synthesis:

i) Biodiesel can be obtained from various vegetables oils like soyabean oil, palm oil, groundnut oil, cotton seed oil, sunflower oil, etc. and also from animal fats. It is obtained by transesterification of vegetable oil or animal fats with methyl alcohol using sodium metal or sodium methoxide as catalyst. Transesterification is the process of converting one ester to another ester.

ii) Vegetable oil or fat is first filtered and then heated at 110°C with stirring to remove any water from it. Sodium methoxide and methanol is then added to it. The mixture is then heated for half an hour with stirring.

iii) The reaction mixture is then cooled and mixed with sufficient amount of water. The glycerol and soap gets dissolved in the water phase. Water insoluble phase is separated and antioxidant is added to it to avoid oxidation and polymerization.

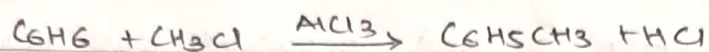
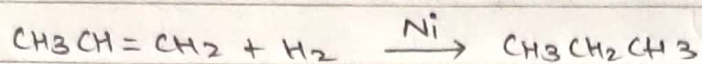


The product is given the name 'Biodiesel' as it is obtained from biological products and it is biodegradable material or green fuel.

Advantages of Biodiesel:

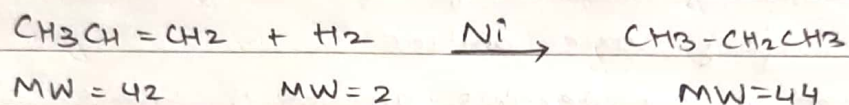
- 1) It is prepared from renewable resources.
- 2) It is biodegradable and non-toxic.
- 3) It is free from sulphur and aromatics.
- 4) It is safer to handle and easy to manufacture.
- 5) It's cetane number is 46 to 52.

2) Calculate the % Atom economy for the following reaction.



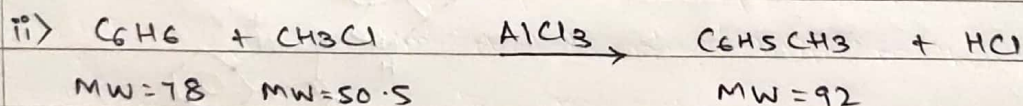
Ans

i)



$$\begin{aligned} \% \text{ Atom Economy} &= \frac{\text{MW of Product}}{\text{Total MW of reactant}} \times 100 \\ &= \frac{44}{42+2} \times 100 \\ &= \frac{44}{44} \times 100 = 100\% \end{aligned}$$

$$\therefore \boxed{\% \text{ Atom Economy} = 100\%}$$



$$\begin{aligned} \% \text{ Atom Economy} &= \frac{\text{MW of Product}}{\text{Total MW of reactant}} \times 100 \\ &= \frac{92}{78 + 50.5} \times 100 \\ &= \frac{92}{128.5} \times 100 = 71.59\% \end{aligned}$$

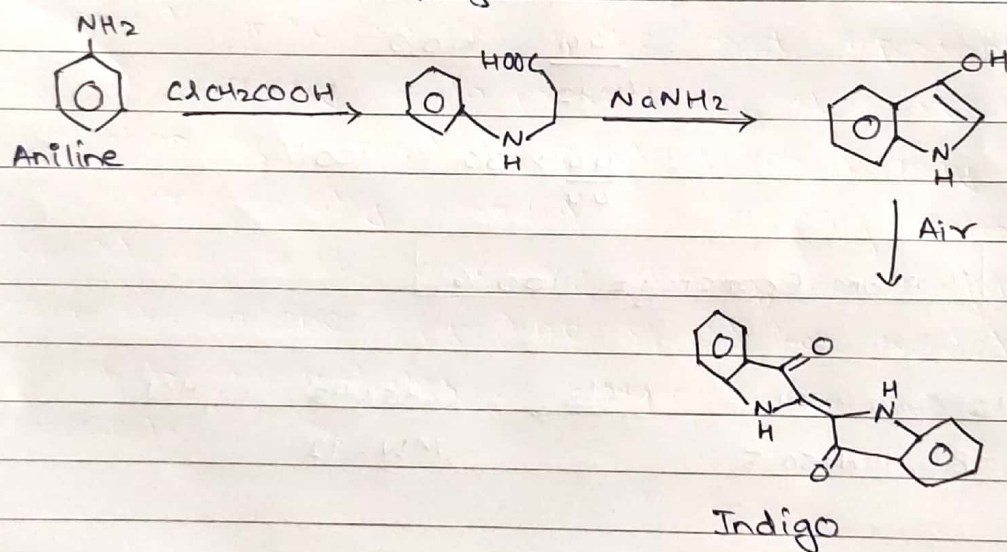
$$\therefore \boxed{\% \text{ Atom Economy} = 71.59\%}$$

