



Green Chemistry

Green Chemistry

- ❖ Definition
- ❖ principles
- ❖ Goal & need
- ❖ Efficiency Parameters



Green Chemistry

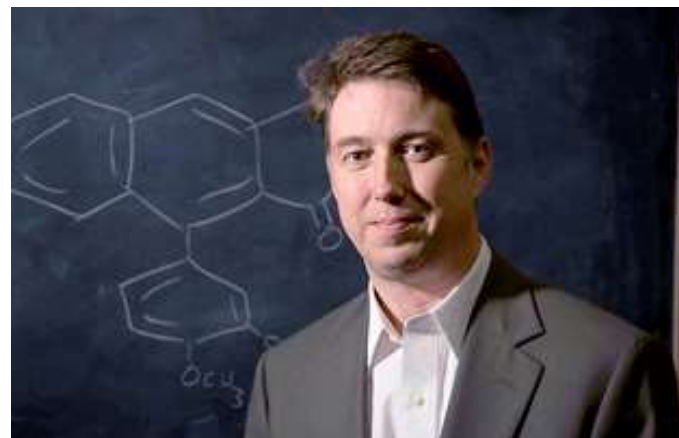
design of chemical products and processes that reduce or eliminate the use or generation of hazardous substances

Focus on Chemical Synthesis Process Chemistry and Chemical Engineering

- ❖ **Alternative Reaction Condition**
- ❖ **Incorporation of catalyst**
- ❖ **Alternative pathway**
- ❖ **Synthesis of biodegradable material**

Green Chemistry

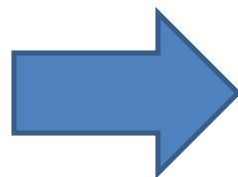
- ❖ Green Chemistry was Coined by **Paul T Anastas**
- ❖ **Green chemistry** also called sustainable **chemistry**
- ❖ An area of **chemistry** and **chemical** engineering focused on the designing of products and processes that minimize the use and generation of hazardous substances.



Paul T Anastas

Green Chemistry

**Green Chemistry
Aims at Reducing**



Waste

Materials

Hazard

Risk

Energy



Principles Of Green Chemistry





Goals of Green Chemistry

- ❖ To reduce adverse Environmental Impact
- ❖ To prefer renewable materials
- ❖ to Reduce use of Toxic materials
- ❖ To prefer hazard free processes
- ❖ To reduce byproduct formation
- ❖ To reduce use of Toxic Solvents
- ❖ To improve Energy Efficiency
- ❖ To develop processes for toxicity monitoring
- ❖ To prefer and synthesize biodegradable materials

