



Fundamentals of BCTMP
Brightness Stability

Art J. Ragauskas



Fundamentals of Brightness Stability

Research Objective:

- Investigate mechanisms of brightness reversion**
- Develop photostabilization technologies**

Project Goal:

- Increase the usefulness of high-yield fibers**



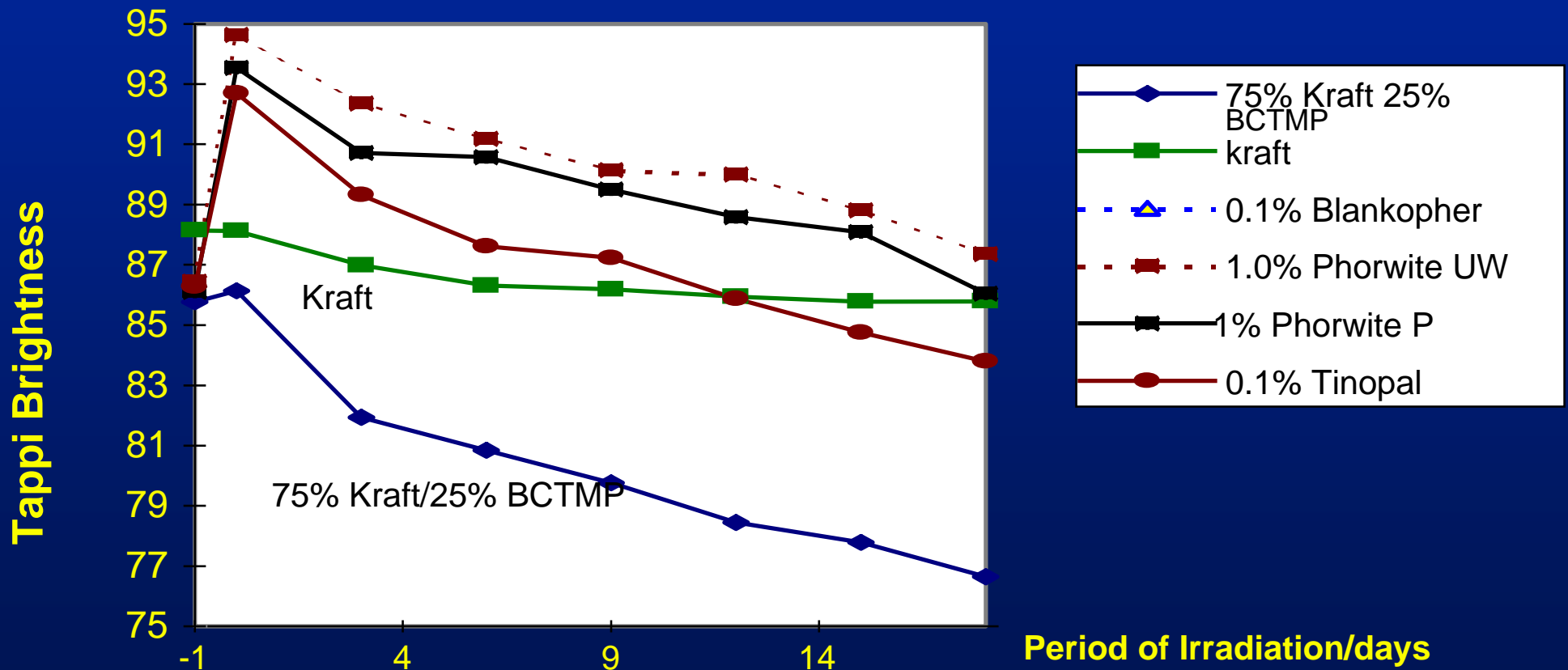
Fundamentals of Brightness Stability


Past Accomplishments

- | Developed new UV screens for high brightness mechanical pulps
- | Demonstrated that additive combinations are more effective at retarding brightness reversion than individual agents
- | Discovered use of FWA as brightness reversion mitigators

Fundamentals of Brightness Stability

Past Accomplishments





FWA Photostabilization Effects

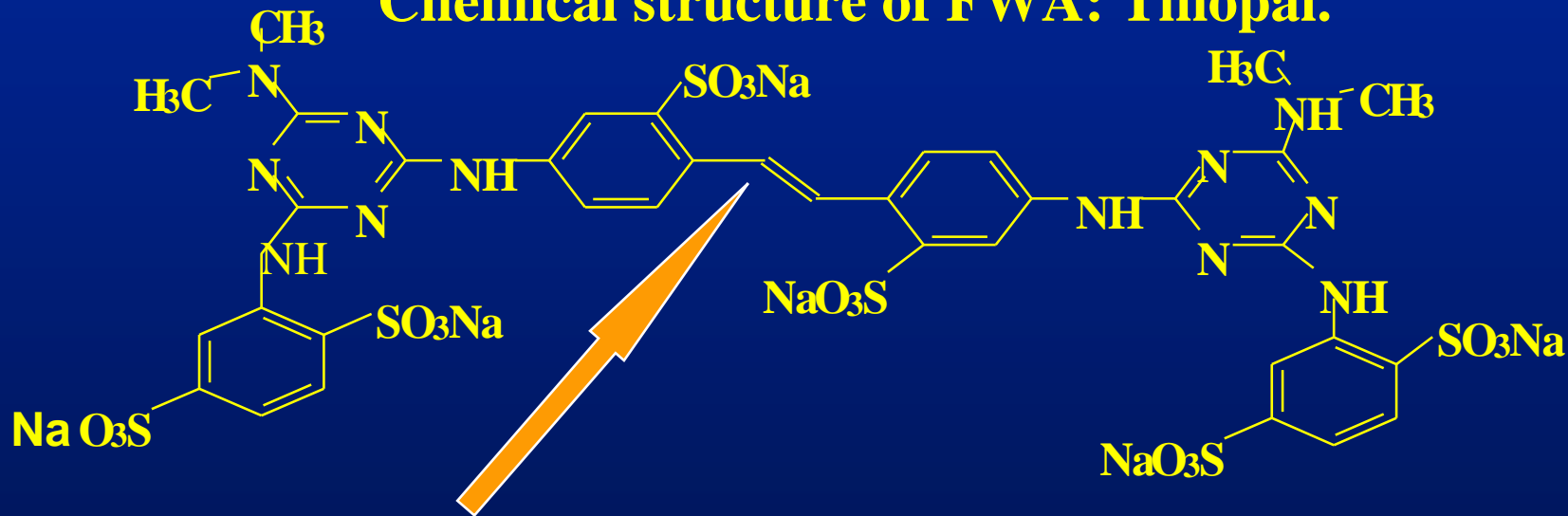
Introduction

| Historical Notes

- FWA employed in P&P industry**
- Muller reported potential economic benefits for use of FWA for high-brightness CTMPs**
- Doshi found no effect for groundwood**
 - » nature of surface lignin may be important**

FWA Photostabilization Effects - Introduction

Chemical structure of FWA: Tinopal.



absorbs 300-400 nm $h\nu$ re-emits > 410 nm



Tinopal Photostabilization Effects

- | **Tinopal application maintains +85 Tappi Brightness for 8 - 12 days of continuous light exposure**
- | **Use of radical scavenger, ZnO/TiO₂, or carrier molecule (PEG or PVA) extends photostabilization effect**
- | **UV-absorber are antagonist**



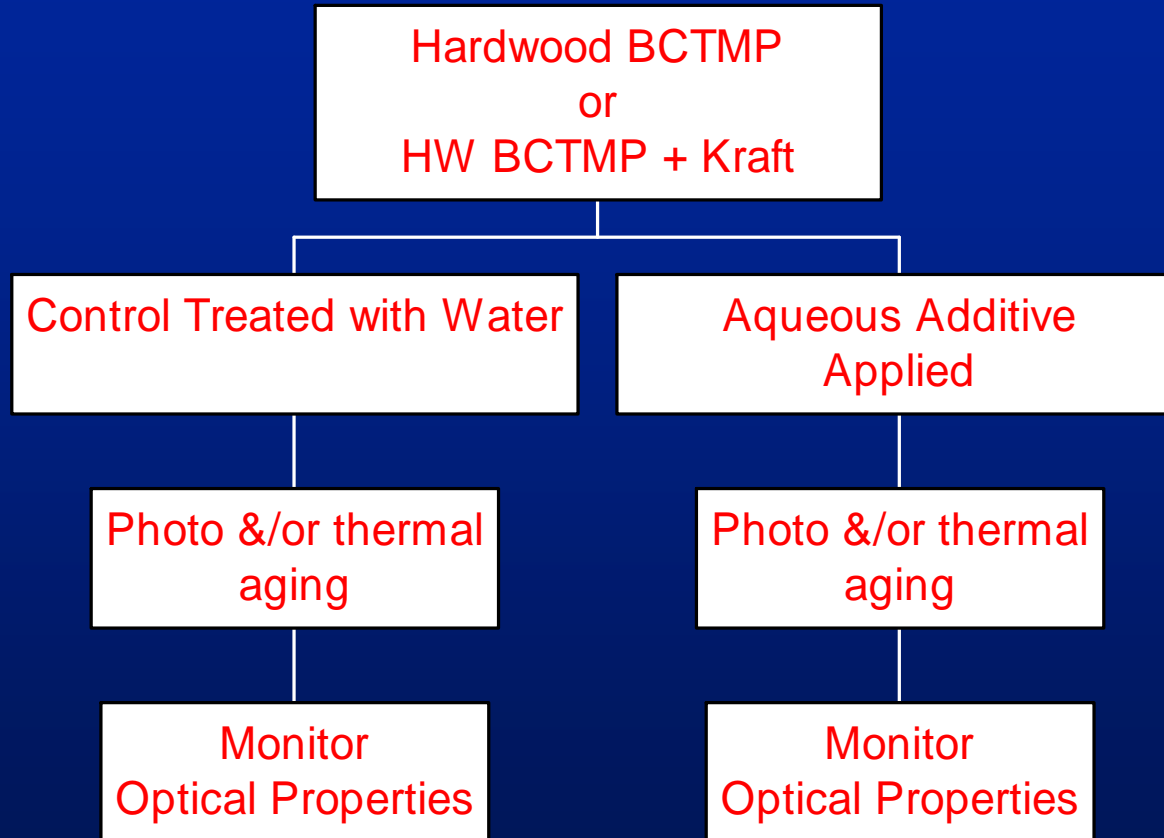
FWA Photostabilization Effects

- | Study thermal reversion properties of FWA treated BCTMP/kraft handsheets**
- | Optical characterization of BCTMP/kraft handsheets with FWA with natural & office lighting**
- | Study the effects of light-dark cycling on photoreversion of FWA treated BCTMP/kraft testsheets**

