



2006 **\$300,000,000,000** (Billion)
value of imported oil

We need engineers to become more efficient

To reduce consumption

To reduce CO₂

To reduce \$ outflow

September 25, 2007

DOE/EIA Report 0383 (2007)

Crude Oil to DVDs

The Production of a Common Product
from Raw Materials

Iyyanna Gavini
Chemical
Engineering
UIC

UIC COLLEGE OF
ENGINEERING

Megan Pukala
Chemical Engineering
Northwestern University



John Stushek
Electrical Engineering
UIC

UIC COLLEGE OF
ENGINEERING

Presentation Outline

Iyyanna Gavini
Chemical Engineering
UIC

Megan Pukala
Chemical Engineering
Northwestern
University

John Stushek
Electrical Engineering
UIC

Crude oil



Benzene



Polycarbonate



DVDs

Crude Oil to Benzene



University of Illinois at Chicago

Iyyanna Gavini
Chemical

Introduction

- Black gold
- Unprocessed oil
- Fossil fuel
- Distillation of crude
- Products for consumers



Extraction



- From
 - Oil wells
 - Porous rocks in the Earth's crust
 - Oil sands
 - Oceans



Transportation

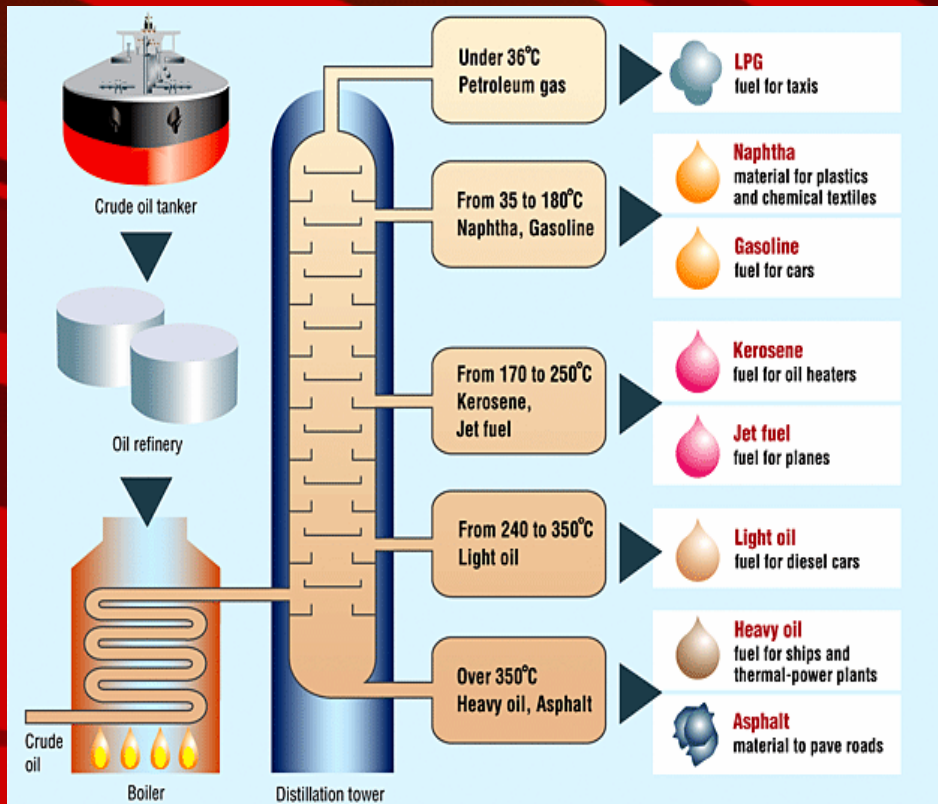
- Preferred modes of transport
 - Pipelines
 - Oil tankers
 - Railroads
- Other modes
 - Trucks for local delivery
 - Barges

Oil Tankers



- Tanker carrying 2 million barrels of crude oil
- Supertanker is 1504 ft long & 226 ft wide
- More economical than pipelines in water
- Environmentally damaging oil spills are possible

Distillation



- Crude heated at 700F
- Light components out top
- Heavy components out bottom
- Fractional distillation
- More on oil refining

