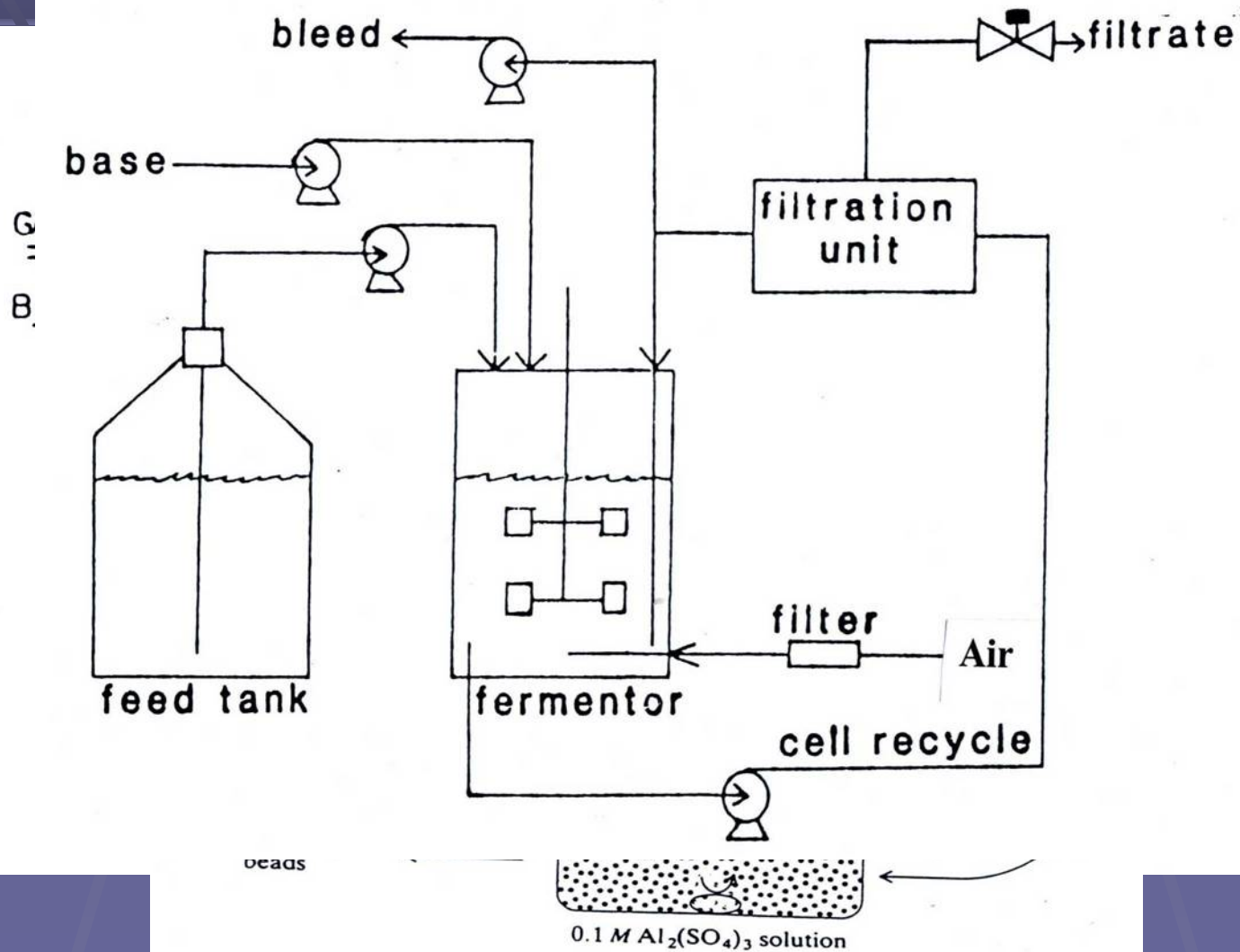


Biofilm bioreactors for biofuel productions

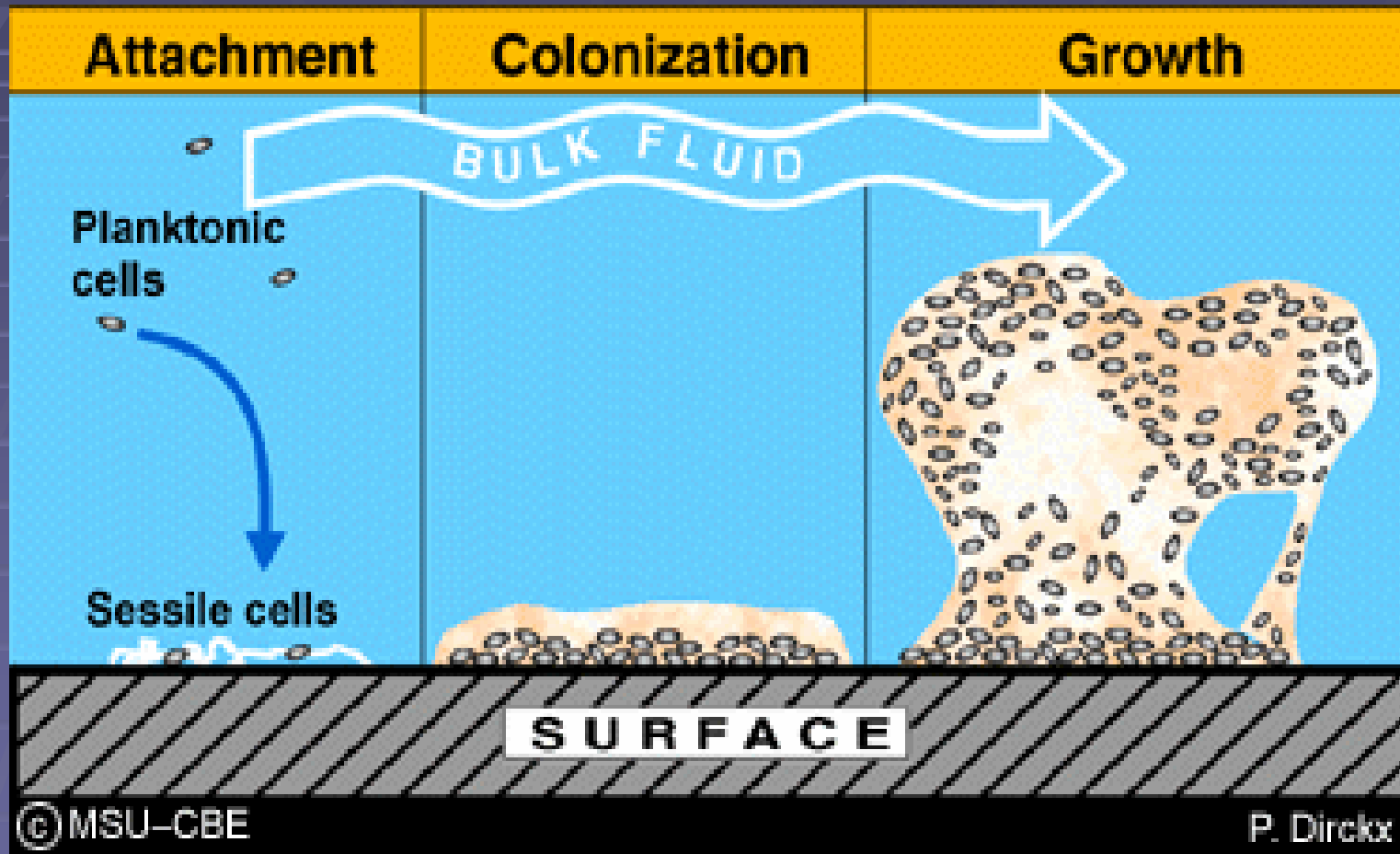
Ali Demirci

Department of Agricultural and Biological Engineering
The Huck Institutes of the Life Sciences
The Pennsylvania State University