FWA Photostabilization Effects

- | Determine photostabilization effects of carrier molecules (PVA, PEG, *Polyvinylpyrrolidone, commercial surfactants*) with Phorwite P & UW
- | *Study failure mechanism(s) of FWA*

General Experimental Method

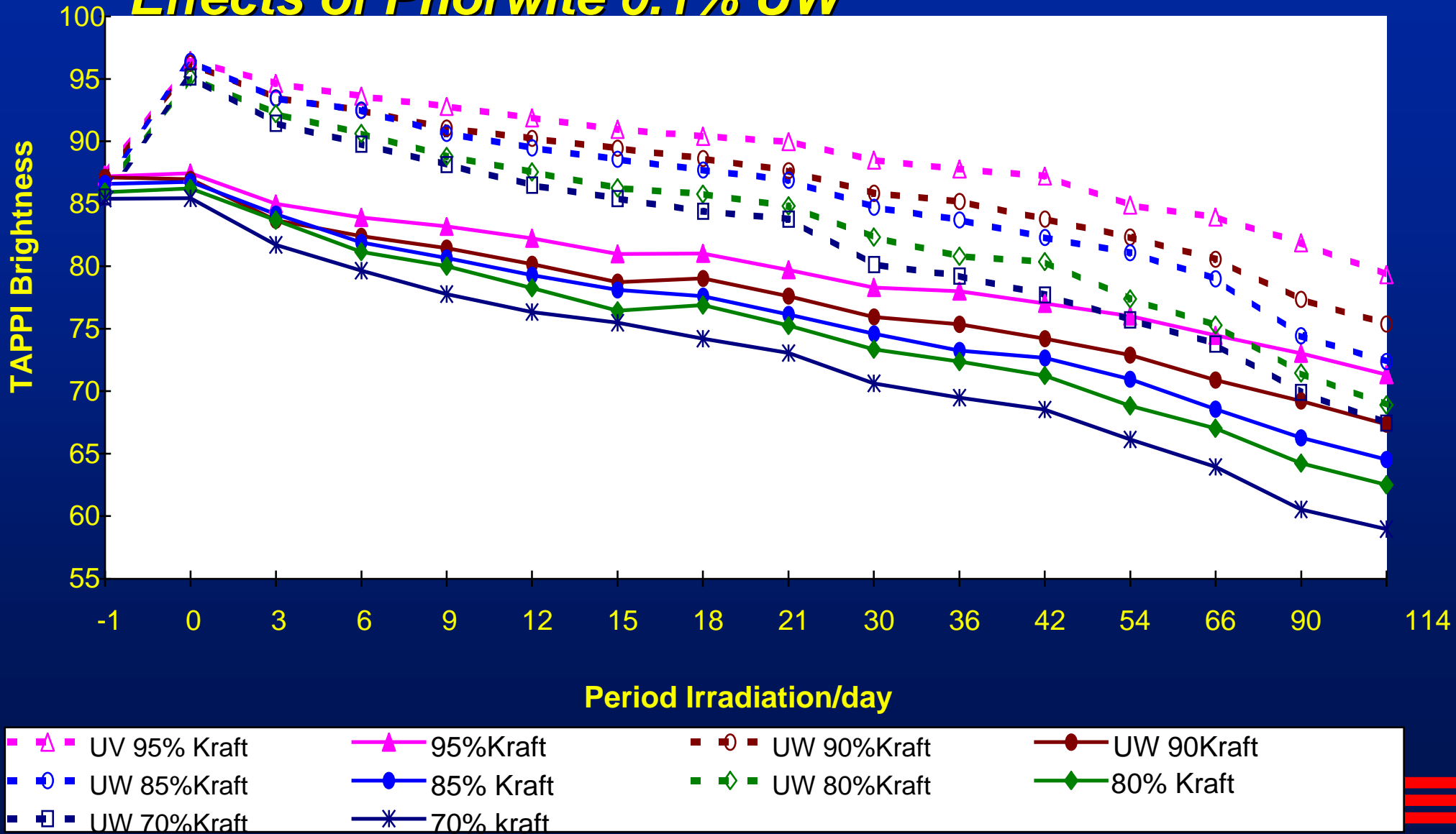


Results: Photoreversion of Kraft/BCTMP - Effects of Phorwite UW

- | Employed 1.25 gr handsheets
- | Applied 0.1% Phorwite UW
- | Mixtures of Kraft/BCTMP used
 - 100:0, 90:10, 80:20, 70:30, 60:40, 50:50, 40:60,
 - 30:70, 20:80, 10:90, 0:100
- | Examined Tappi Brightness with & without fluorescence

