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Development of a Novel Off-line Enricher Reactor Process Scheme for the Activated Sludge Degradation of Hazardous Wastes

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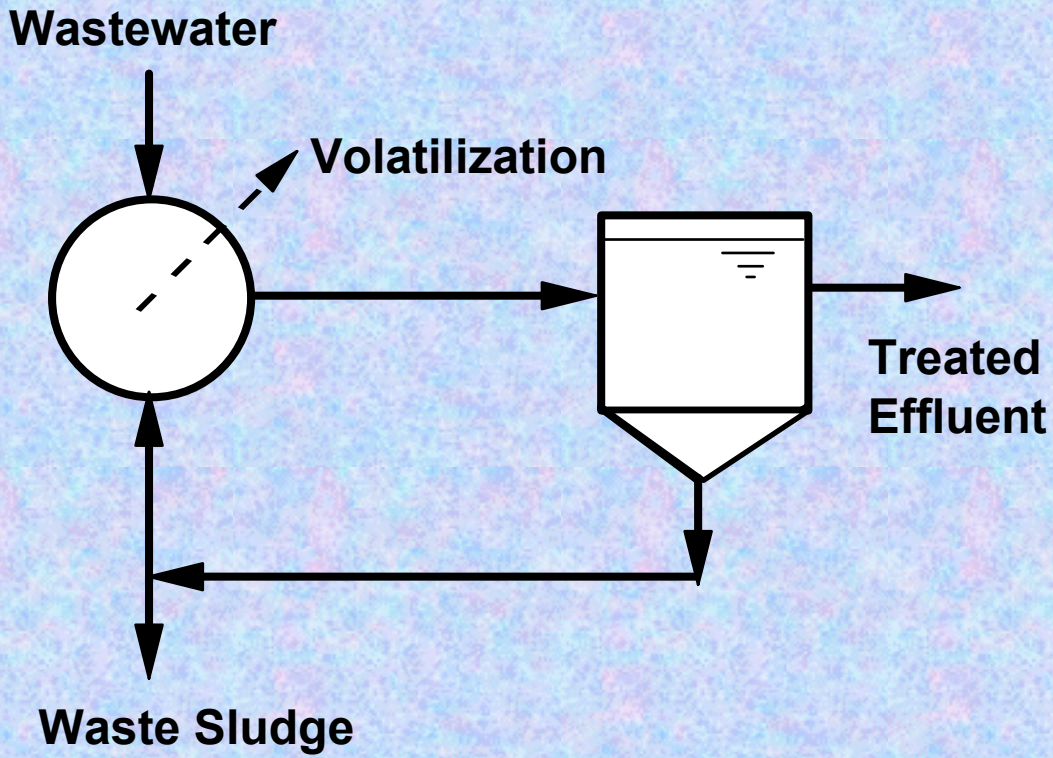
Outline

1. Enricher Reactor Concept
2. Previous Work
3. Current Studies
4. Inducer Compounds
5. Future Directions

PREVIEW

1. **Enricher Reactor Concept**
2. ***Original Work***
3. ***Process Improvement***
4. ***Inducer Compounds***
5. ***Future Directions***

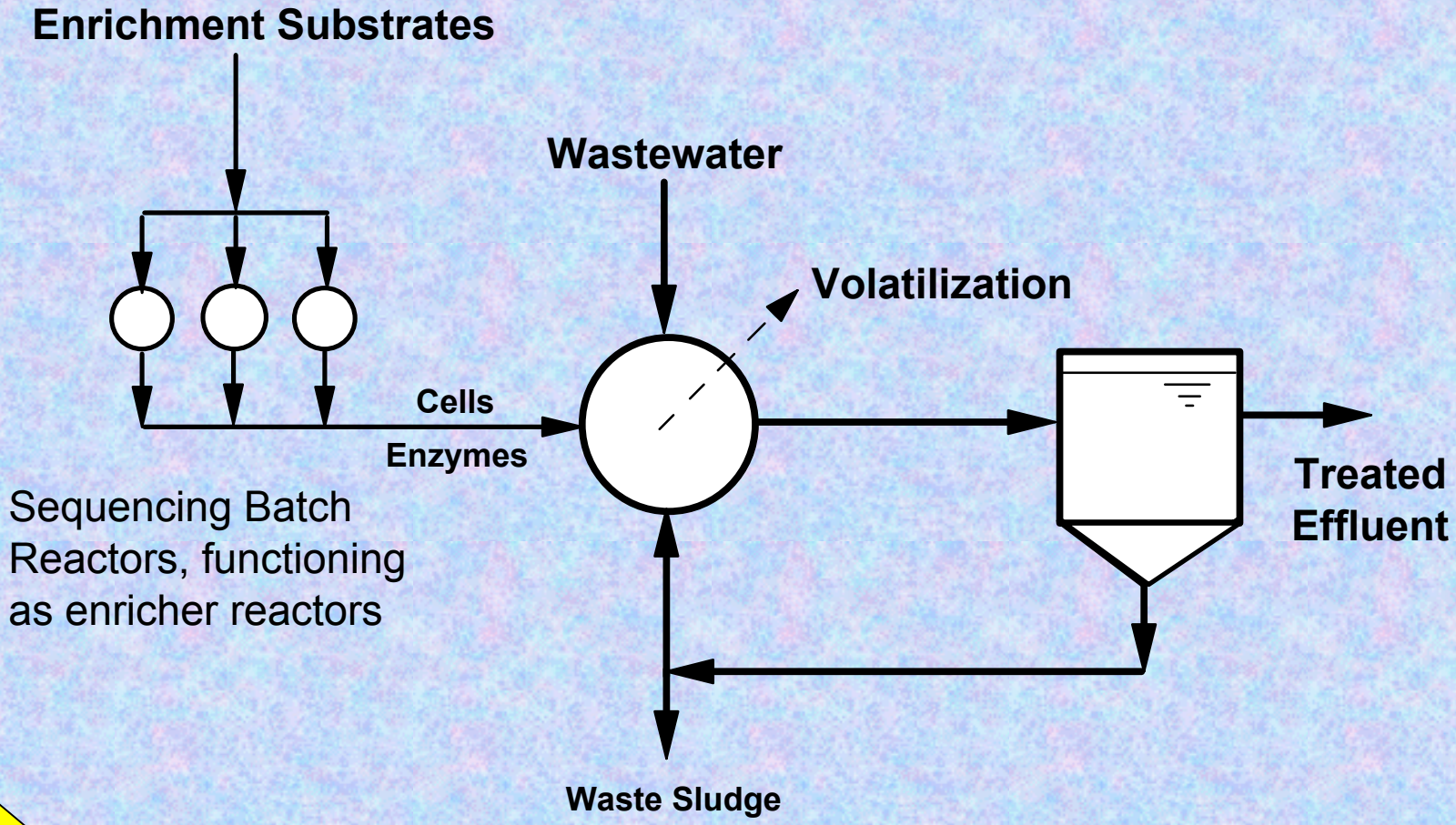
Activate Sludge Process



Process Modifications

- Complete Mixing
- Conventional or Plug Flow
- Extended Aeration
- Step Feed
- Contact Stabilization
- High Purity Oxygen

Enricher Reactor System



ADVANTAGES

Independence of Enricher Reactor

- protected from periodic upsets and operating constraints of main reactor
- back-up culture
- optimized growth conditions
- acclimation to volatile compounds
- uncompromised operation

