# Bio-treatment of Waste Streams Containing Organic Compounds and Copper (Subtask C-1-2)

## Simultaneous Removal of Organic Compounds and Copper

*Arturo Ruiz-Yeomans, Kimberly Ogden*
*Chemical and Environmental Engineering,*
*University of Arizona*

## Objectives:

- Investigate feasibility of biotreatment process for organic and copper containing wastewater
- Develop low energy, high efficiency process for treatment, reclaim and potential recycle of organic and copper containing wastewater.

## ESH Impact:

- Without treatment and reclaim or recycle of waste waters, large quantities of effluent are discharged.
- CMP and electroplating bath processes are known to utilize as much as 30% of a fab's UPW and contribute significantly to Copper contamination
- Effluent may be contaminated with hard-to-remove organic compounds.

# Introduction

**Have developed biotreatment reactor for degradation of IPA in wastewater**

- **Fluidized bed system, bacterial consortium immobilized on GAC support**
- **Capable of degrading >95% of incoming IPA**
- **Resistant to IPA and pH shocks in inlet**
- **Developed model that provides good prediction of system**

**Have developed biotreatment reactor for adsorption of copper from wastewater**

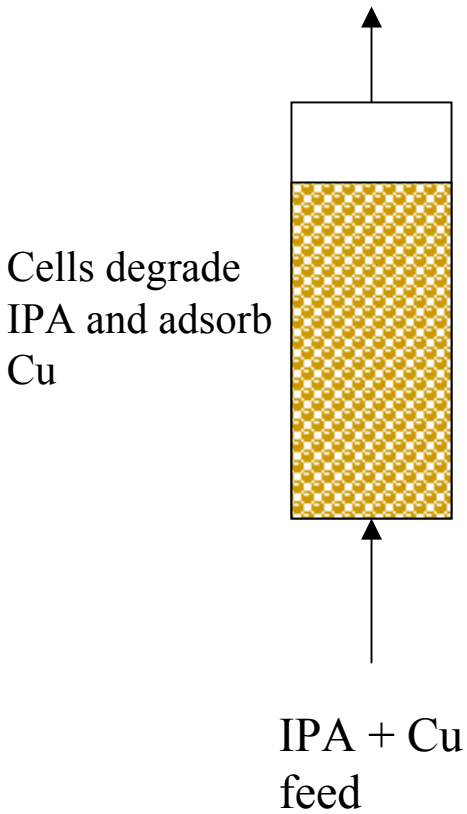
- **Packed bed system, bacterial strain encapsulated on alginate support**
- **Capable of adsorbing >95% of incoming Cu**
- **Cu can be desorbed and recovered**
- **able to predict system performance based on empirical model**

# Simultaneous removal of Cu and IPA

- Things to consider
  - Adsorption of Cu and degradation of organics have different time scales
    - Adsorption is on surface of live or dead cell
    - Degradation occurs as organic is metabolized internally
    - Use one strain or a consortium?
  - Reactor configuration
    - FBR seems more appropriate for degradation
    - Packed bed works well for adsorption
    - Which support is more appropriate?