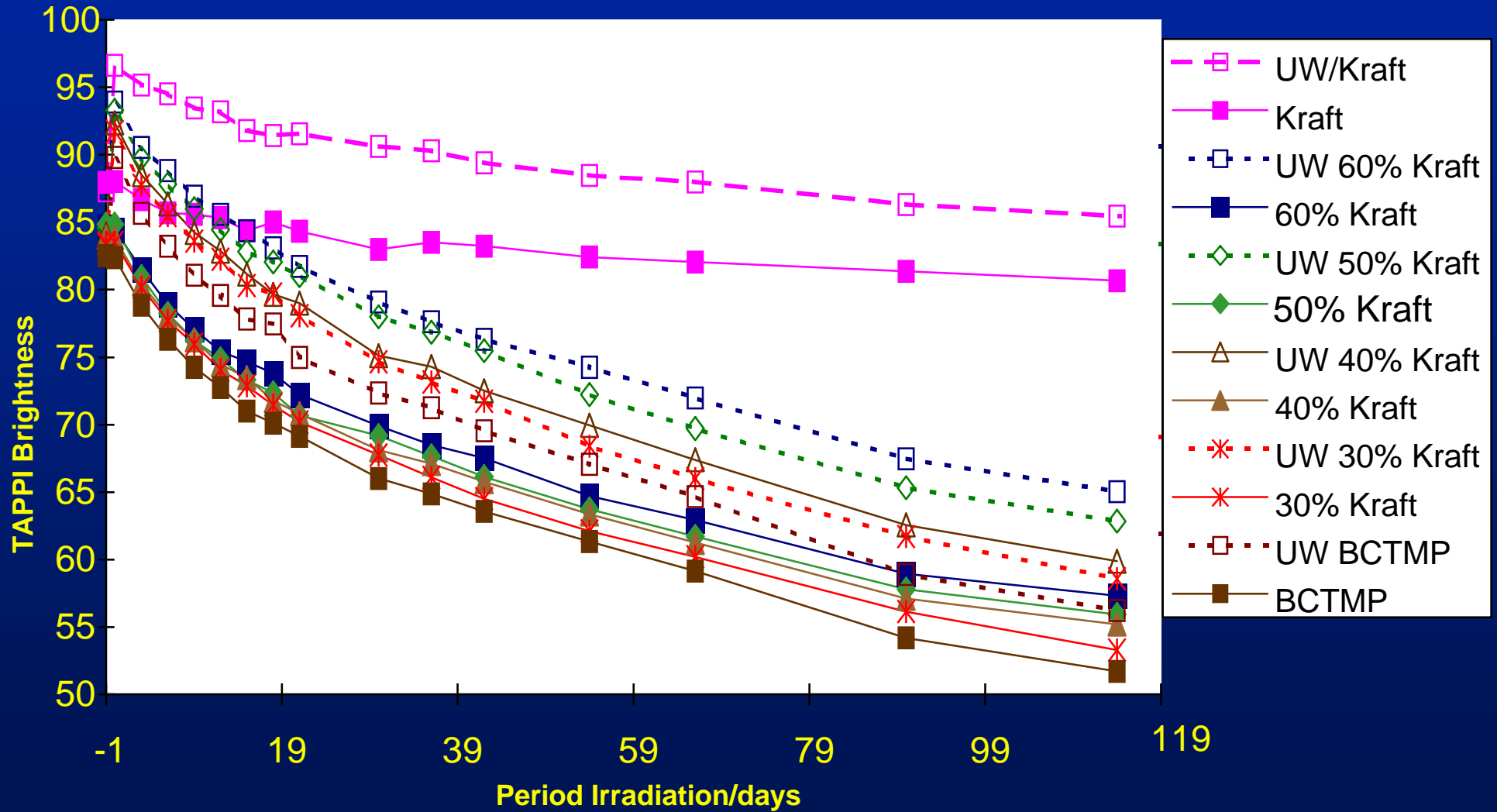
Results: Photoreversion of Kraft/BCTMP

Effects of Phorwite 0.1% UW

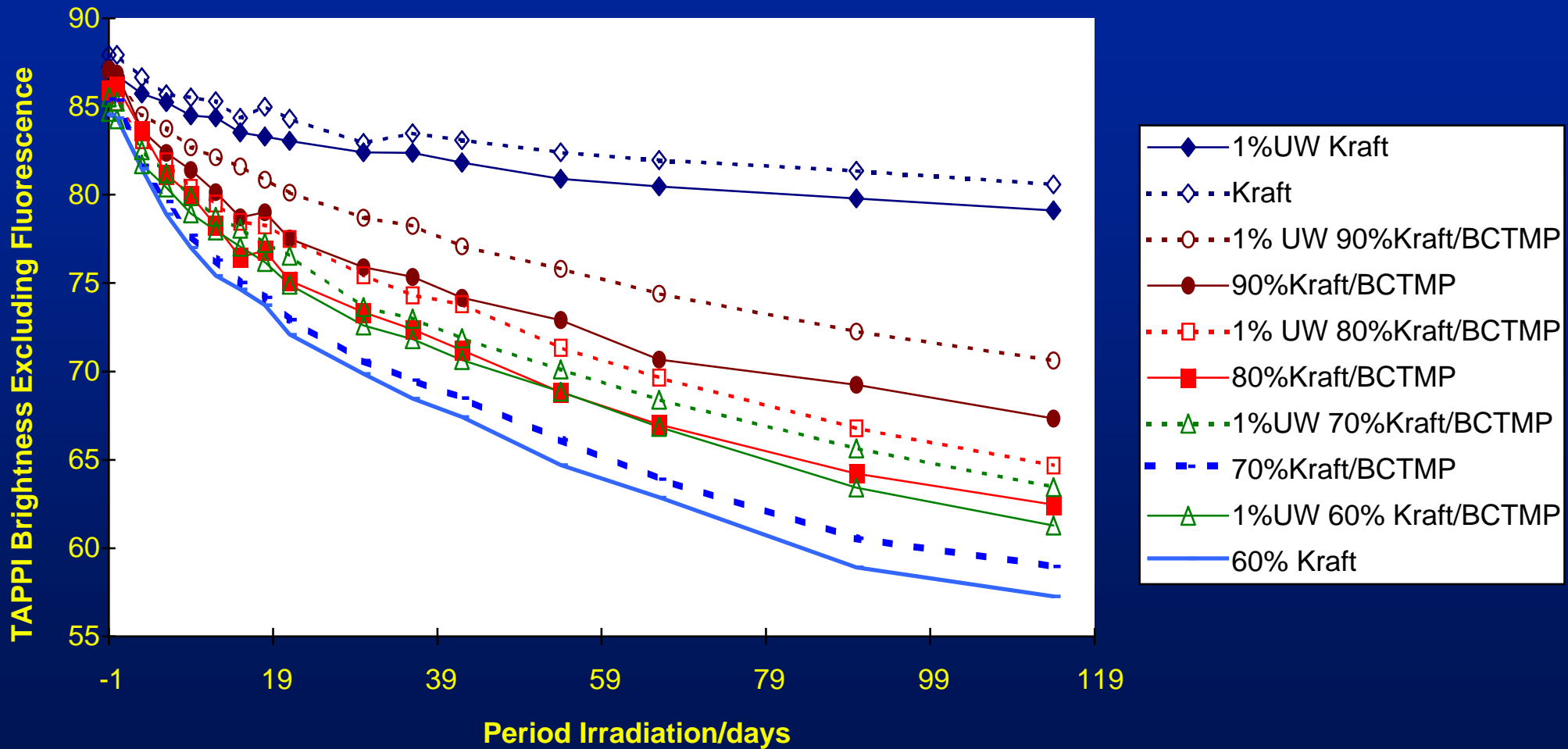


Photoreversion of Kraft/BCTMP

Effects of 0.1% Phorwite UW



Results: Photoreversion of Kraft/BCTMP Effects of Phorwite UW Excluding Fluorescence

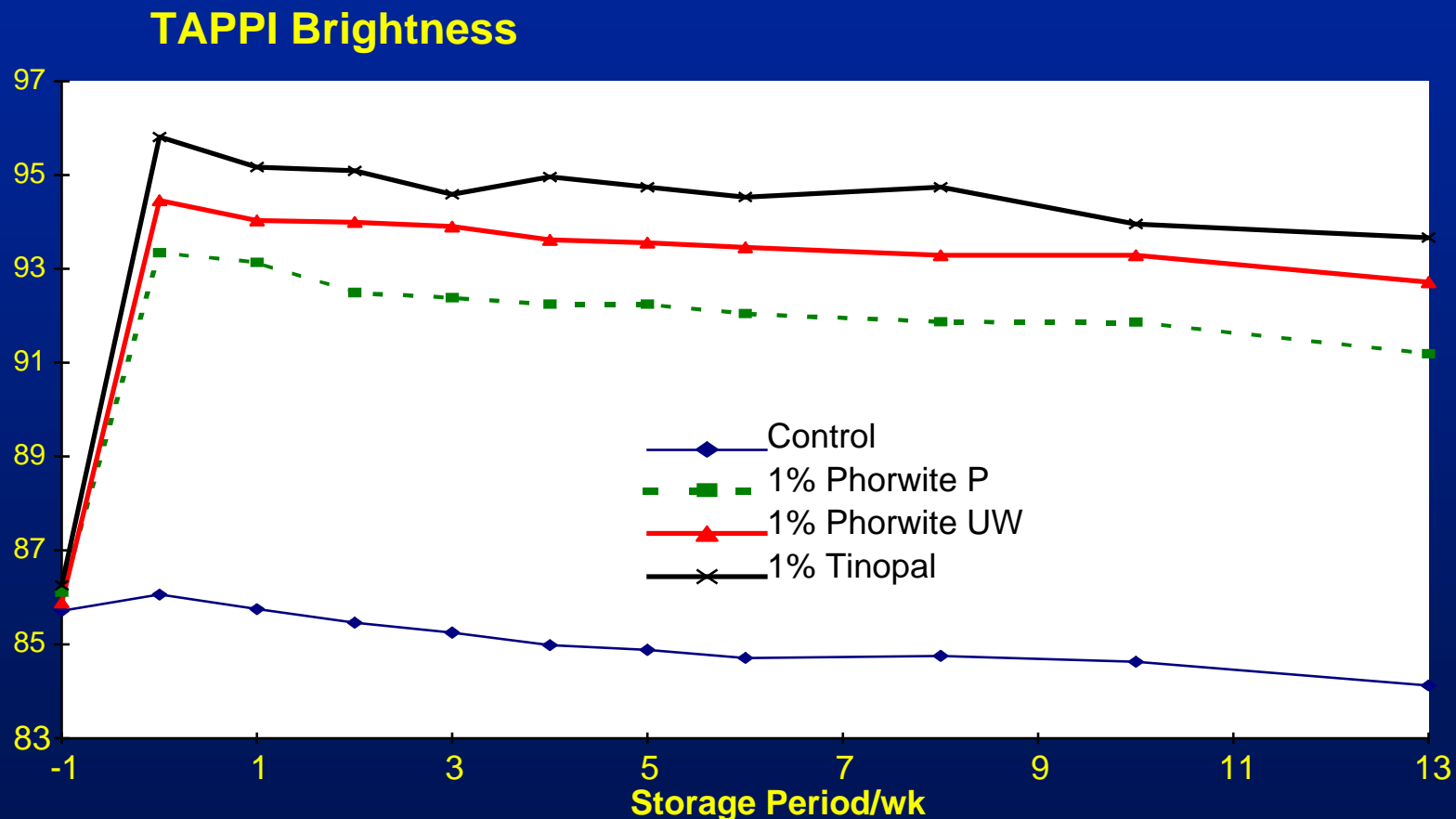





Results: Thermal Reversion Studies For FWA Treated Kraft and BCTMP

- | Employed 1.25 gr handsheets
- | Applied 1% Phorwite UW
- | Handsheets stored at 28°C

Results: Thermal Reversion Studies for 75% Kraft/BCTMP Testsheets



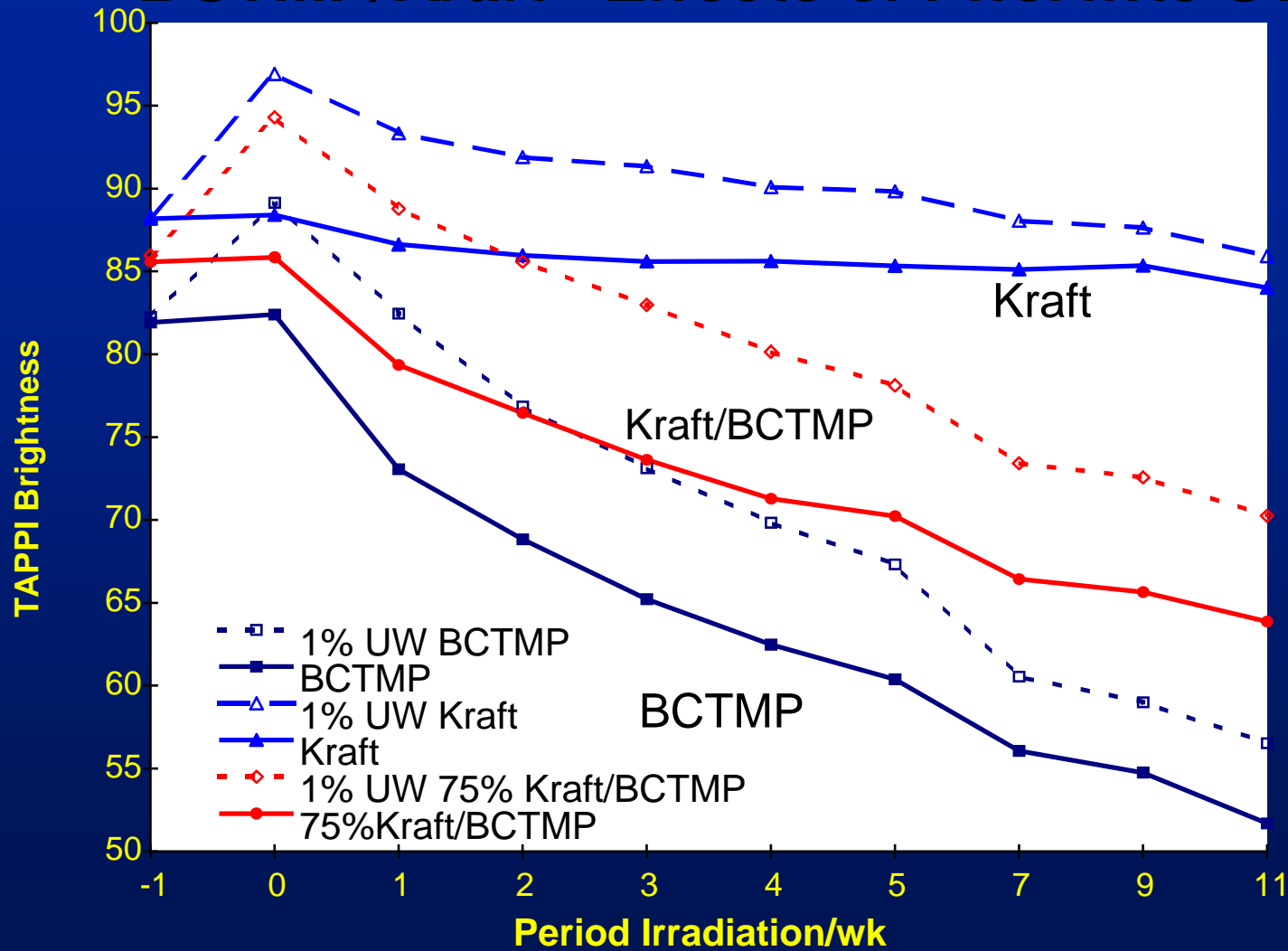
No accelerated reversion occurring!



