

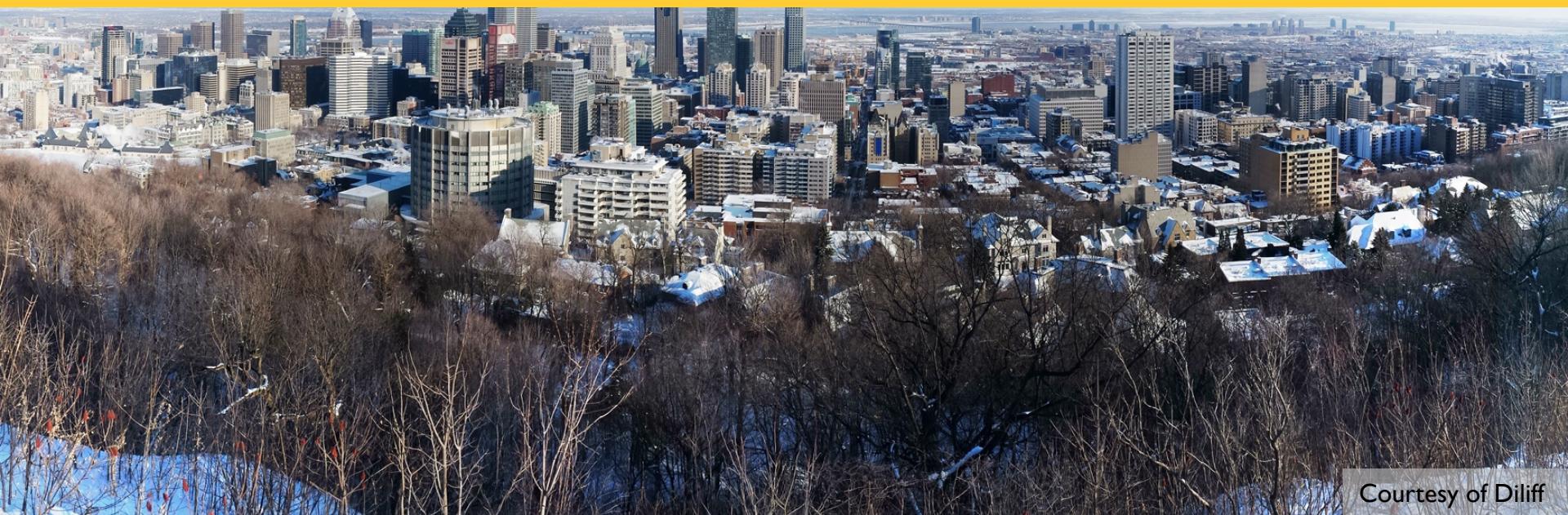
Effect of RH Change on Pressure Drop of Loaded Cellulose Filter Media with Hygroscopic Deposits

Chenxing Pei, Qisheng Ou, and David Y.H. Pui
Particle Technology Laboratory, University of Minnesota





Seasonal Variation





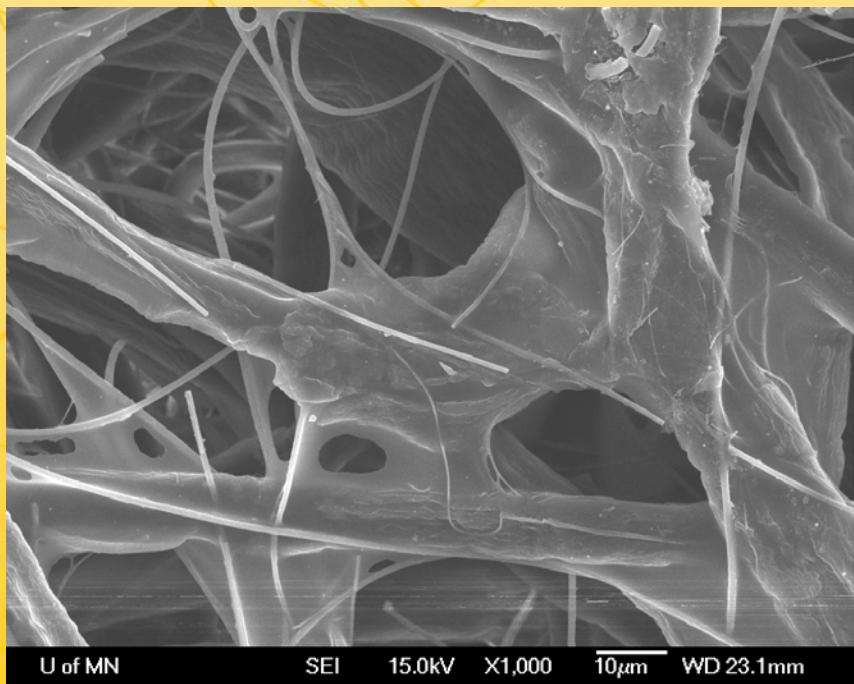
Diurnal Variation

Courtesy of Stephen Wilkes

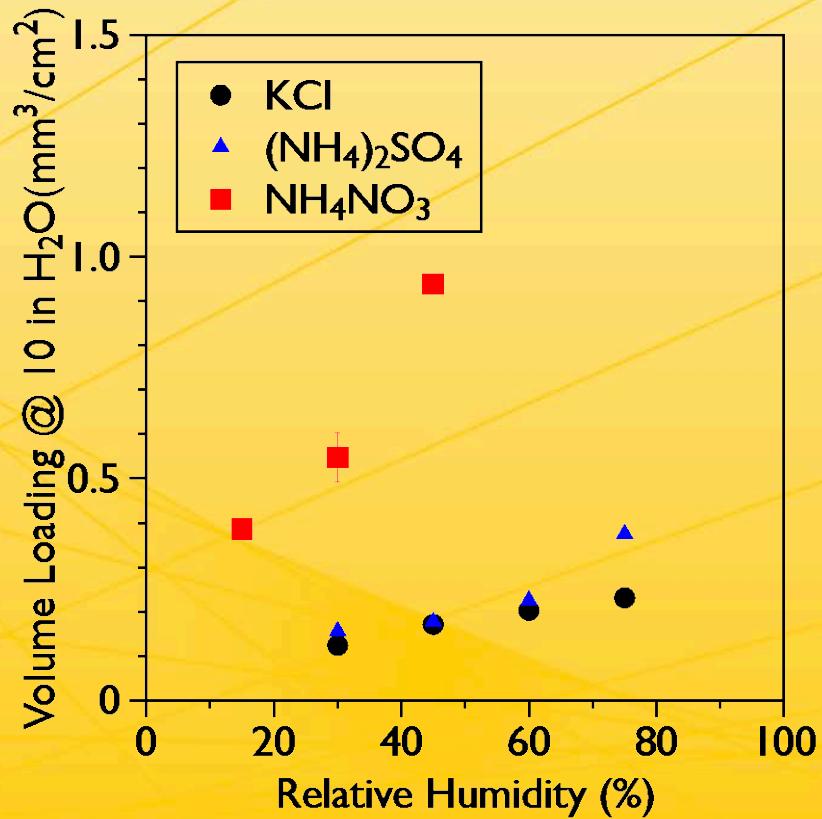
Previous Study of Conventional Cellulose Filter Media

(Last Oct CFR Meeting)