METHODS TO INCREASE BIOMASS IN REACTOR



BIOFILM FORMATION



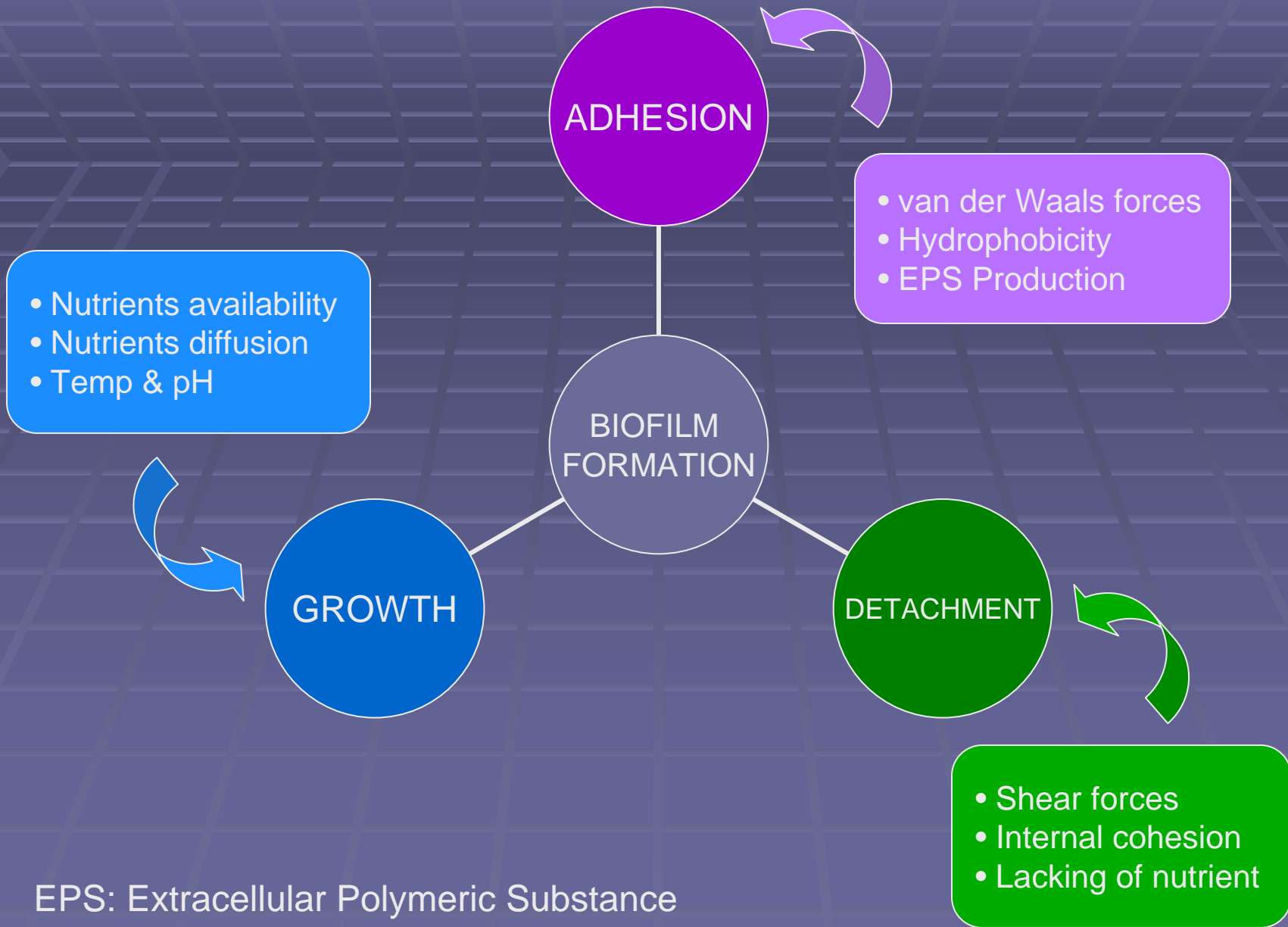
BIOFILM

- Disadvantages:

- Infections: dental, implant
- Fouling: pipe, pump, heat exchanger

- Advantages:

- Value-added products: organic acid, ethanol
- Waste water treatment
- Bioremediation: metal recovery, bioconversion