Cost Effectiveness

- utilization of existing infrastructure
- small size

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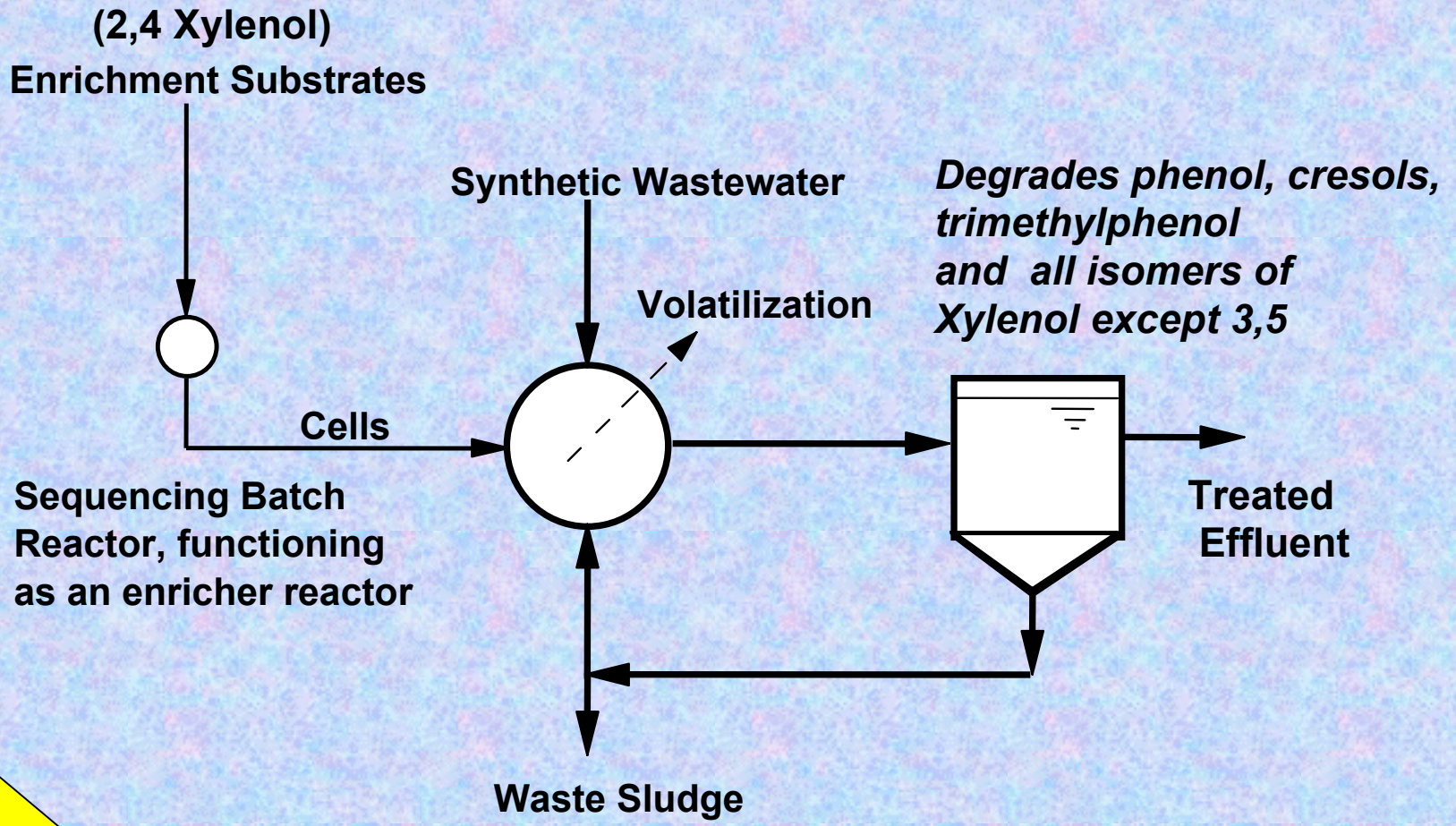
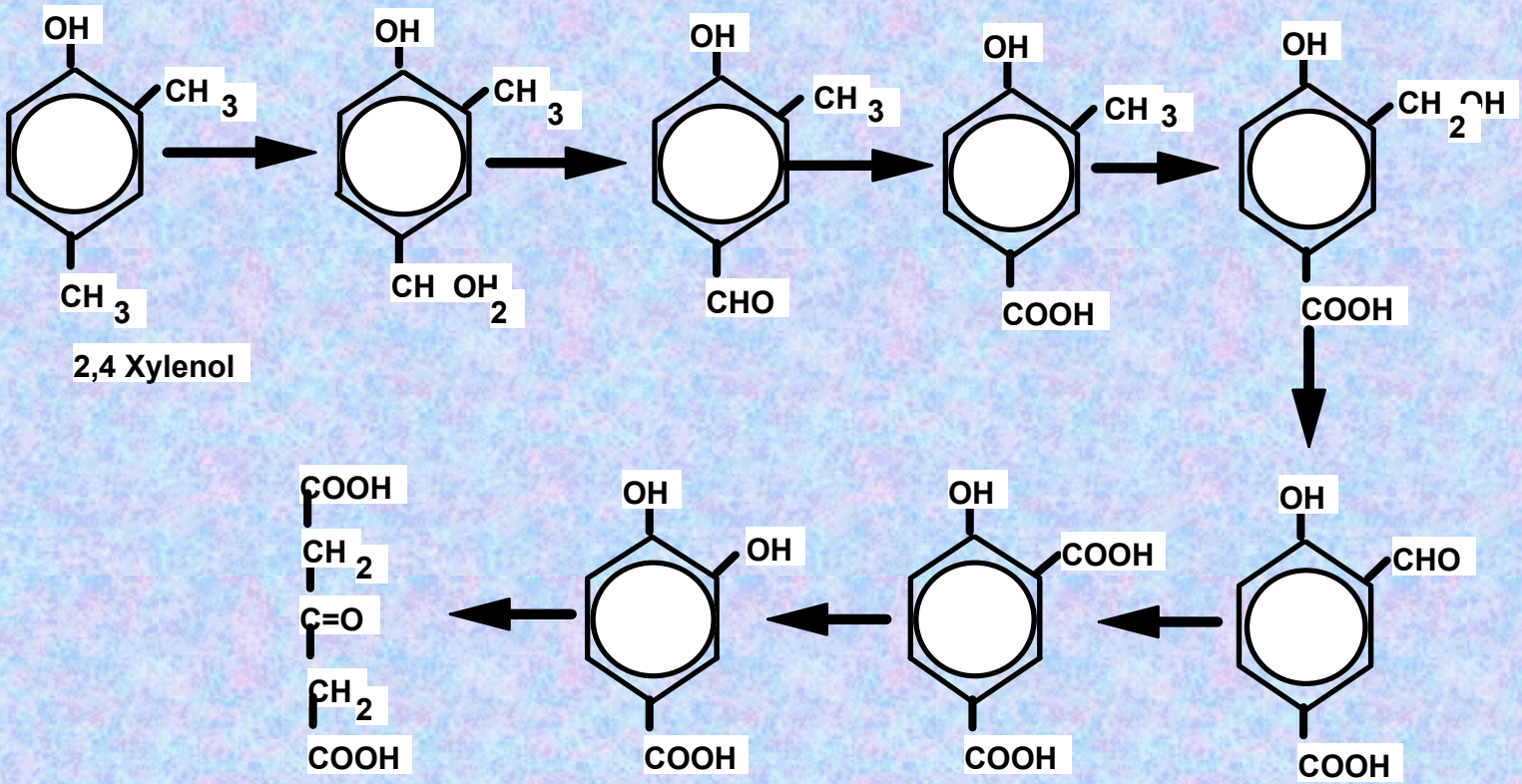
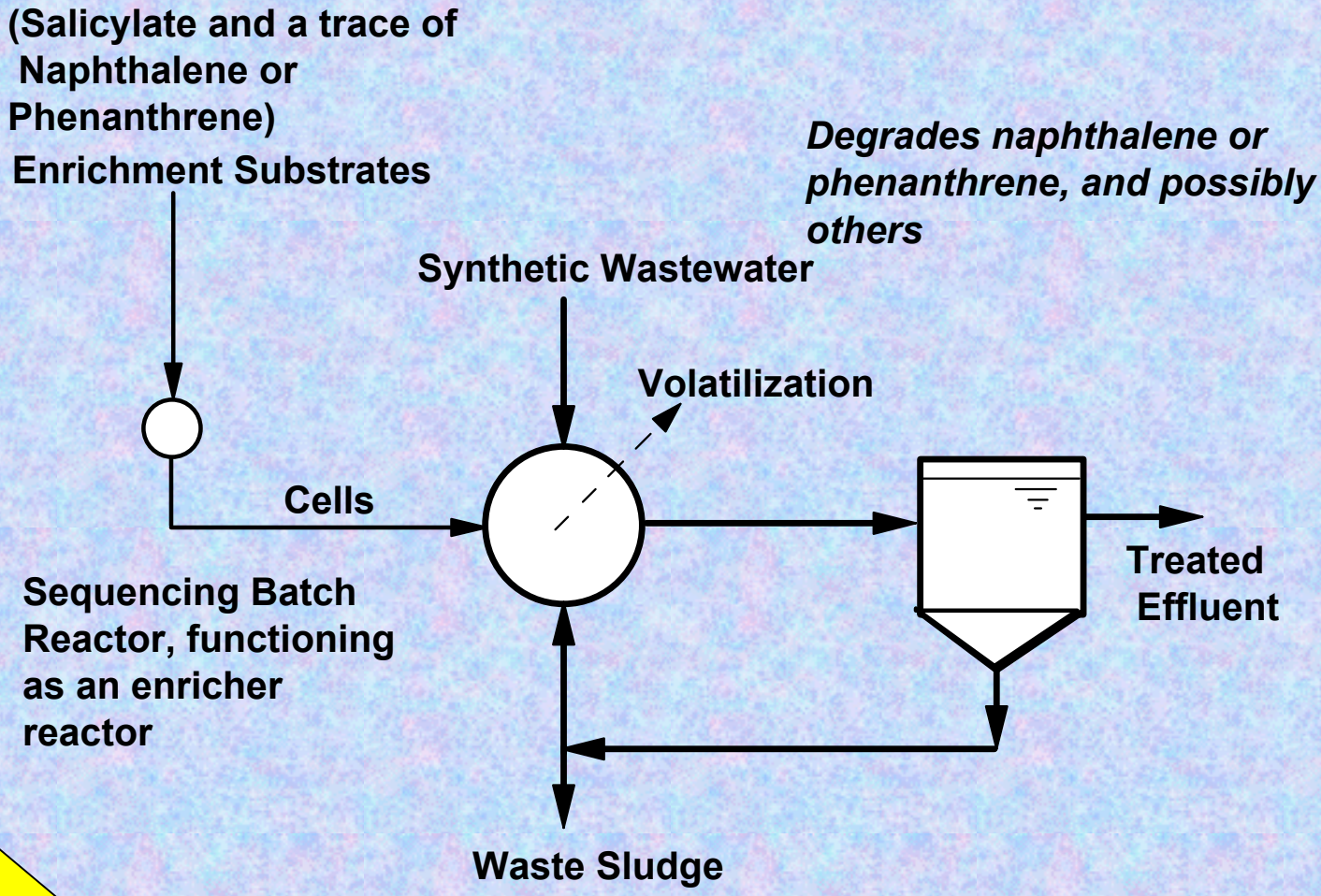
2,4 XYLENOL ENRICHER REACTOR SYSTEM



2-4 XYLENOL PATHWAY



NAPHTHALENE ENRICHER REACTOR SYSTEM



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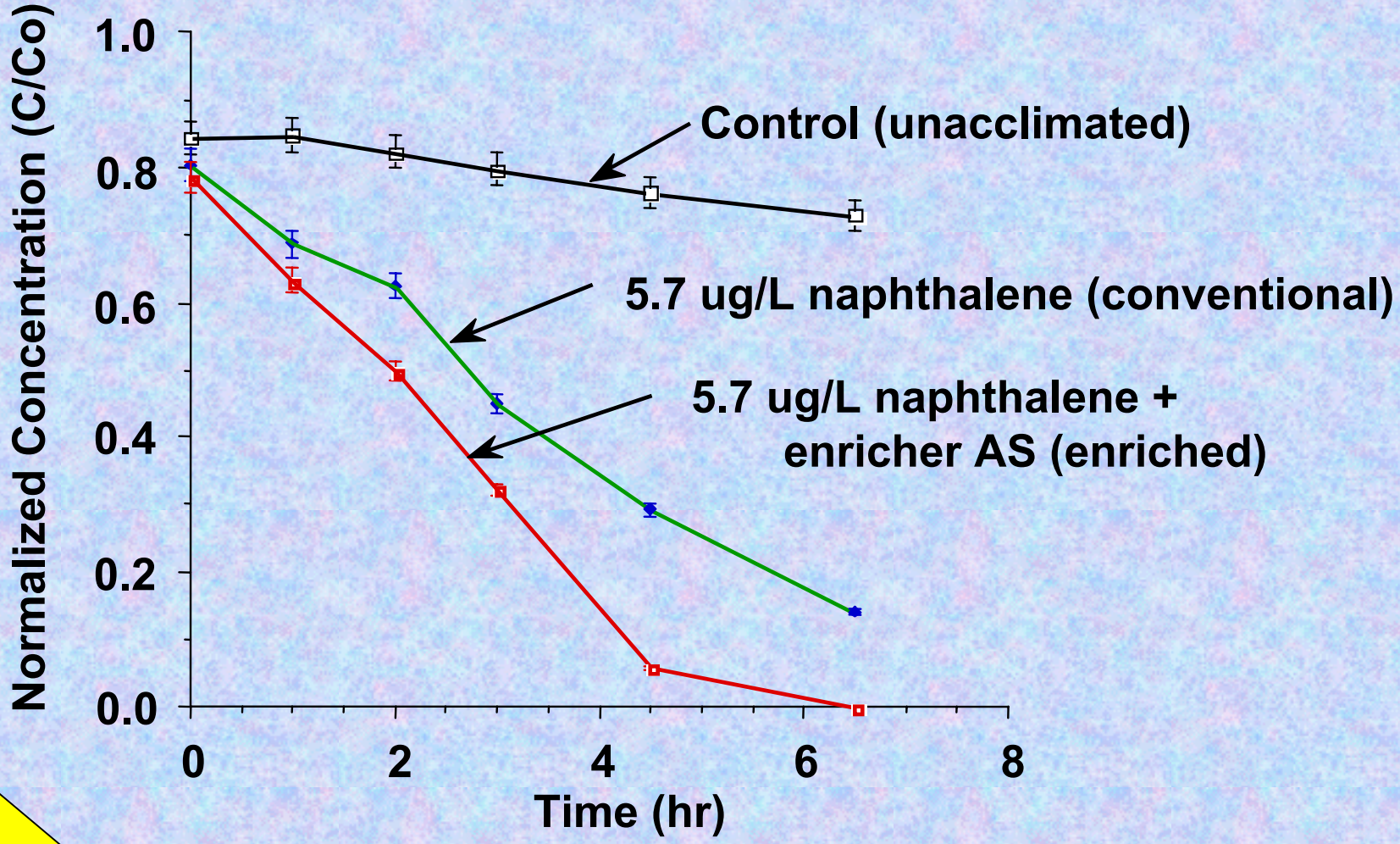
Degradation Of Naphthalene By A CFSTR Augmented With Cells From An Enricher Reactor



