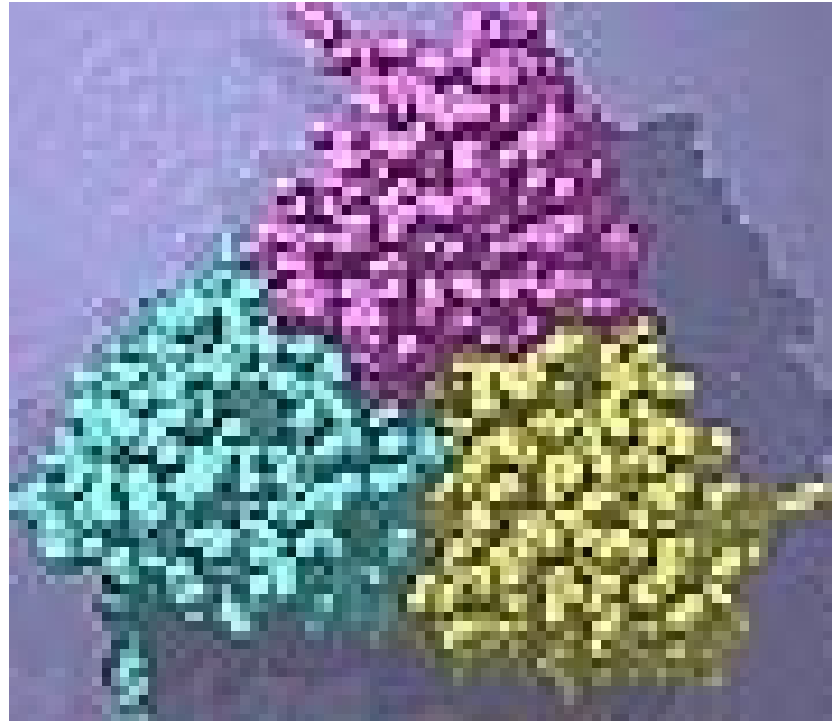


Protein Crystal Growth in Space

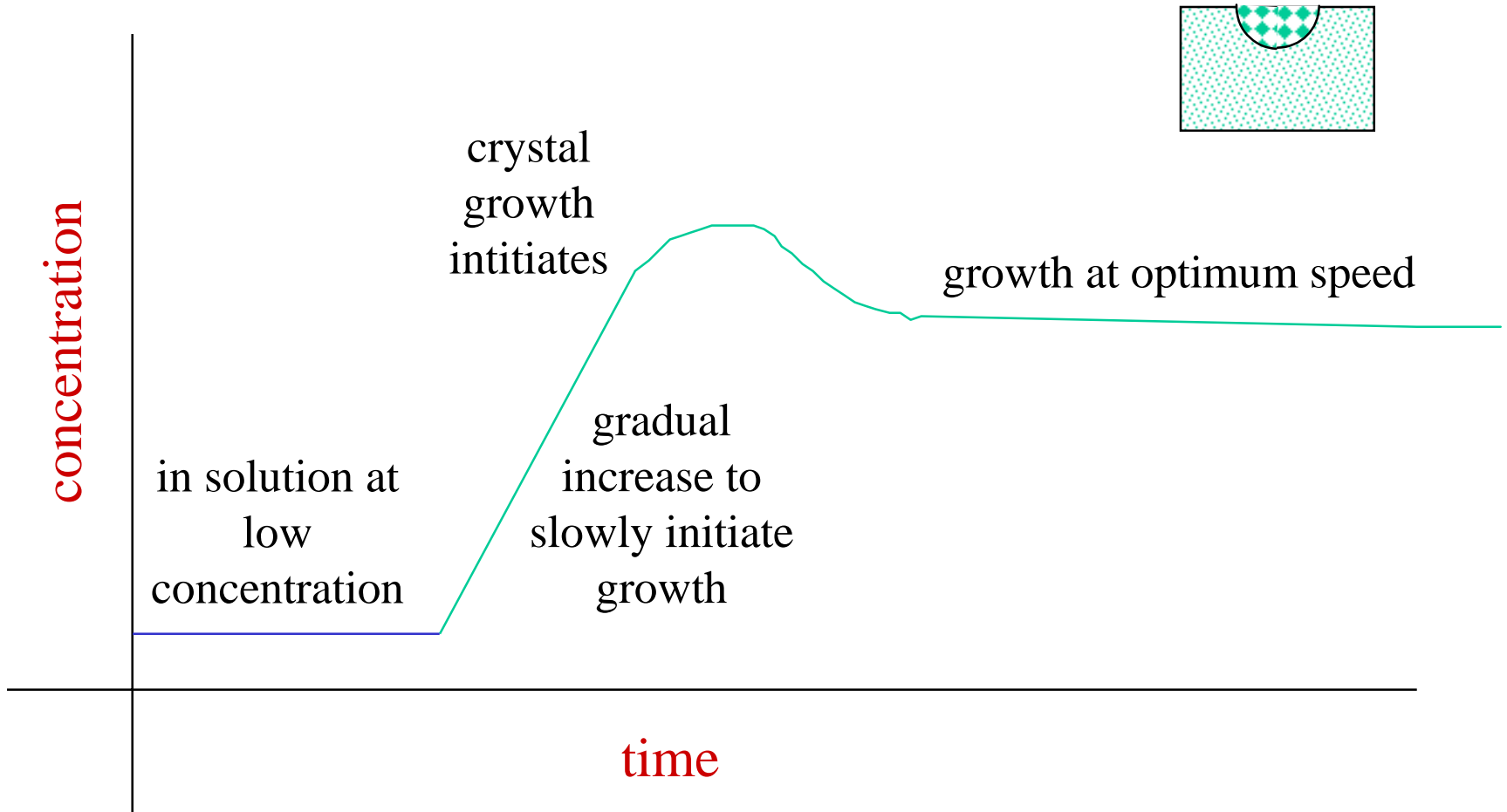


Jenny Kellogg

Goals of Crystal Growth

- Pharmaceutical advancement
 - Understand structure of protein molecules
 - Grow high purity crystals in space
- Current protein experimentation
 - Lung disease in children
 - Liver regeneration
 - Alpha-Interferon (Leukemia, AIDS related disease, hepatitis Band C)

How does a Crystal Grow?



Crystal Growth Experimentation

- Both diffusion and fluid flow play a part in designing an experiment
- Scientists design experiments involving different mixtures designed to promote crystal growth