Without Nano-fiber Coating



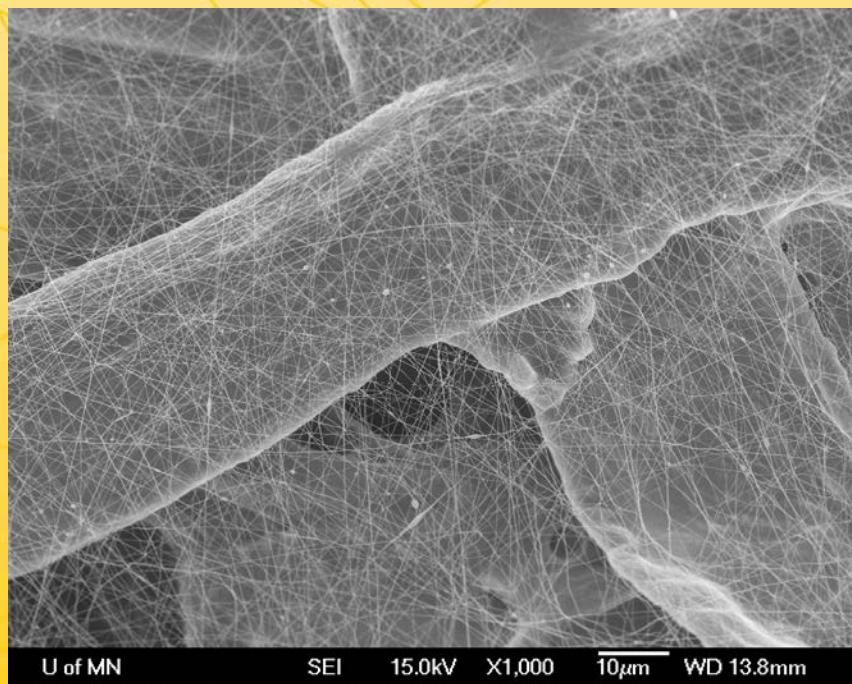
Volume loading results



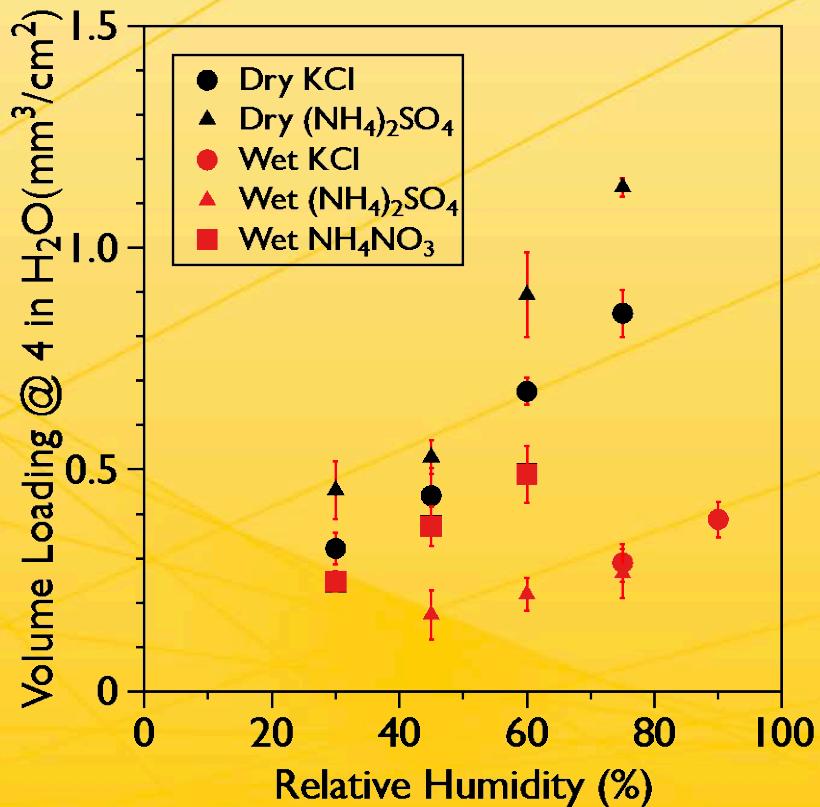
Previous Study of Nano-fiber Coated Cellulose Filter Media

(Last May CFR Meeting)