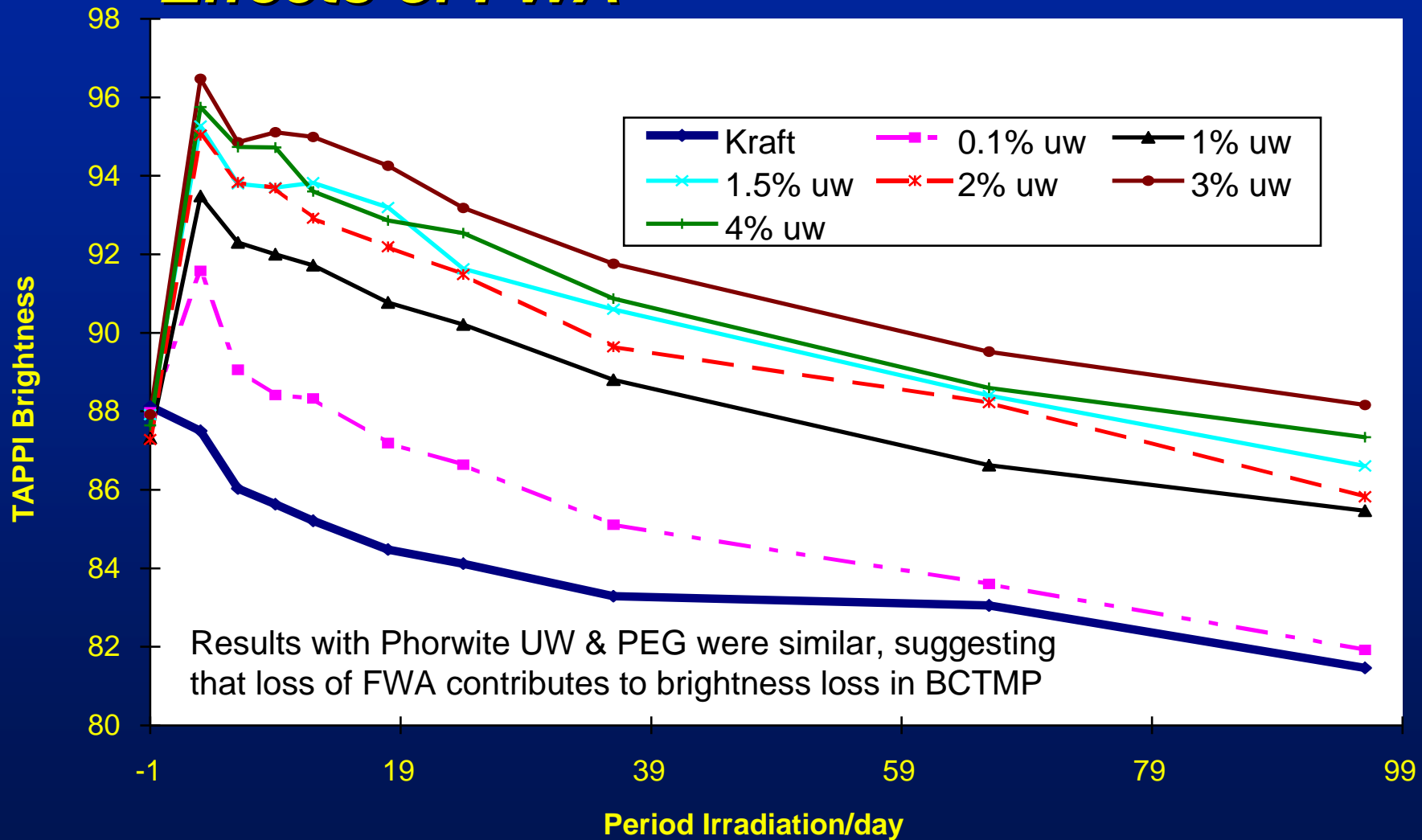
Photoreversion of BCTMP, Kraft, & BCTMP/Kraft - Effects of Phorwite UW

- | Examined 3 types of handsheets
 - 100% kraft, 100% BCTMP, 75% Kraft/25%BCTMP
- | Varied Phorwite UW
 - 0.1%, 1.0%, 1.5%, 2.0%, 3.0%, 4.0%
- | Examined use of carrier compound
 - 0% & 1.0% PEG
- | Examined TAPPI brightness, with/without fluorescence, $L^*a^*b^*$, abs./scatt. coeff.

Results: Photoreversion of BCTMP, Kraft, & BCTMP/Kraft - Effects of Phorwite UW



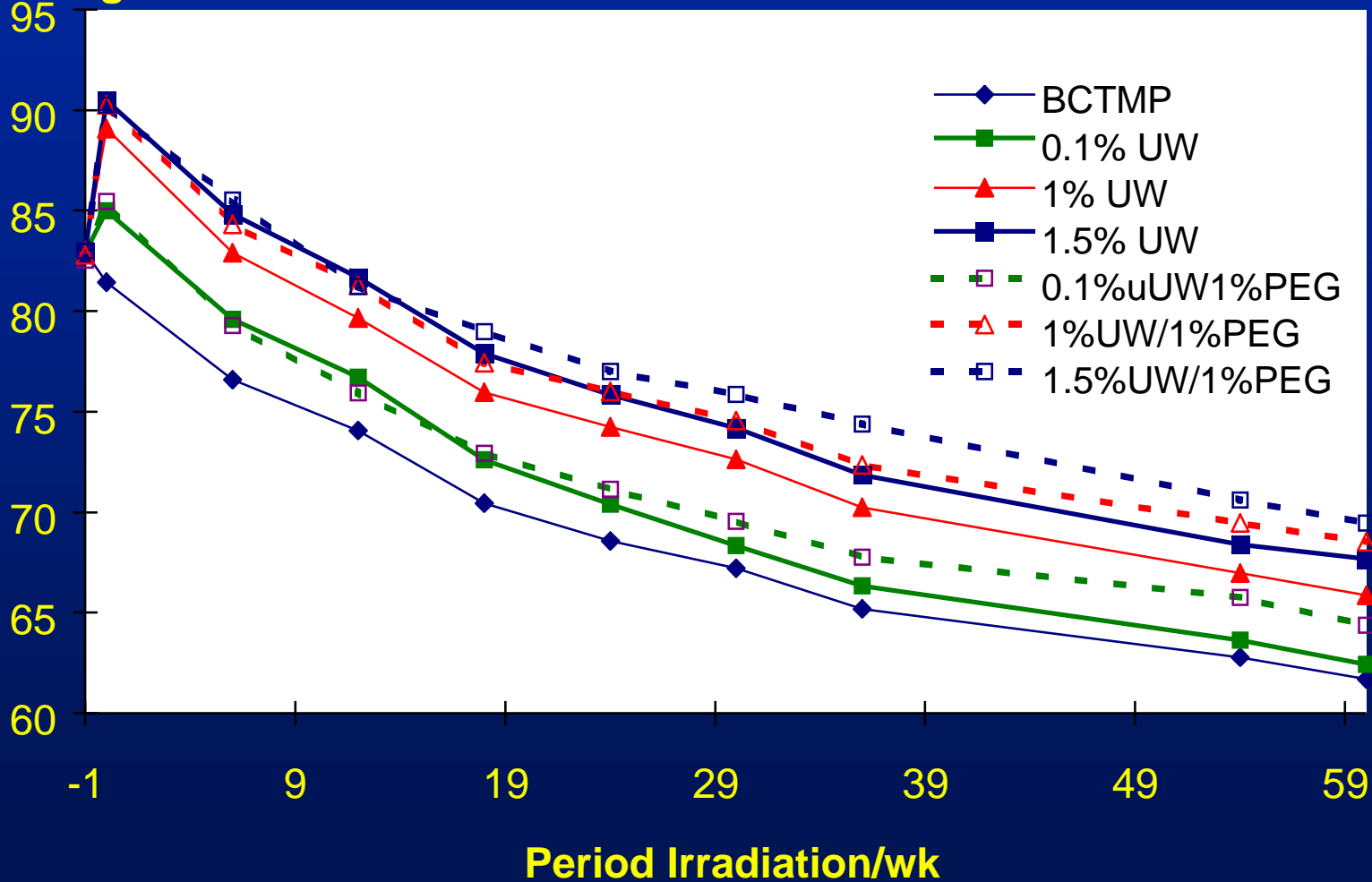
Results: Photoreversion of 100%Kraft Effects of FWA