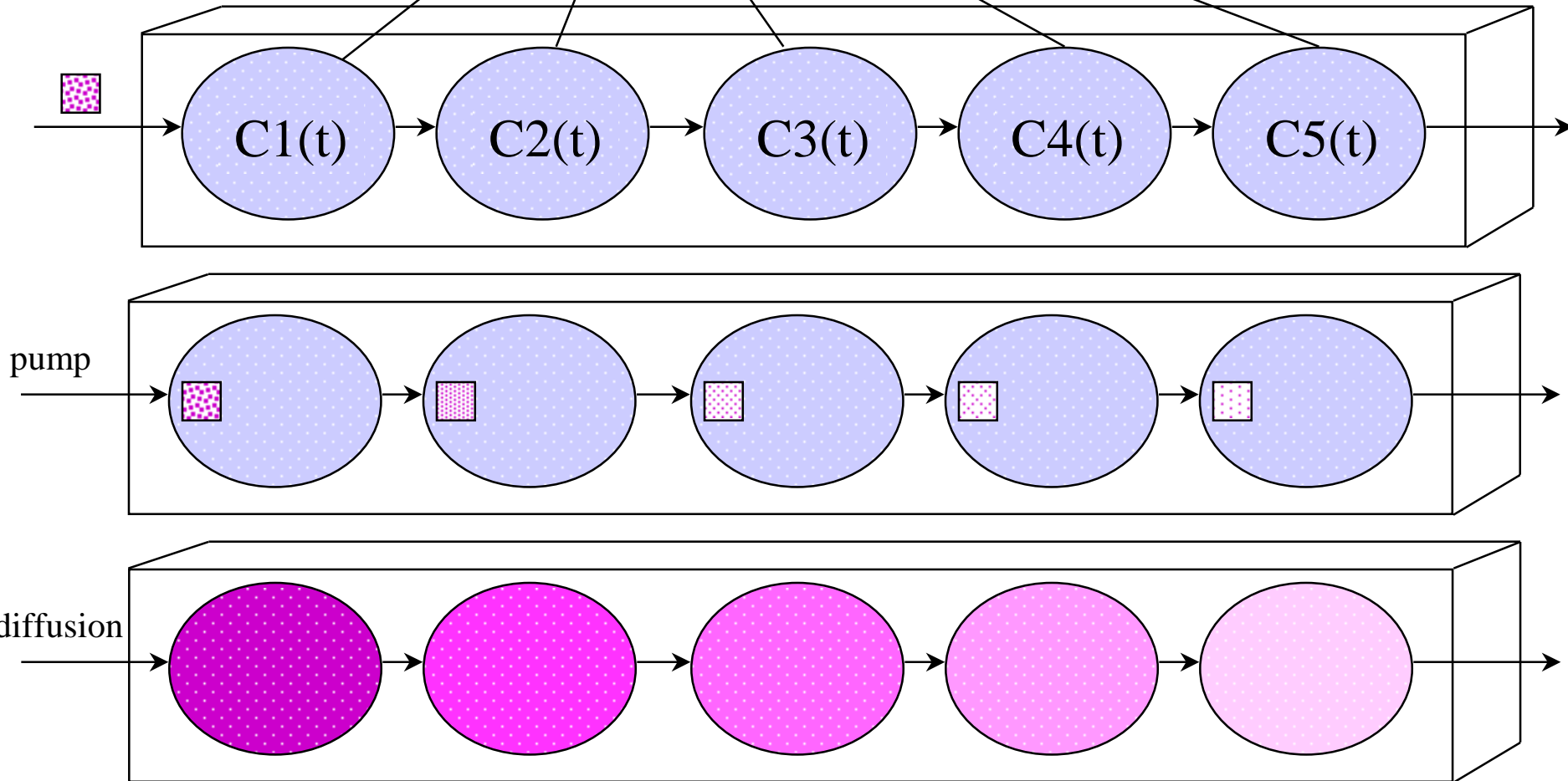
Diffusion Apparatus

$V_p = 2\mu\text{L}/\text{min}$

@

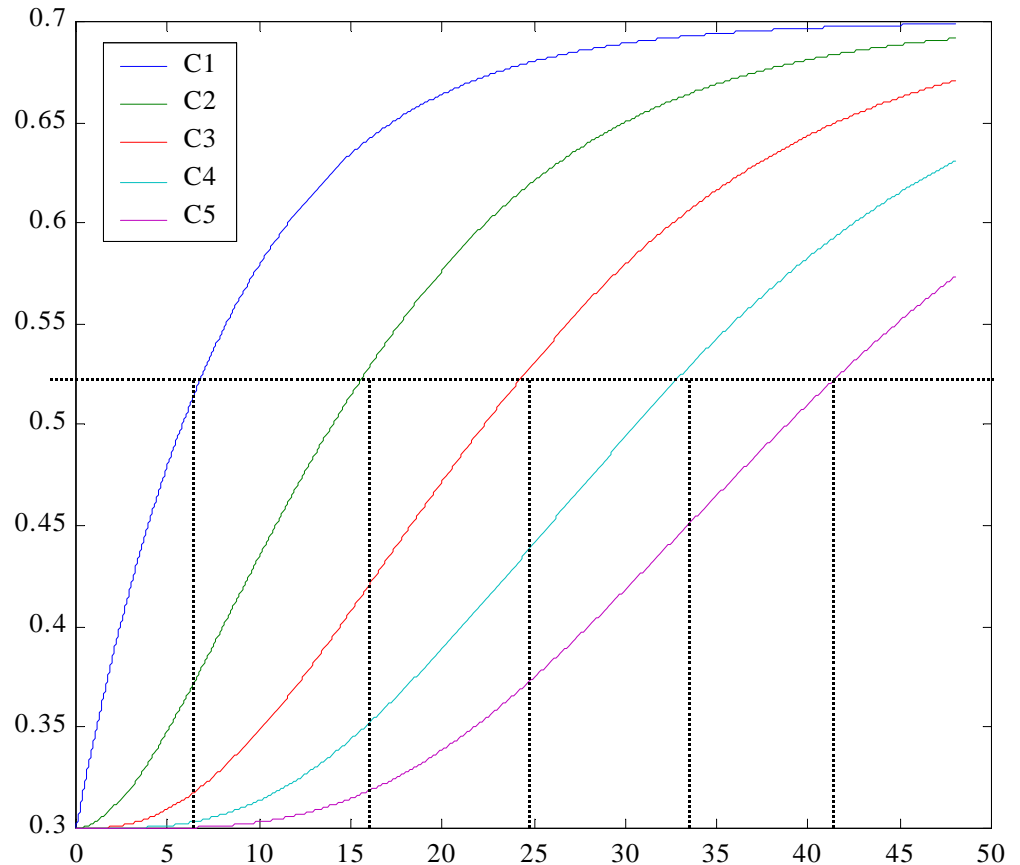
$C_{in} = 70\%$

$V_c = 1\text{mL}, C_o = 30\%$