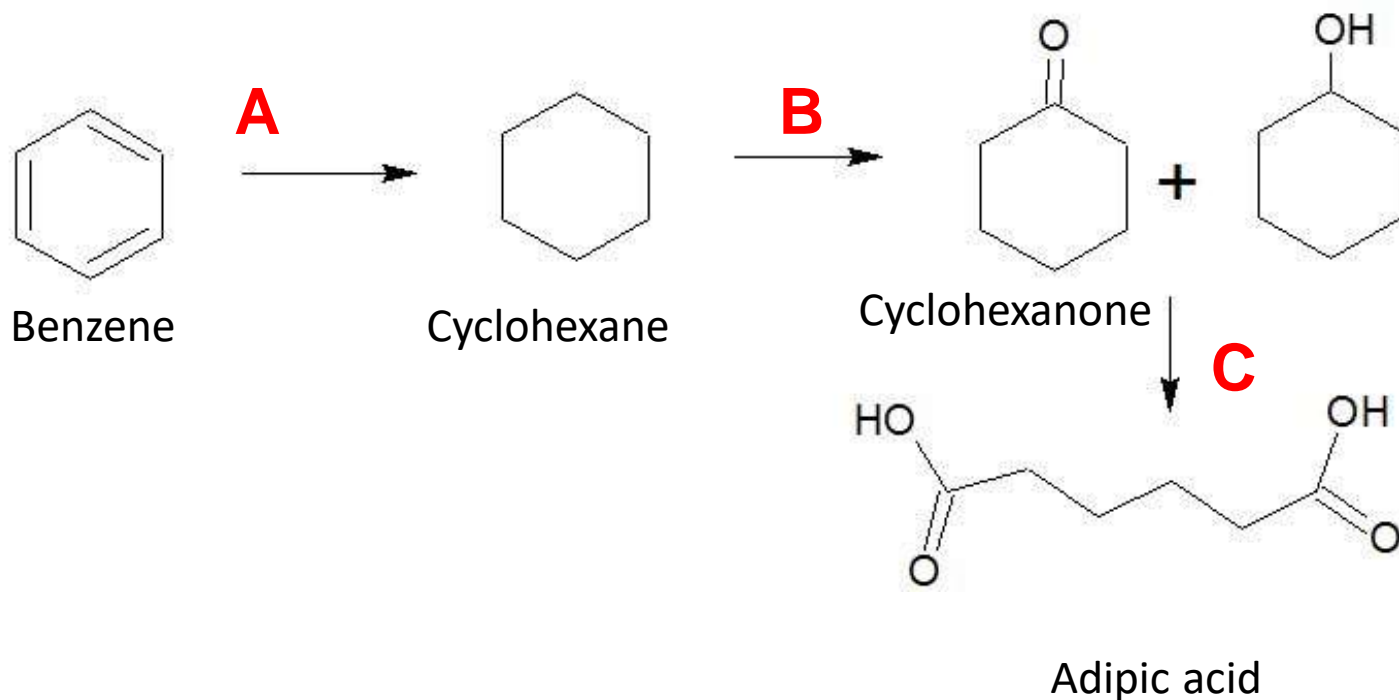


Efficiency Parameters

- ❖ Atom Economy
- ❖ Yield of reaction
- ❖ Environmental load factor
- ❖ Mass intensity
- ❖ Conversion
- ❖ Reaction Selectivity