Products



■ Major Products

- Gasoline
- Jet fuel
- Diesel
- Petrochemical

■ By-Products

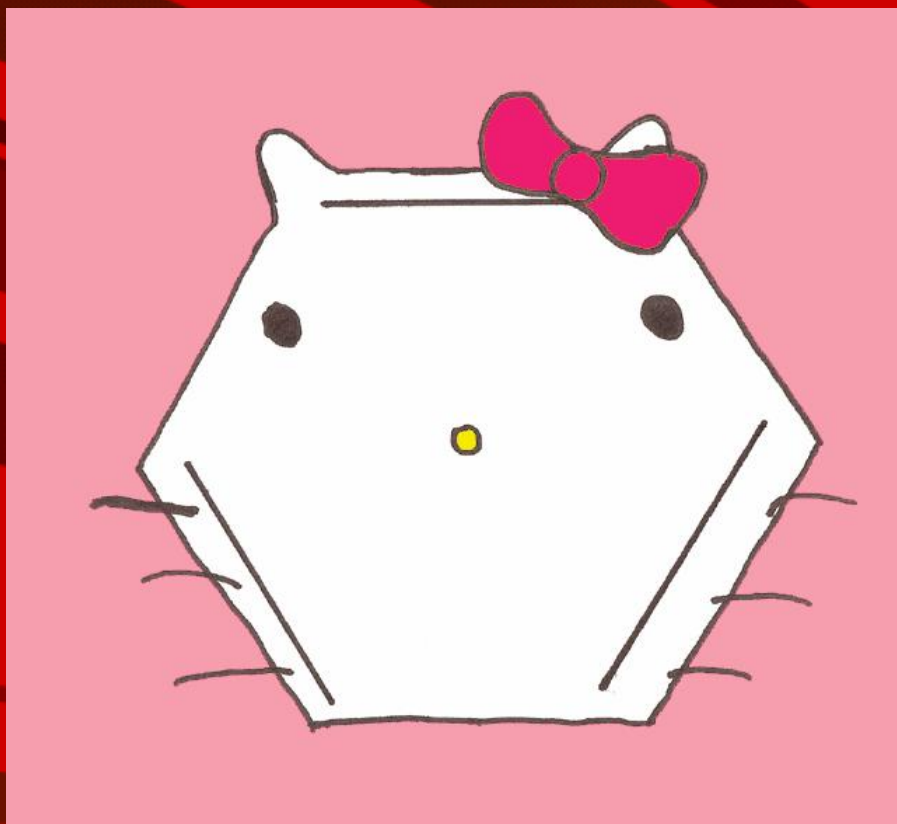
- Asphalt
- Wax
- Lubricants
- Sulfur

Petrochemicals

- Organic compounds
- Raw materials
 - Oil and gas
- Uses
 - Synthetic fibers
 - Pesticides
 - Food
- PVC'S in industry
- Puma's use of PVC
- More on petrochemicals
- Benzene



Benzene



- Natural constituents
- Aromatic hydrocarbon
- Important industrial solvent
- Carcinogenic
- Steam cracking

