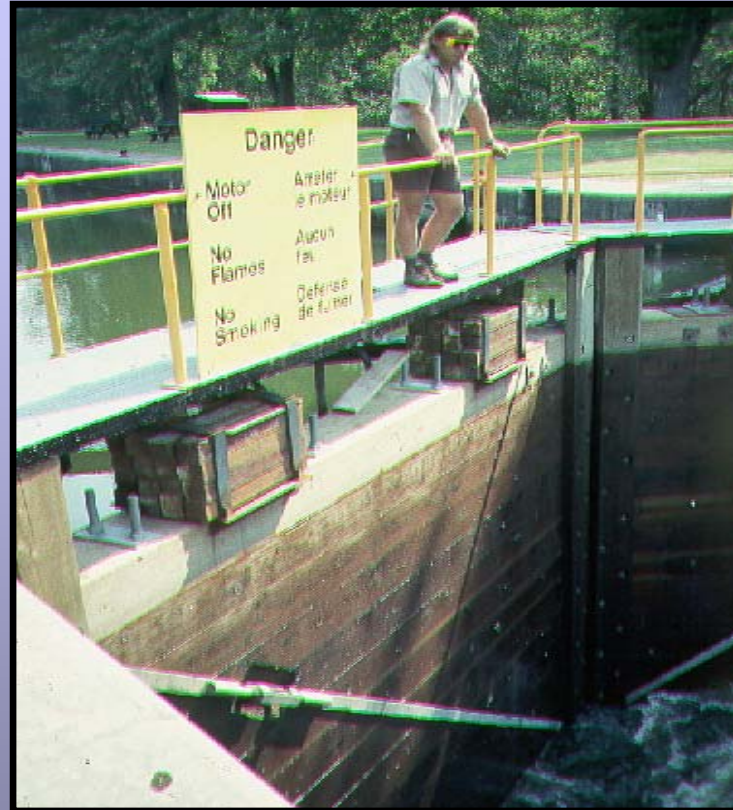


Modeling of wood preservative leaching in service

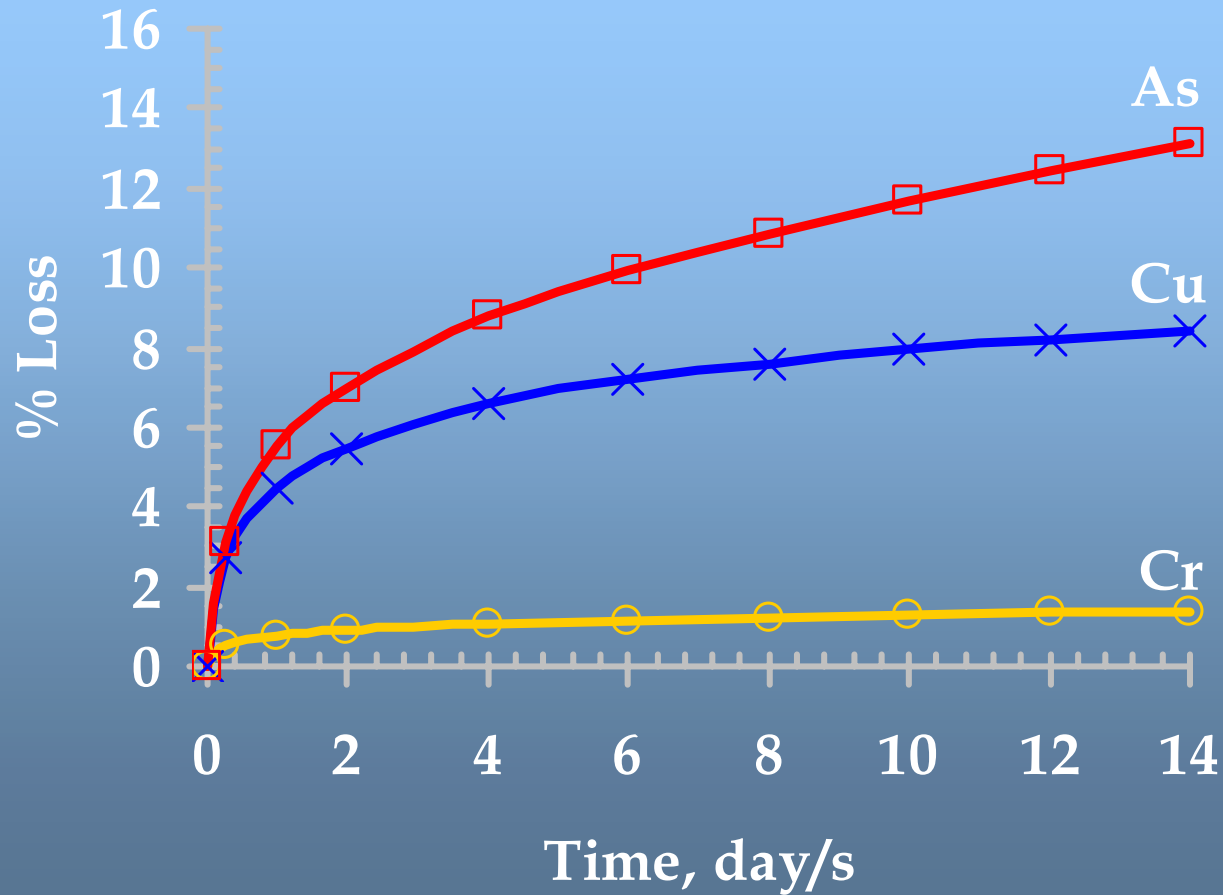


Levi Waldron, Tony Ung & Paul Cooper
Faculty of Forestry, University of Toronto

FICISS, Orlando Florida

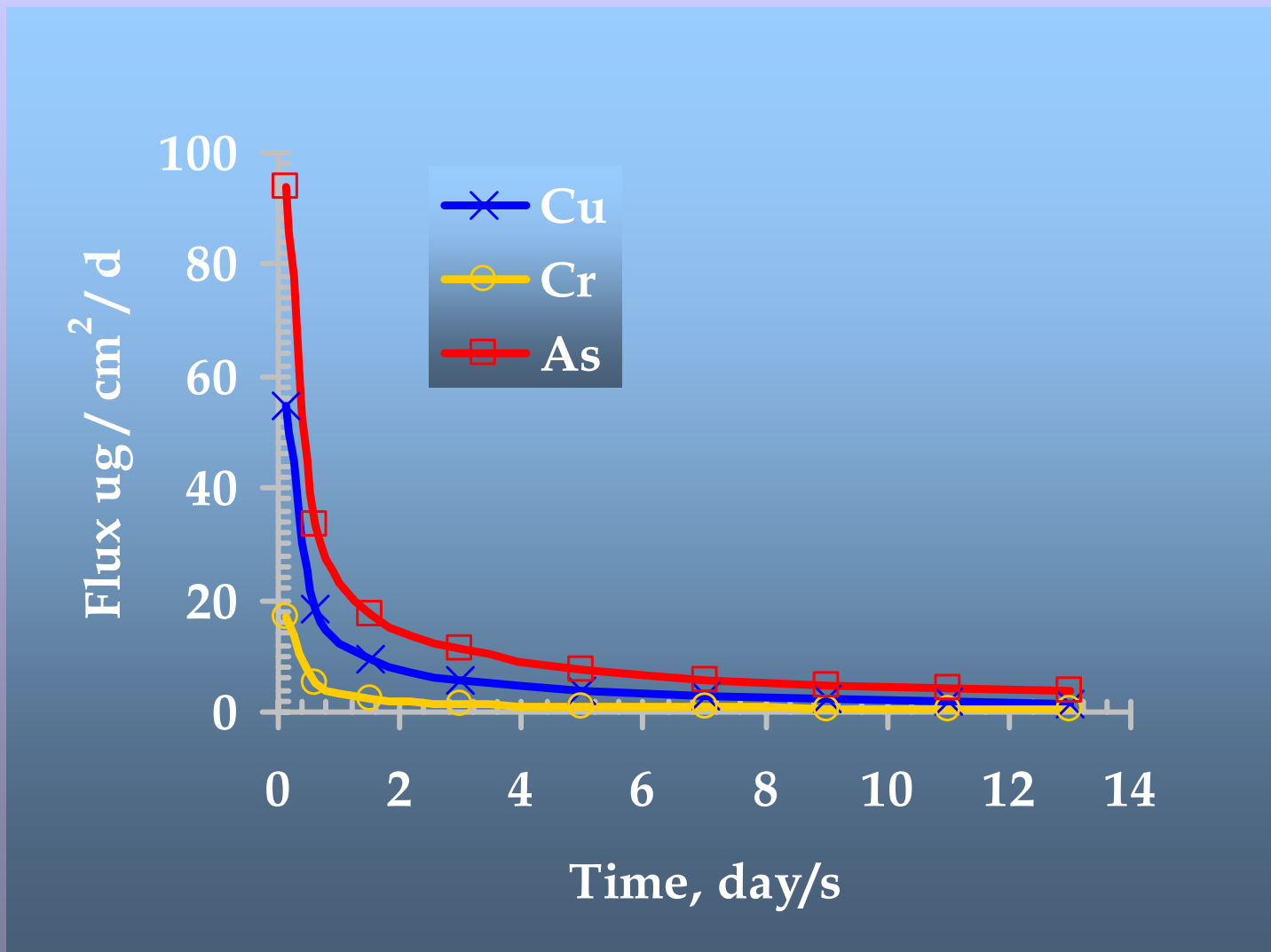


Prediction of leaching from wood



AWPA E11

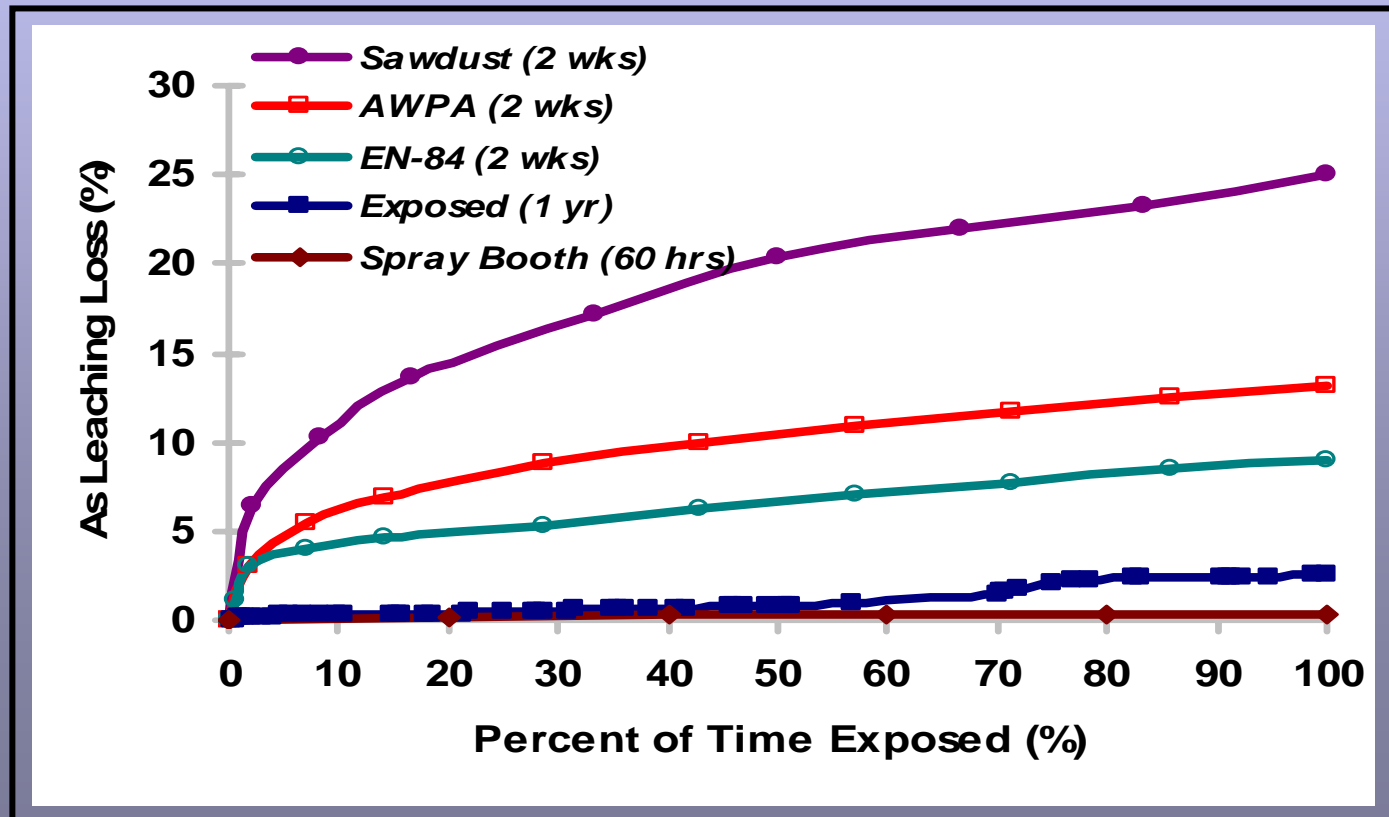
Leaching Flux of CCA components from SYP



Empirical models depend on:

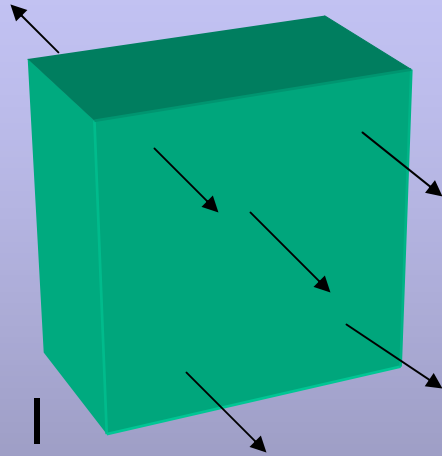