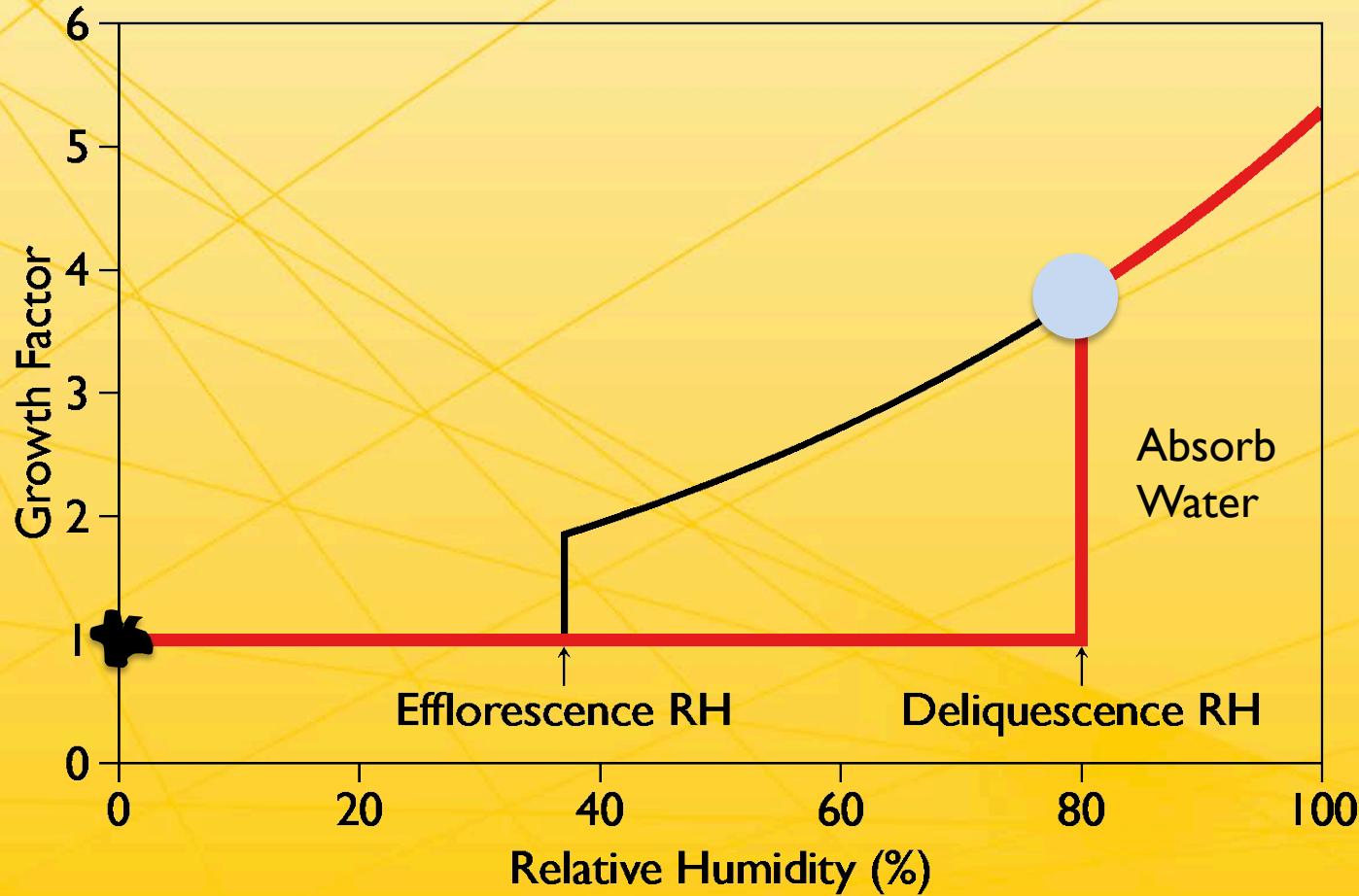
With Nano-fiber Coating



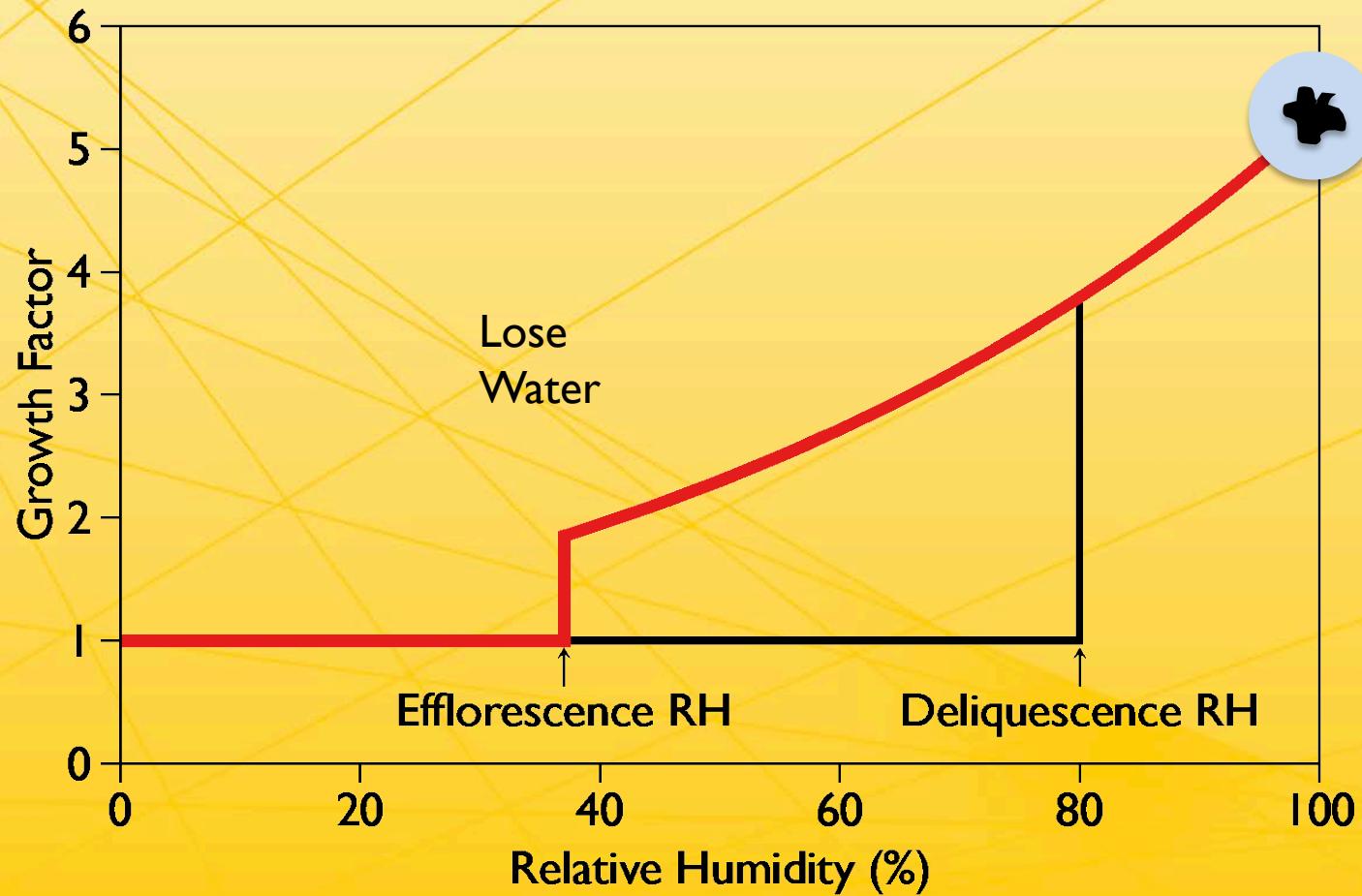
Volume loading results



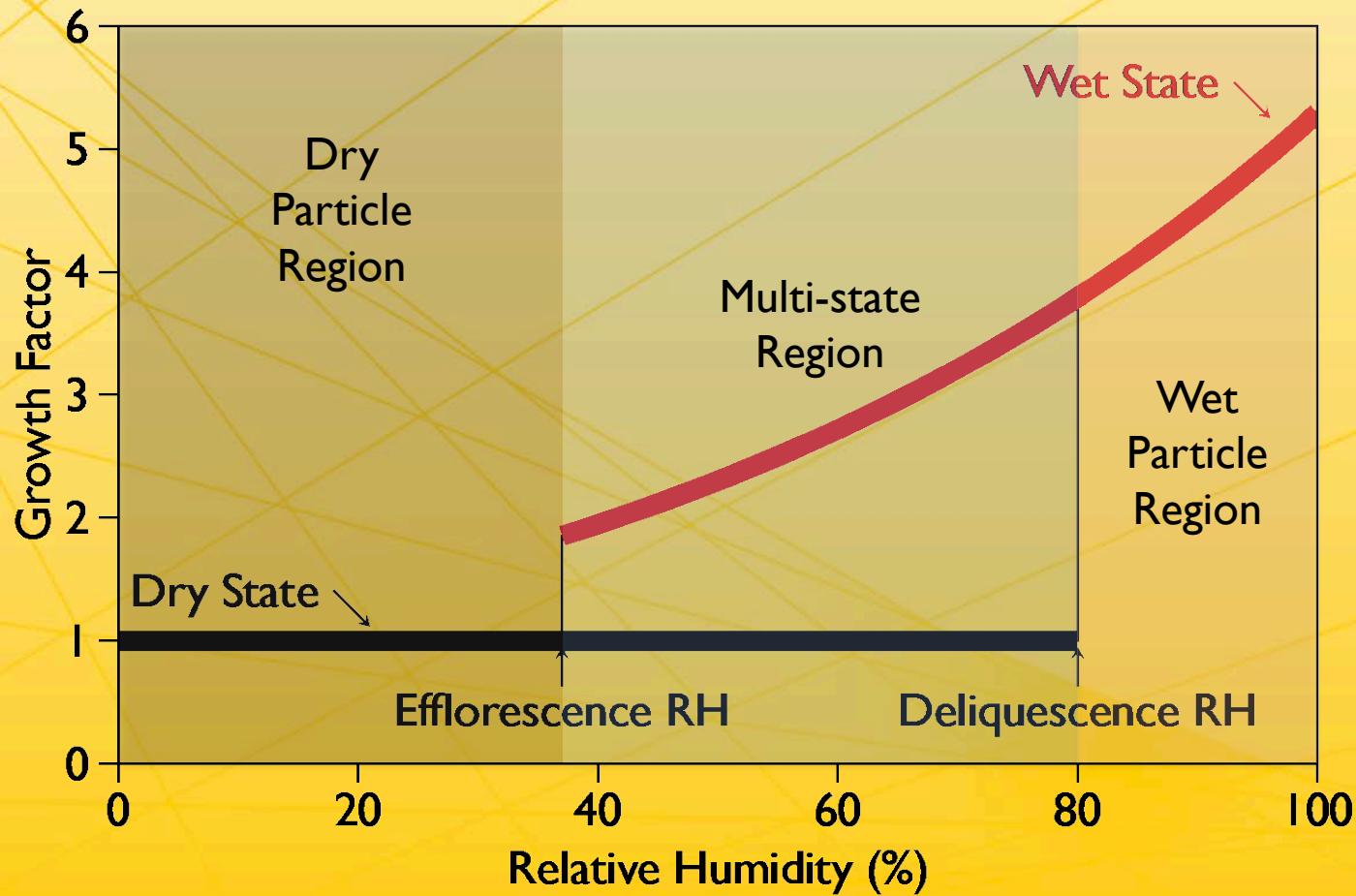
Hydration of a Salt Particle



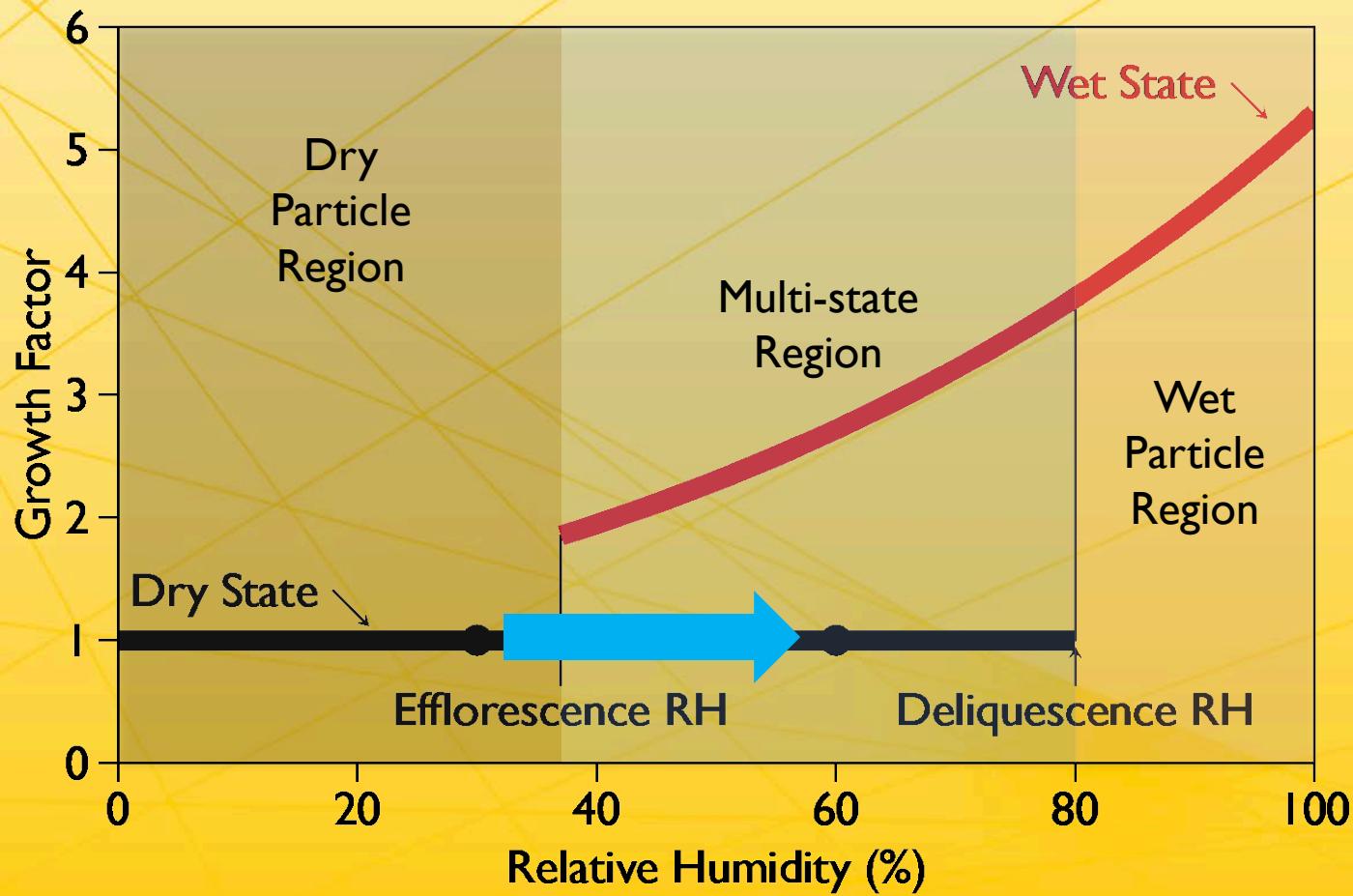