Chemical Route For Adipic Acid



A: Ni Al₂O₃

B: CO O₂ 120 psi

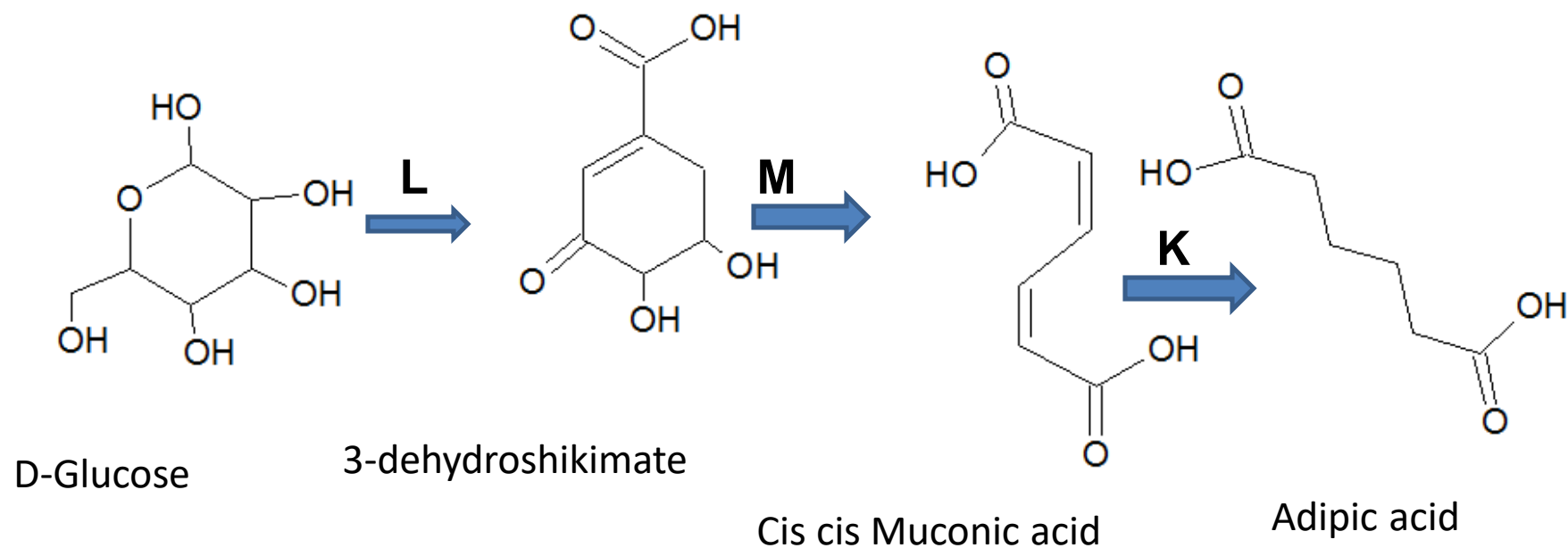
C: Cu NH₄VO₃ HNO₃



Drawbacks Of Chemical Route Of Adipic Acid

- ❖ **Benzene is Carcinogenic Staring Material**
- ❖ **High Pressure and high Temp requirement**
- ❖ **Less Atom Economy**