- Dimensions (diffusion distance)
- Direction - end grain effect
- Wood permeability

As



DIFFUSION MODEL

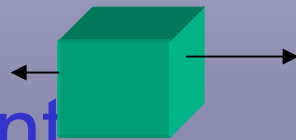
$$M / M_{\text{inf}} = \sum_{n=0}^{\infty} \frac{8}{(2n+1)^2 \pi^2} e^{-\frac{D(2n+1)^2 \pi^2 t}{4l^2}}$$



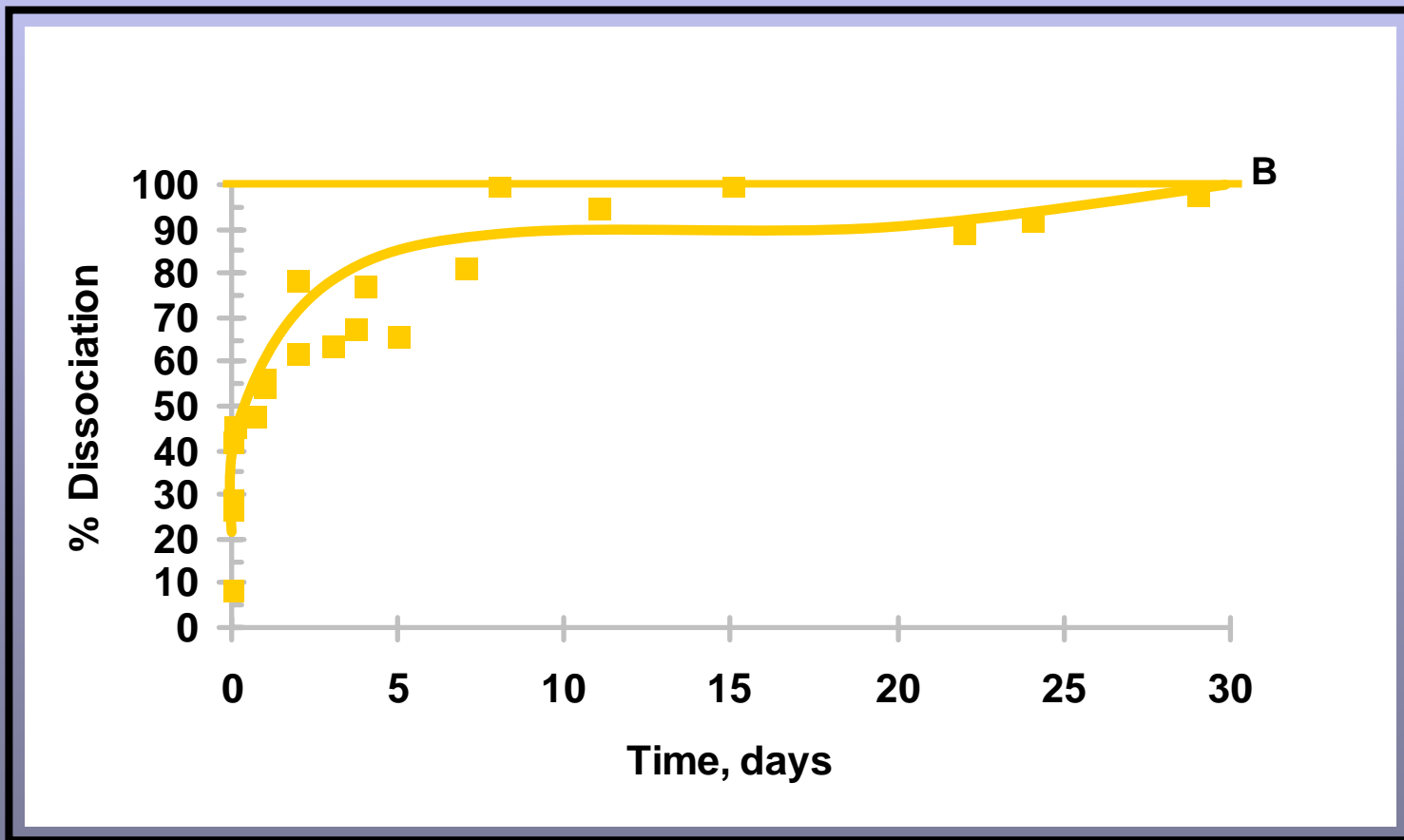
- Takes into account dimensions (l) and direction D_T vs D_L
- Can be expressed as % Loss or as flux (leaching rate - $\mu\text{g}/\text{cm}^2/\text{d}$) for any increment of time Δt
- But how is M_{inf} defined?

