Principles of Green Chemistry:—

(1) Prevention:—

It is better to prevent waste than to treat or clean up waste after is formed.

(2) Atom Economy:—

Synthetic methods should be designed to maximize the incorporation of all materials used in the process into the final products.

(3) Less hazardous Chemical synthesis:—

Wherever practicable synthetic methods should be designed to use and generate substances that possess little or no toxicity to human health & environment.

(4) Designed Safer Chemicals:—

Chemical products should be designed to preserve efficacy of function while reducing toxicity.

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(5) Safer Solvents & auxiliaries:—

The use of auxiliaries substances (eg: solvents, separation agents etc) should be made unnecessary wherever possible and innocuous when used.

(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 feed stocks:—

A raw material feed stock should be renewable rather than depleting whenever technically and economically practicable.

(8) Reduced Derivatives:—

Unnecessary derivatization (use of blocking groups, protection, deprotection temporary modification of physical/chemical process) should be avoided whenever possible.

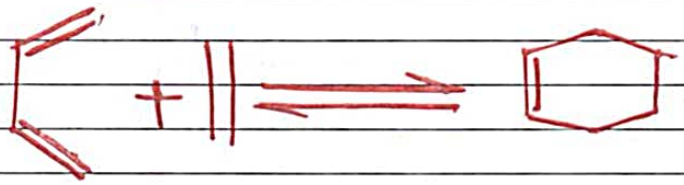
① Atom Economy :-

Atom economy is defined as the ratio of the formula weight of the target molecule to the formula weight of all the starting materials and the reagents.

$$\% \text{ atom economy} = \frac{\text{mass of atoms in desired products}}{\text{total mass of atoms in reactants}} \times 100$$

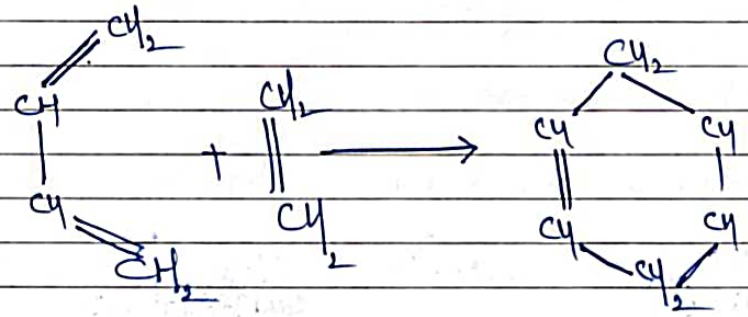
For a reaction to be considered as green synthesis, the atom economy must be very high, approching or equal to 100%. Then most of the reactant atoms are incorporated into the final product, thereby reducing the waste or the by products.

Eg:- Calculate % atom economy for cyclo addition reaction of ethene and butadiene to form cyclohexene.



1,3 butadiene ethene cyclohexene.

Sol^n



1,3 butadiene ethene. cyclo-hexene.

molecular mass of butadiene C_4H_6	molecular mass of ethene C_2H_4	molecular mass of cyclohexene C_6H_{10}
4C + 6H	2C + 4H	6C + 10H
4X12 + 6X1	2X12 + 4X1	6X12 + 10X1
48 + 6	24 + 4	72 + 10
54 gm	28 gm	82 gm.

% of atom economy = $\frac{\text{mass of atoms in desired product}}{\text{total mass of atoms in reactants.}} \times 100\%$

$= \frac{82}{54+28} \times 100\%$

$= \frac{82}{82} \times 100\%$

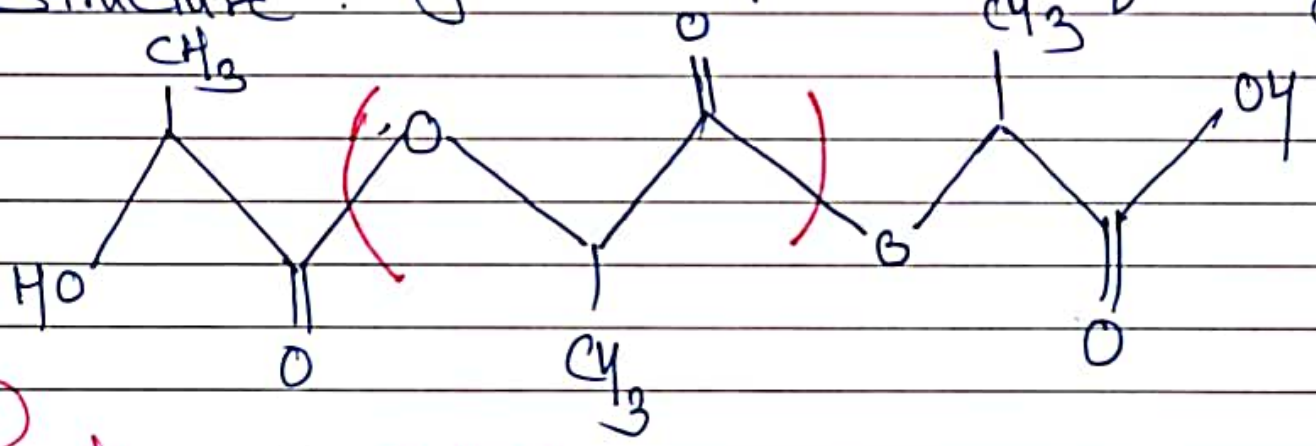
$= 100\%$

Biodiesel & carbon neutrality :-

Biodiesel is said to be carbon-neutral because the carbon dioxide that is absorbed by the plants for photosynthesis process is equal to the carbon dioxide that is released when the fuel is burnt. So there will be no net increase of CO_2 emission to the atmosphere.

Polylactic acid :-

- This is a biodegradable thermoplastic polyester.
- It belongs to the class of polyhydroxy alkanoates.
- Are derived from renewable sources such as starch or sugar cane posses the following structure.



Properties of PLA :-

- PLA polymers range from amorphous glassy polymers to semi crystalline & highly crystalline polymer.
- The glassed transition temperature of PLA is 60-65°C
- Melting point of PLA is 173-178°C
- It possess good bio compatibility, processability as well as high strength.