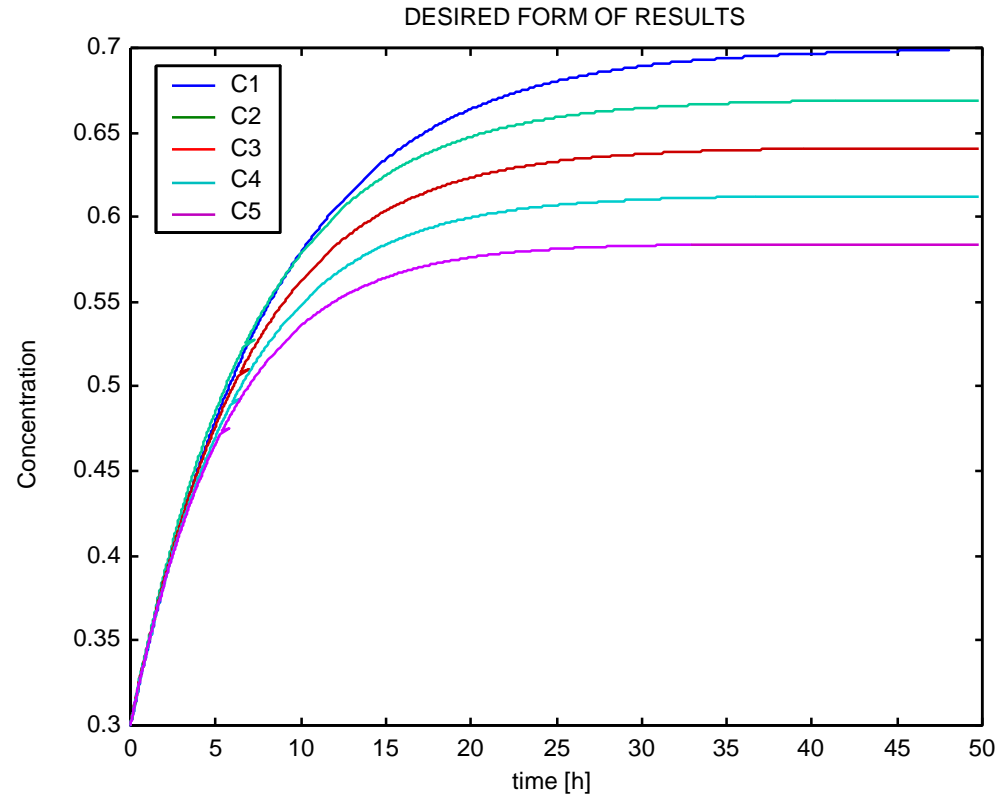
Analysis of Existing Design

- Assume thorough diffusion occurs between pump cycles
- Crystals begin to grow in each chamber sequentially