Dehydration of a Salt Particle



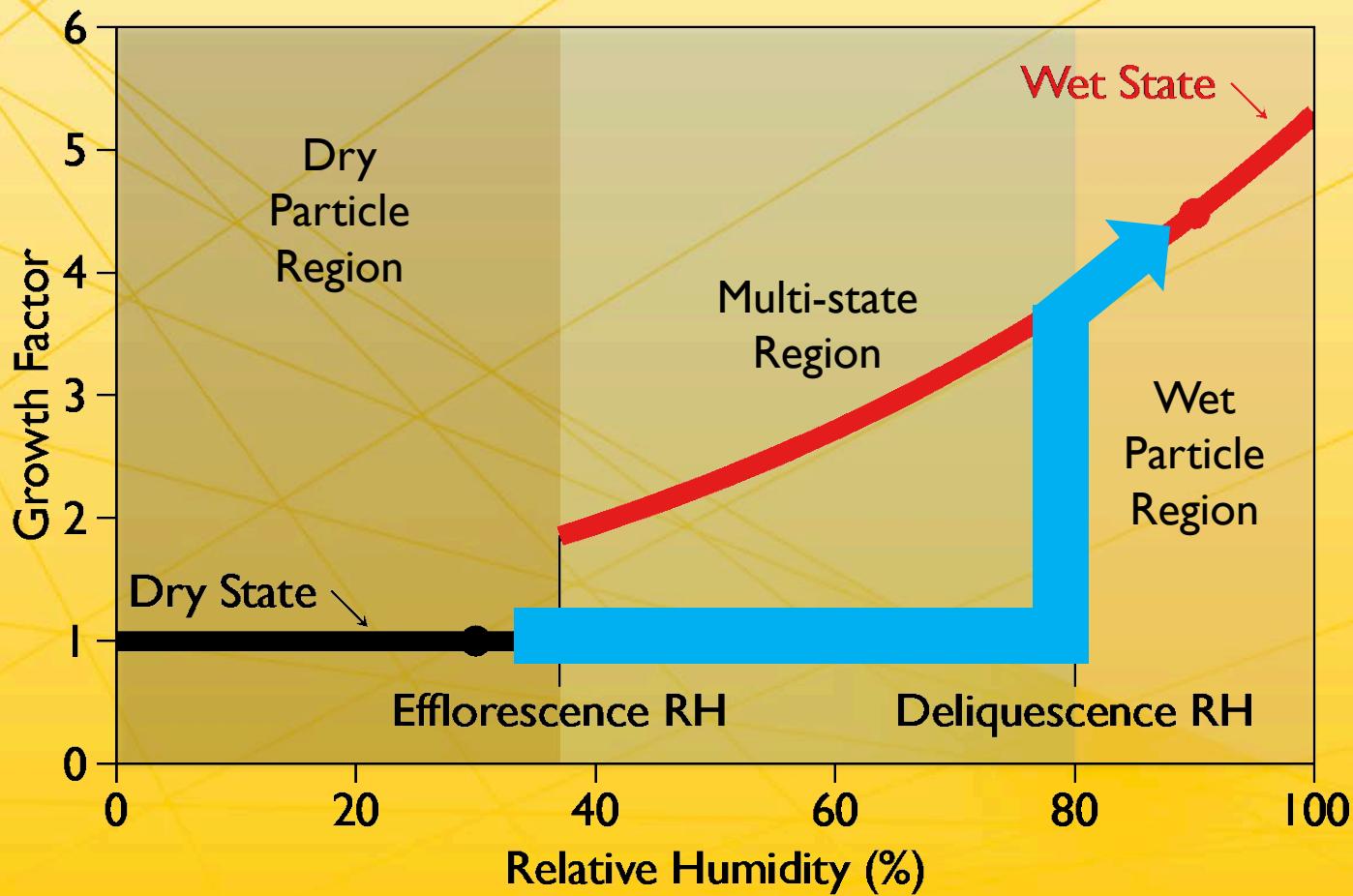
Test Matrix



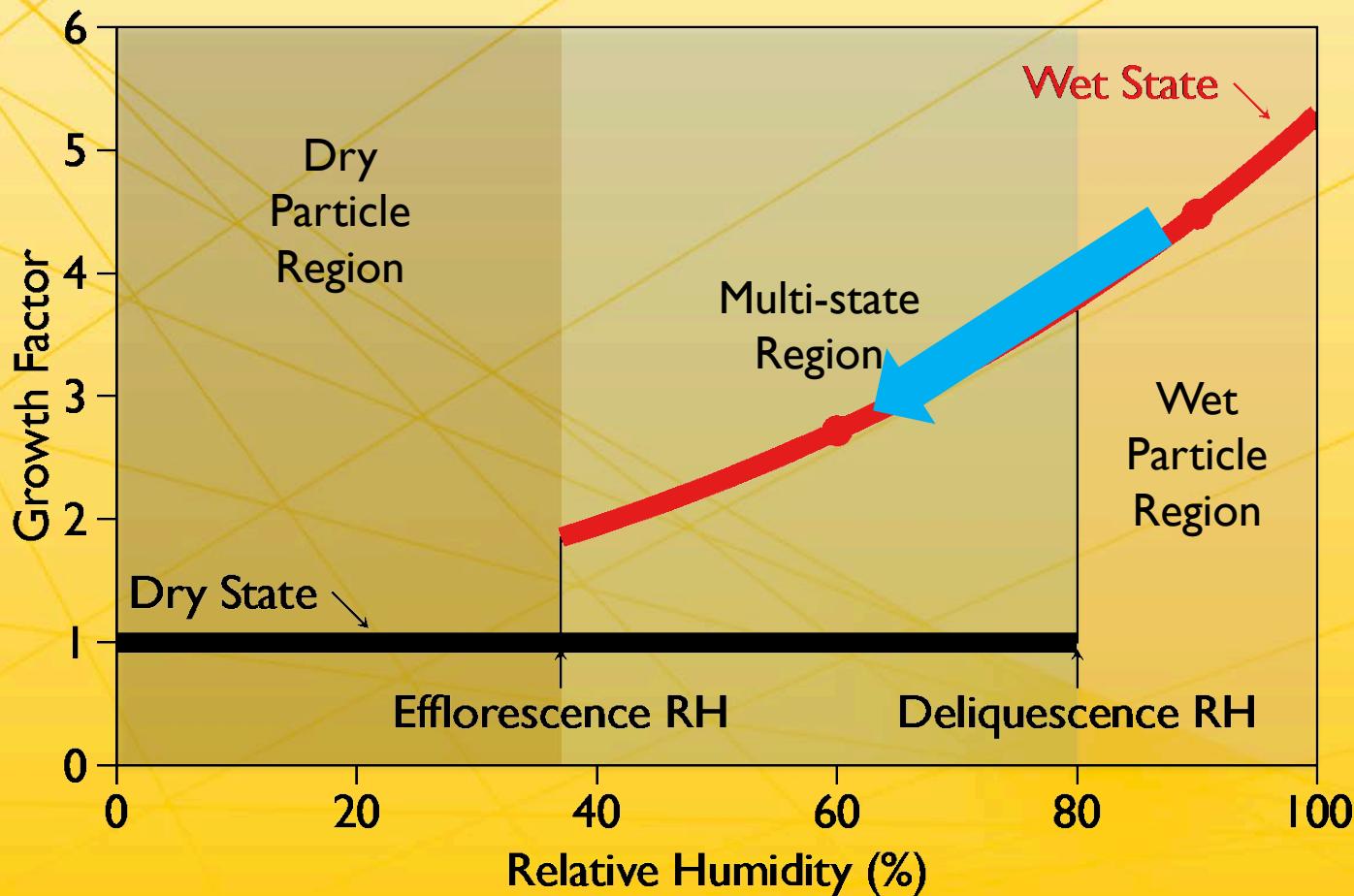
Test Matrix-type I



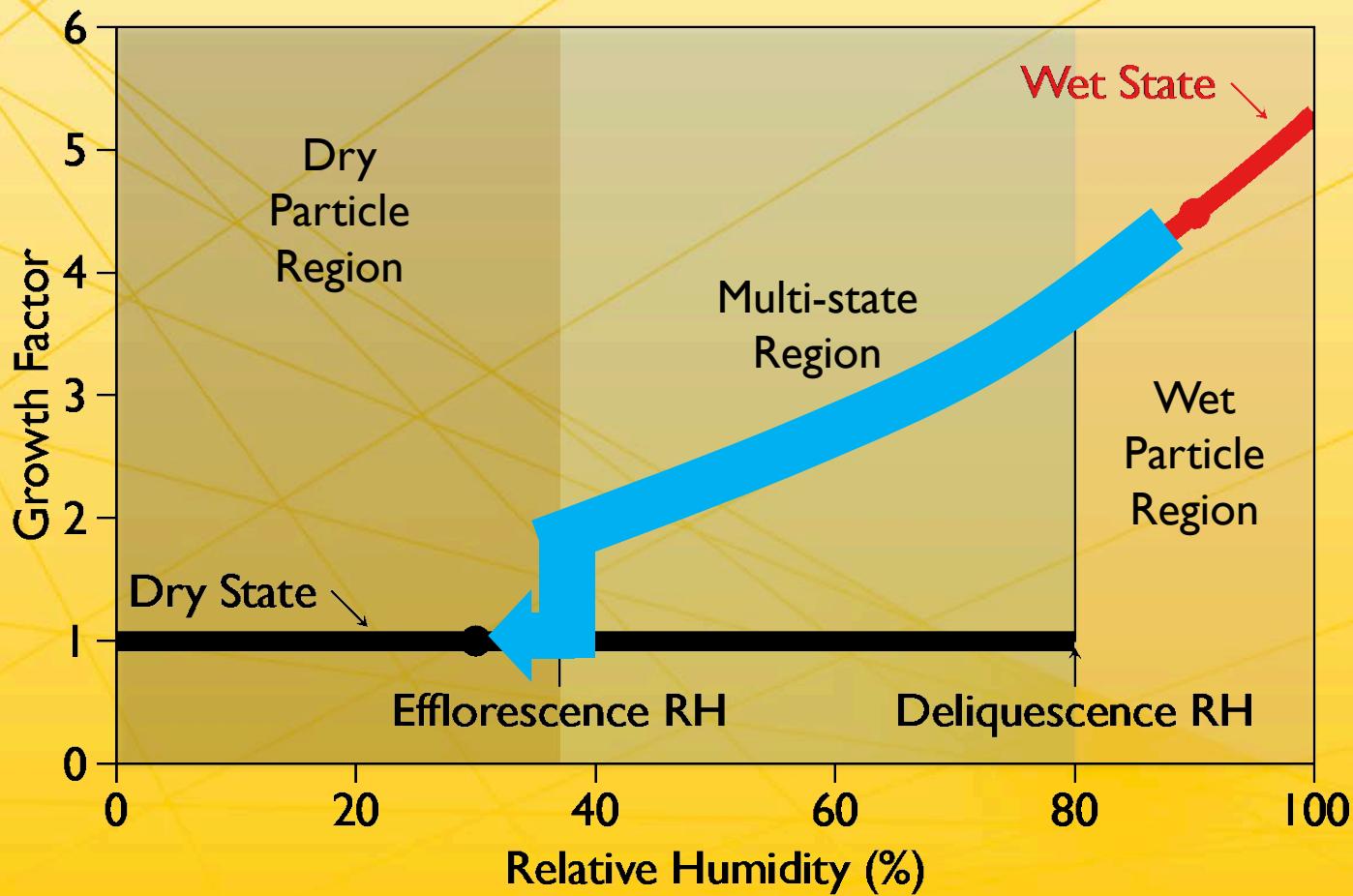
Test Matrix-type I