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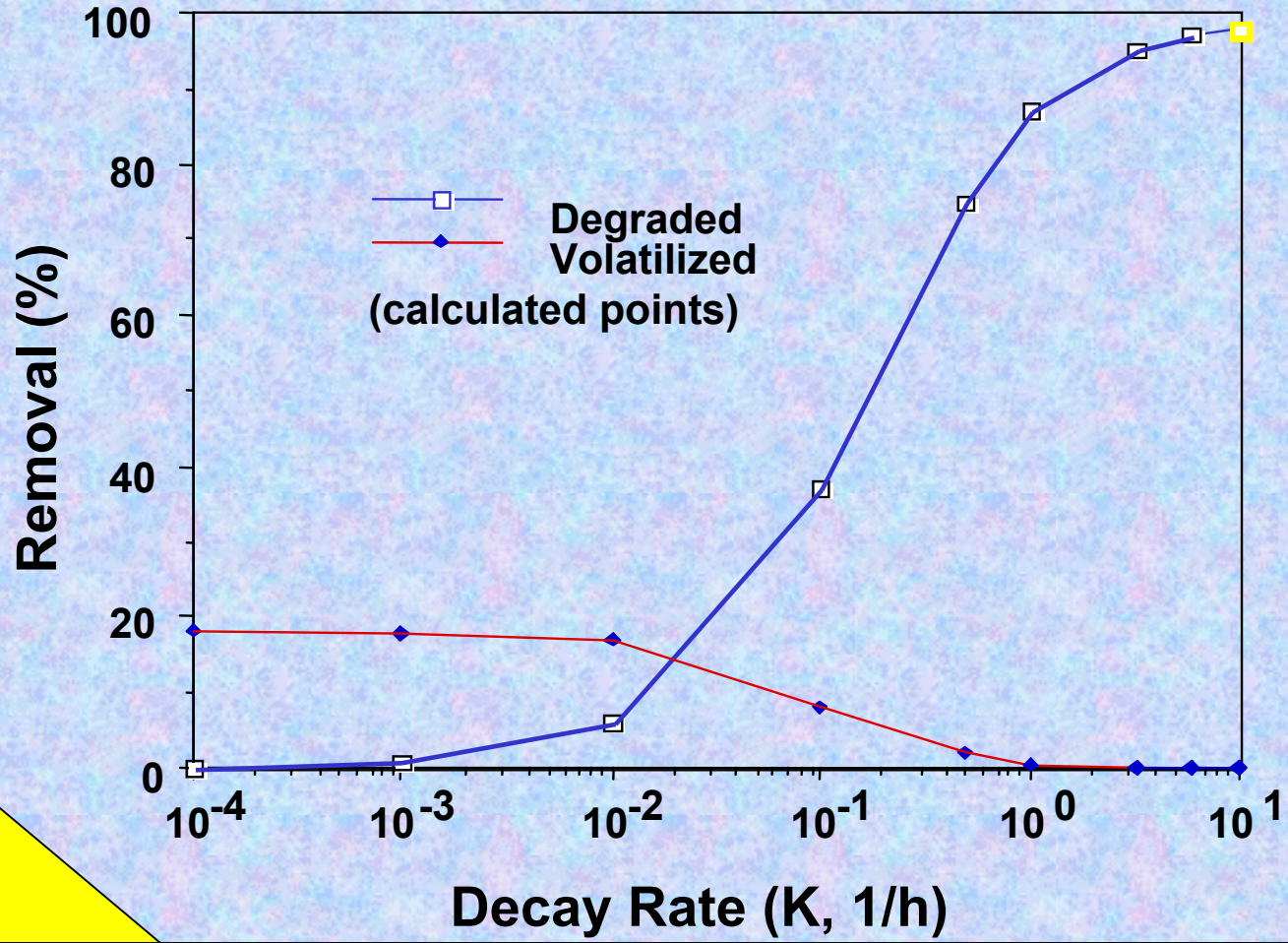
Naphthalene Volatilization Rate from a Typical Wastewater Treatment Plant



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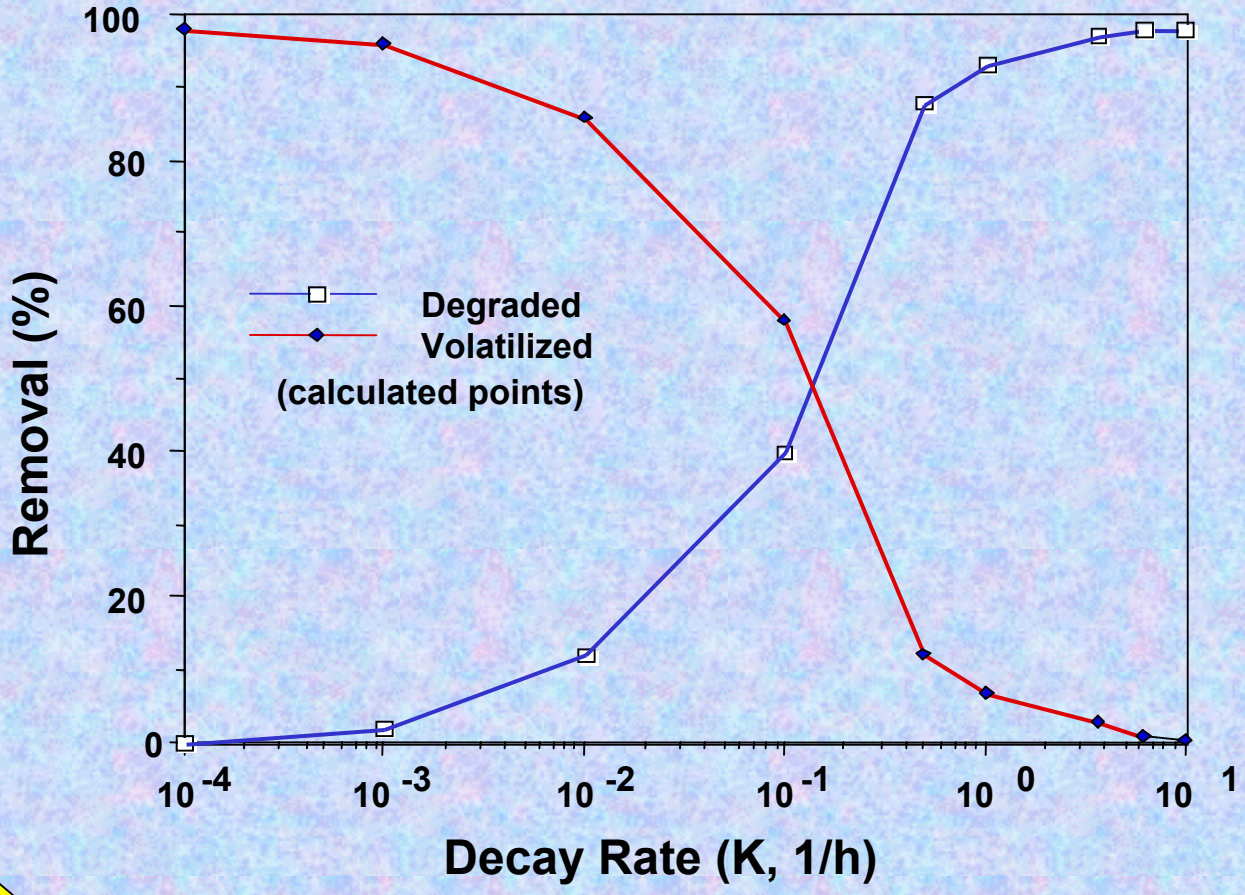
Naphthalene Volatilization Rate from a Laboratory Reactor



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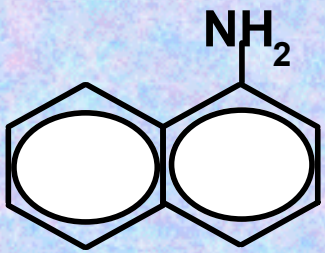
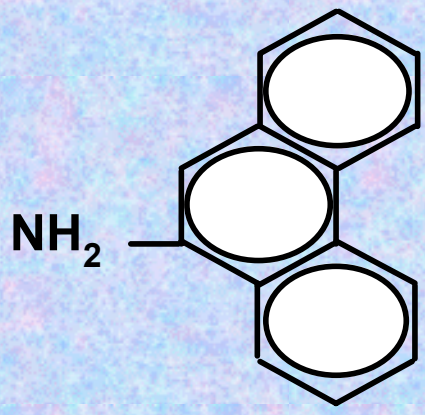
MODEL HAZARDOUS COMPOUNDS

AMINO PAH'S



1 - Naphthylamine
(1-NA)



9 -
Aminophenanthrene
(9-AP)

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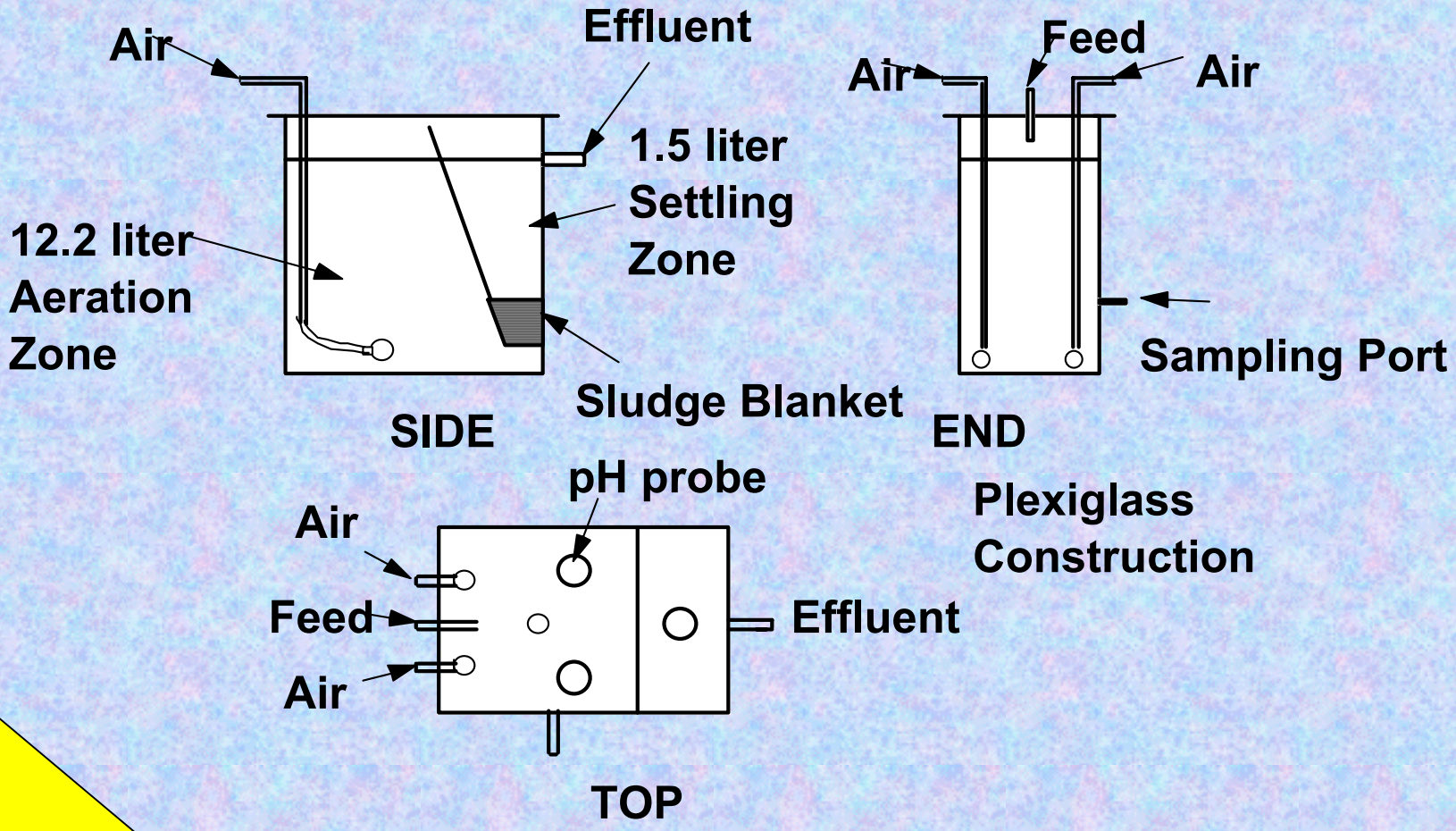
LABORATORY REACTORS