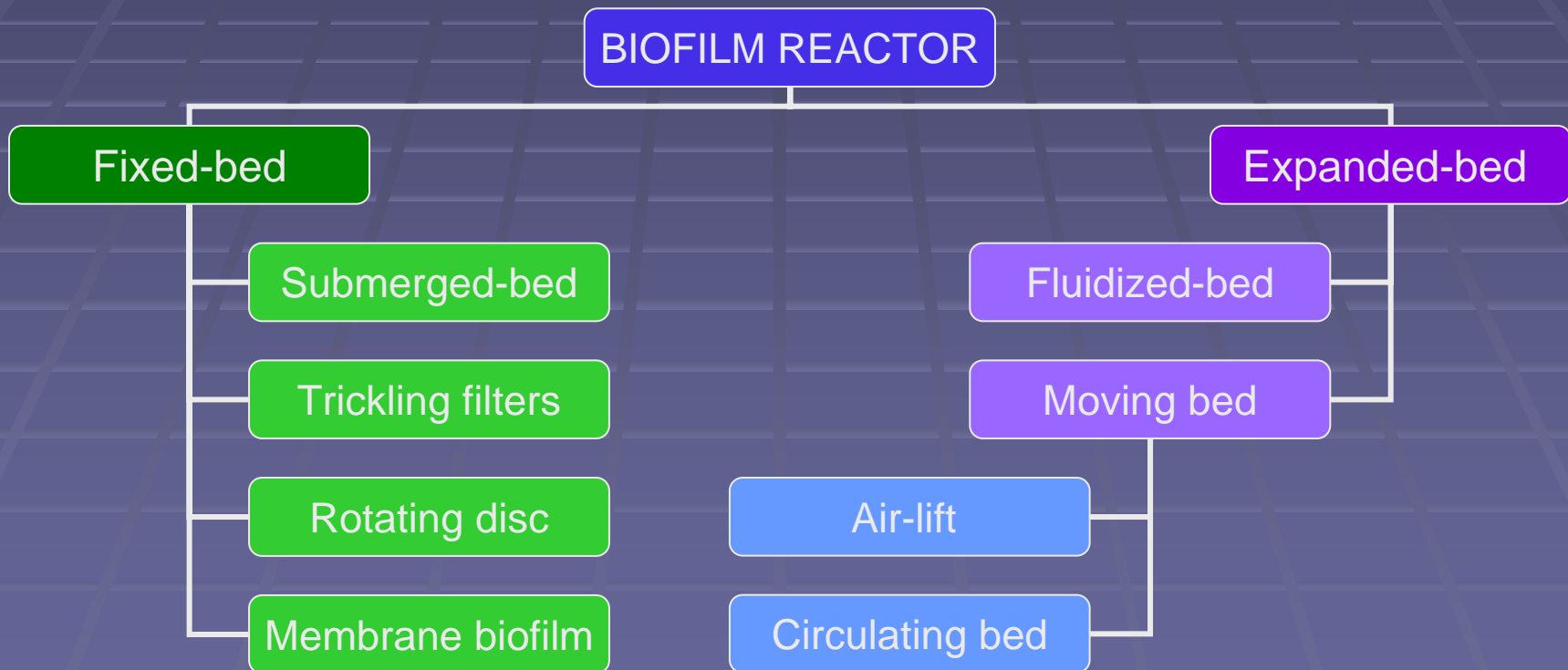


EPS: Extracellular Polymeric Substance

ADVANTAGES OF BIOFILM REACTOR

- Higher biomass density in reactor
- Increasing production rates
- Reuse of cell without cell recycle
- No need of re-inoculation in repeated-batch fermentation
- Prevent “wash out” when using continuous process at high dilution rate
- High operation stability (more resistance to extreme conditions)