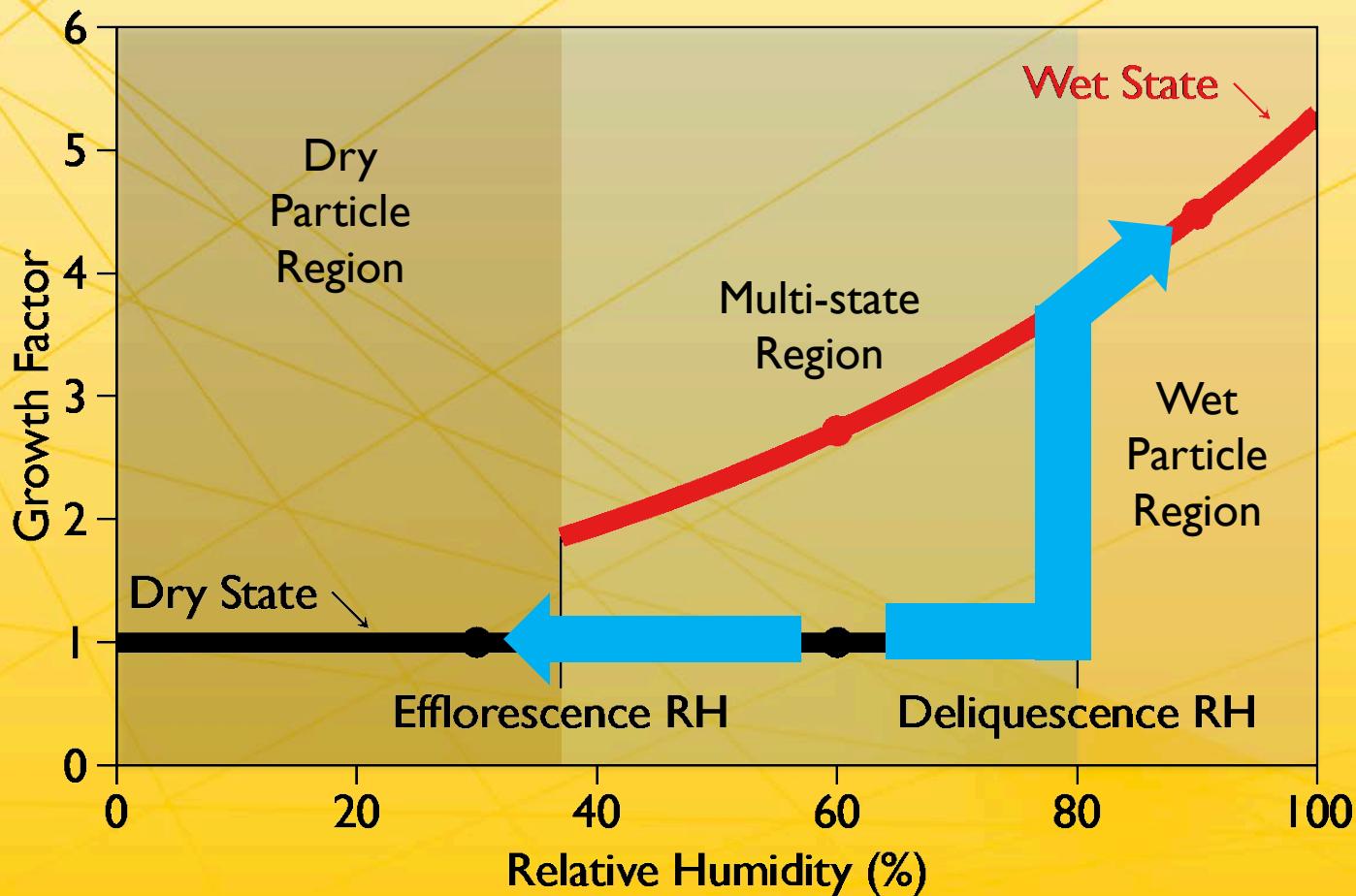
Test Matrix-type 2



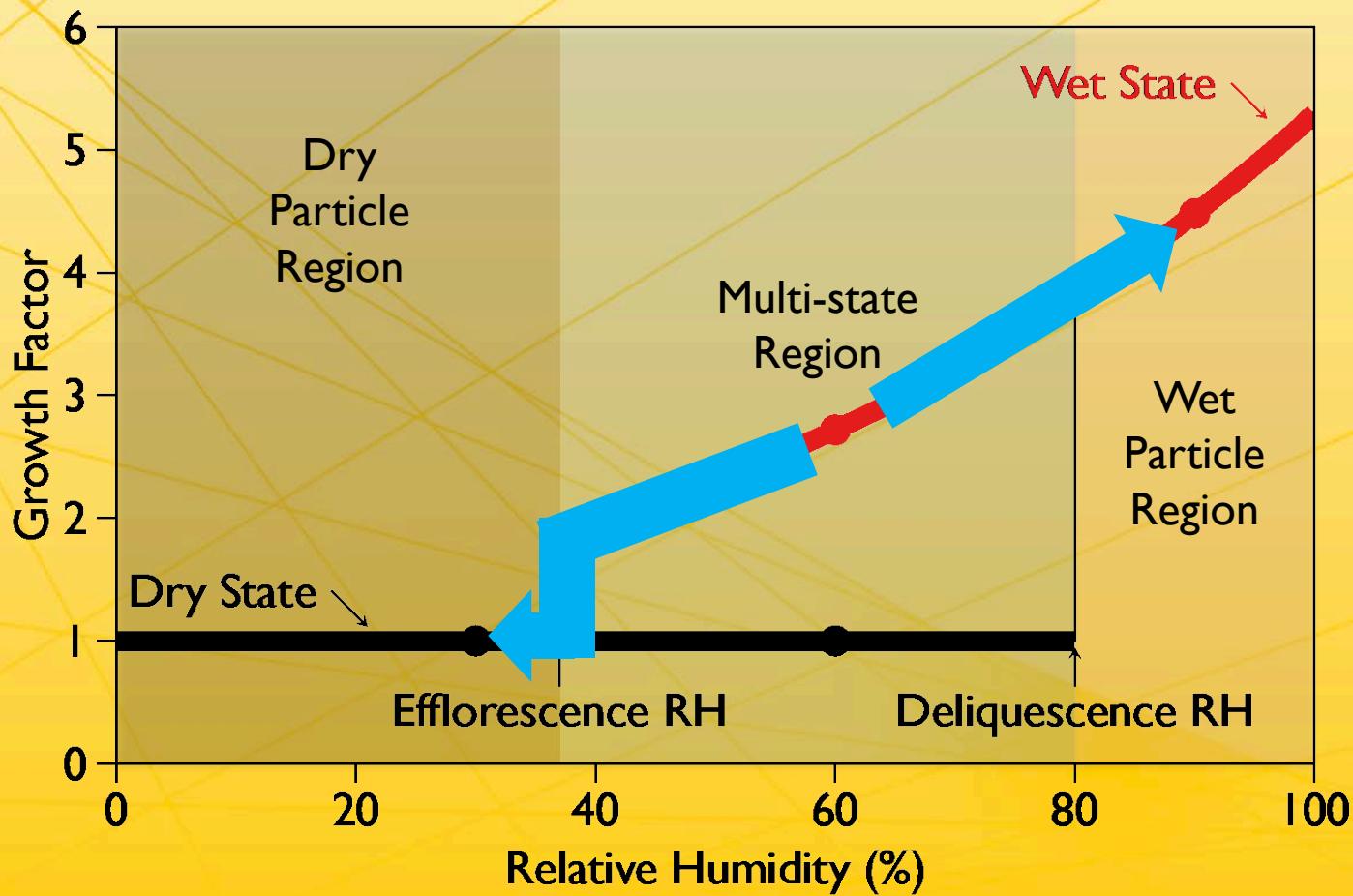
Test Matrix-type 2



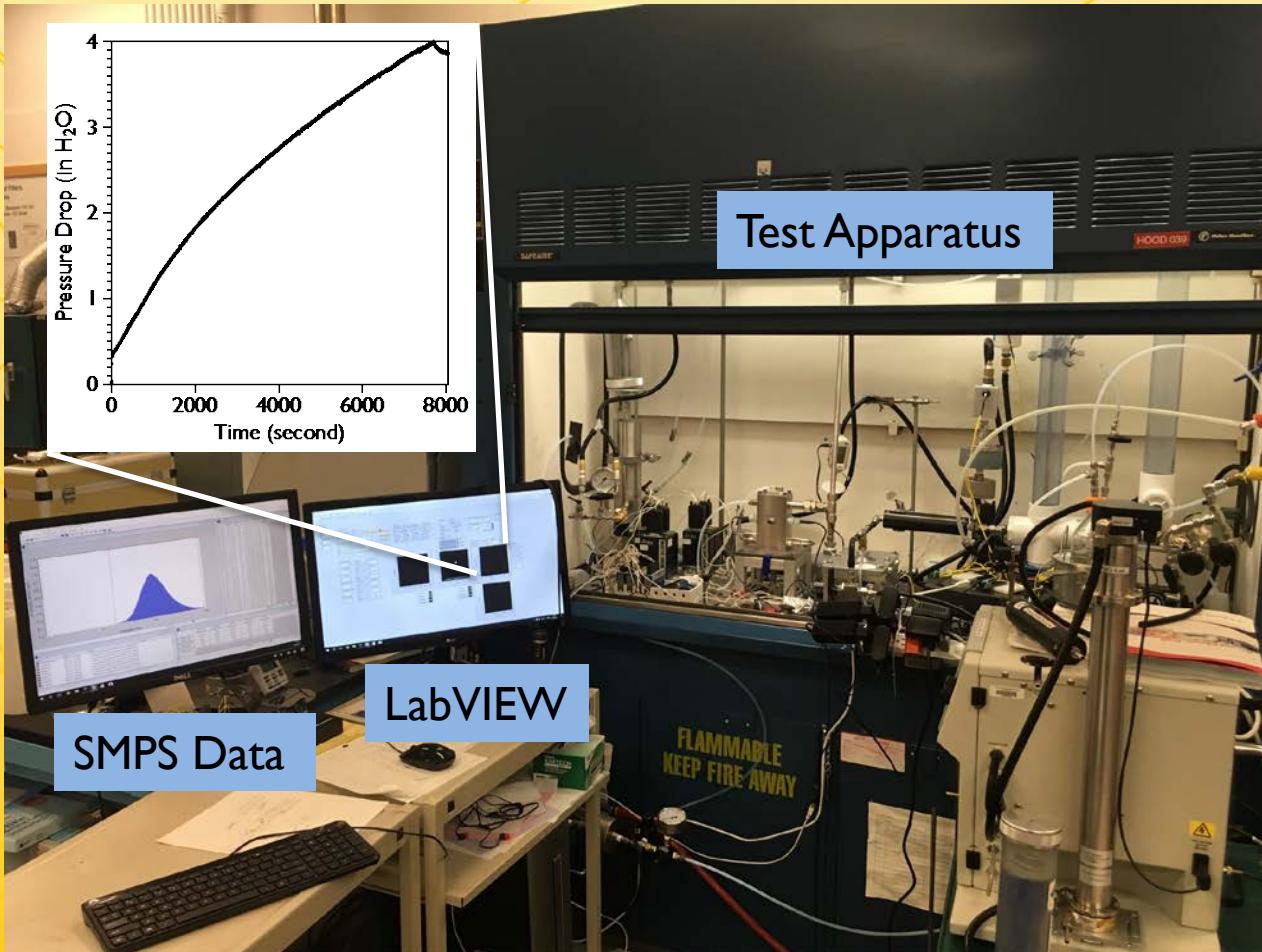
Test Matrix-type 3



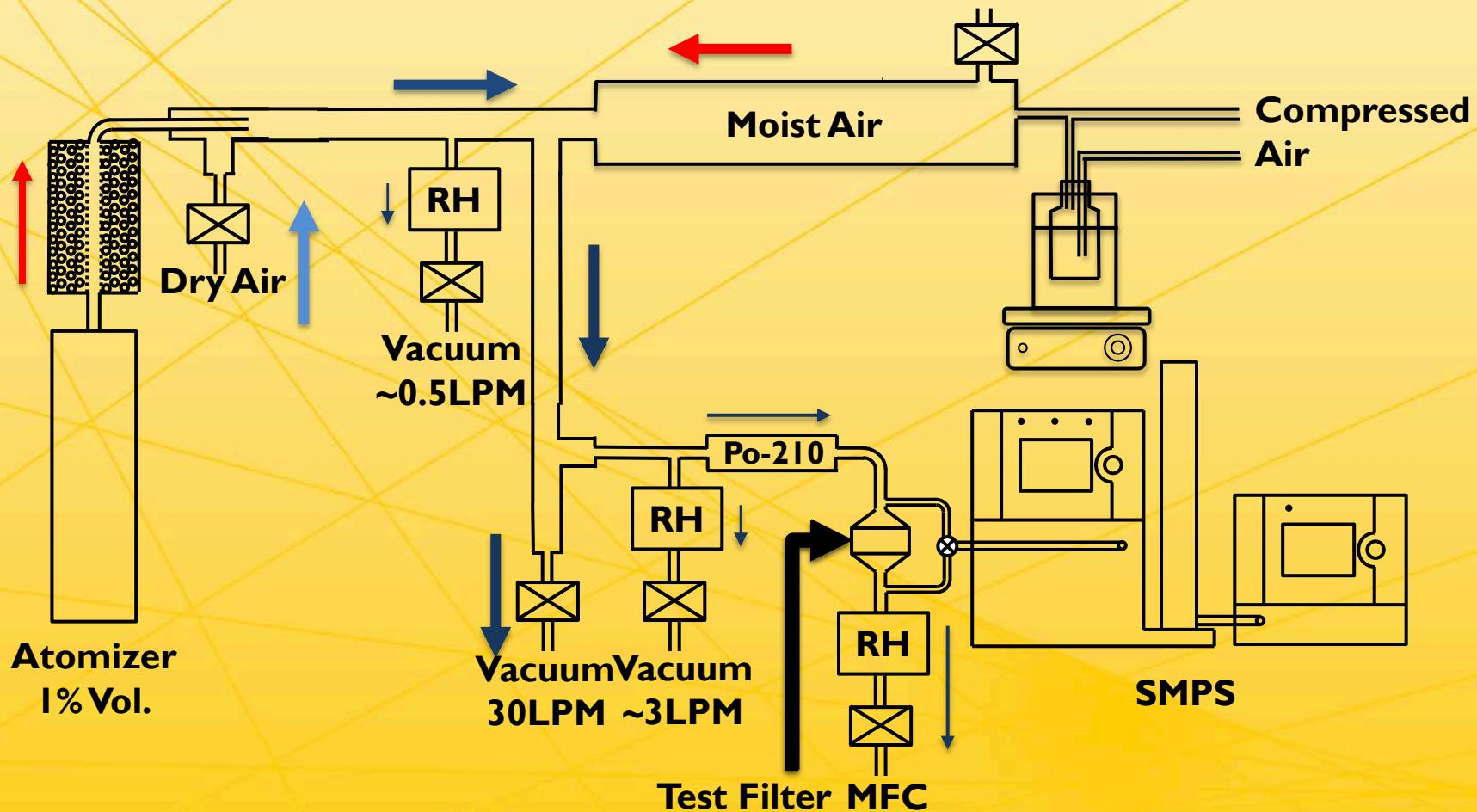