Approach:

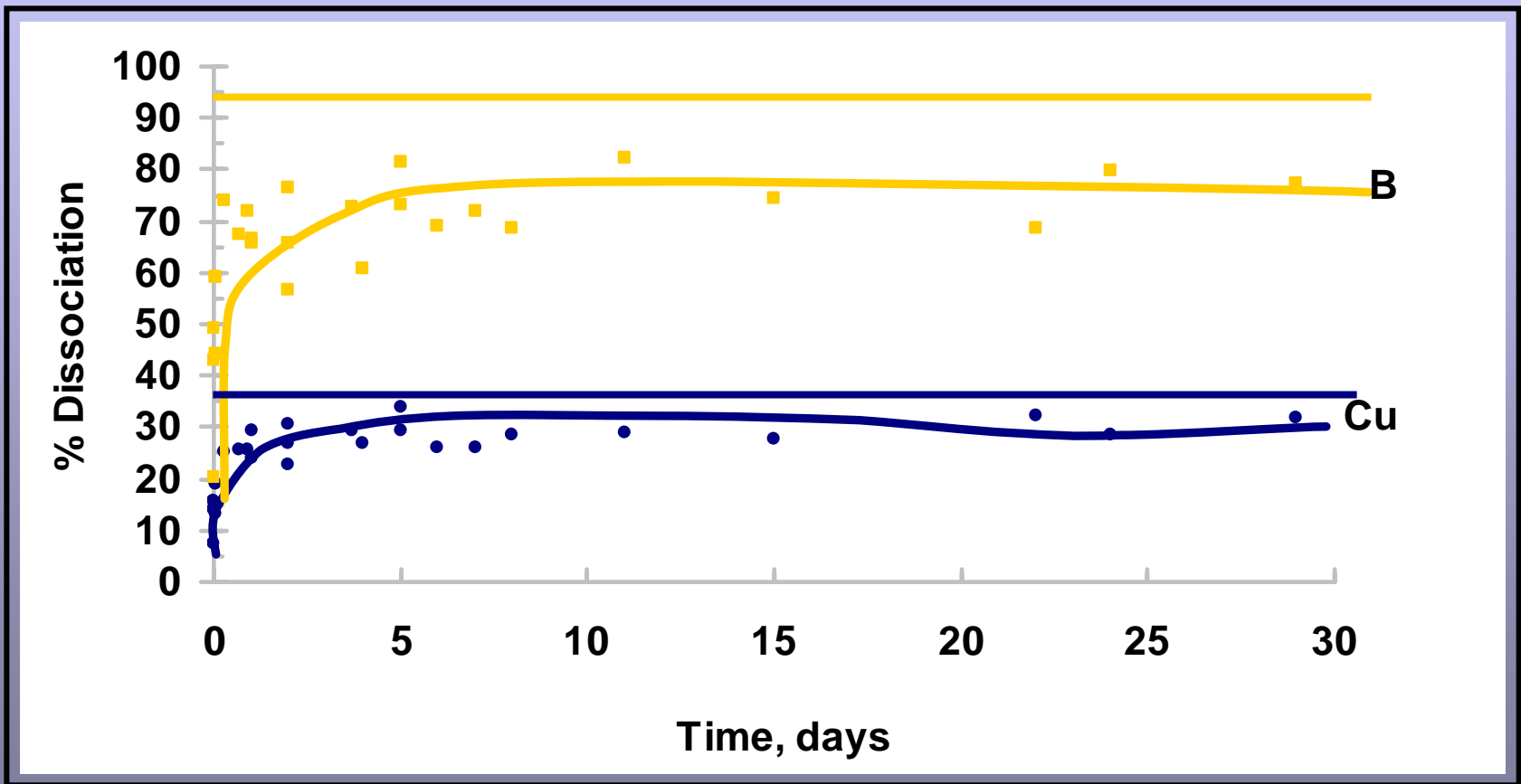
- Estimate total potential for leaching (Sawdust leach test = M_{inf})
- Determine equilibrium dissolved/dissociated concentration (effective short term M_{inf})
- Determine characteristic diffusion coefficient \parallel grain and \perp grain
- Predict % loss and flux under different scenarios



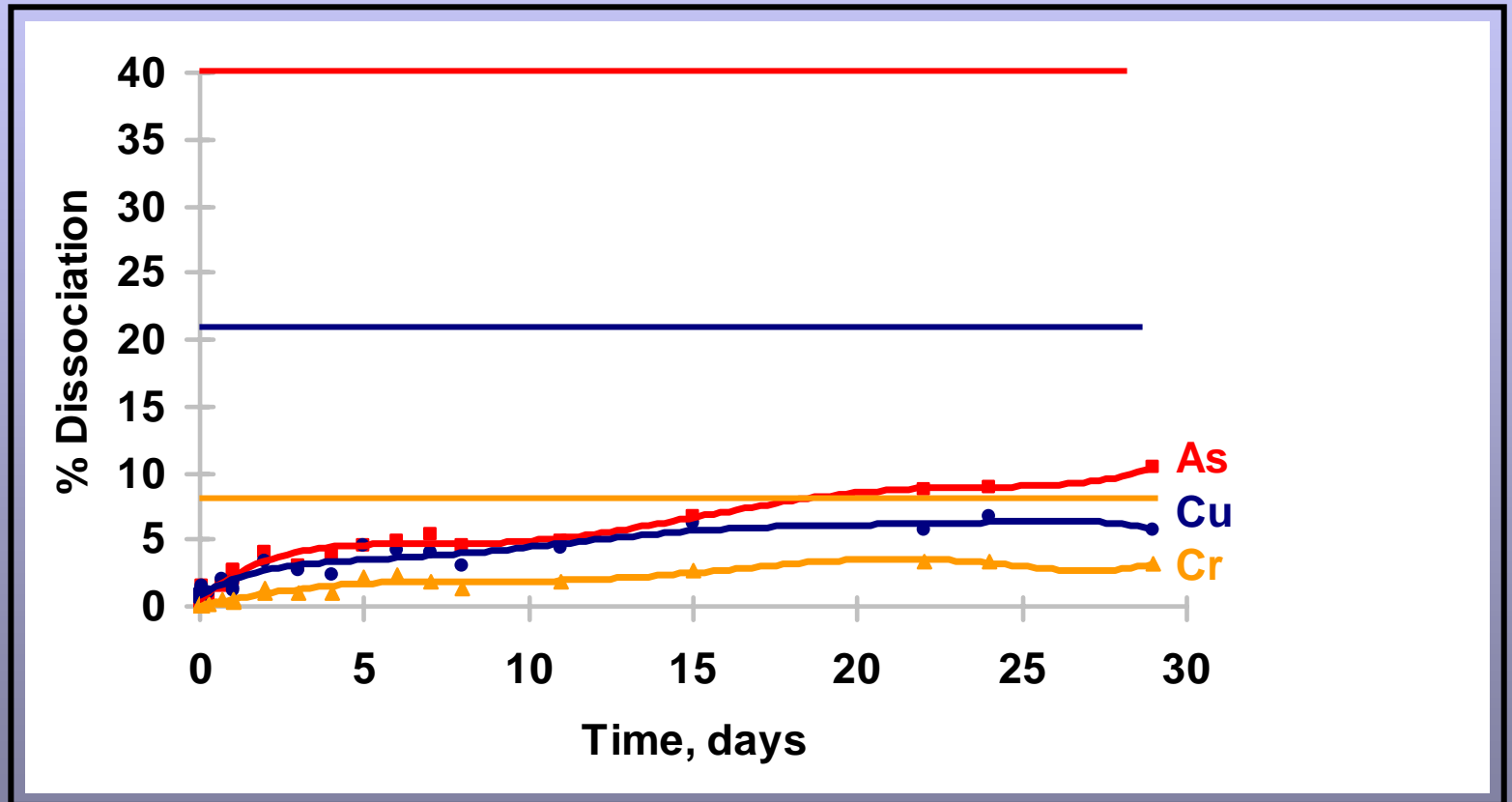
Dissociation of boron from Disodium Octaborate treated wood