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Lab Reactor

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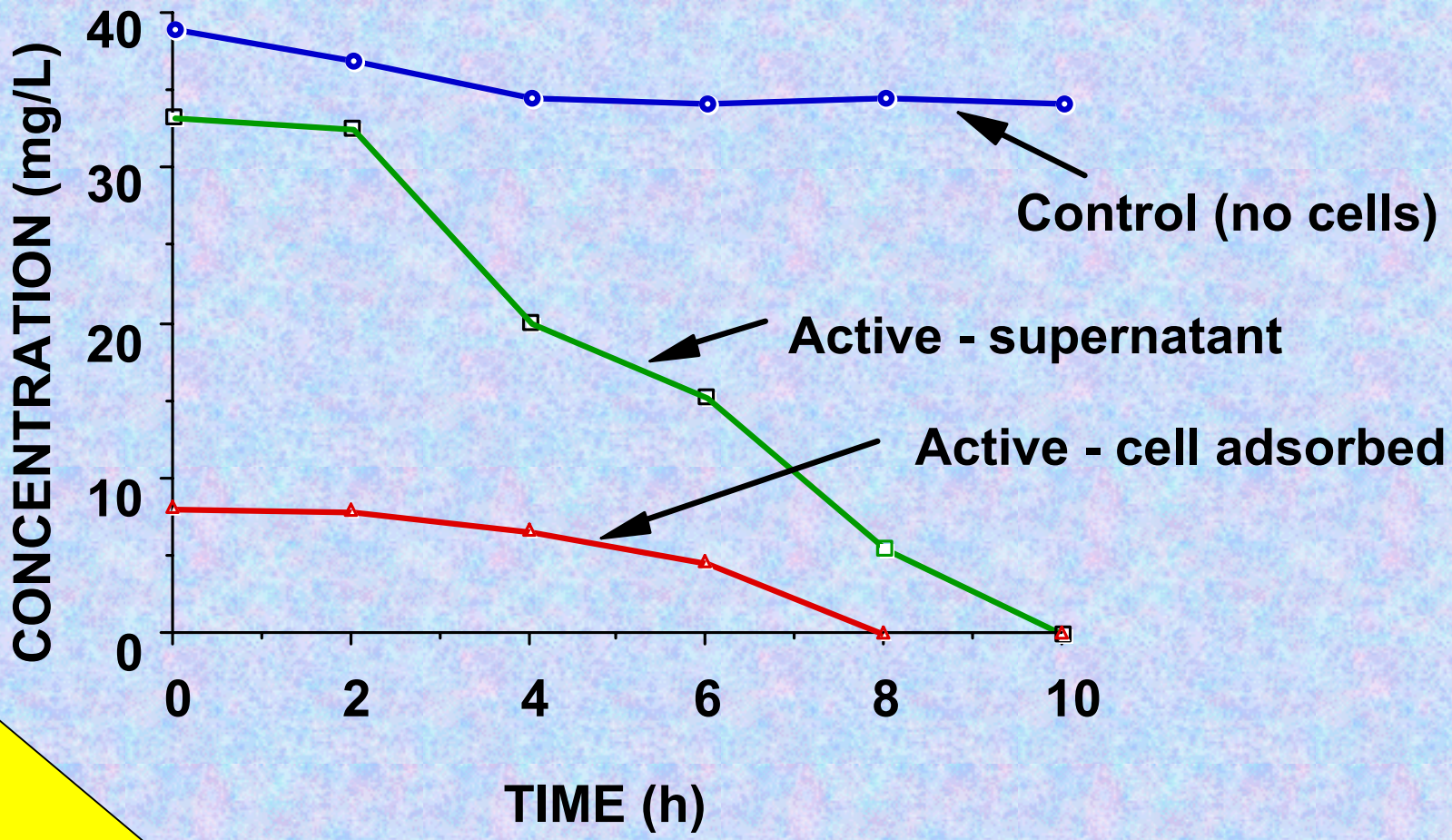
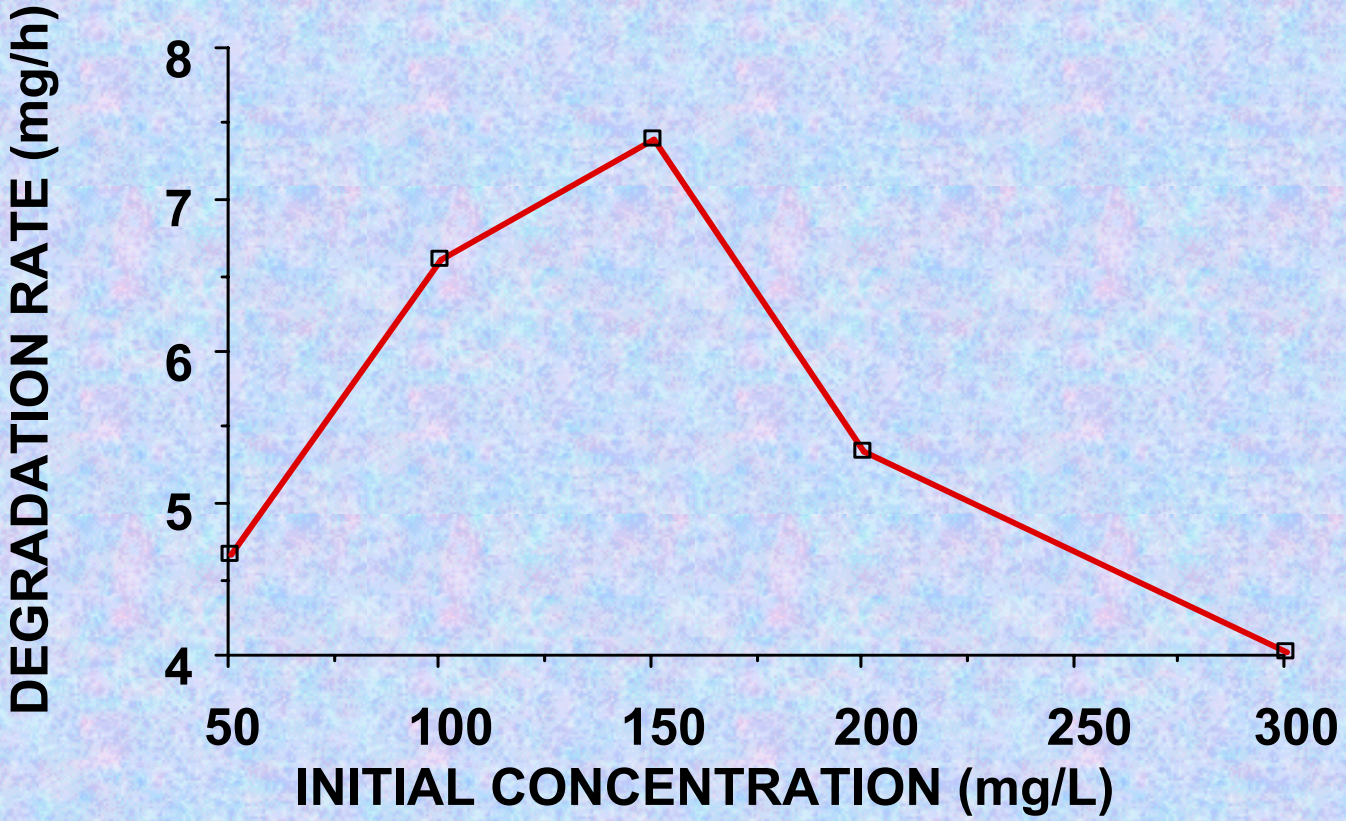
Phase I - Acclimation and Enrichment

1. Salicylic acid media
2. Deep purple culture
3. Isolates

Removal of 50 mg/L 1-NA in an Enricher Reactor



Degradation of Various Concentrations in an Enricher Reactor



Phase II - Bioaugmentation

1. Steady-state
2. Batch experiments
3. Bioaugmentation level studies

SUBSTRATES

CFSTR's

Control	No target compounds
Conventional I	1-NA (1 mg/L)
Conventional II	9-AP (0.1 mg/L)
Enriched I	1-NA (1mg/L) + 2% inoculum E1
Enriched II	9-AP (0.1 mg/L) + 2% inoculum E2

SBR's

E1	1-NA (150 mg/L)
E2	9-AP (20 mg/L)