Results: Photoreversion of HW BCTMP

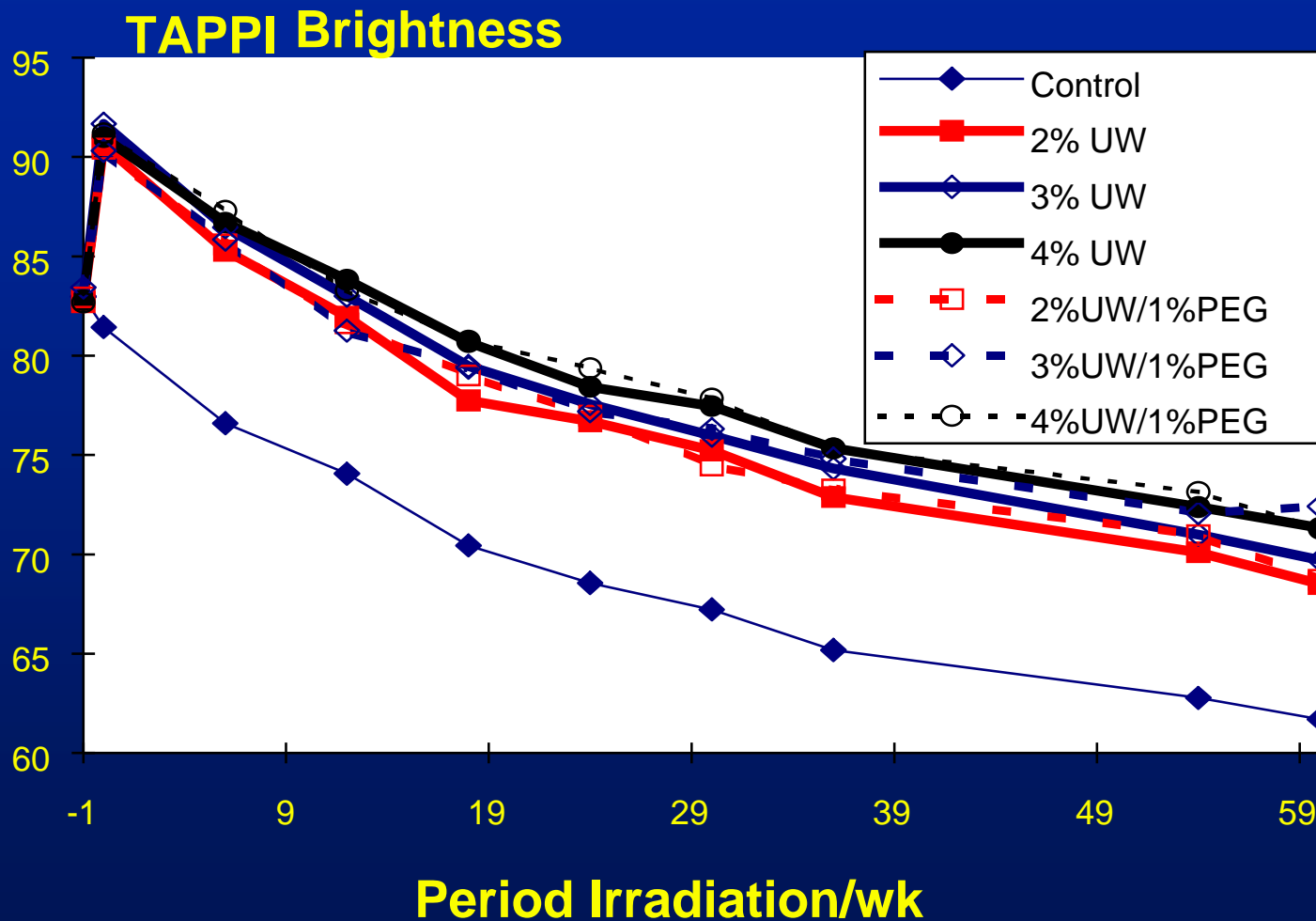
Effects of FWA + Carrier molecule

TAPPI Brightness



Results: Photoreversion of HW BCTMP

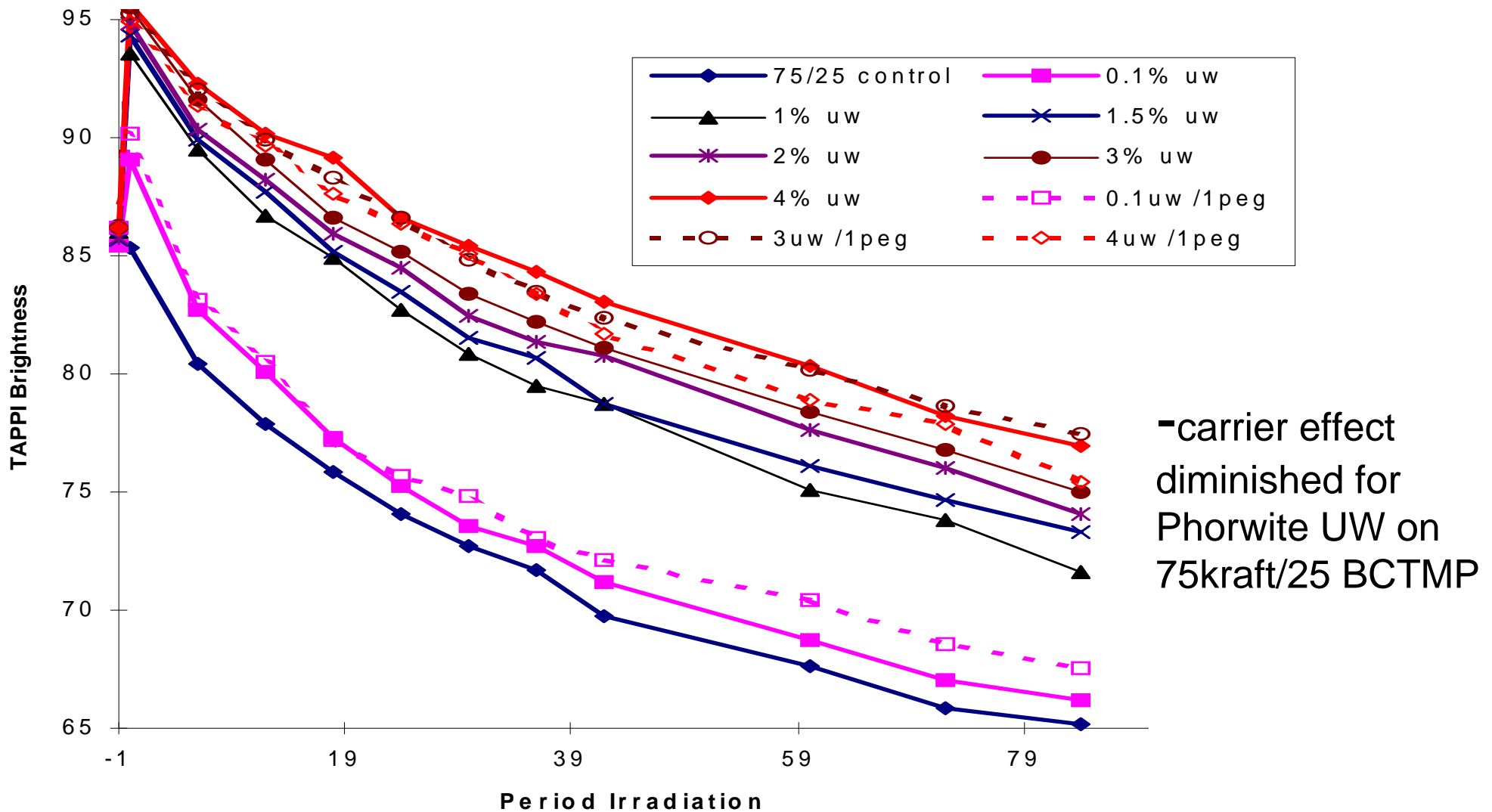
Effects of FWA + Carrier molecule



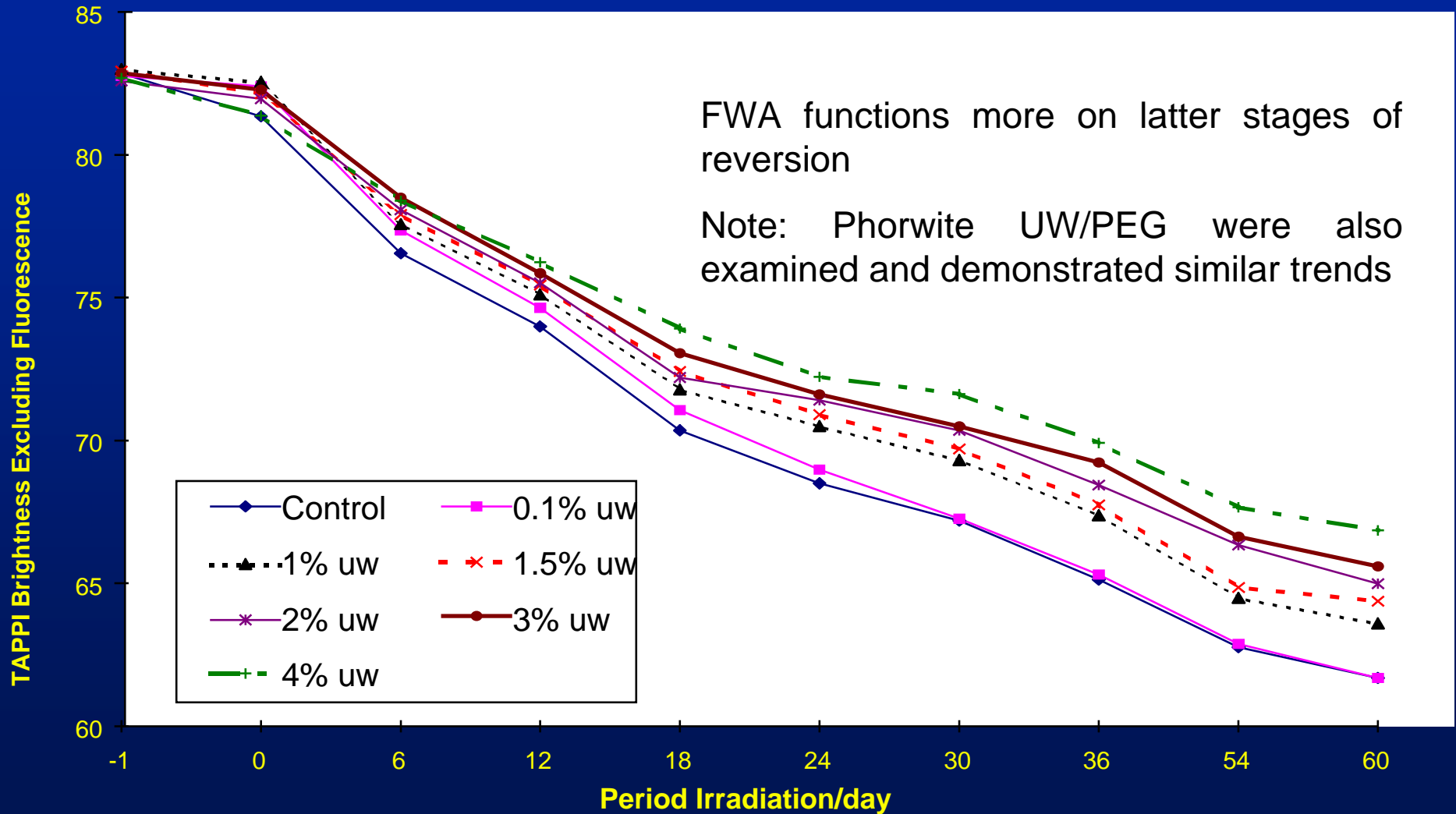
at charges < 2%
PEG carrier
molecule is
effective at higher
values effect
diminishes