Benzene to Polycarbonate

Megan Pukala

Chemical Engineering



NORTHWESTERN
UNIVERSITY



NORTHWESTERN
UNIVERSITY

Polycarbonate Commercial Importance

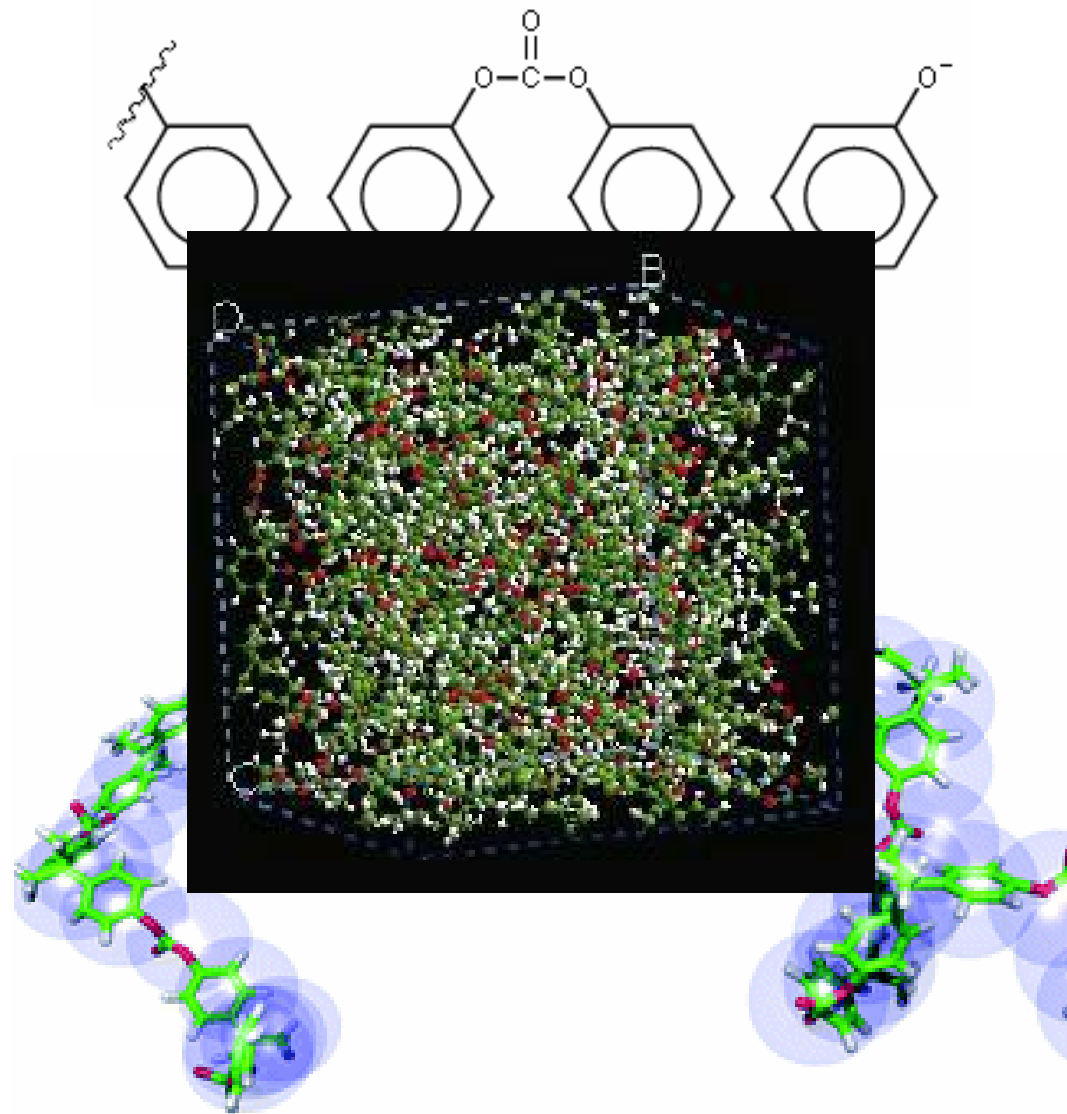




NORTHWESTERN
UNIVERSITY

Polycarbonate Structure & Properties

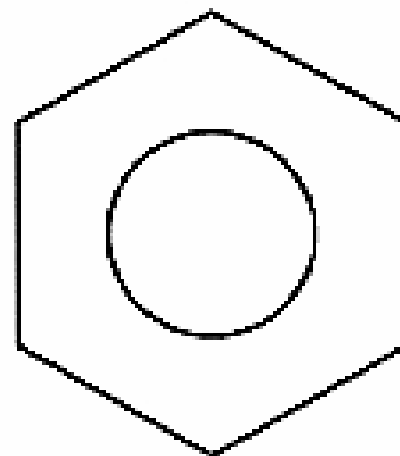
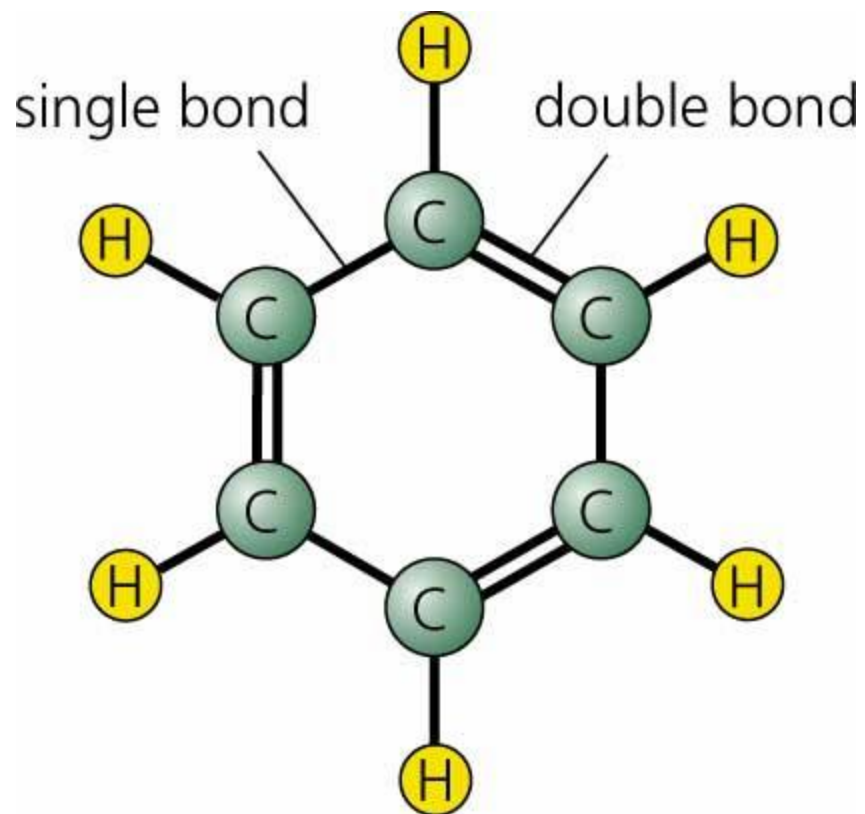