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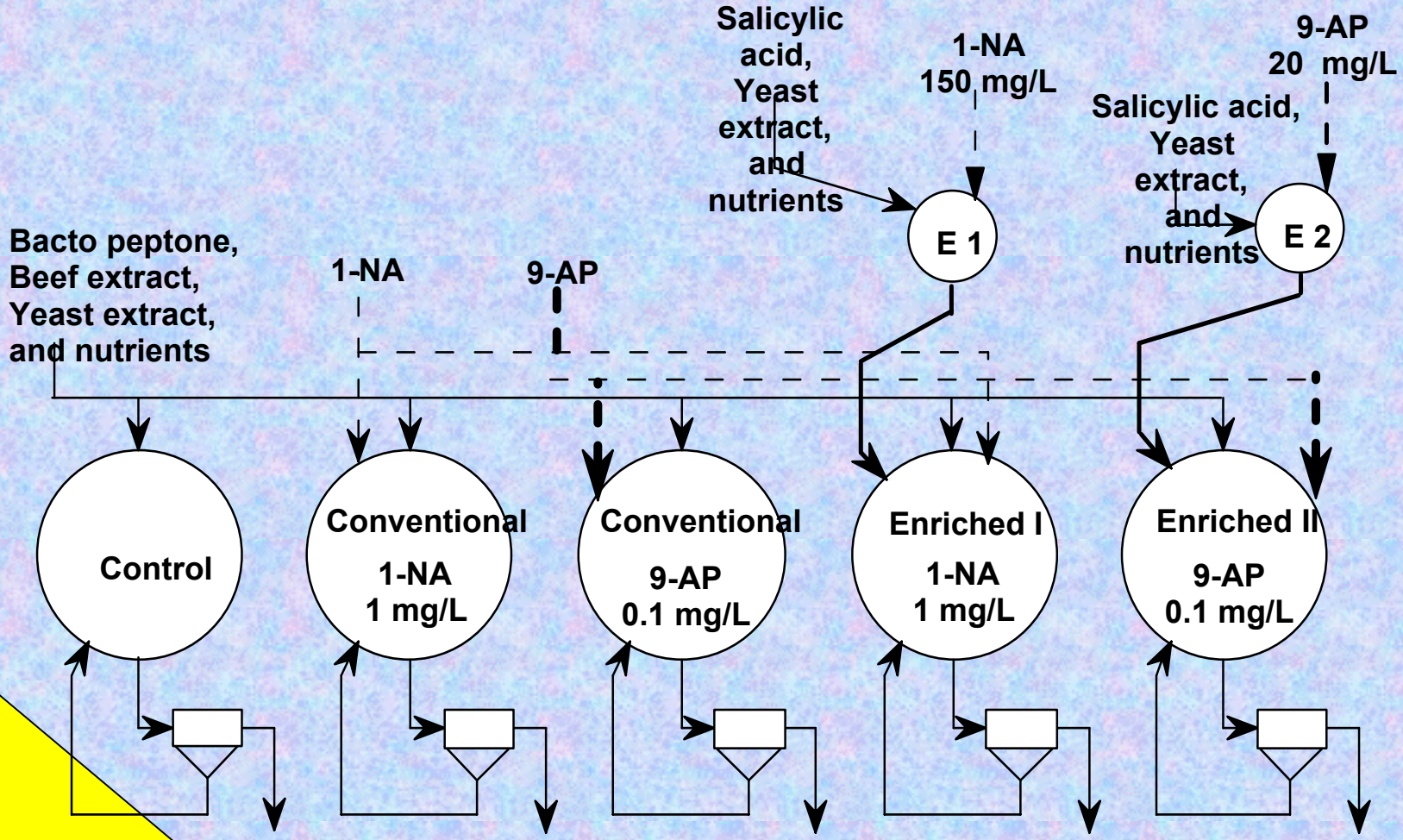
LABORATORY ENRICHER REACTOR SET-UP



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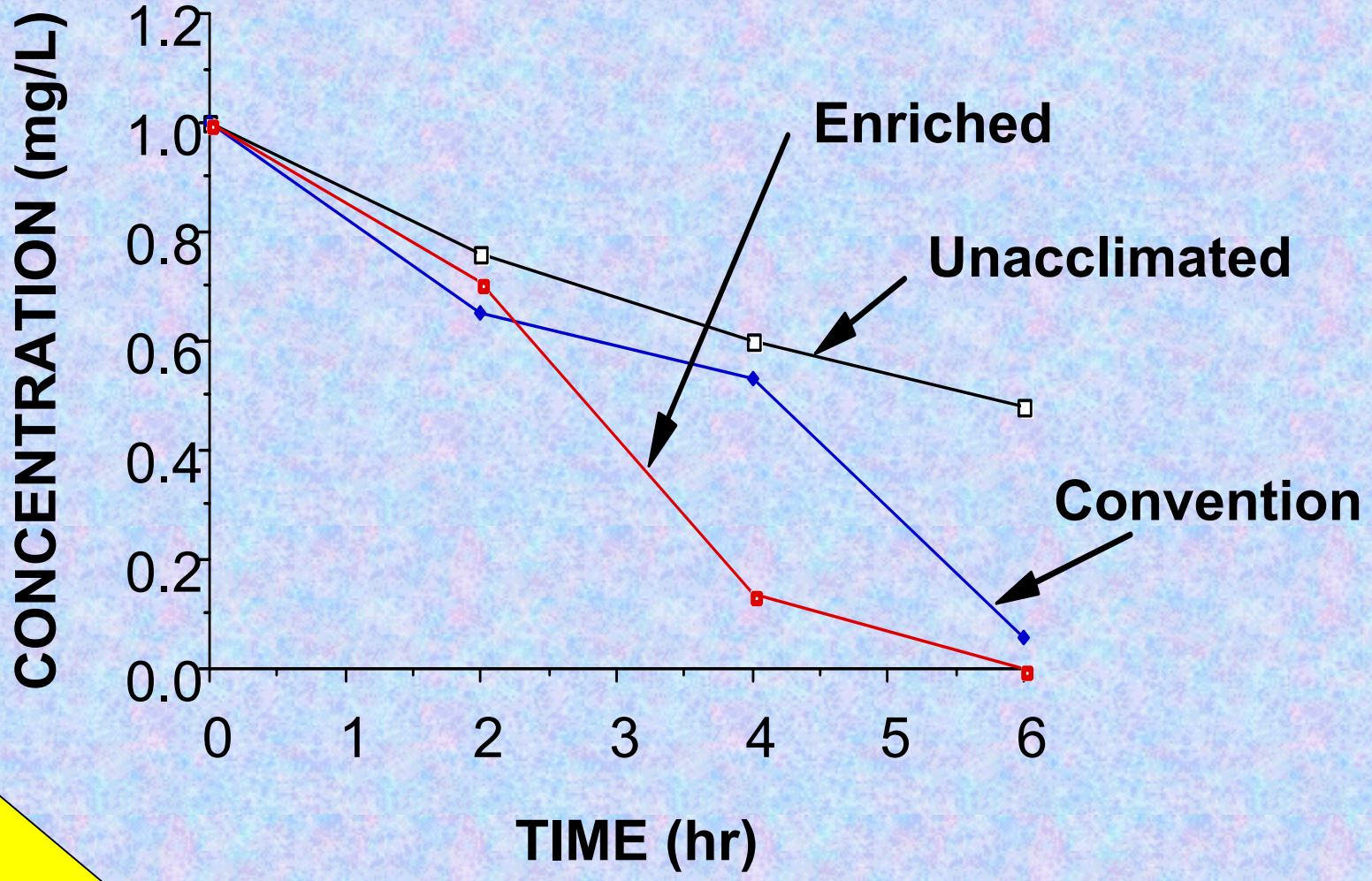
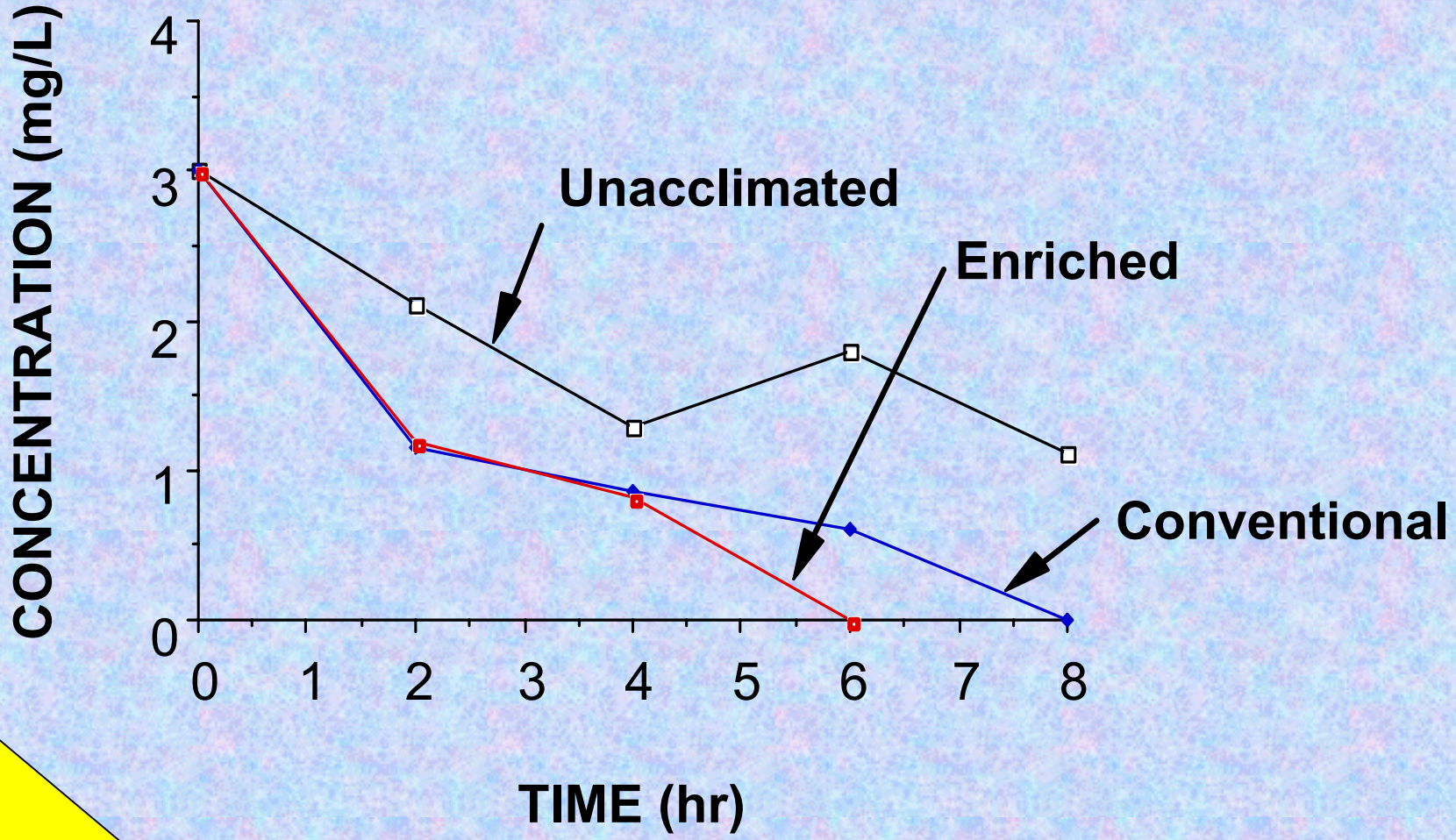
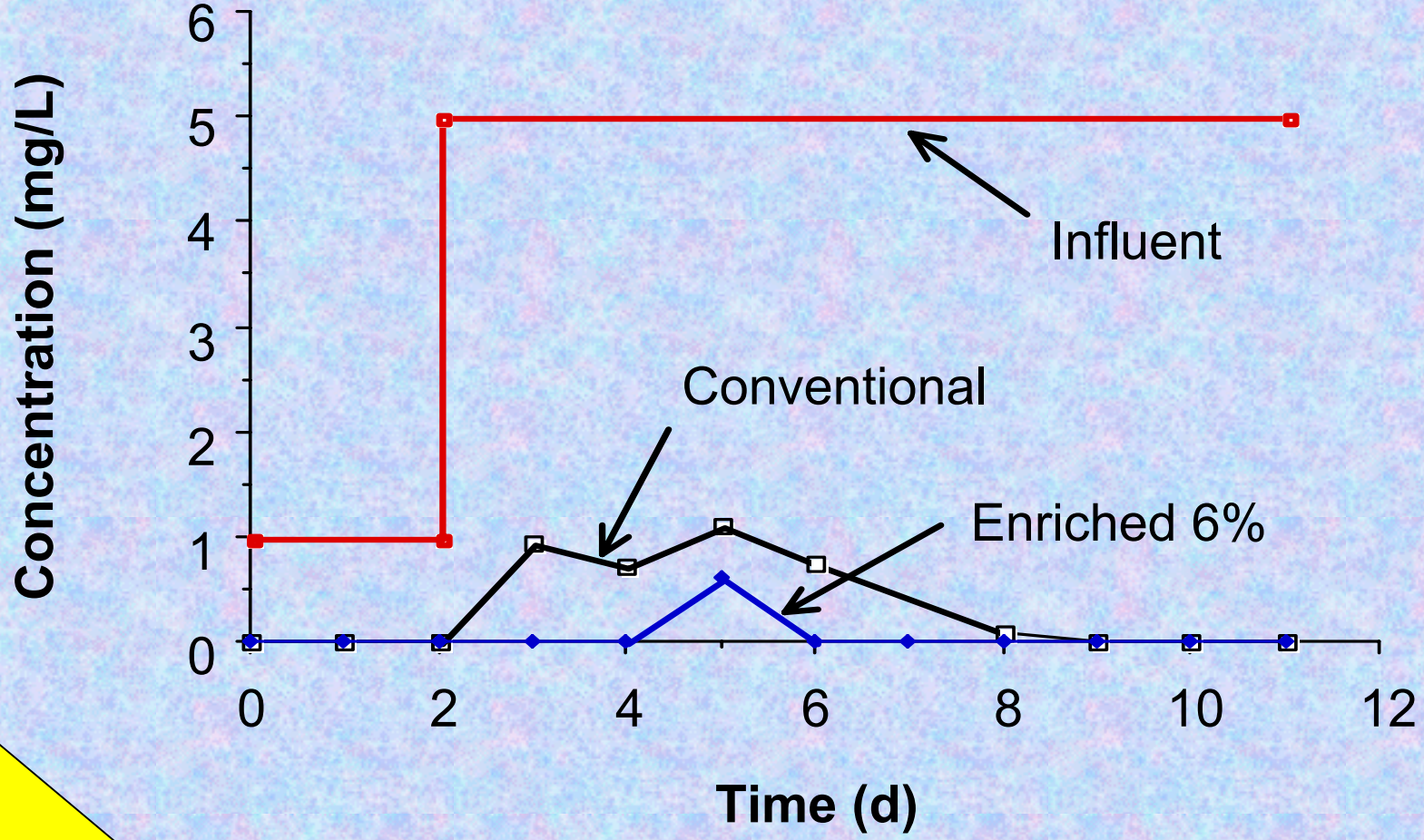
Batch Biodegradation Test (1 mg/L)