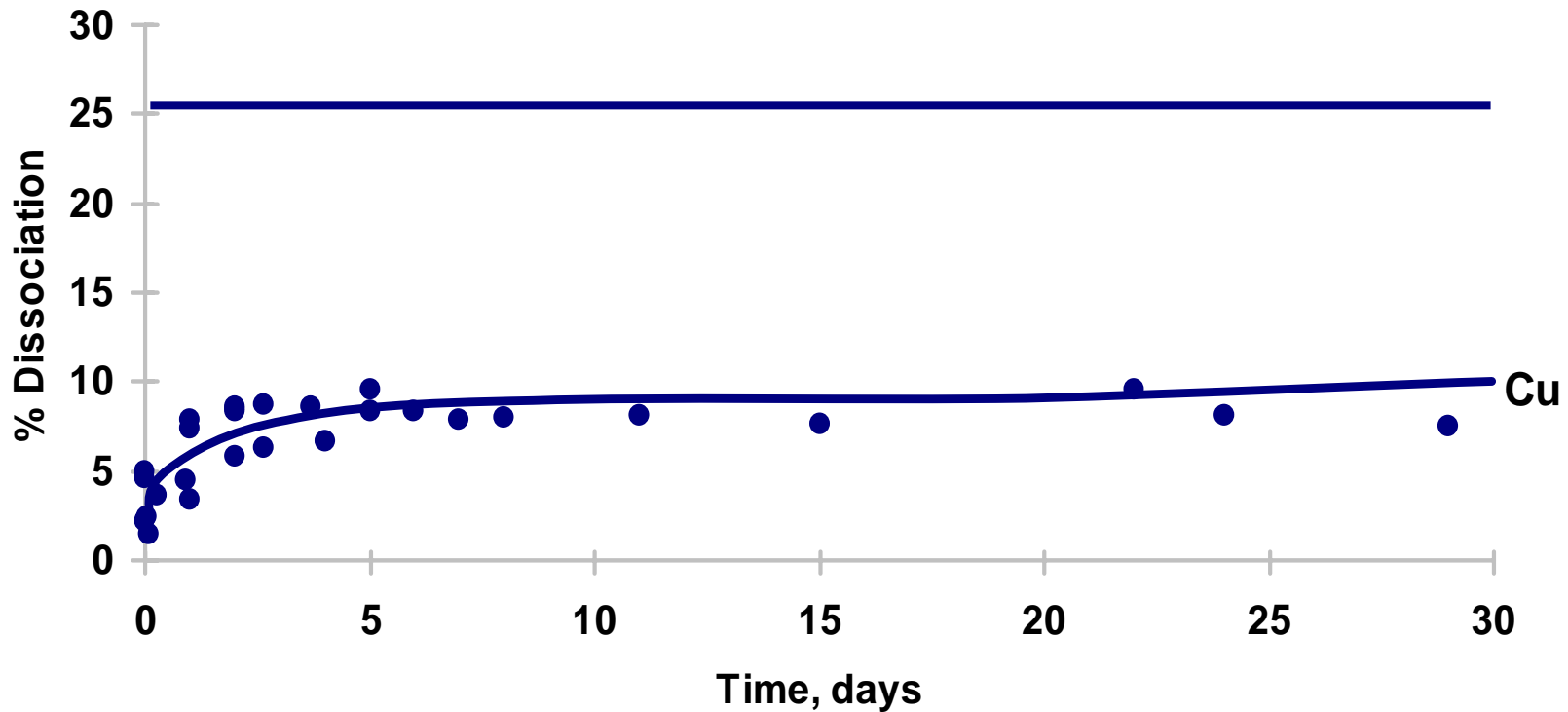
Dissociation of elements from ACQ treated wood



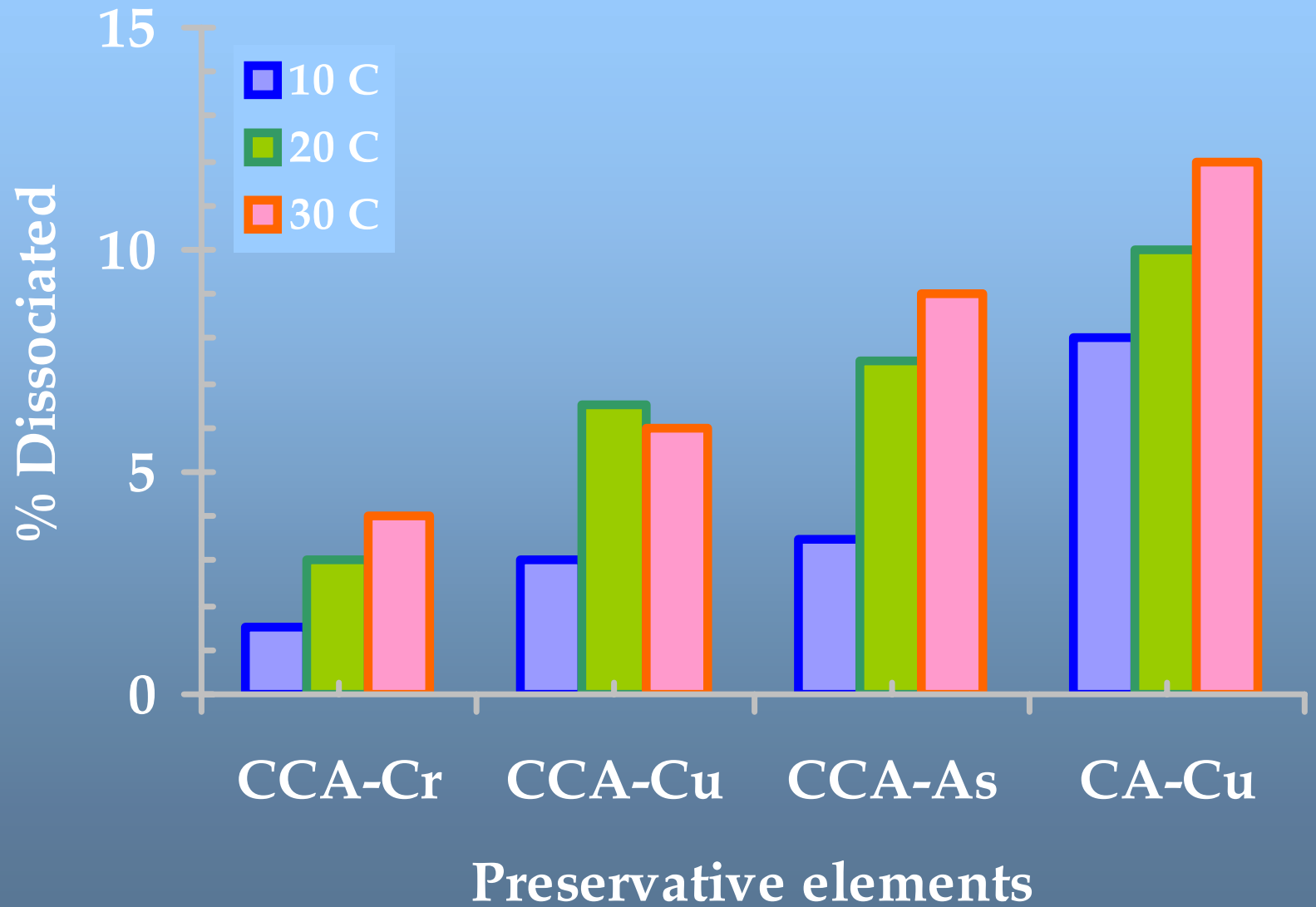
Dissociation of elements from CCA treated SYP wood (6 kg/m³)



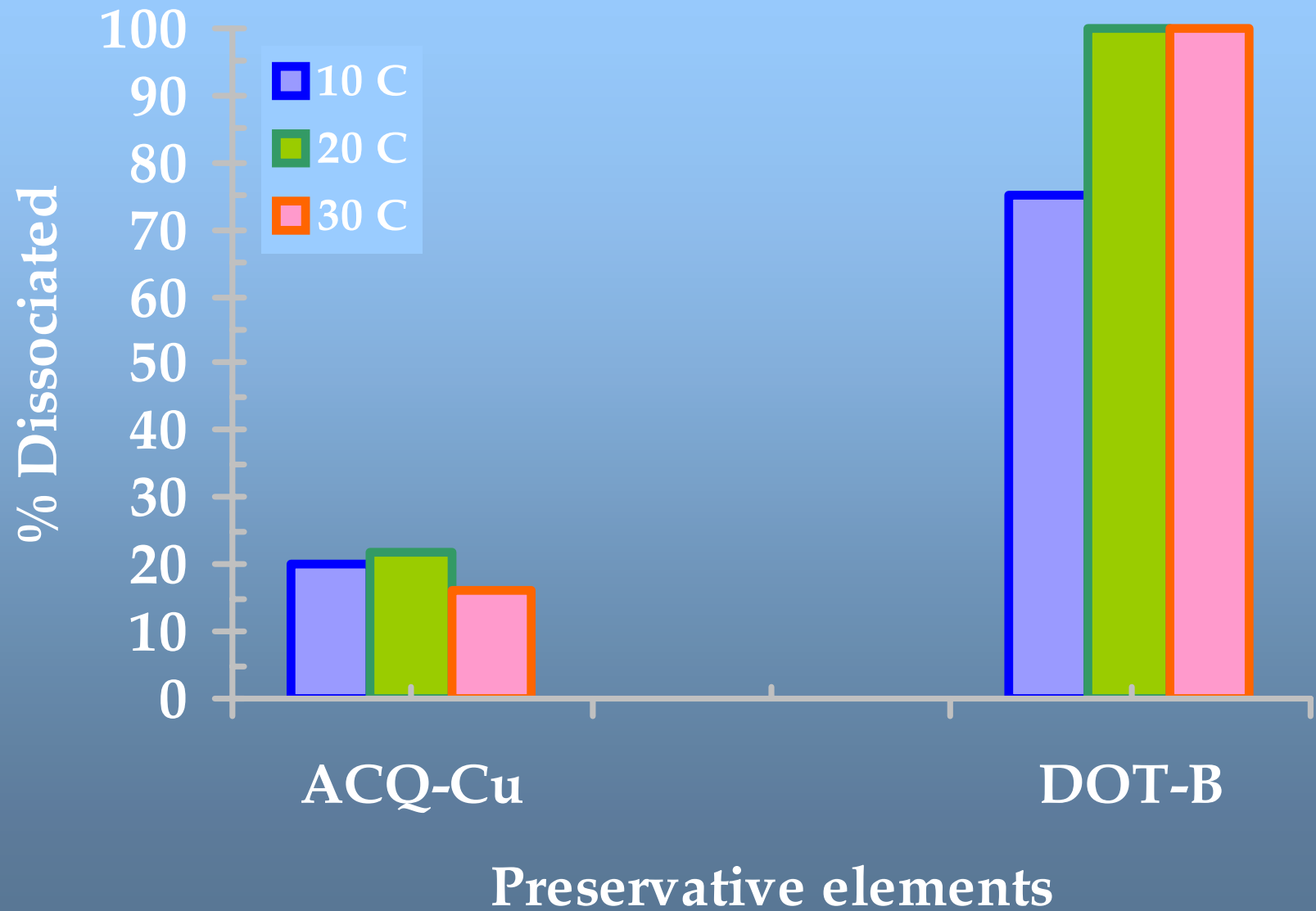
Dissociation of copper from Cu-Azole treated wood