Test Matrix-type 4



Test System

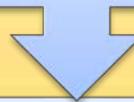


Test System

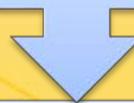


Test Process

Load test filter at **X%** RH until 4 in. H_2O Pressure Drop



Shut down atomizer while keep the test filter flow



Condition test filter at **Y%** RH



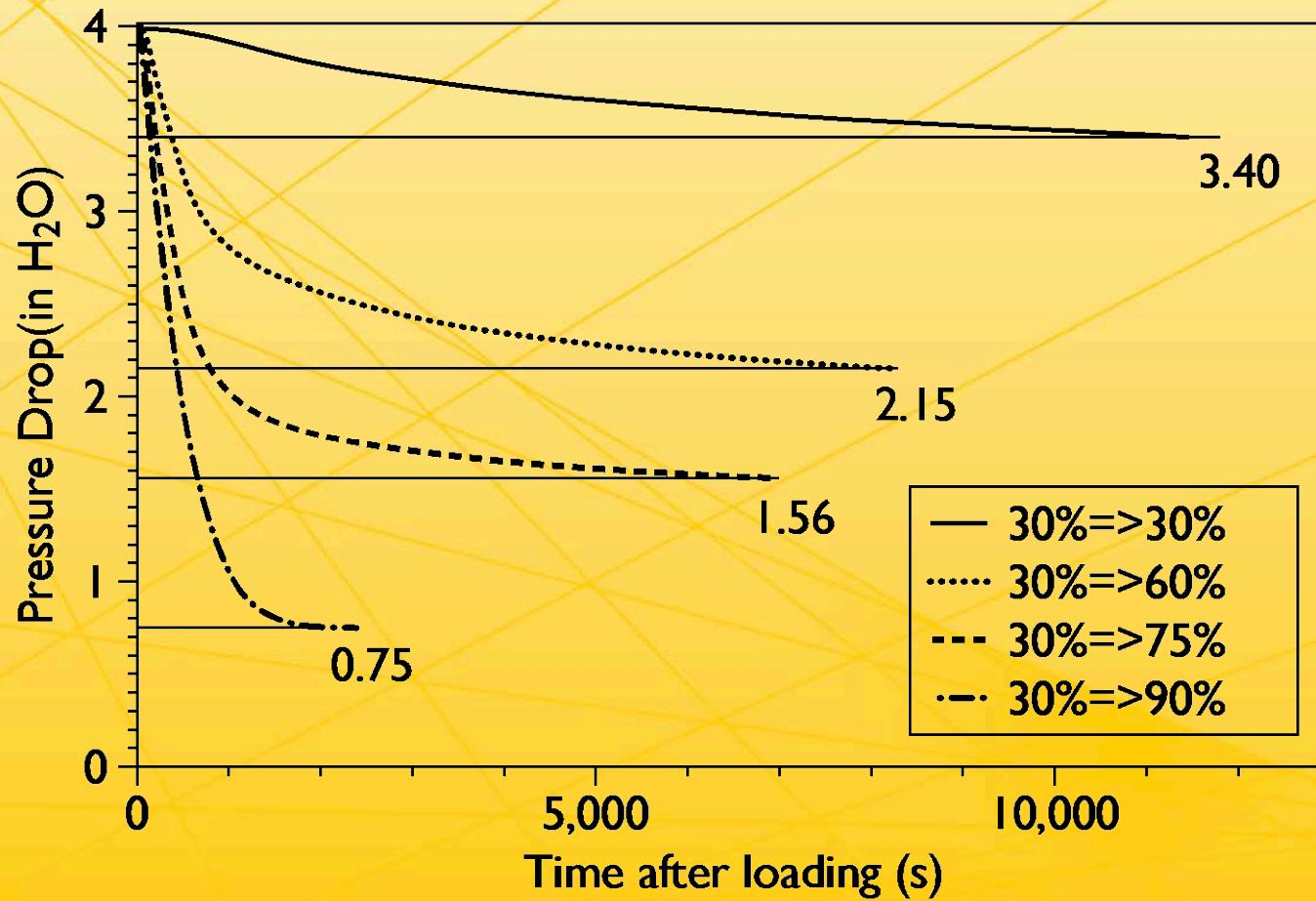
Stop until Pressure (**Terminating Pressure**) Drop
instantaneous decreasing rate less than 0.1 in. H_2O /hr