Batch Biodegradation Test (3 mg/L)



CFSTR RESPONSE TO A STEP LOADING INCREASE



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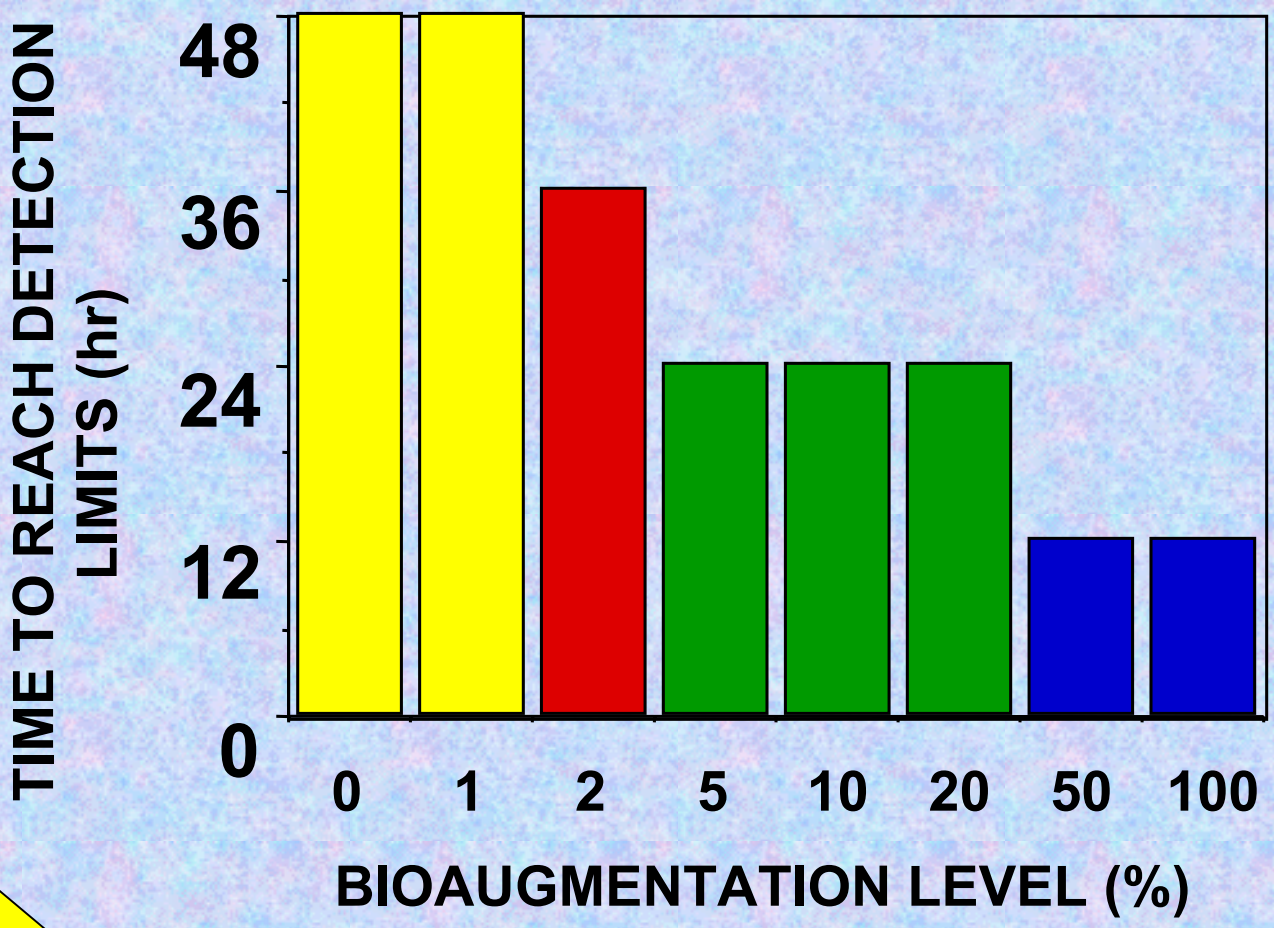
BATCH BIOAUGMENTATION LEVEL TEST (10 mg/L)



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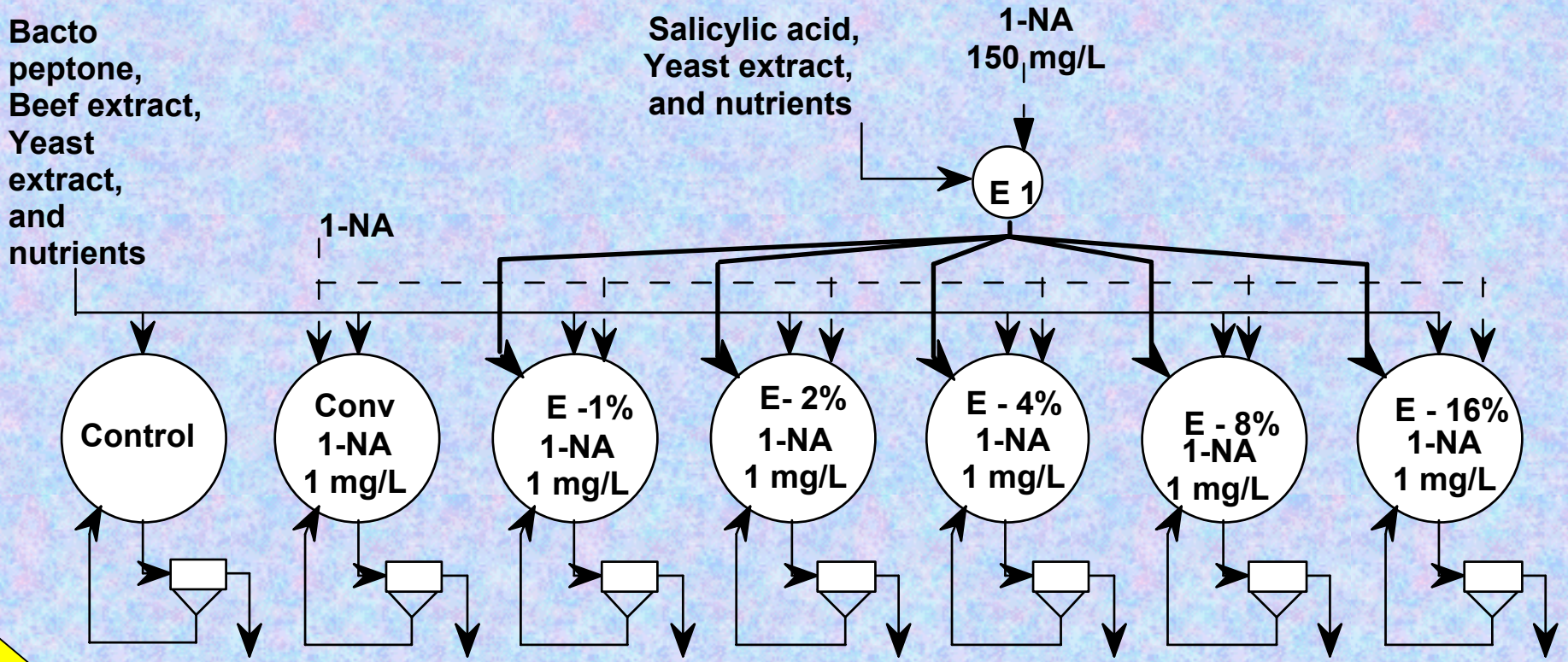
LABORATORY BIOAUGMENTATION LEVEL SET-UP



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INDUCER COMPOUNDS

- Use compounds other than 1 NA to induce 1 NA biodegradation
- Use these compounds in the enricher reactor
- Select compounds similar to the target compound (1 NA)
- Hopefully less hazardous and inexpensive
- Hopefully easier to analyze and manage

SELECTED INDUCER COMPOUNDS

- 1-acetate-naphthalene (1AN)
- 1- naphthalene-sulfonic acid (1SN)
- 1-naphthoic acid (1NO)
- 1-chloro-naphthalene (1CN)
- Gentistic acid (GA)