Results: Photoreversion of 75%Kraft/25%BCTMP

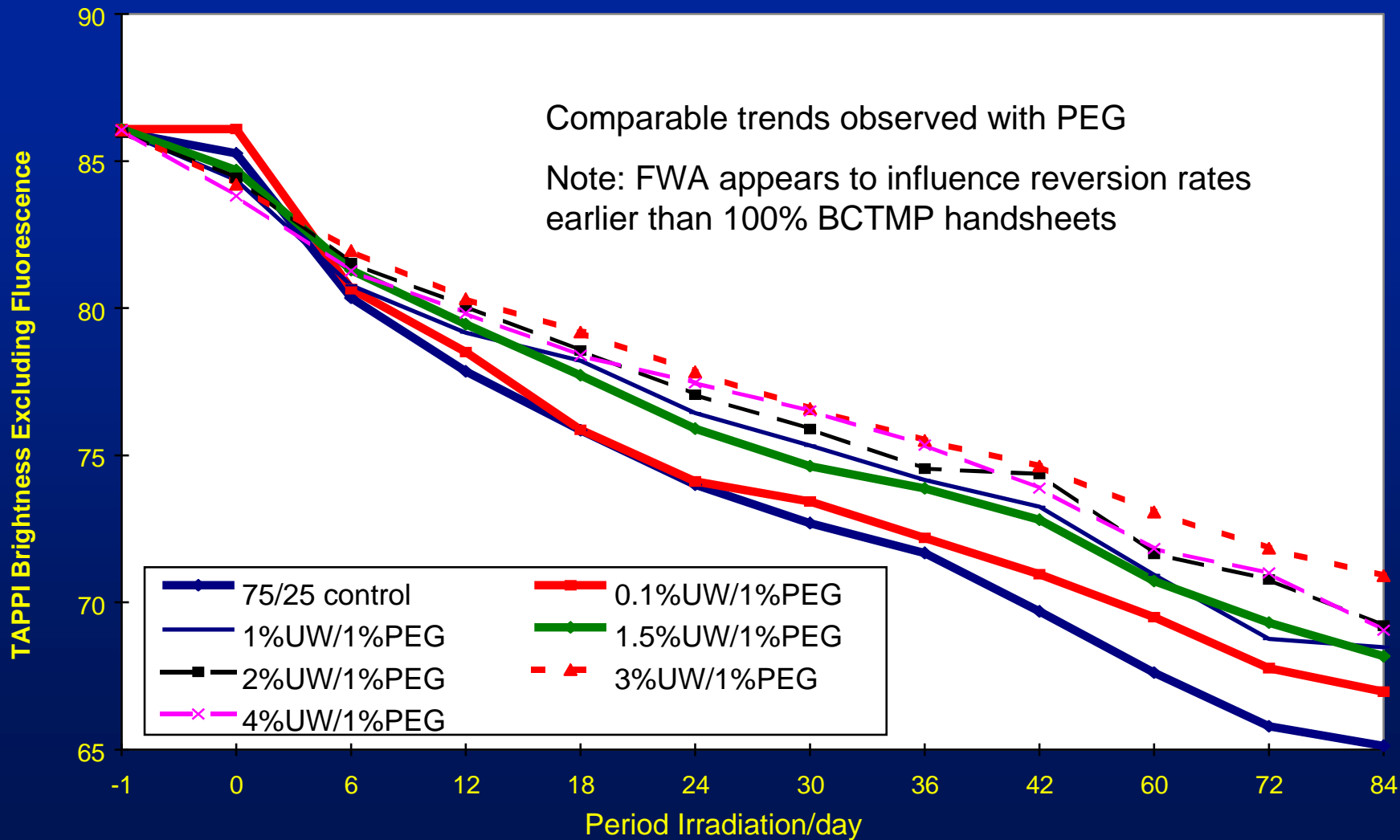
Effects of FWA + Carrier molecule



Results: Photoreversion of HW BCTMP Effects of FWA without Fluorescence



Results: Photoreversion of 75% Kraft/25% BCTMP Effects of FWA without Fluorescence