- 3) With traditional and green synthesis of indigo, explain the green principle involved in it.

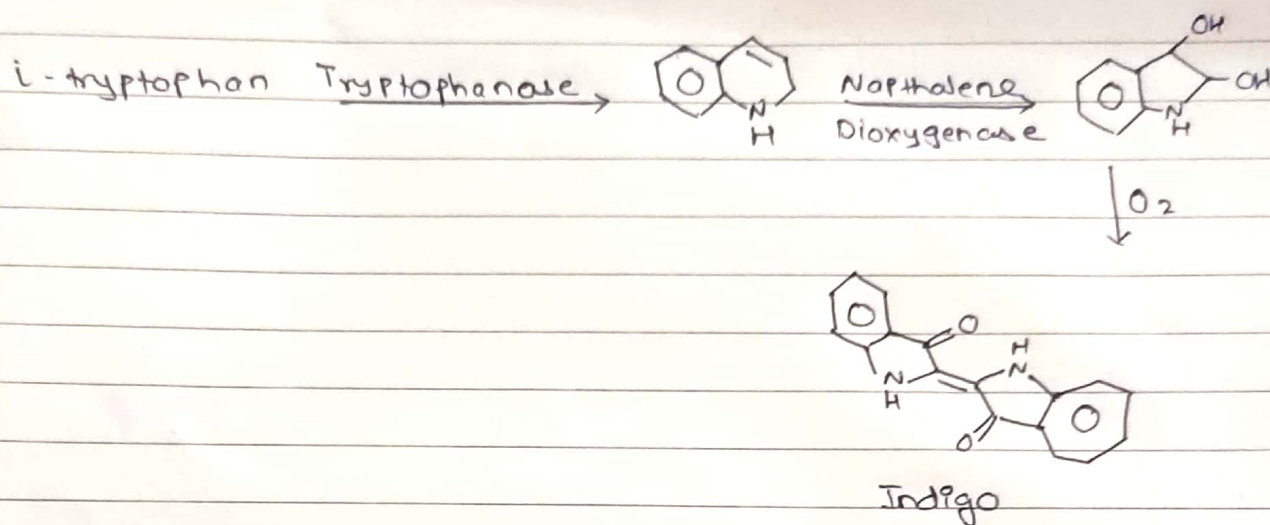
Ans 1) Indigo is the dye which is used to colour blue jeans. The conventional route makes use of aniline as a starting material. The commercial process is facing the problems of:

- (a) Use of highly toxic aniline.
- (b) Generation of considerable amount of waste salts, thereby causing disposal problems.

2) The conventional route for the production of indigo using hazardous aniline is given below:



3) The greener ~~makes~~ route makes use of the reaction in which the side chain of tryptophan is removed enzymatically to give indole. It can be dehydroxylated enzymatically and then oxidized with oxygen to indigo.



4) Green principle involved in it is design less hazardous chemical syntheses. One of the most important principle of green chemistry is to prevent or at least minimize the formation of hazardous product which may be toxic and or environmentally harmful. The starting material selected should be least toxic. eg. use of carcinogenic compounds such as benzene, pyridine should be avoided. The reactions in which intermediates or reagents are toxic should not be followed.