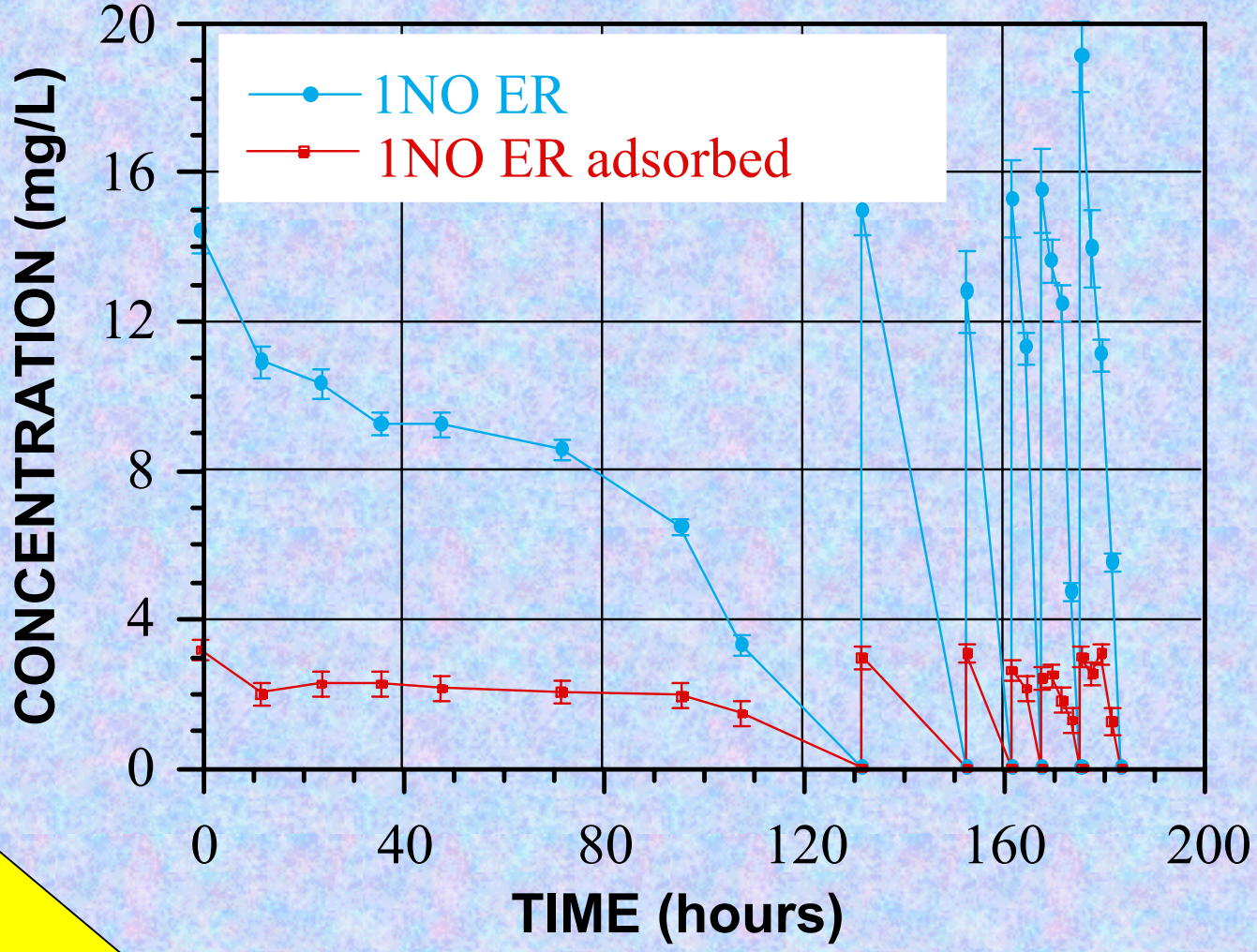
Culture Growth

Cultures were grown on each compound in fill and draw reactors.

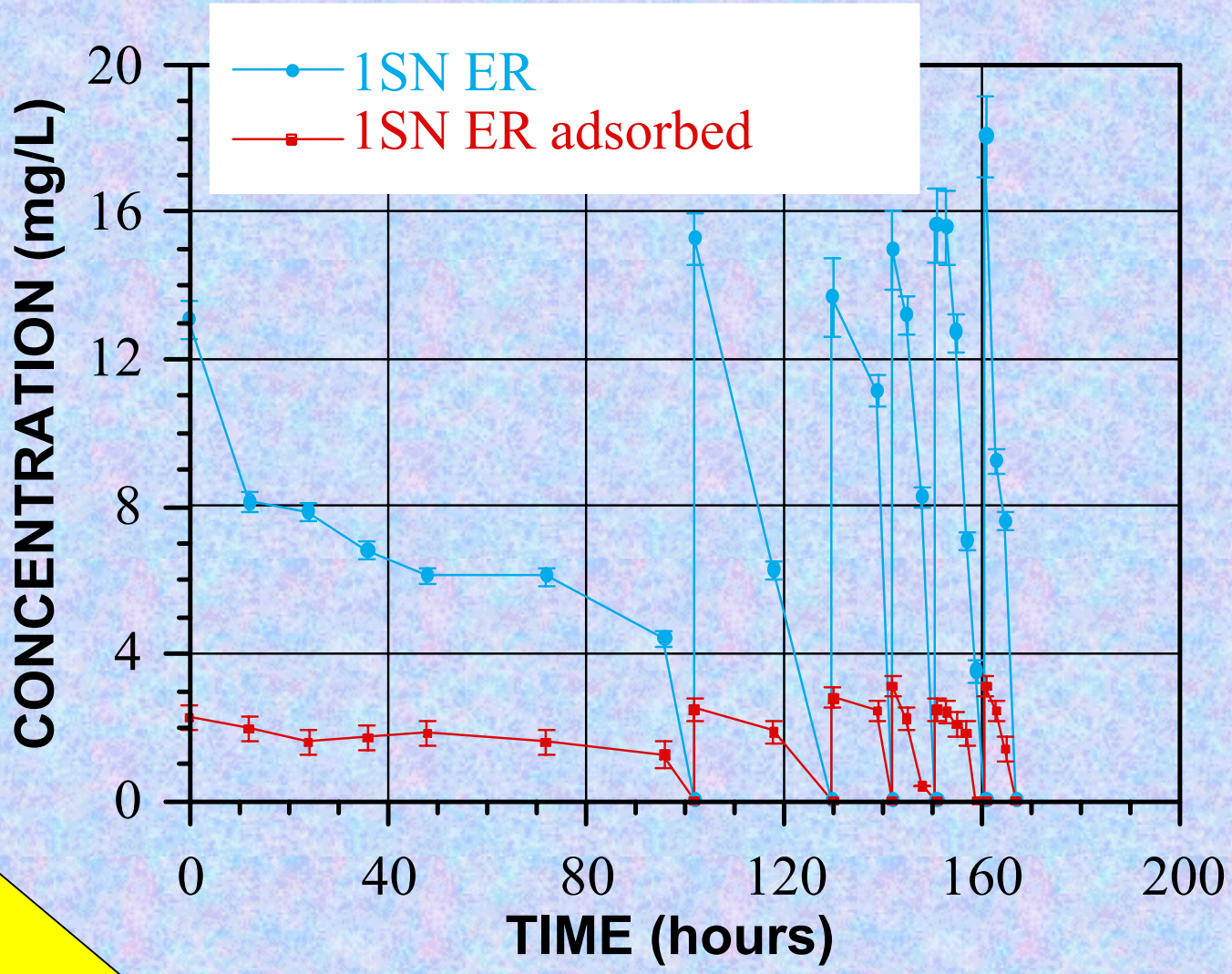
Maximum growth rates were determined for comparisons later.

Tested later with 1 NA.