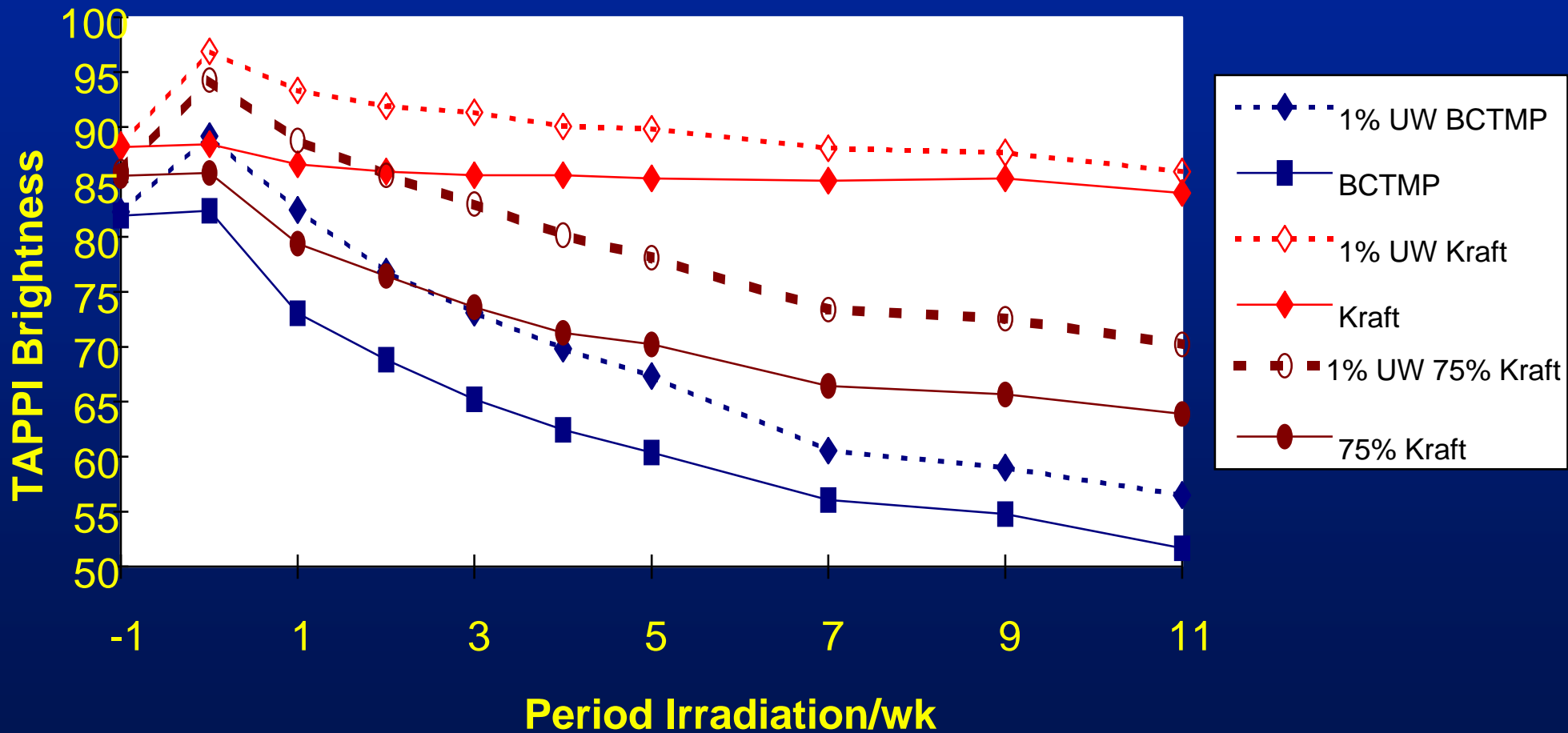




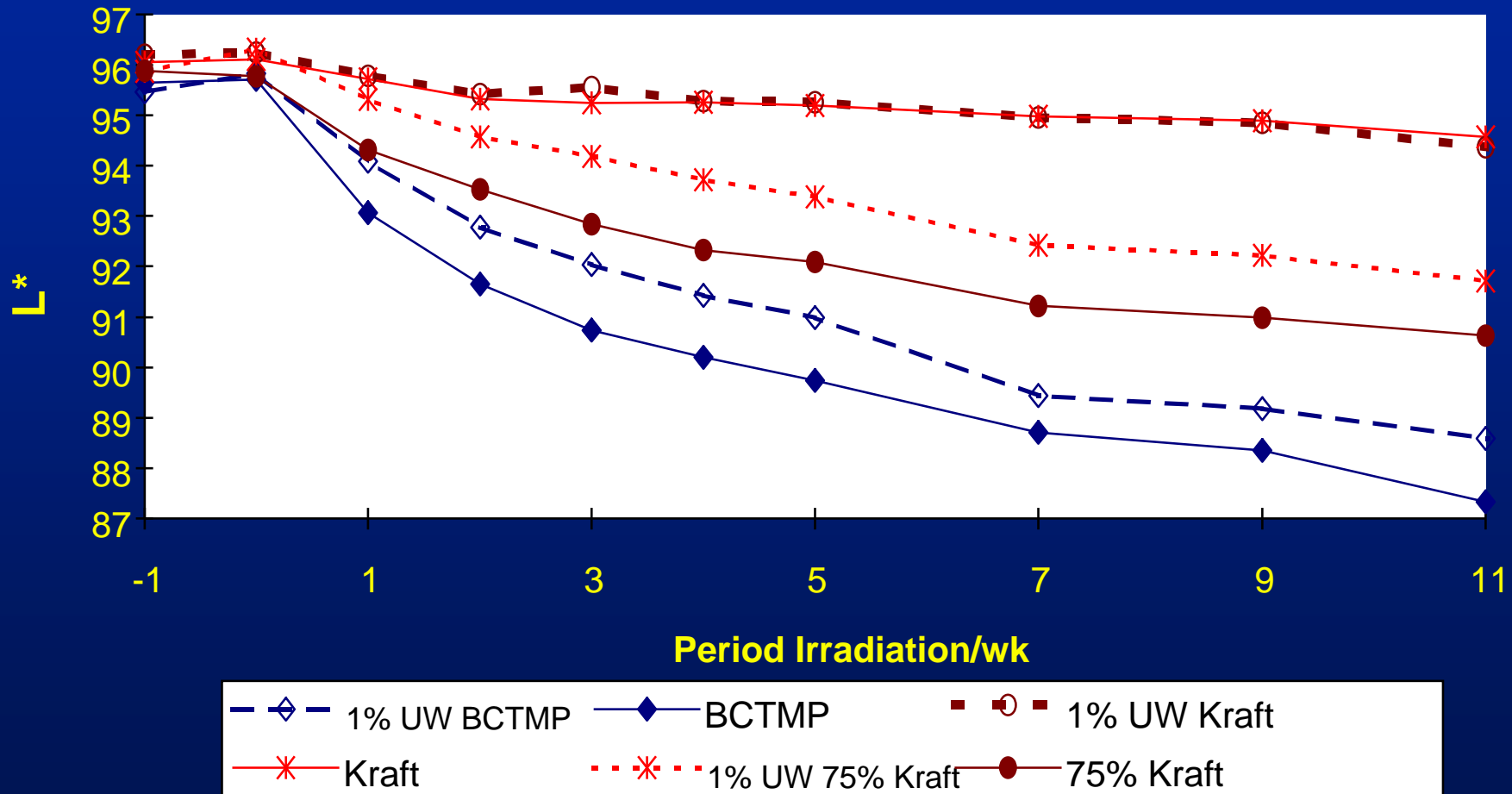
Results: Solar Photoreversion of BCTMP, Kraft, & BCTMP/Kraft - Effects of Phorwite UW

- | Examined solar aging of BCTMP, Kraft, & 75% Kraft-25%BCTMP handsheets
- | With & without Phorwite UW
- | Measured Brightness with/without fluorescence, $L^*a^*b^*$, abs/scatt. coeff.

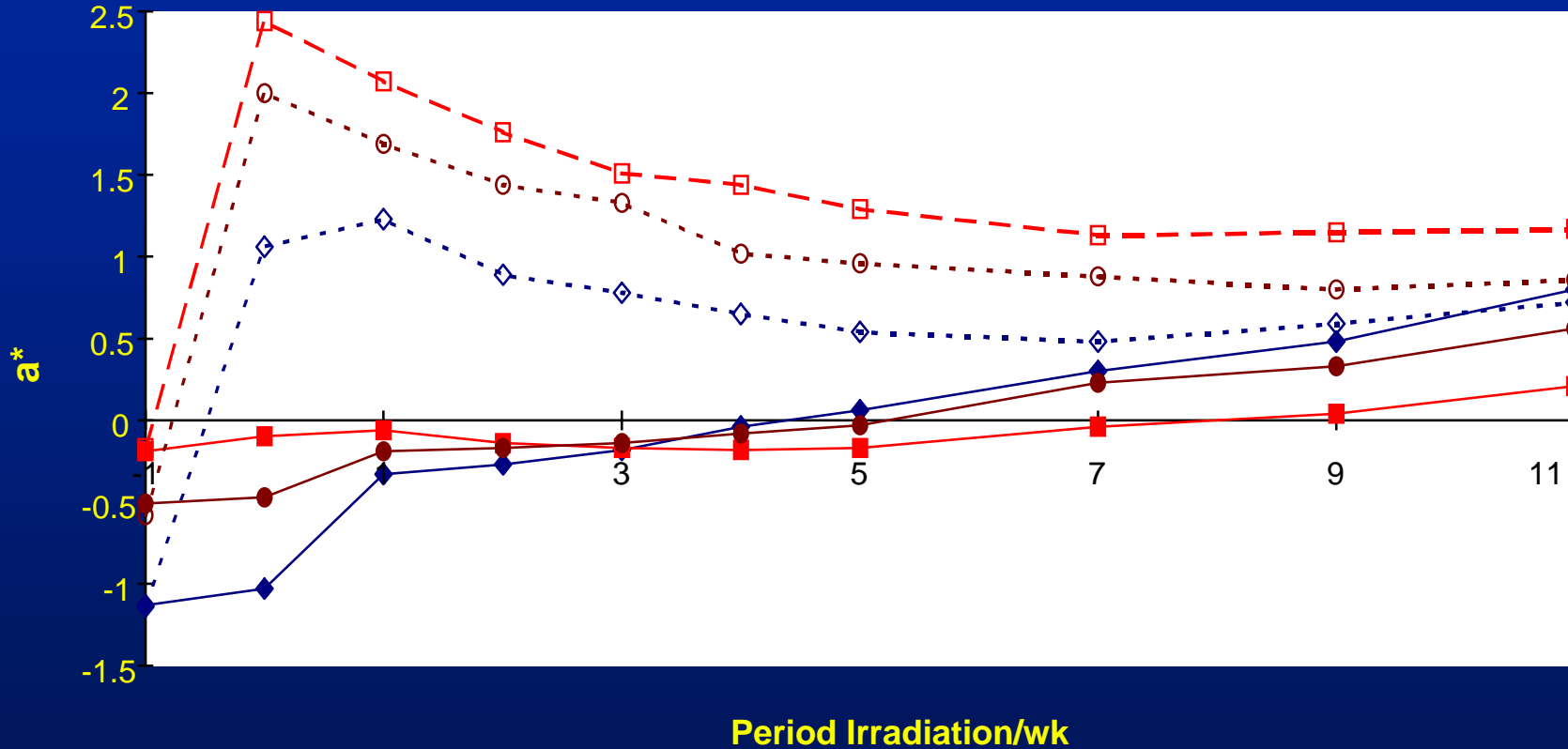
Results: Solar Photoreversion of BCTMP, Kraft, & BCTMP/Kraft - Effects of Phorwite UW



Results: Solar Photoreversion of BCTMP, Kraft, & BCTMP/Kraft - Effects of Phorwite UW

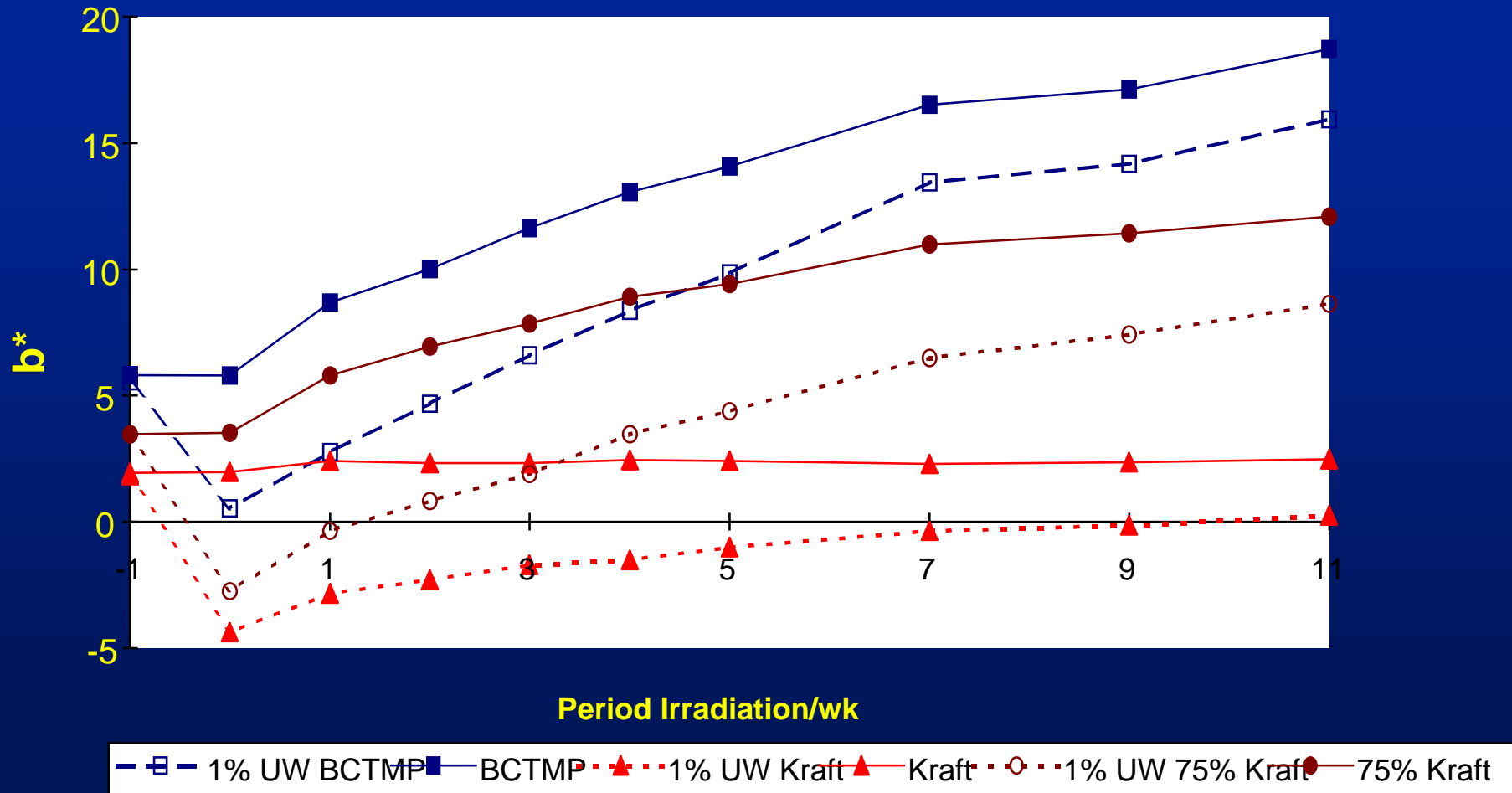


Results: Solar Photoreversion of BCTMP, Kraft, & BCTMP/Kraft - Effects of Phorwite UW