TYPES OF BIOFILM REACTOR

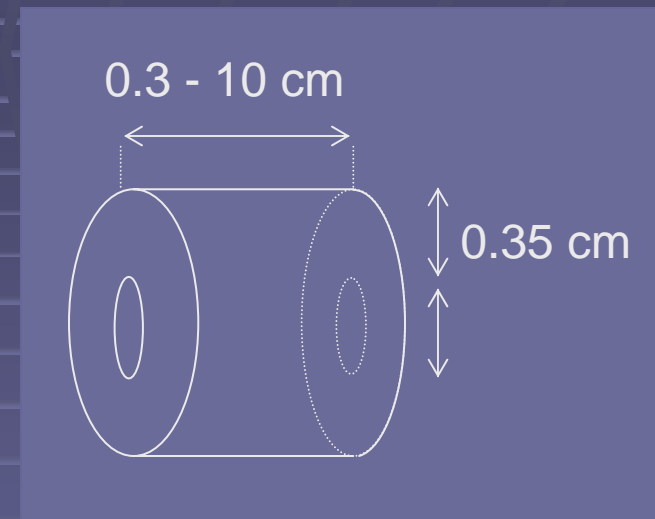


BIOMASS SUPPORT PARTICLES

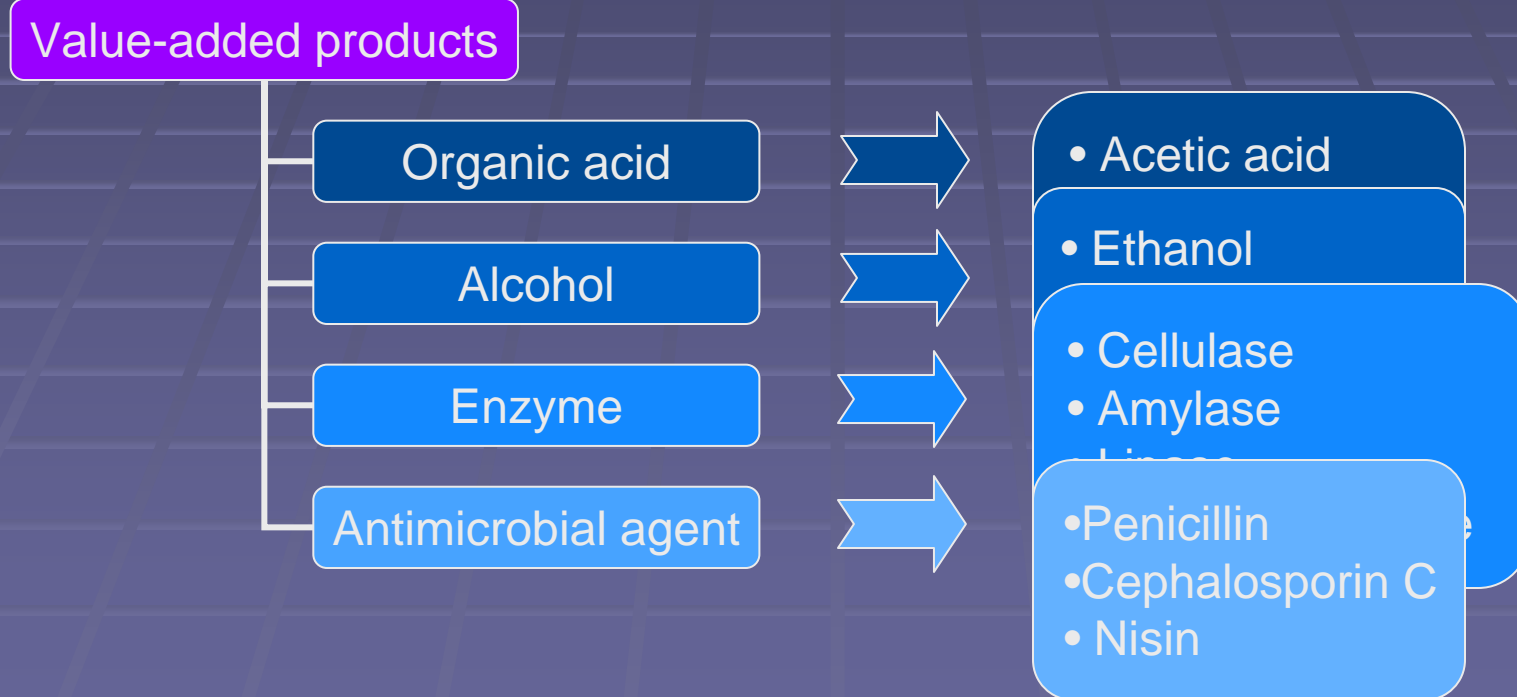
- Favor microbial adhesion
 - Surface charge
 - Hydrophobicity
 - Roughness
 - Porosity
 - Specific area (area per volume)
- High mechanical resistance
- Great availability
- Cost effectiveness

PLASTIC COMPOSITE SUPPORT (PCS)