Acclimation of 1-NO



Acclimation of 1 SN



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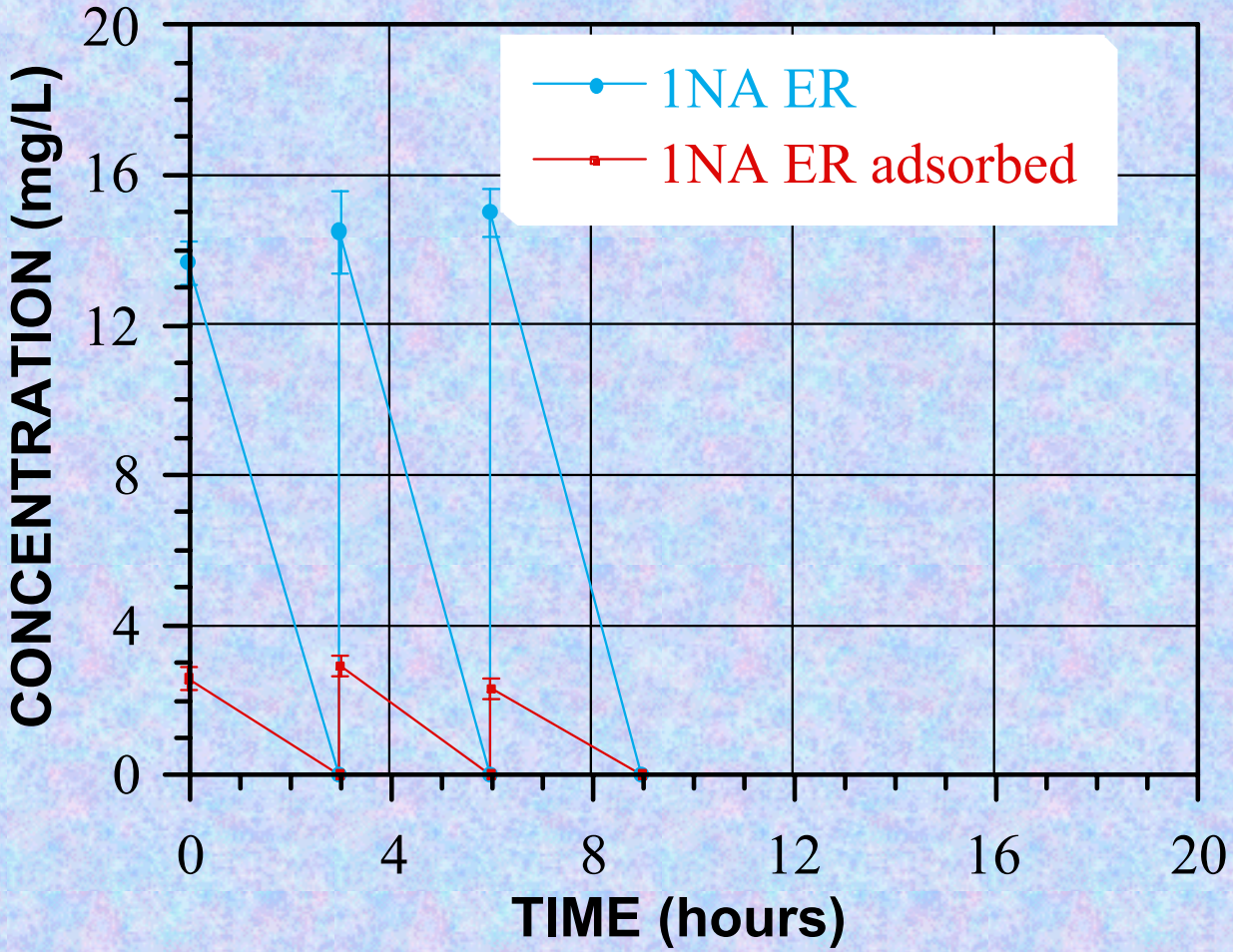
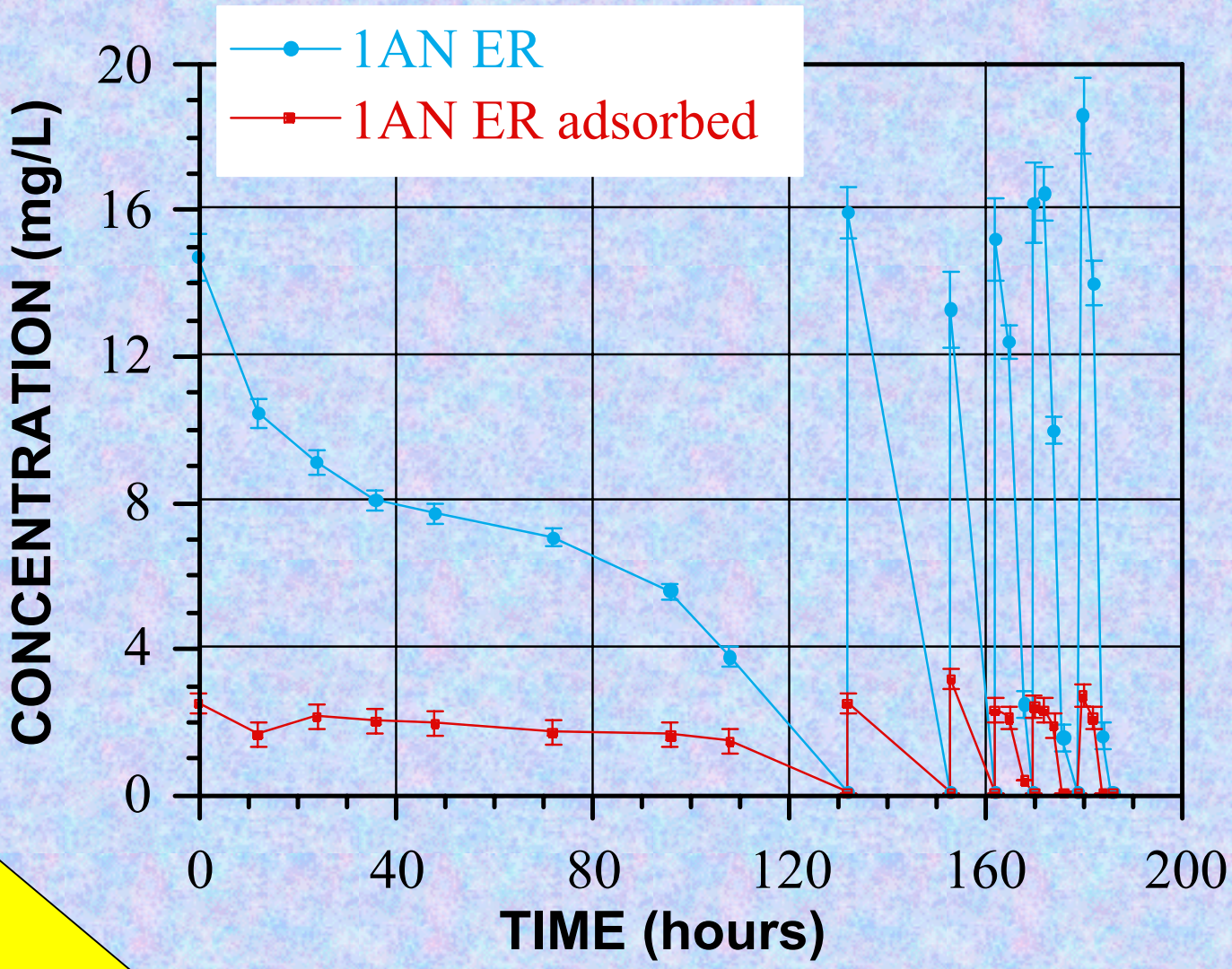
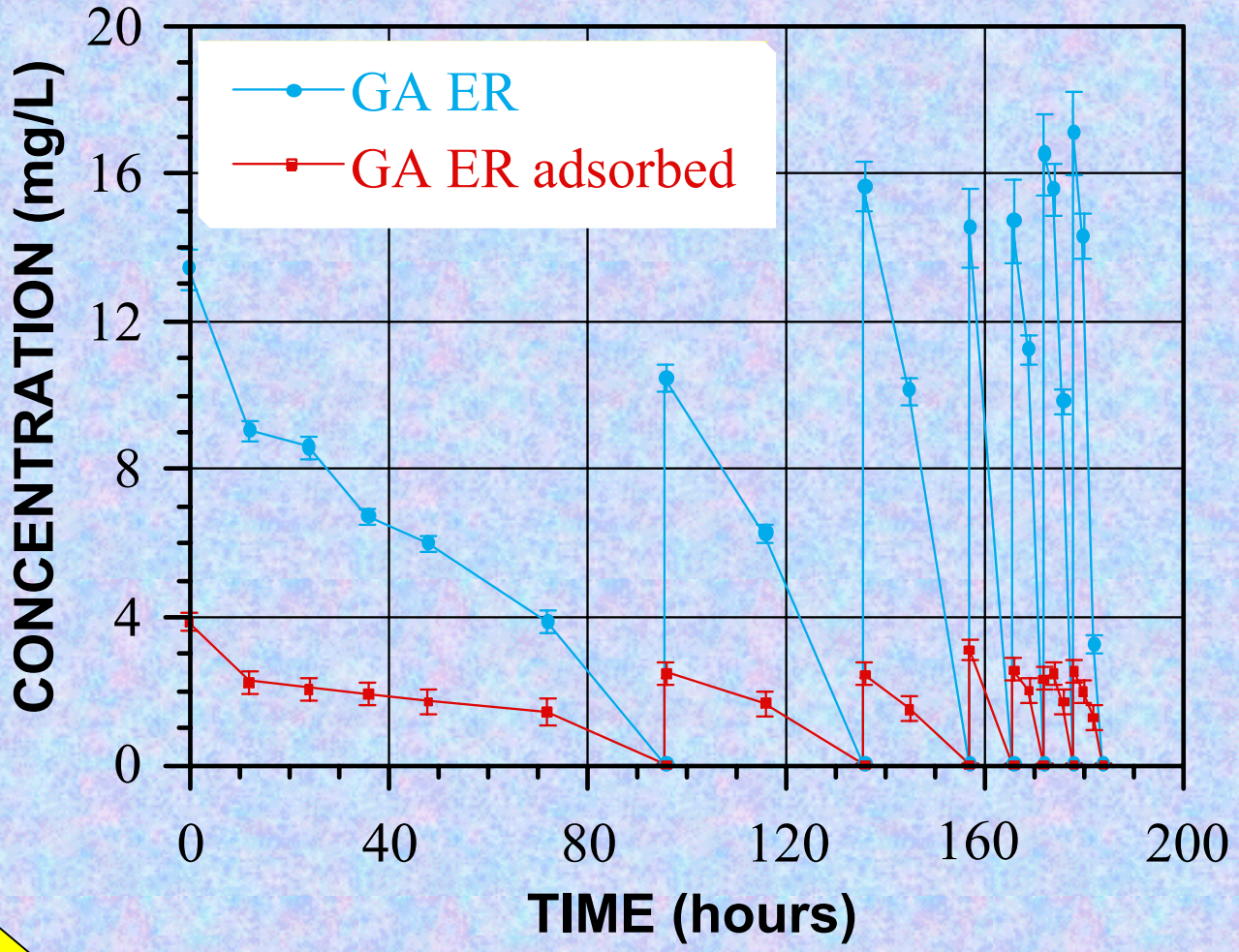
1 NA Biodegradation



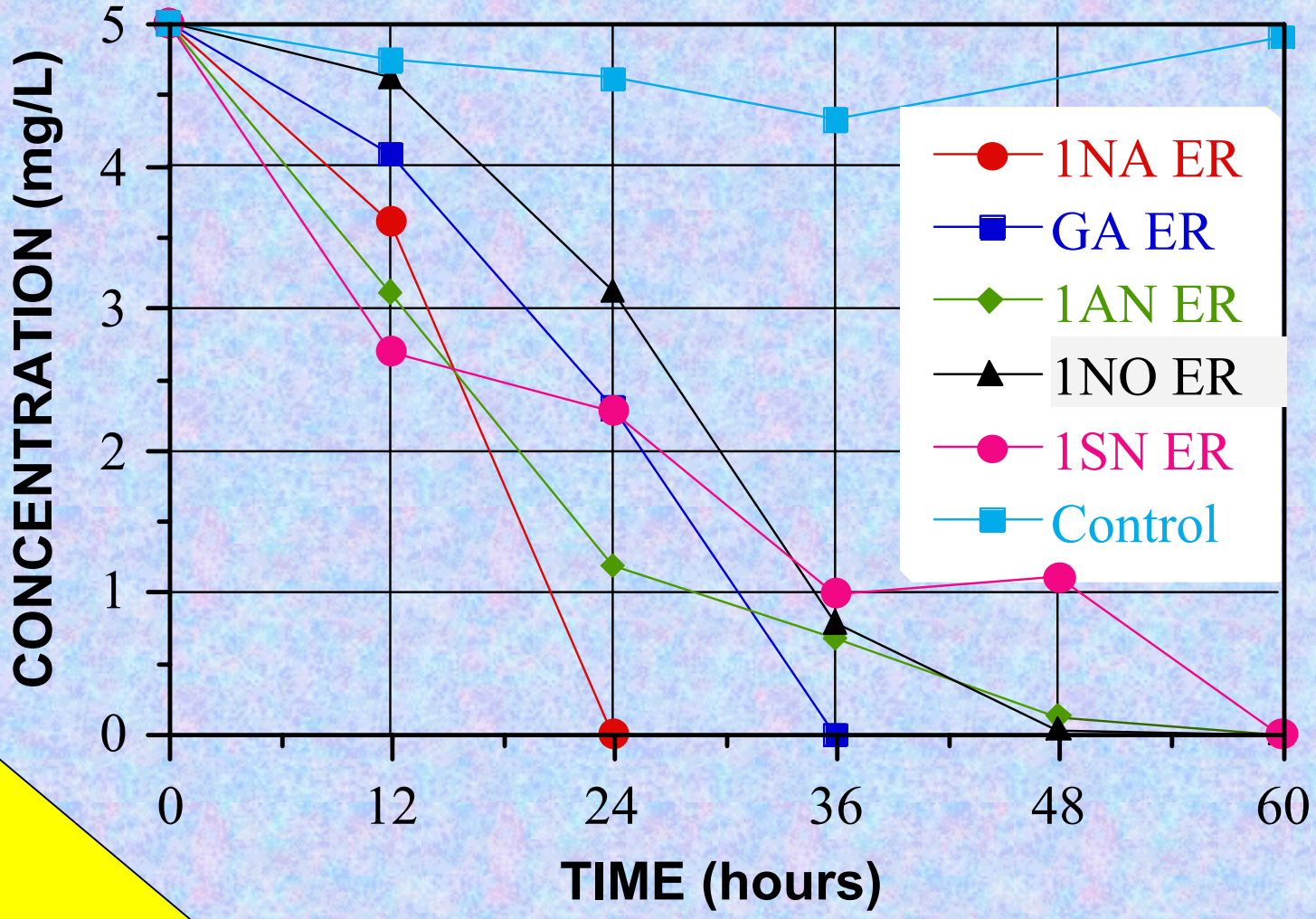
Acclimation of 1 AN



Acclimation of GA



Disappearance of 1 NA Comparison



DIRECTIONS

Process Engineering

- show improvement with bioaugmentation level
- scale-up design (kinetics)
- generalizations

Microbiology

- health of cells
- sustainability of activity
- substrate composition
- optimum enrichment cultures

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- US National Science Foundation
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- All my former and current graduate students