M.SC Semester III
Core Course XII
Environmental Chemistry

TOPIC:- Unit IV, Green Chemistry, Ultrasound Mediated Reaction

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Ultrasound Mediated Reaction

- Ultrasound is defined by the American National Standards Institute as "sound at frequencies greater than 20 kHz."
- Ultrasound is sound waves with frequencies higher than the upper audible limit of human hearing.
- Ultrasound is no different from 'normal' (audible) sound in its physical properties, except in that humans cannot hear it.

Ultrasound Mediated Reaction

- The ultrasound irradiation (also referred to as sonochemistry) is an important tool in the field of organic chemistry.
- This technique has become extremely popular in promoting various chemical reactions since the decade 1990–1999.
- The application of ultrasound has been useful in accelerating dissolution, enhancing the reaction rates, and renewing the surface of a solid reactant or catalyst in a variety of reaction systems.
- In recent years, the effect of ultrasonic energies in organic synthesis (homogeneous and heterogeneous reactions) has widely increased.

Ultrasound Mediated Reaction

- The use of ultrasound in chemical reactions in solution provides specific activation based on a physical phenomenon.
- acoustic cavitation. Cavitation is a process in which mechanical activation destroys the attractive forces of molecules in the liquid phase.
- Applying ultrasound, compression of the liquid is followed by rarefaction (expansion), in which a sudden pressure drop forms small, oscillating bubbles of gaseous substances.
- These bubbles expand with each cycle of the applied ultrasonic energy until they reach an unstable size; they can then collide and/or violently collapse.

Ultrasound Mediated Reaction

- Two of the most important advantages in the use of sonochemistry in organic synthesis.

1. Increase of reaction rates
2. Increase of product yields

- So this methodology is more convenient when compared with the traditional method, and it can be easily controlled.
- For Heterocycles Heterocycles are one of the most popular and important organic compounds because they are involved in many fields of science.

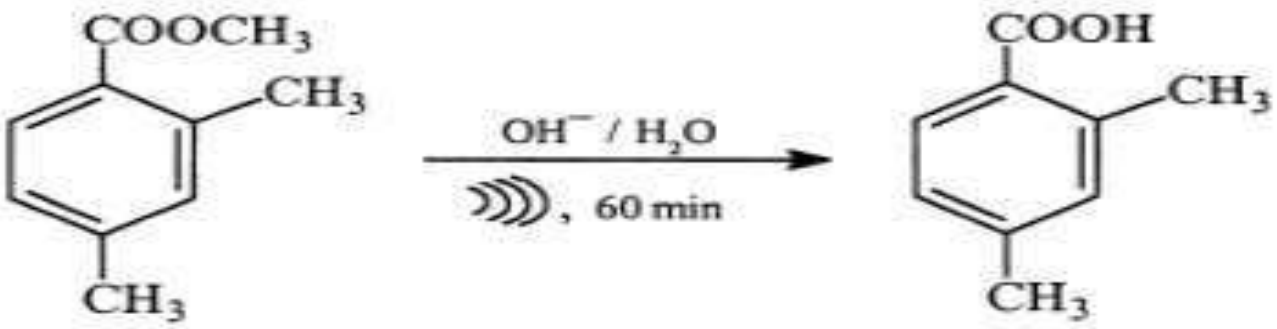
Ultrasonic Reactions

- Esterification:
- This is generally carried out in presence of a catalyst like sulphuric acid, p-toluenesulphonic acid, tosylchloride, polyphosphoric acid, dicyclohexylcarbodiimide etc. The reaction takes longer time and yields are low.

Scheme 1

Ultrasonic Reactions

- Saponification: can be carried out under milder conditions using sonification. Thus, methyl 2,4-dimethylbenzoate on saponification (20 KHz) gives the corresponding acid in 94% yield (Scheme 2), compared to 15% yield by the usual process of heating with aqueous alkali (90 min).



Scheme 2