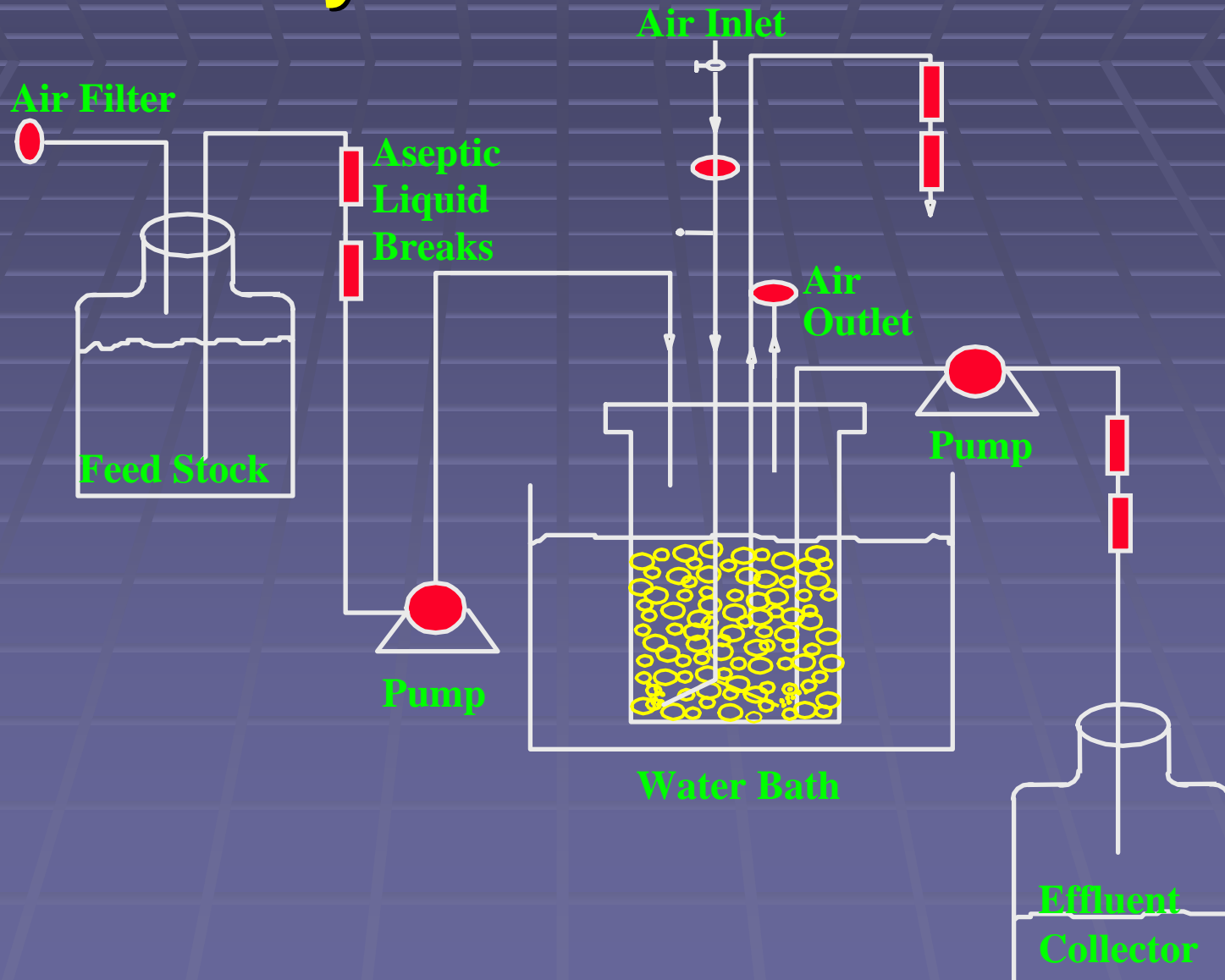
- Developed at Iowa State University
(U.S. Patent Number: 5,535,893)
- Extrusion of
 - Polypropylene (50%w/w): Matrix
 - Agricultural products: Provide essential nutrients
 - Soy bean hull 35% (w/w)
 - Yeast extract 5%
 - Soy bean flour 5%
 - Dried bovine albumin 5%
 - Mineral salts trace amount