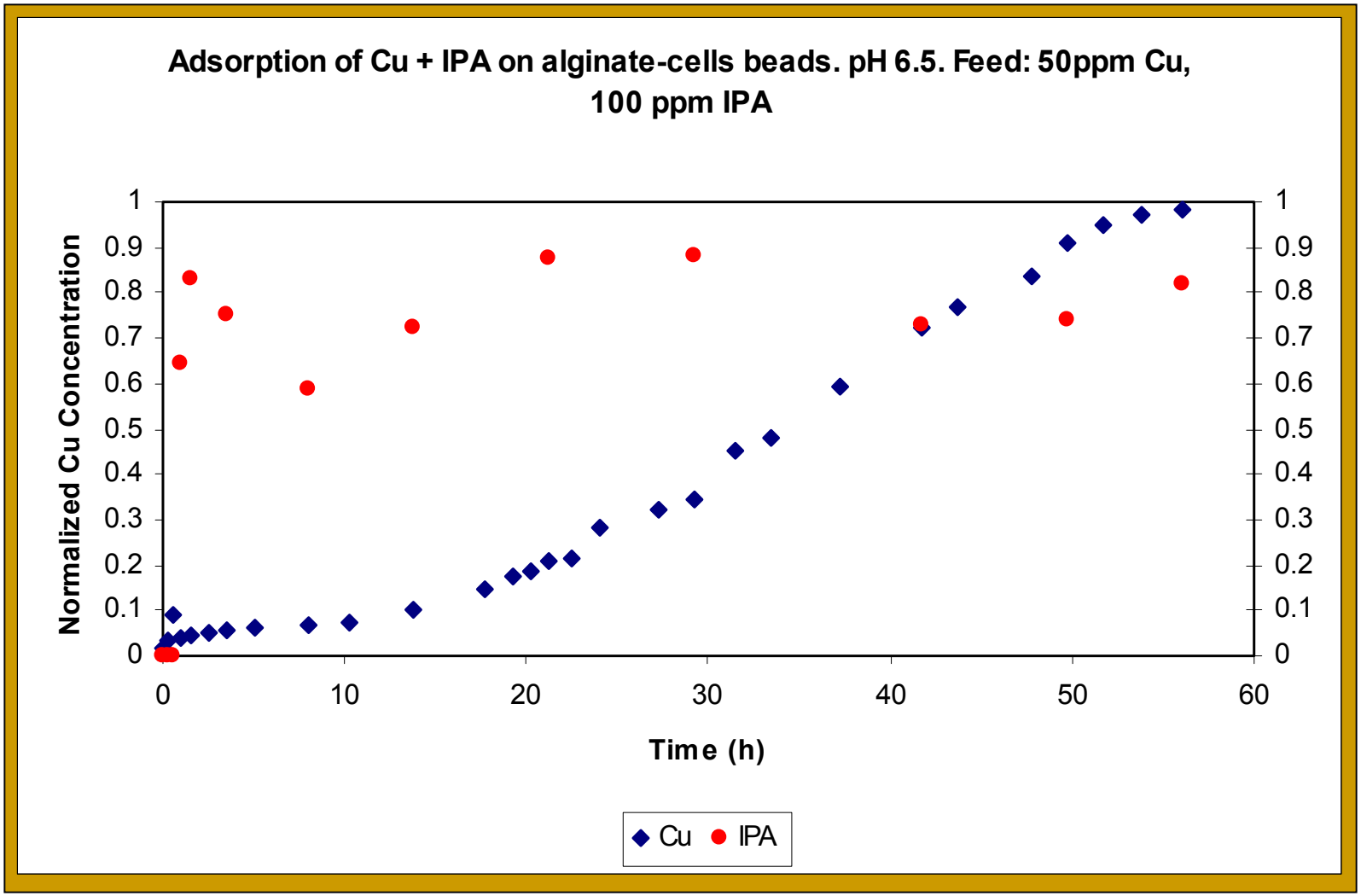
# Simultaneous Removal of Cu and IPA

One stage reactor



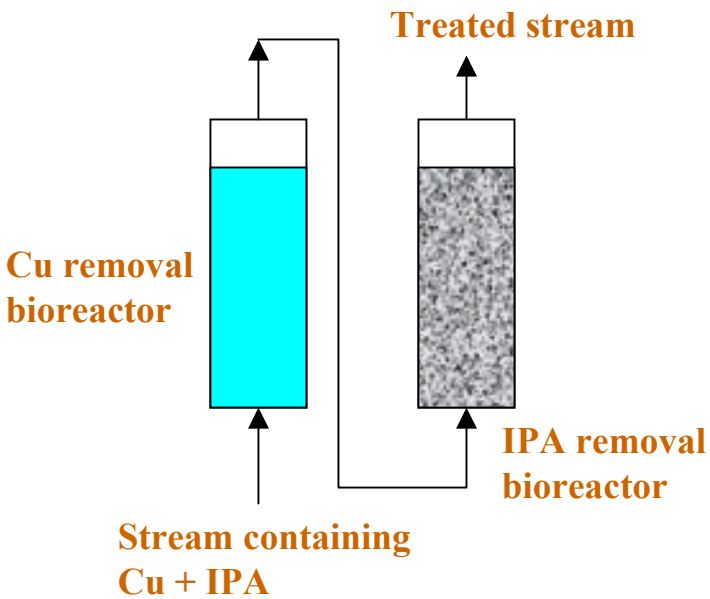

IPA4 cells on
alginate bead support

# Results for one pass system



# Simultaneous Removal of Cu and IPA

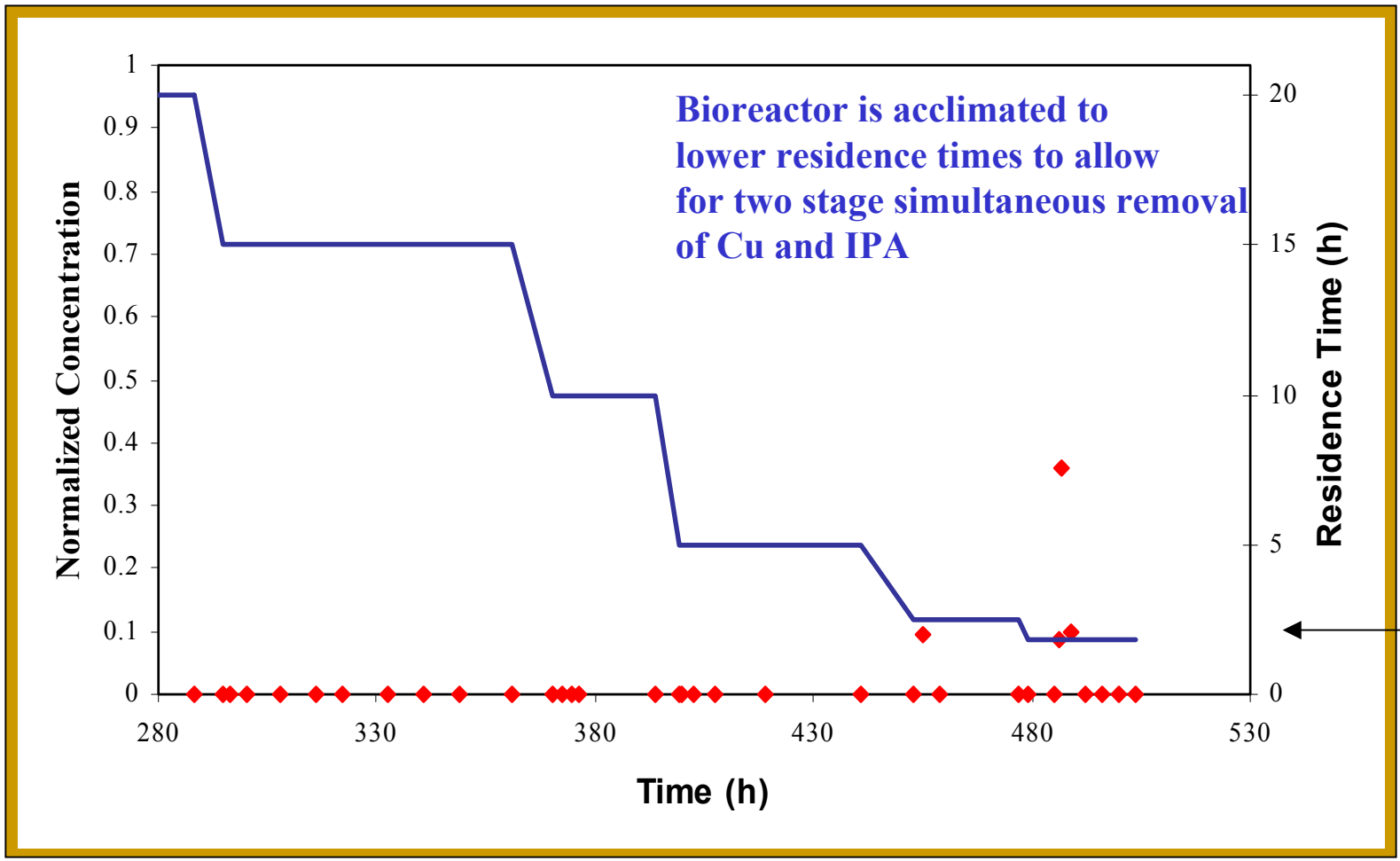
Two stage system



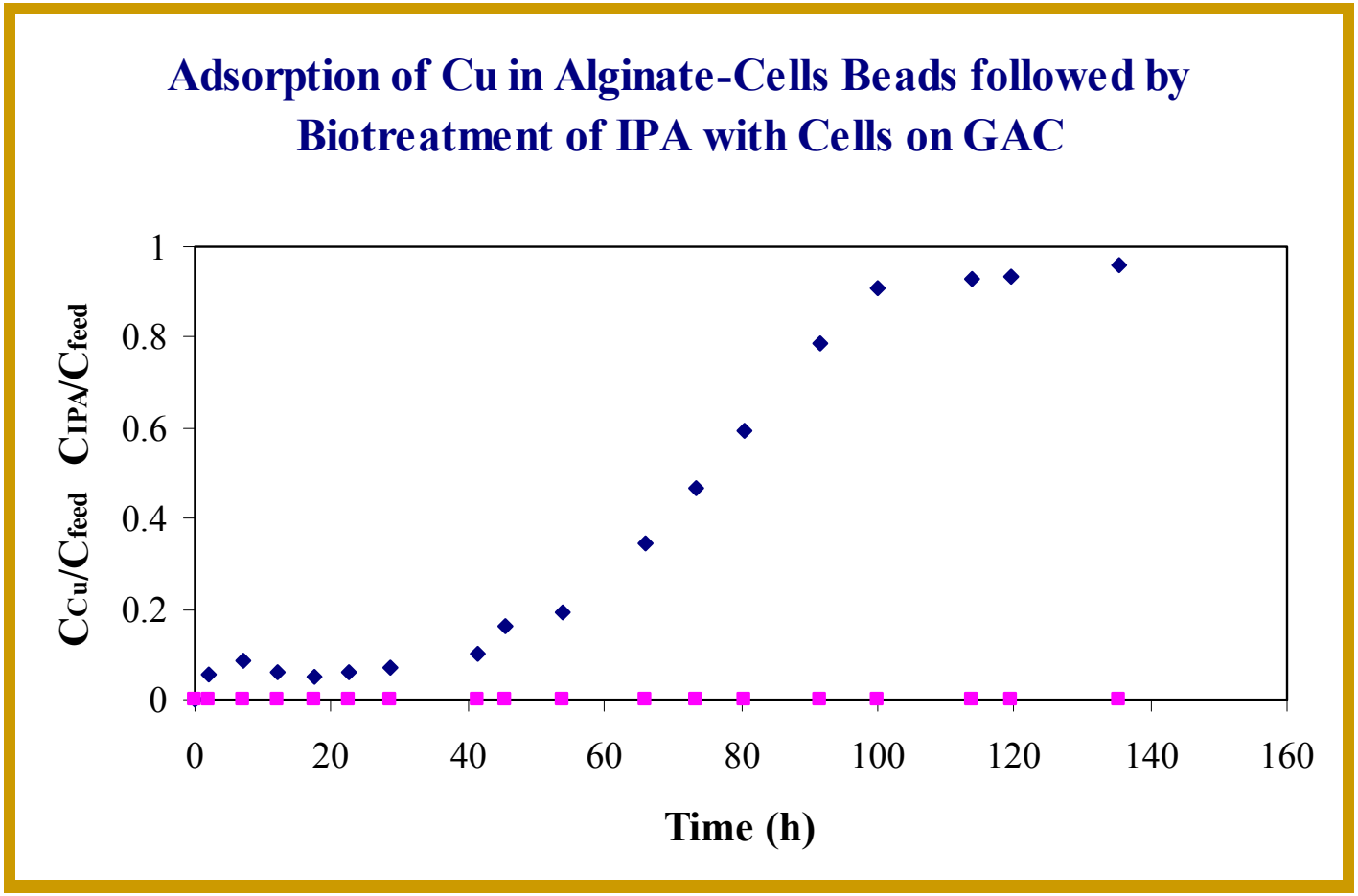

- Y5 cells on alginate beads
- IPA consortium on GAC

Main issue: residence time on GAC reactor

# Bioreactor results for organic containing streams



# Two-Stage Removal of Cu and IPA



# Conclusions

- One Stage System
  - Simpler set up (one reactor)
  - One bacteria strain
    - Less robust
    - Not best individual performer
  - Time scales not similar
  - Support
    - Degradation, mechanical stability
    - Allows good diffusion into particle

# Conclusions

- Two Stage System
  - More elaborate set up
  - Consortium of bacteria
    - More robust
    - May use best performers
  - FBR configuration
    - multi pass allows same residence times
    - allows better mass transfer
  - Support
    - GAC Aids in IPA and other organic adsorption
    - Good stability, industry standard
    - Alginate still has stability problems