- Synthetic
- Thermoplastic
- Amorphous
- Transparent (optical clarity)
- High temperature and impact resistance





NORTHWESTERN
UNIVERSITY

Benzene (C_6H_6)





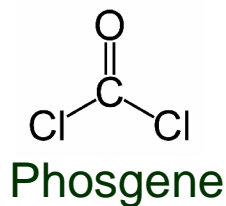
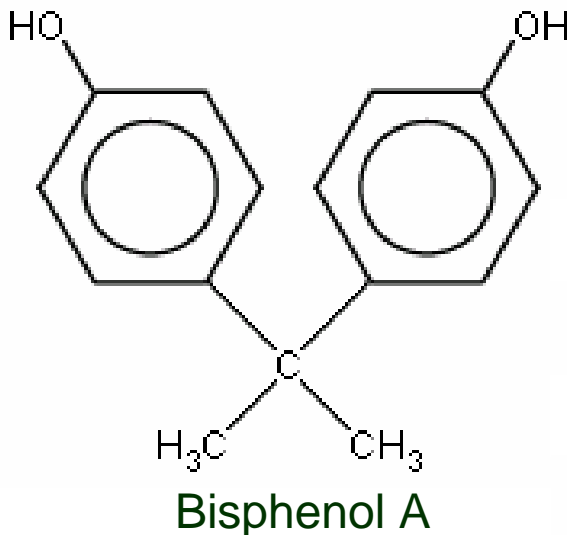
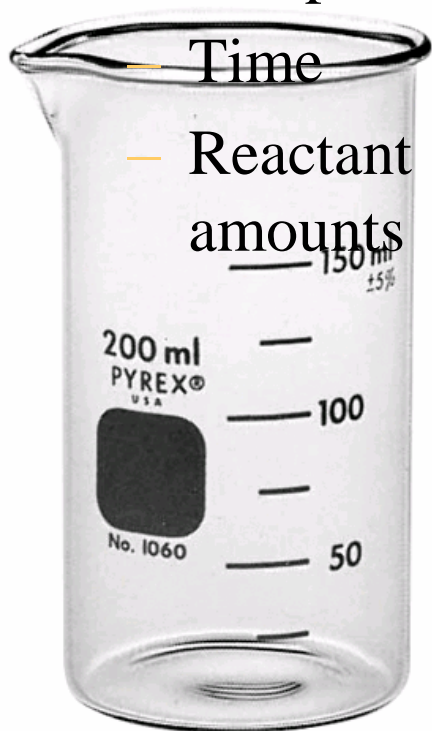
Polymerization