Greener Route For Adipic Acid

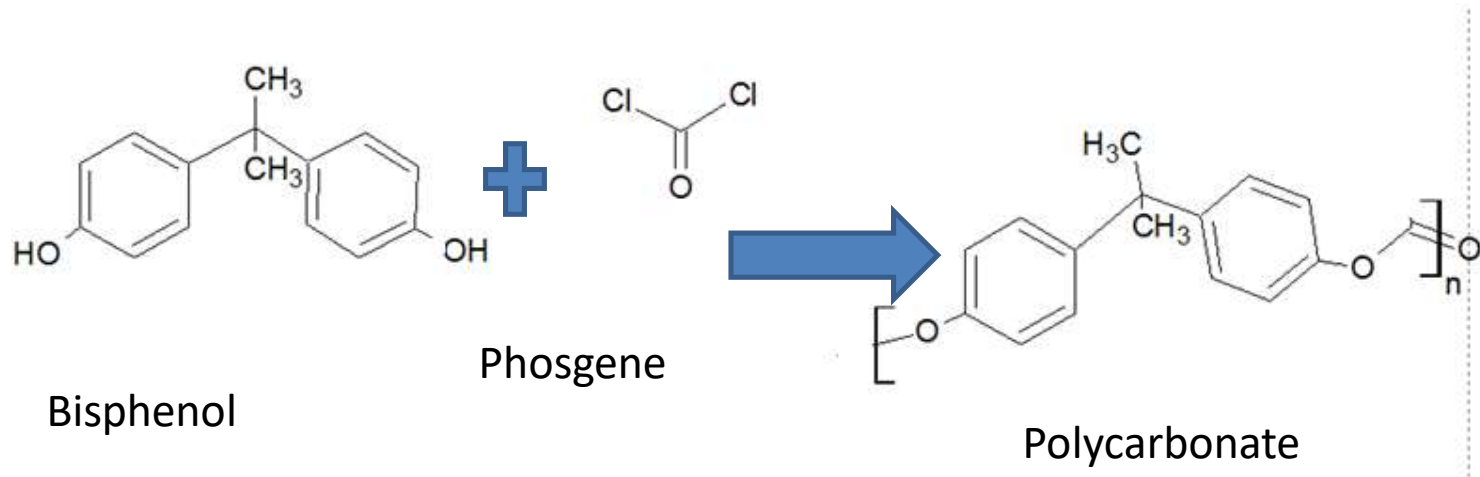


L : E.Coli

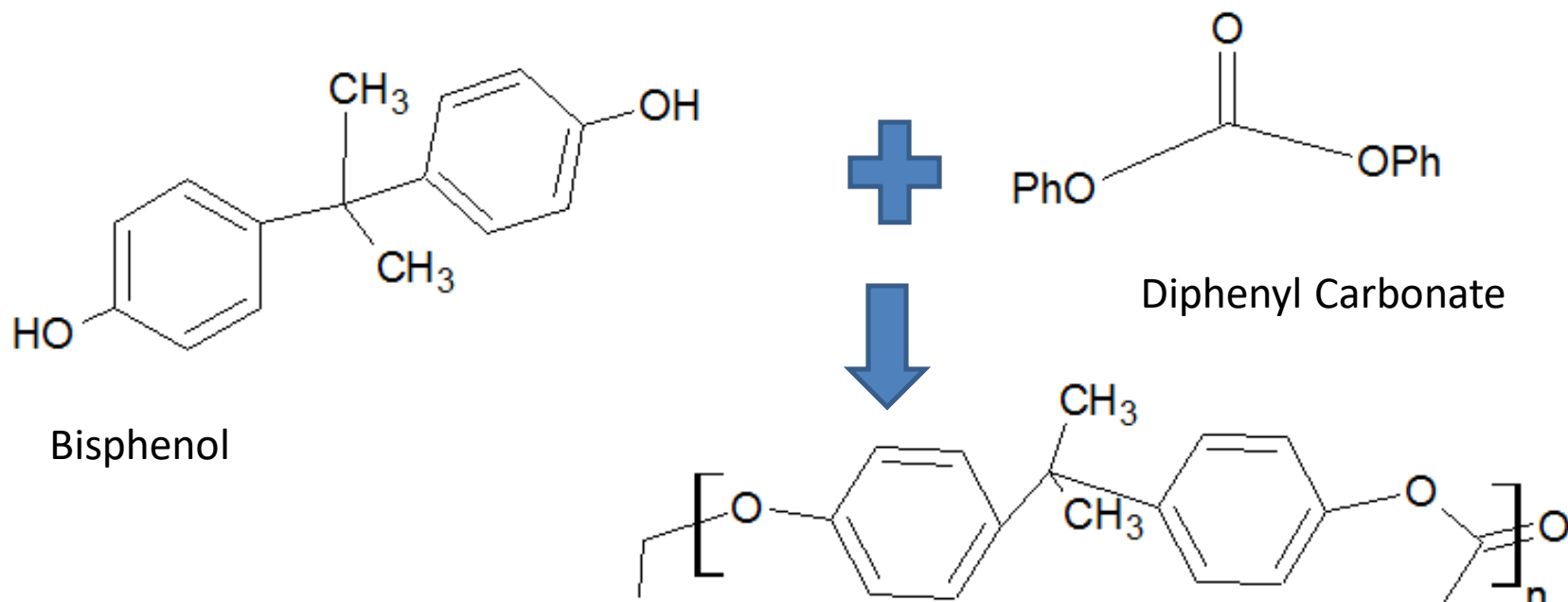
M: E.Coli

K : H₂/Pt

Chemical Route For Polycarbonate



Greener Route For Polycarbonate





Advantages Of Greener Route Of Polycarbonate

- ❖ Komiya et al reported synthesis of polycarbonate (Asahi chemical Japan)
- ❖ No need of Solvent (Solid phase Synthesis)
- ❖ Polymerization takes place in Molten state
- ❖ Use of DCM is Eliminated



Industrial Applications Of Green Chemistry

- ❖ DMC is used as Electrolyte in Ion Battery
- ❖ Selective palladium ($\text{Pd}(\text{OAc})_2$)- catalyzed cyclocarbonylation reactions were carried out for the synthesis of lactones from allyl phenol derivatives in DMC

Reference: <https://doi.org/10.1016/j.cogsc.2017.03.012> (Sang-Hyun Pyoa, Ji Hoon Parkb, Tae-Sun Changb, Rajni Hatti-Kaula)



Use Of DMC

- ❖ DMC chemistry has been extended to include acid catalyzed reactions of different aliphatic alcohols and phenols
- ❖ DMC has shown a good extraction performance for triglycerides
- ❖ DMC as Methylating agent in place of DMS



Polyurethane Via Green Approach

- ❖ Chemical route involve use of phosgene
- ❖ In greener route Phosgene is replace by CO₂