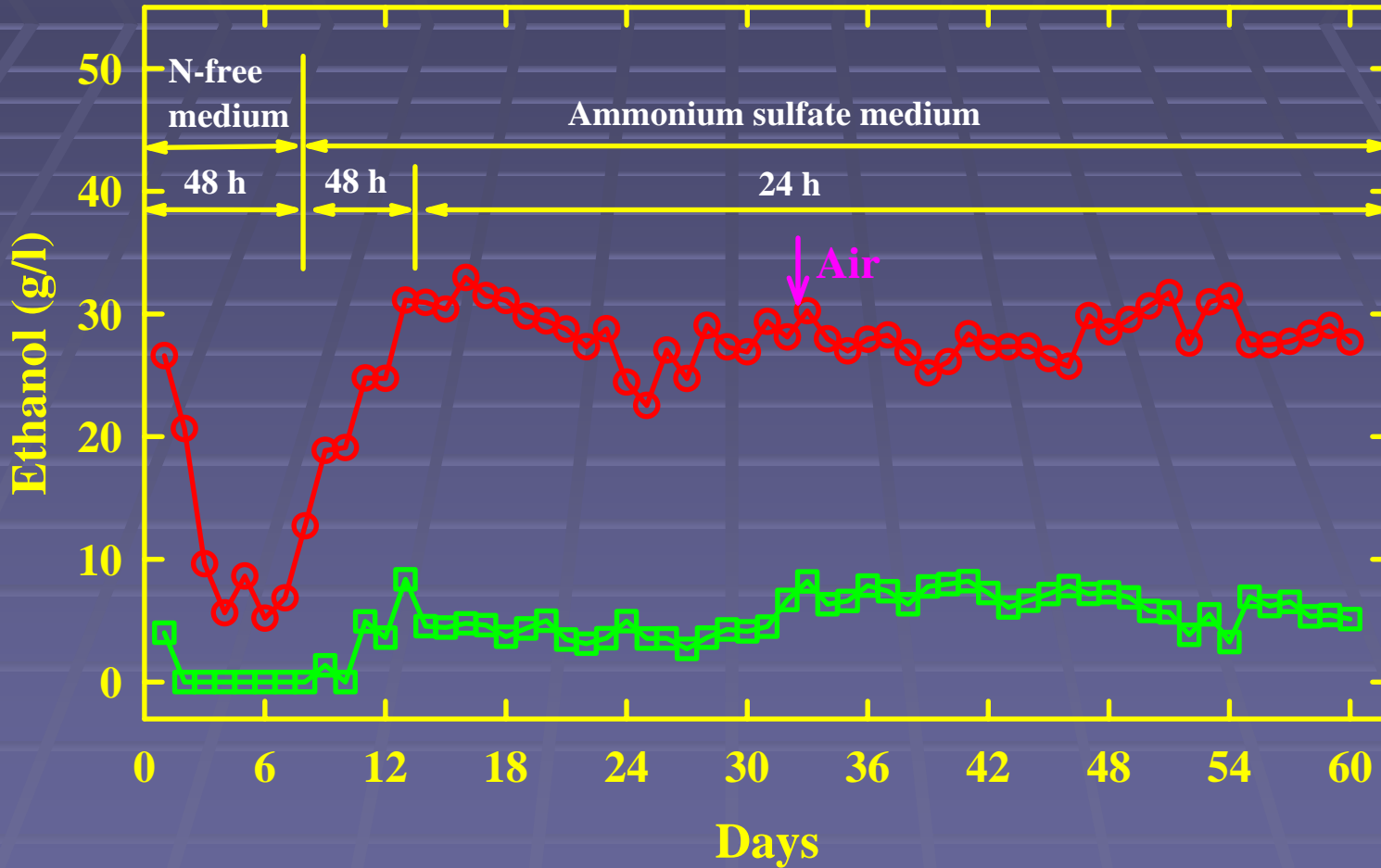
APPLICATIONS OF BIOFILM REACTOR



Repeated Batch Fermentation by *S. cerevisiae*



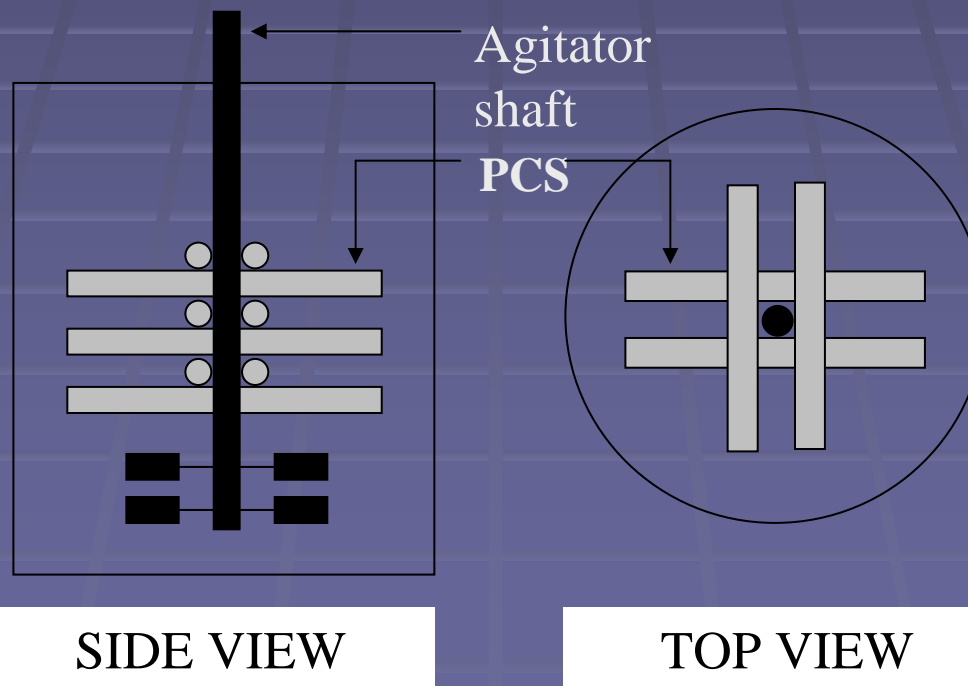
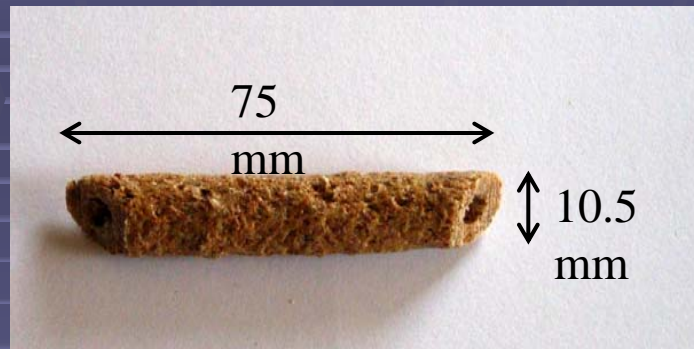
Repeated Batch Fermentation by *S. cerevisiae*