Effect of temperature

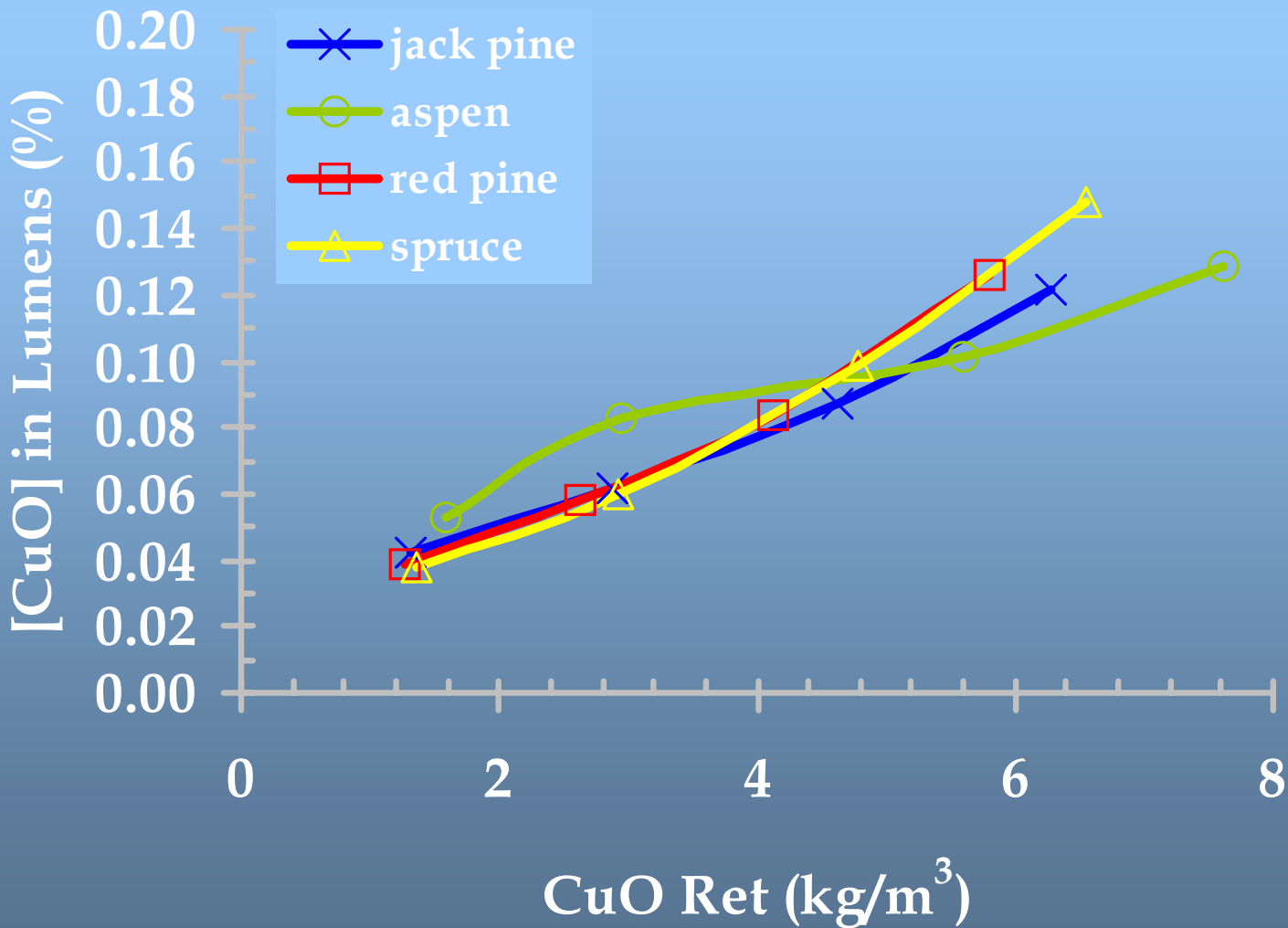


Effect of temperature



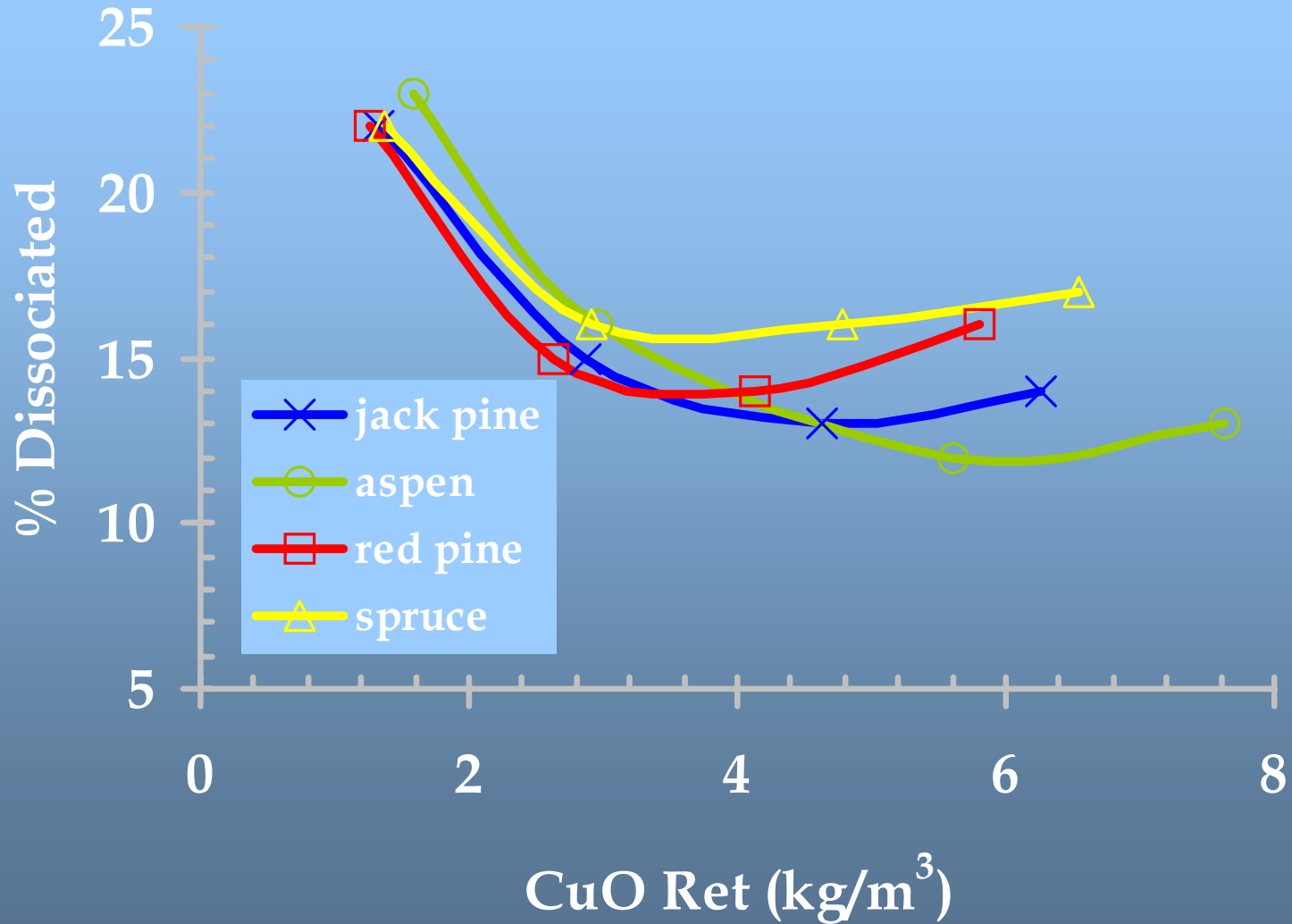
ACQ

Dissociation vs Retention



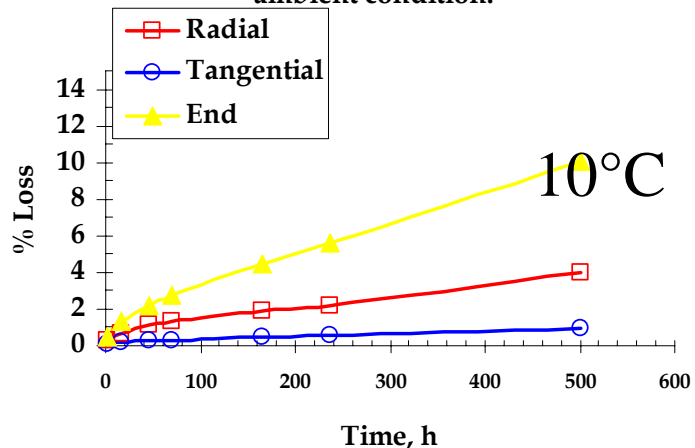
ACQ

Dissociation vs Retention

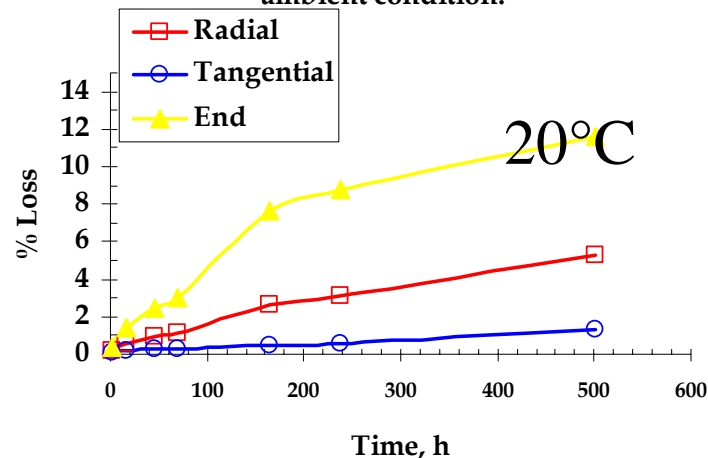


Effect of T and direction - CA

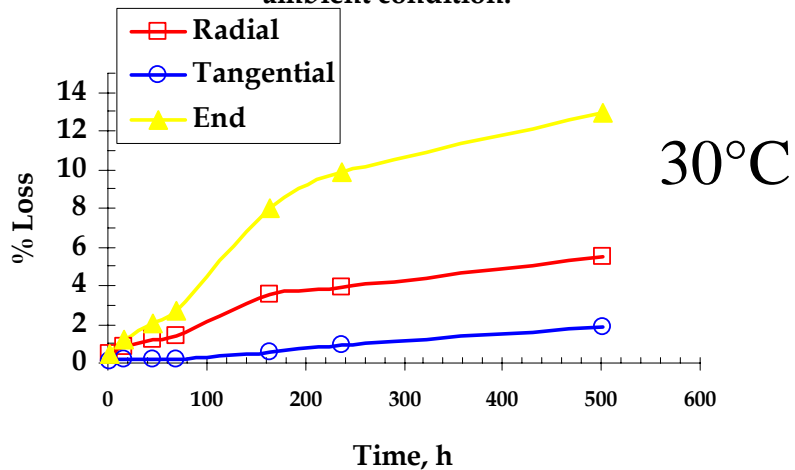