Design Evaluation/Improvement

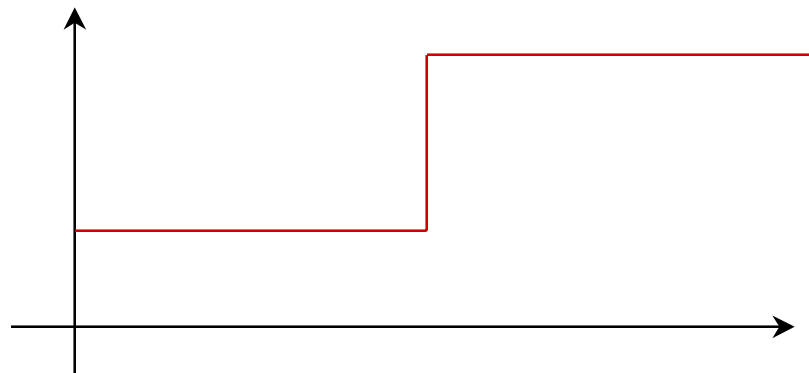
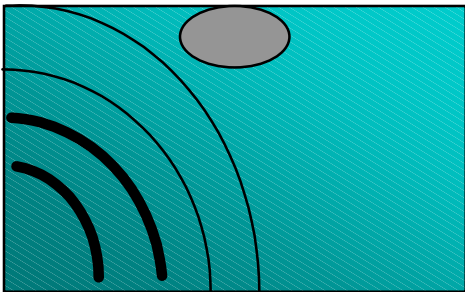
- Perhaps it is desired to activate crystal growth in each chamber simultaneously
- Final concentration is the single variable



Diffusion Model

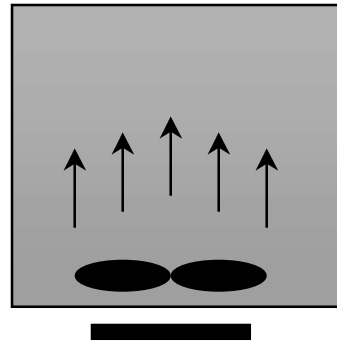
$$x = 2 (Dt / \pi)^{1/2}$$

$$\begin{aligned} t &= (\pi x^2 / 4D) \\ &= (0.01\text{m})^2 \pi / 4(1.35\text{e}-9 \text{ m}^2/\text{s}) \\ &= 58000 \text{ seconds} = 16 \text{ hours} \end{aligned}$$

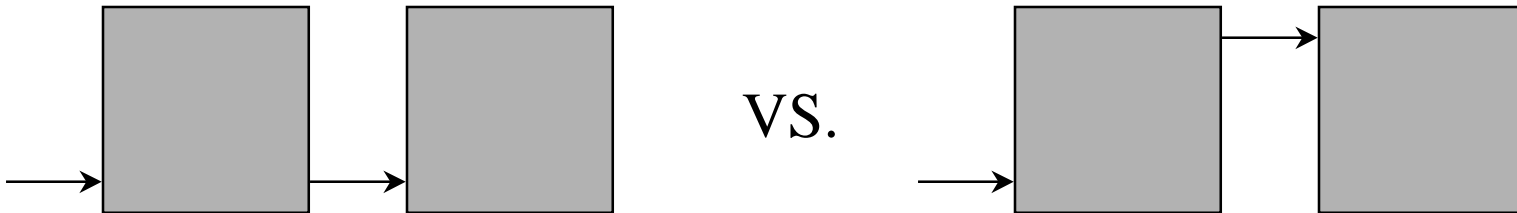


Design Recommendations

- Add mixing



- Appropriate choice of chamber inlets



Conclusion

- Benefits of Protein Crystal Growth include pharmaceuticals, pure science
- Improve design of apparatus by adding mixing mechanism
- Suggest experimentation to accurately model diffusion mechanism

References

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