○ Soy hulls + Soy flour + Yeast extract + Salts

□ Polypropylene alone

PCS Biofilm Reactor

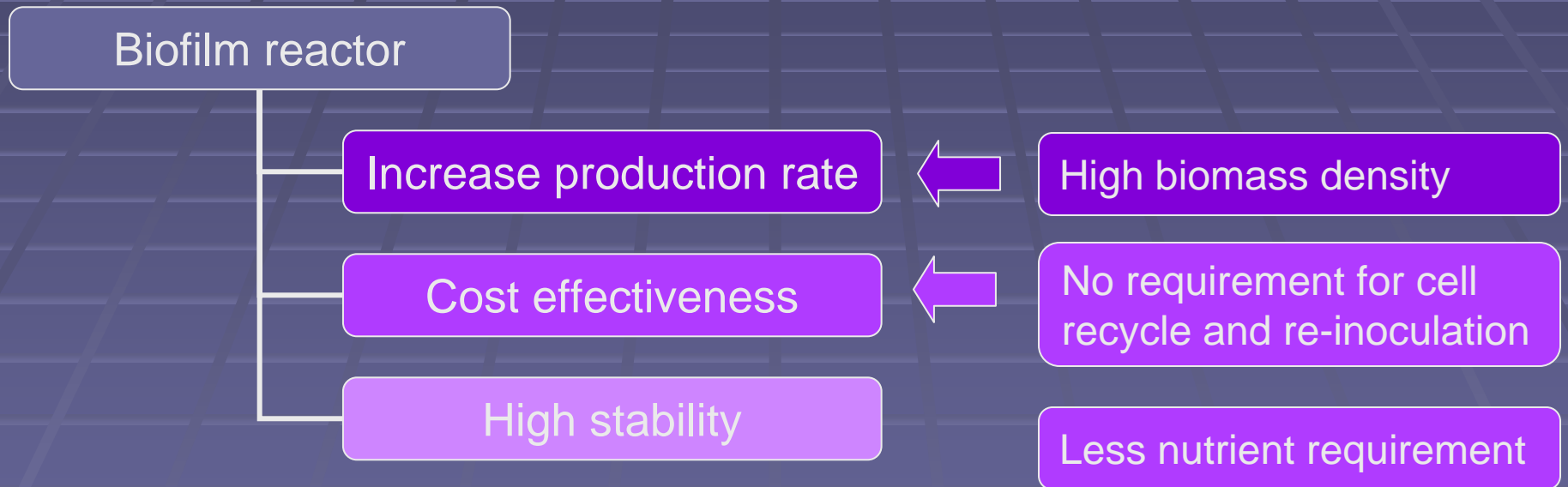




ENZYME PRODUCTION

- **Cellulase production** from *Trichoderma viride*
(Webb *et al.*, 1986)
 - Spouted-bed reactor
 - 1.5 times higher than suspended cell
- **Amylase production** from recombinant *E. coli*
(Oriel, 1988)
 - Submerged-bed biofilm with silicone polymer beads
 - 5 times higher than suspended cell
- **Ligninolytic enzymes production**
from *Phanerochaete chrysosporium*
(Govender *et al.*, 2003)
 - Membrane biofilm reactor
 - 7 times higher than suspended cell

SUMMARY



THANK YOU