Leaching of Cu from CA treated wood with time at ambient condition.



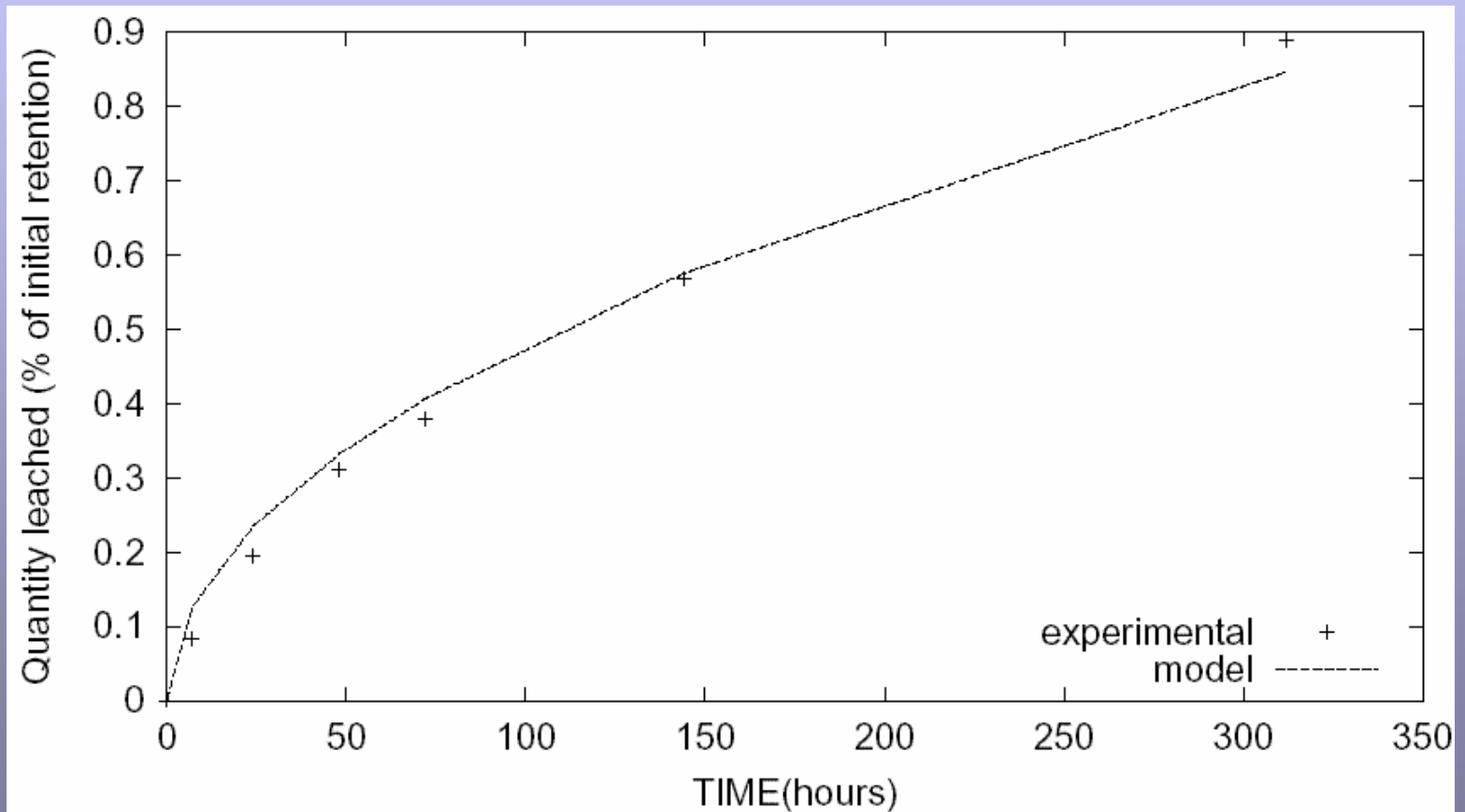
Leaching of Cu from CA treated wood with time at ambient condition.



Leaching of Cu from CA treated wood with time at ambient condition.



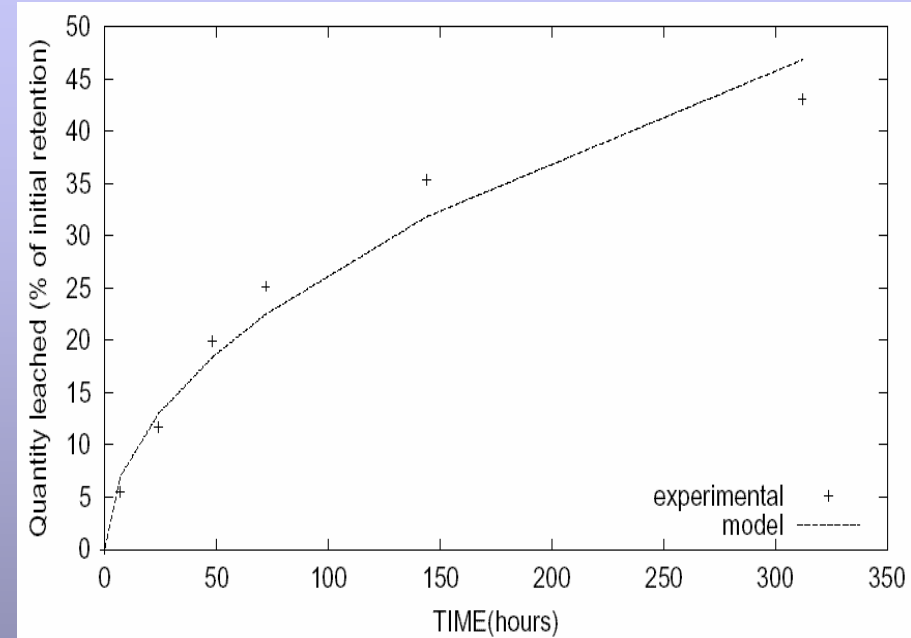
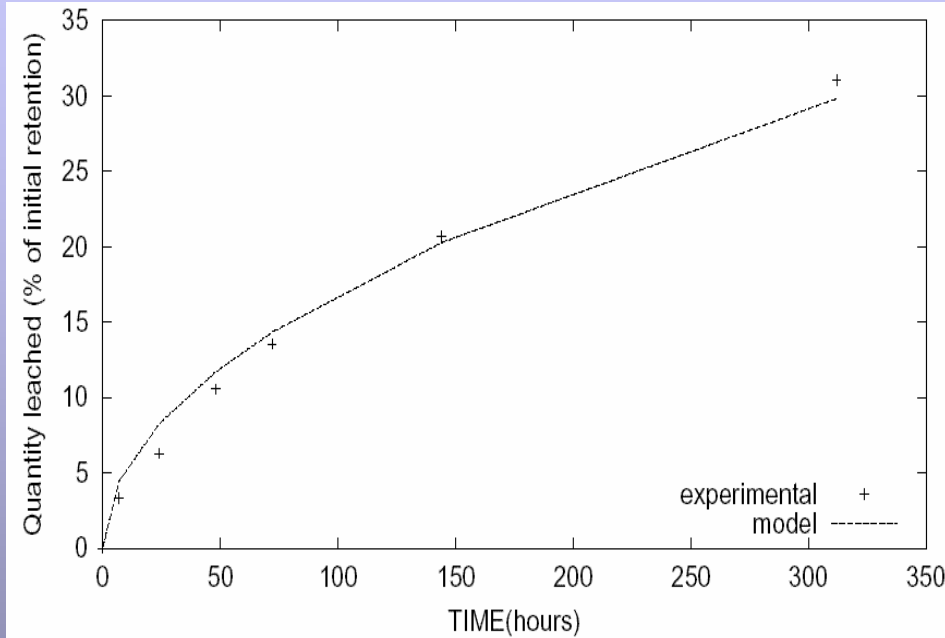
Cr (R) in CCA