- Large scale

- Temperature

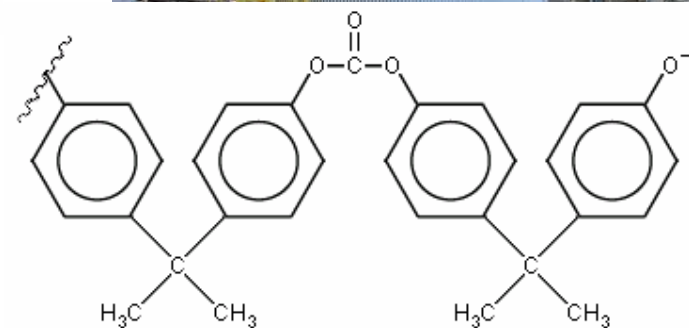
- Time

- Reactant amounts



NaOH
Sodium

- Small scale





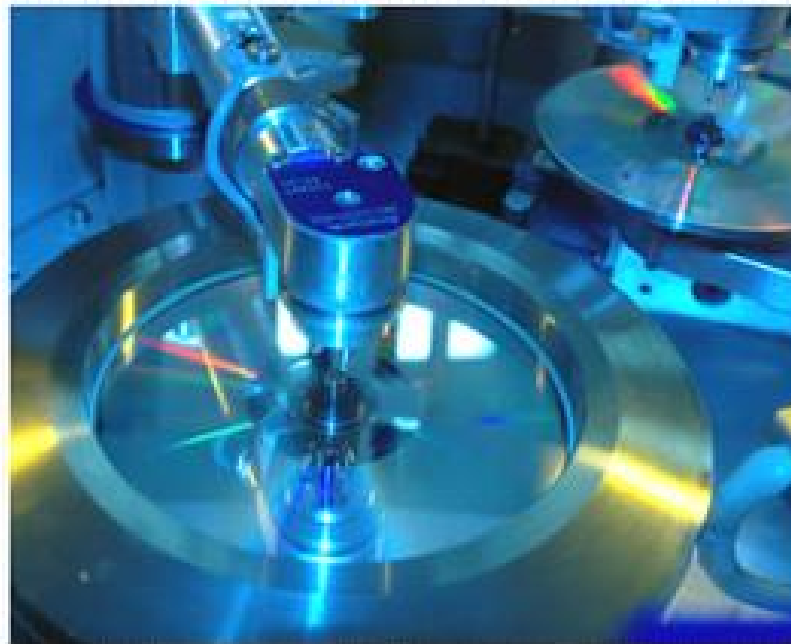
NORTHWESTERN
UNIVERSITY

Final Product

- GE Plastics Lexan resin
 - Injection molded
 - DVD quality resin is boxed and sealed in 3000 lb increments to preserve sterility



Polycarbonate to DVDs



UIC COLLEGE OF
ENGINEERING

John Stushek
Electrical Engineering

Binary

- Analogue prone to error
- Converted to binary
(1 0 0 1)
- Represented as reflective or non-reflective areas on DVD
- Very small spacing between areas



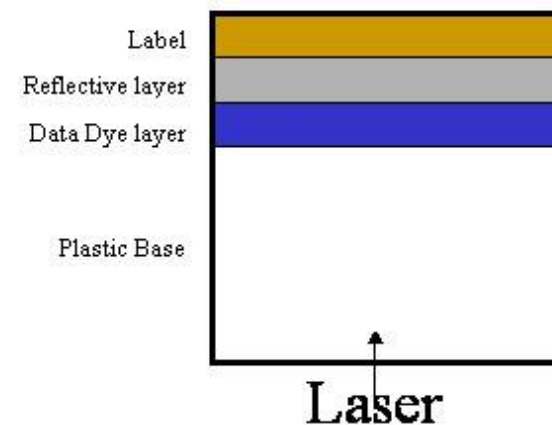
Methods of Production

- Number of different methods
- Type used is determined by a variety of different factors