Legend: 1% UW BCTMP (dotted blue line with diamonds), BCTMP (solid blue line with diamonds), 1% UW Kraft (dashed red line with squares), Kraft (solid red line with squares), 1% UW 75% Kraft (dotted red line with circles), 75% Kraft (solid red line with circles)

Results: Solar Photoreversion of BCTMP, Kraft, & BCTMP/Kraft - Effects of Phorwite UW

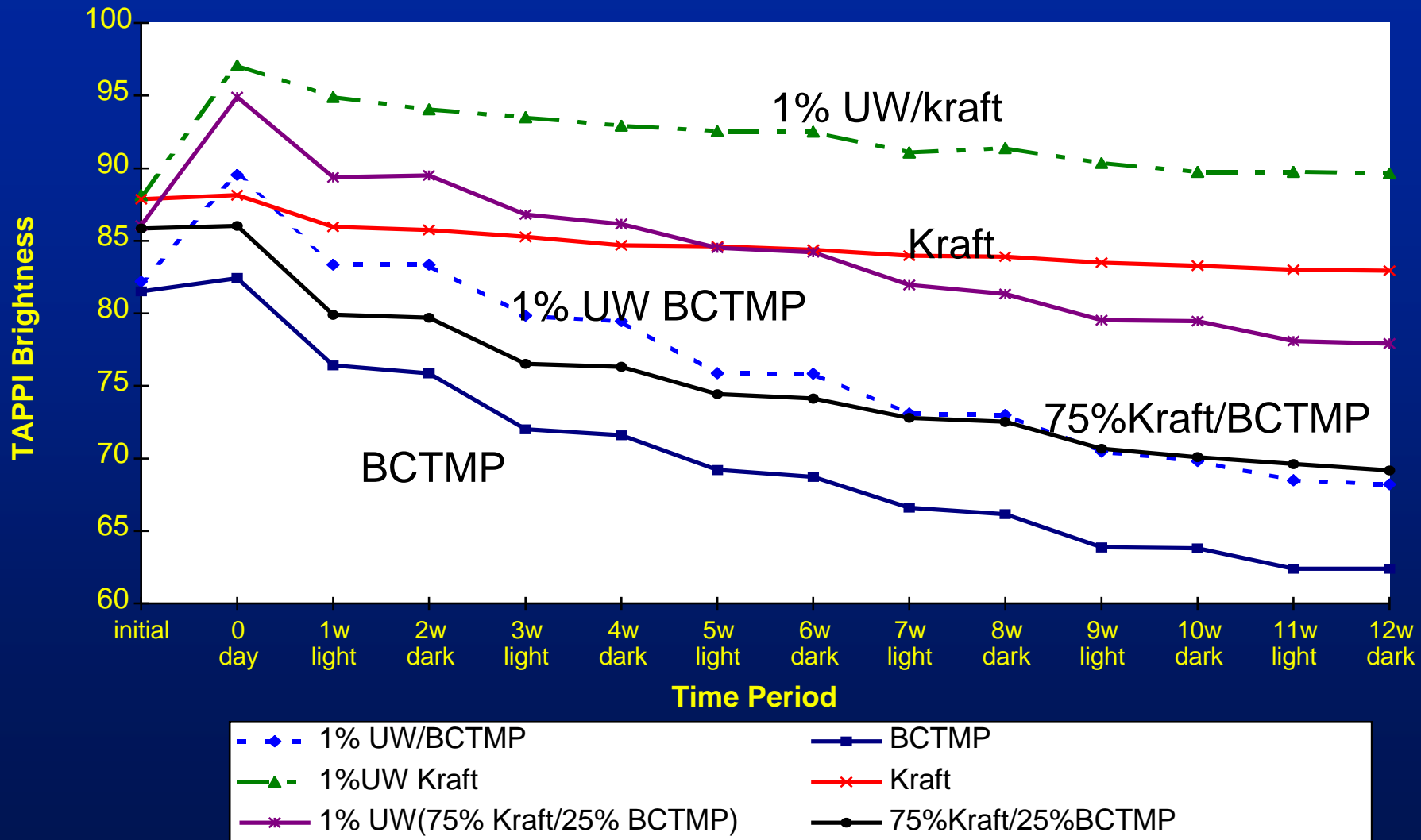




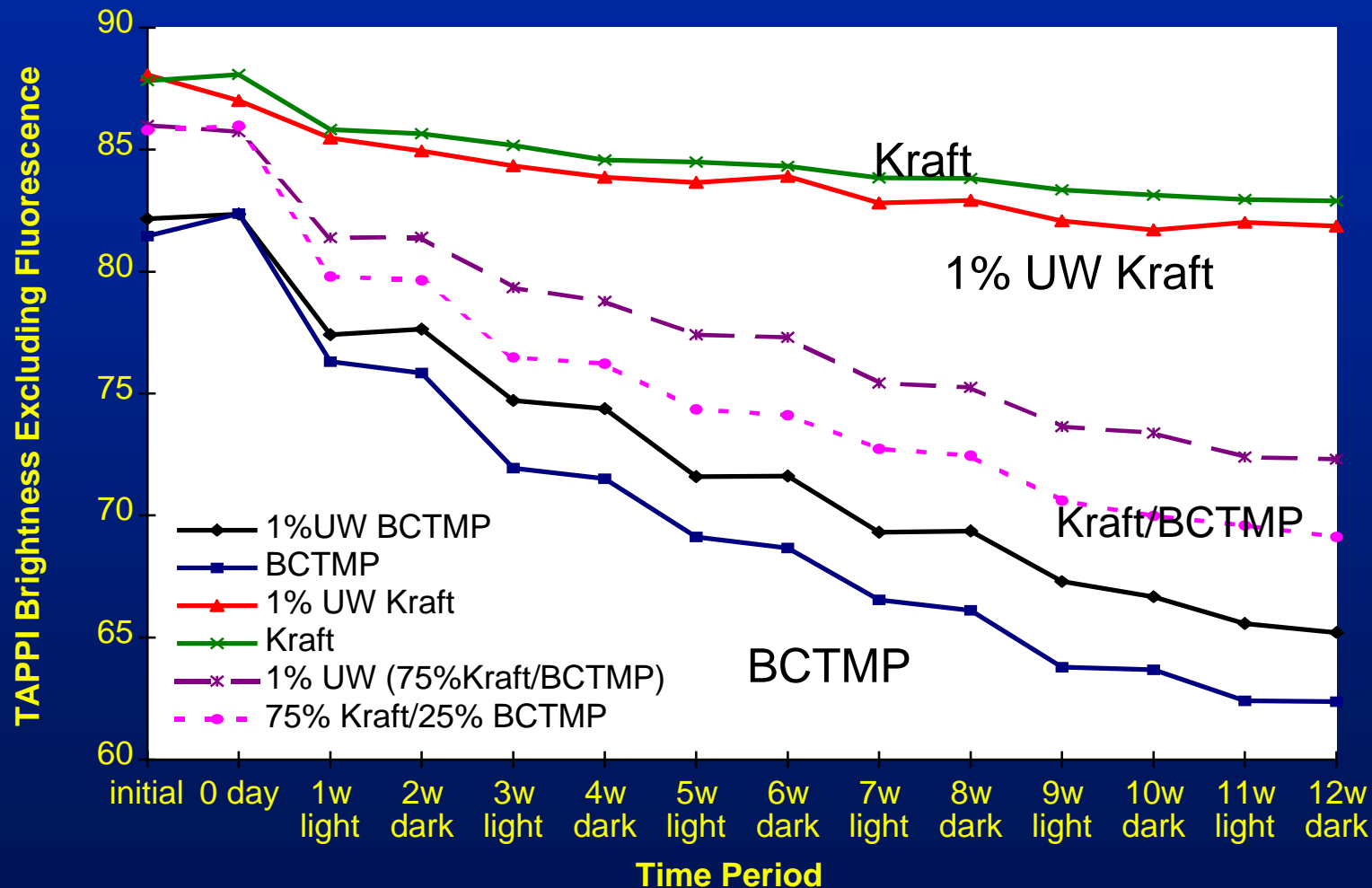
Results: Effects of Light Cycling on Phorwite UW Treated Handsheets

- | Employed kraft, BCTMP, & 75% kraft-25% BCTMP handsheets
- | Exposed to fluorescent light x h then stored for x h.
- | Measured TAPPI brightness values

Results: Effects of Light Cycling on Phorwite UW Treated Handsheets



Results: Effects of Light Cycling on Phorwite UW Treated Handsheets



Note: excluding fluorescent component UW sheets perform better



Conclusions

- | FWA technology for BCTMP is a technology that works
- | Effective at retarding solar/office lighting effects
- | Thermal reversion appears not to be an issue