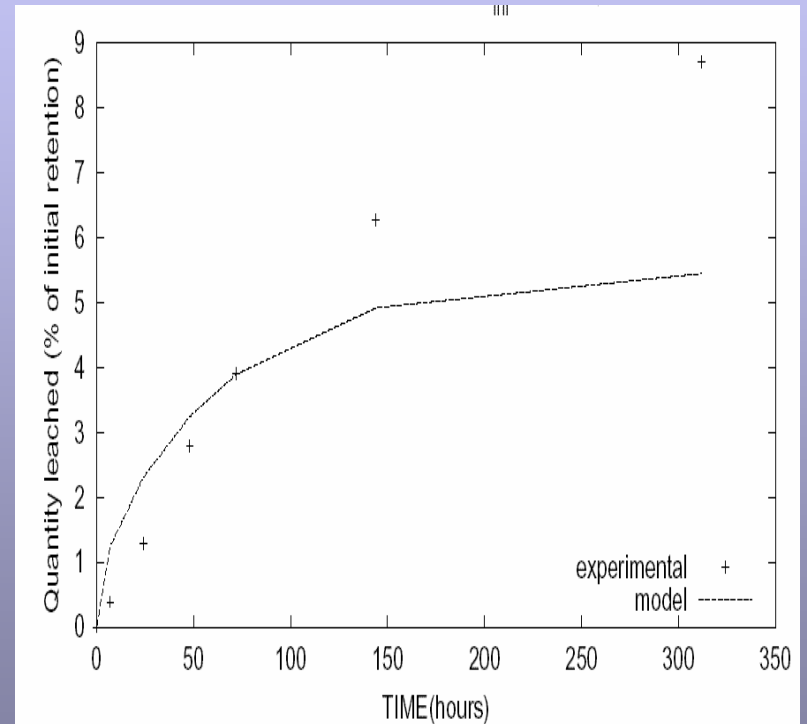
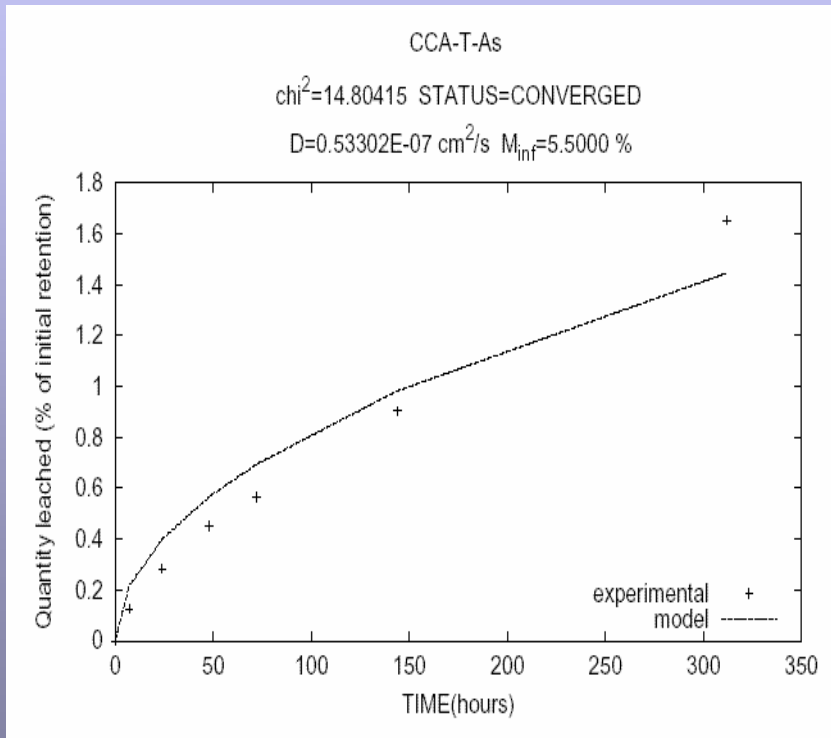
Borate

Radial

Longitudinal



As in CCA



Preliminary findings

Diffusion coefficients

$$D_{\text{Long.}} \gg D_{\text{Rad.}} \gg D_{\text{Tan.}}$$

- *The model can be extended to a Three Dimensional Model if these are known*

$$\text{Cu}_{\text{acq}} > \text{As} > \text{Cr} > \text{Cu}_{\text{CA}} > \text{Cu}_{\text{CCA}}$$

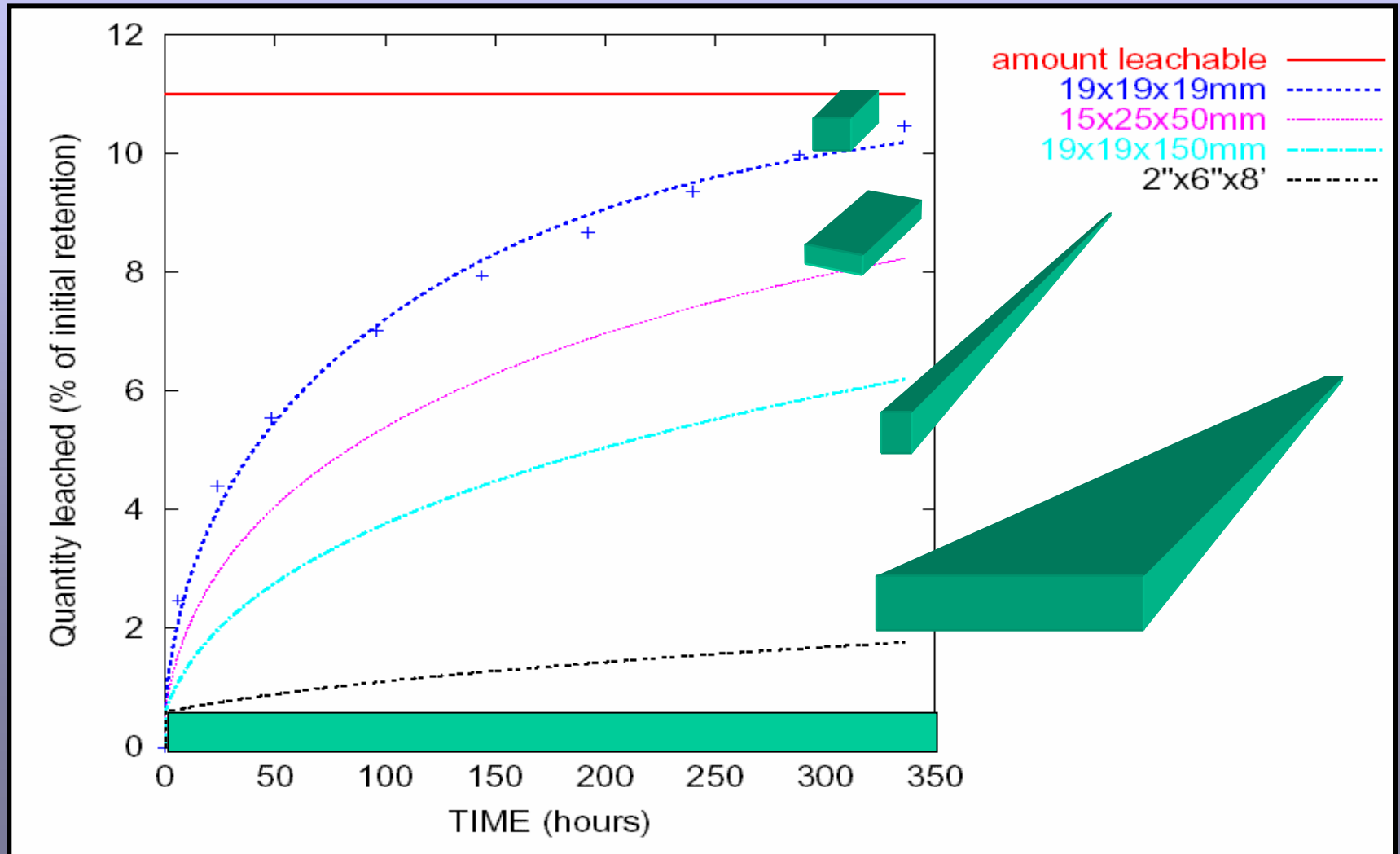
Dissociation

$$\text{B} > \text{Cu}_{\text{acq}} > \text{Cu}_{\text{CA}} > \text{As} > \text{Cu}_{\text{CCA}} > \text{Cr}$$