Method One: Burning

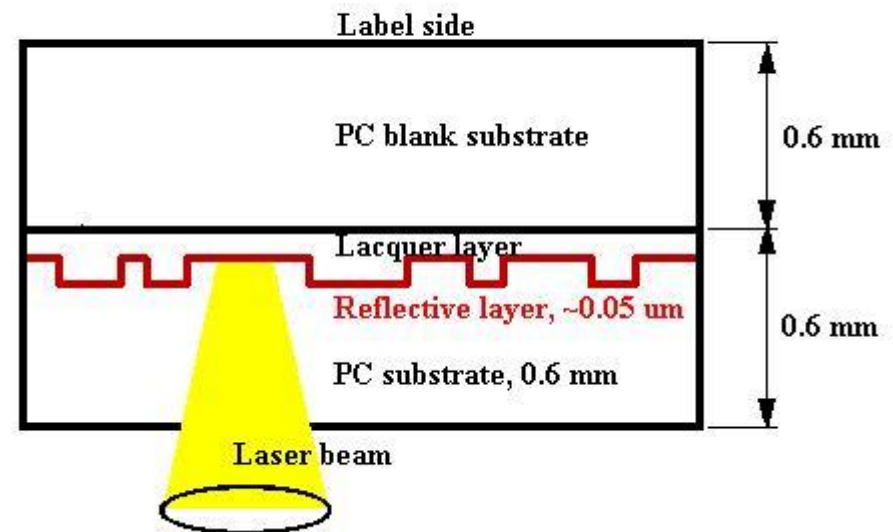
- Only method used at home
- Permanent burning
 - Translucent dye
 - Single use
- Rewritable burning
 - Phase-changing material used
 - Disc formatting possible



Method Two: Stamping

- Glass master burned
- Nickel sputtered onto master
- Metal stamper formed
- Polycarbonate pressed
- Aluminum sputtered
- Substrates bonded

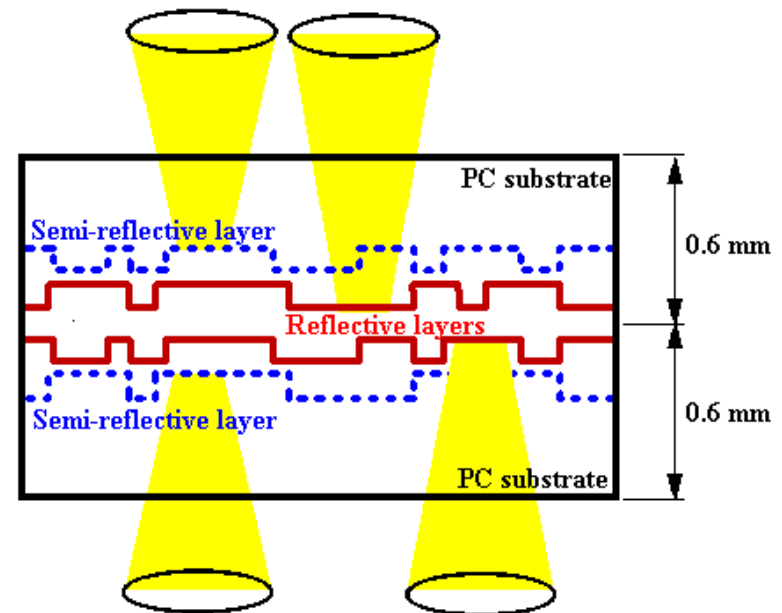
DVD-5: Single Side, Single Layer Disk (4.7 GB)



Multiple Layers

- Double-sided option
- Dual-layer preferable
- Gold is translucent
Aluminum is not
- Bigger spacing between bits

DVD-18: Double Side, Double Layer Disk (17.08 GB)



Final Product



Questions?

Iyyanna Gavini
Chemical
Engineering
UIC

UIC COLLEGE OF
ENGINEERING

Megan Pukala
Chemical Engineering
Northwestern University



John Stushek
Electrical Engineering
UIC

UIC COLLEGE OF
ENGINEERING