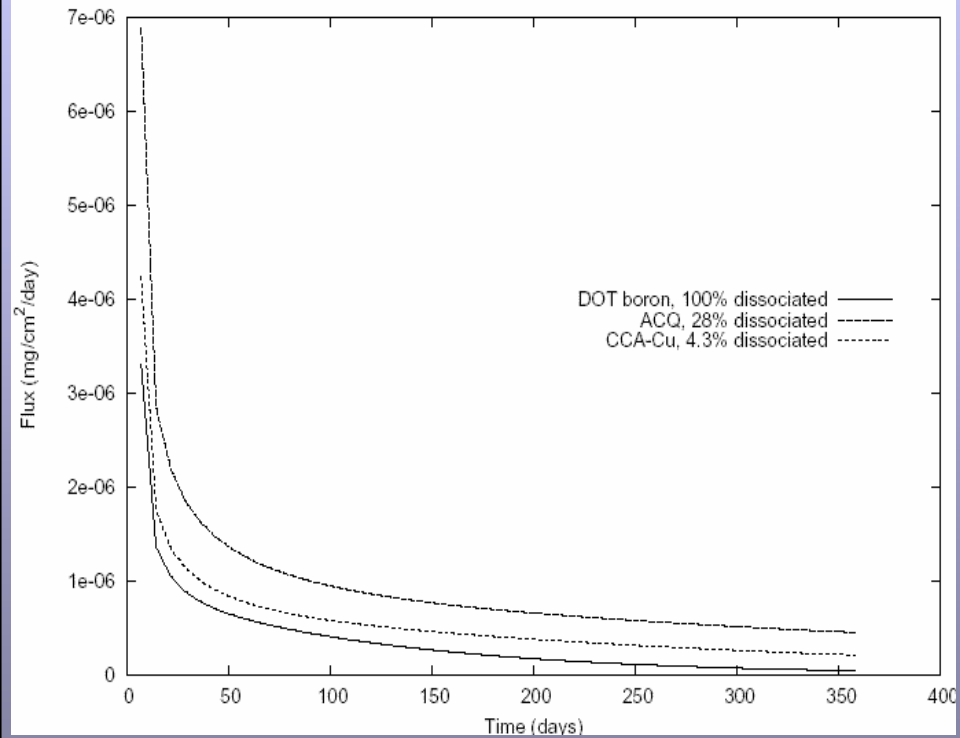
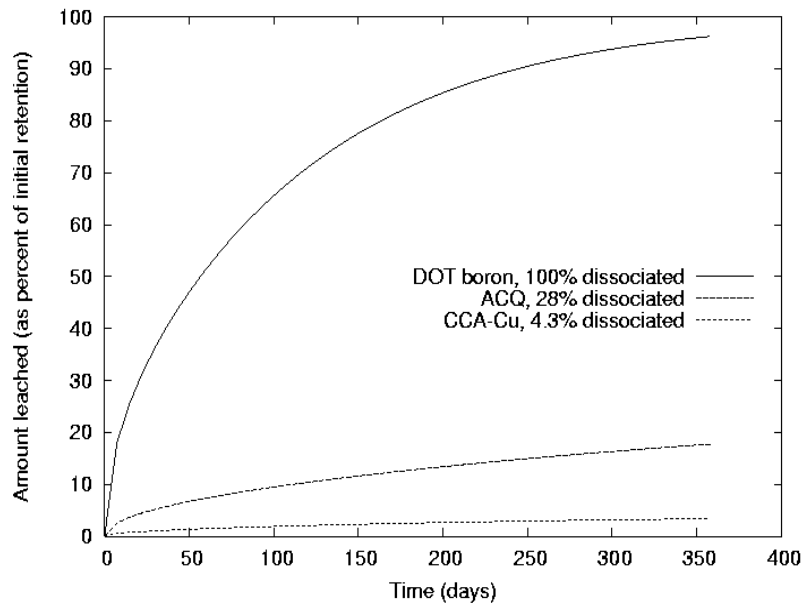
- *Higher leaching rates expected with higher D and higher dissociated concentrations*

Diffusion equation – 3D

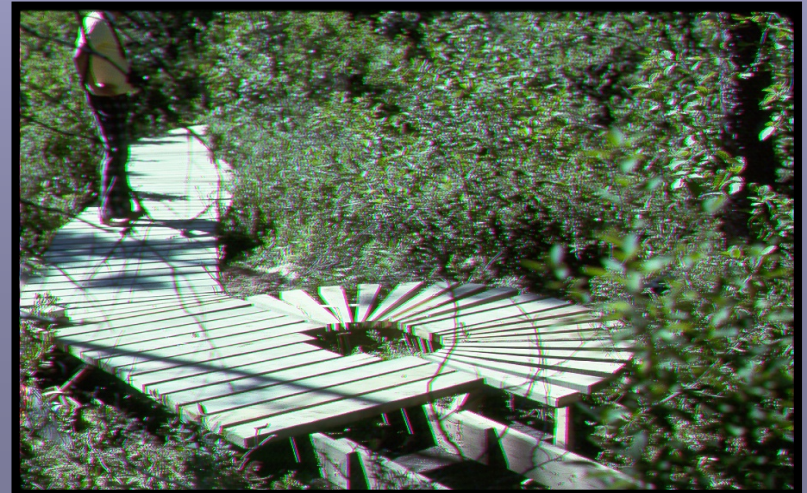
Effect of dimensions and end-grain on As leaching (Assumes D_L $10 \times D_T$)



Application of diffusion equation to deck board

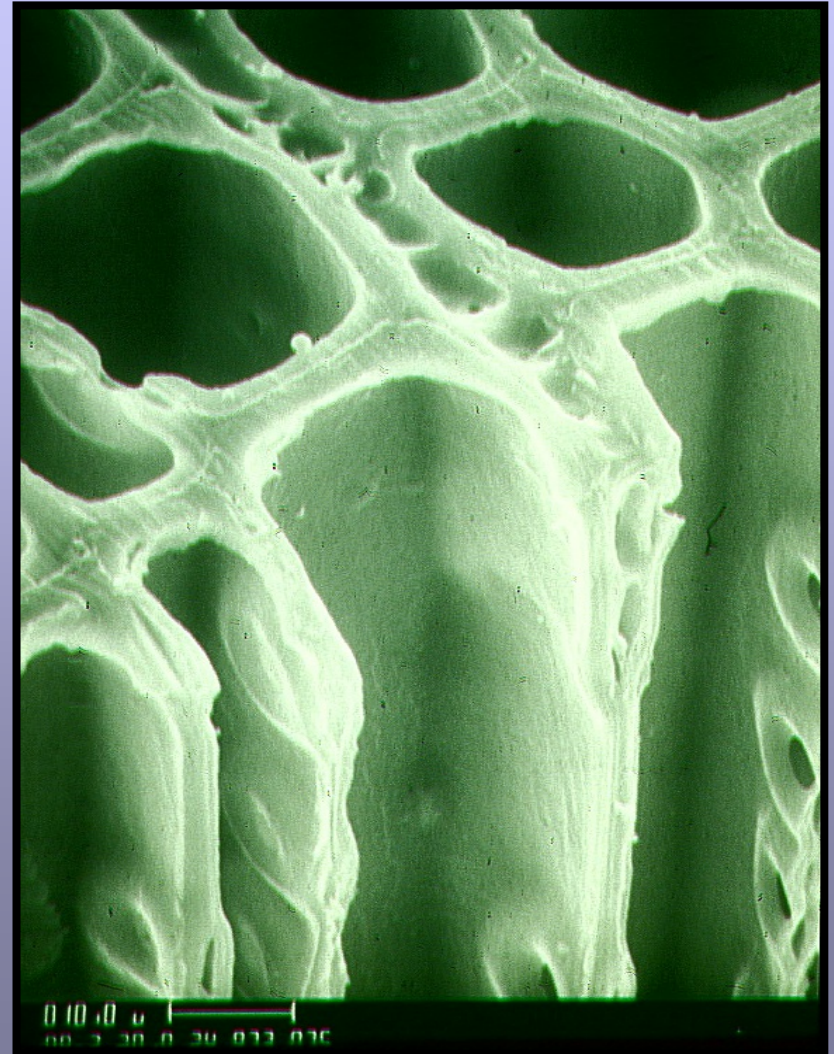


How can we predict leaching under different exposures?



Leaching Above Ground

- Water wets & penetrates wood
- Water dissolves/ dissociates preservative components
- Components diffuse to surface
- Components washed from surface
- Wood dries (wicking?)



Ultimate Goal: Develop predictive model/software to estimate leaching under different conditions



THANK YOU