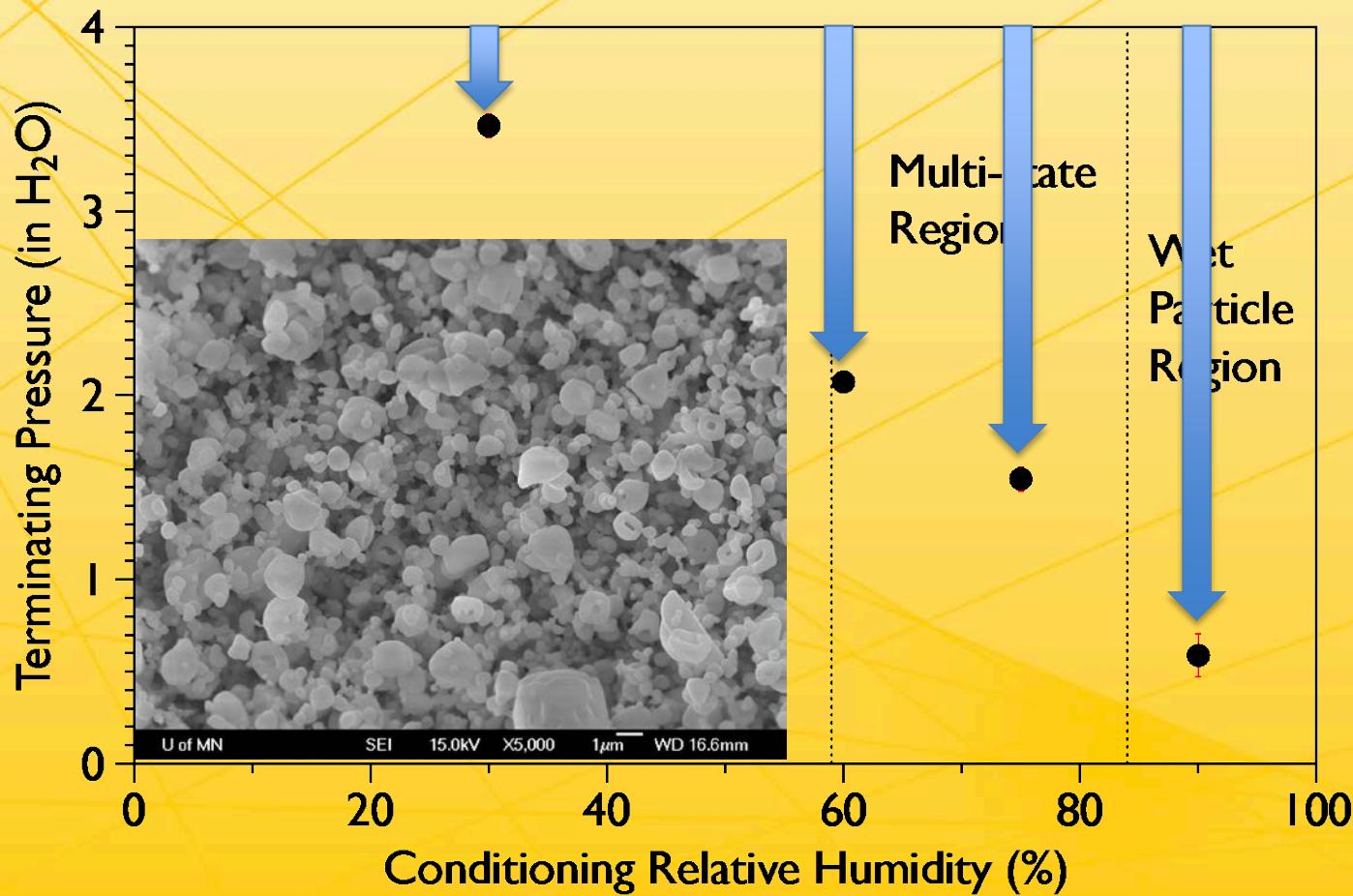
KCI



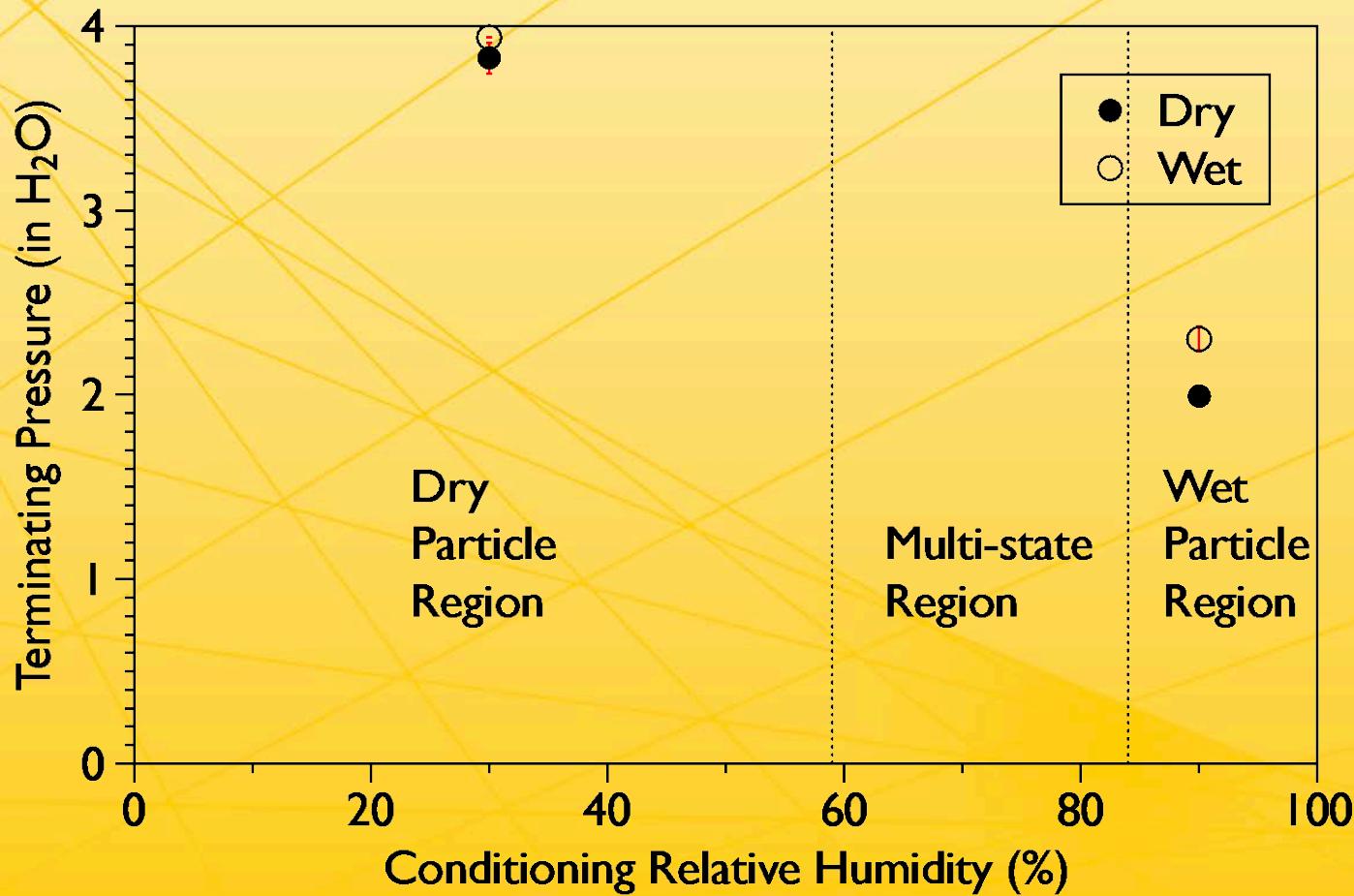
Pressure Drop after loading @ 30%RH



KCl Loading @ 30% RH

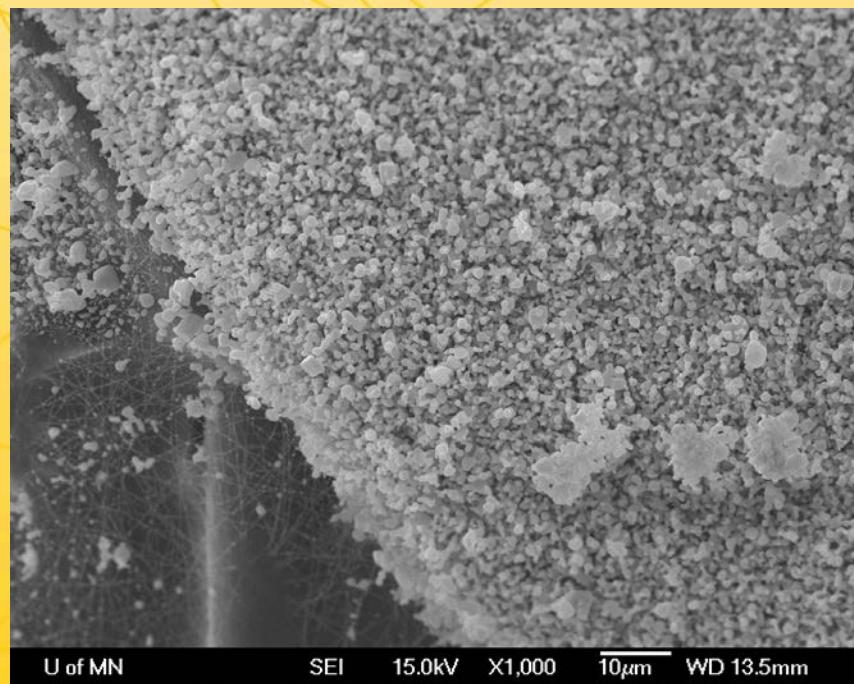


KCl Loading @ 75% RH

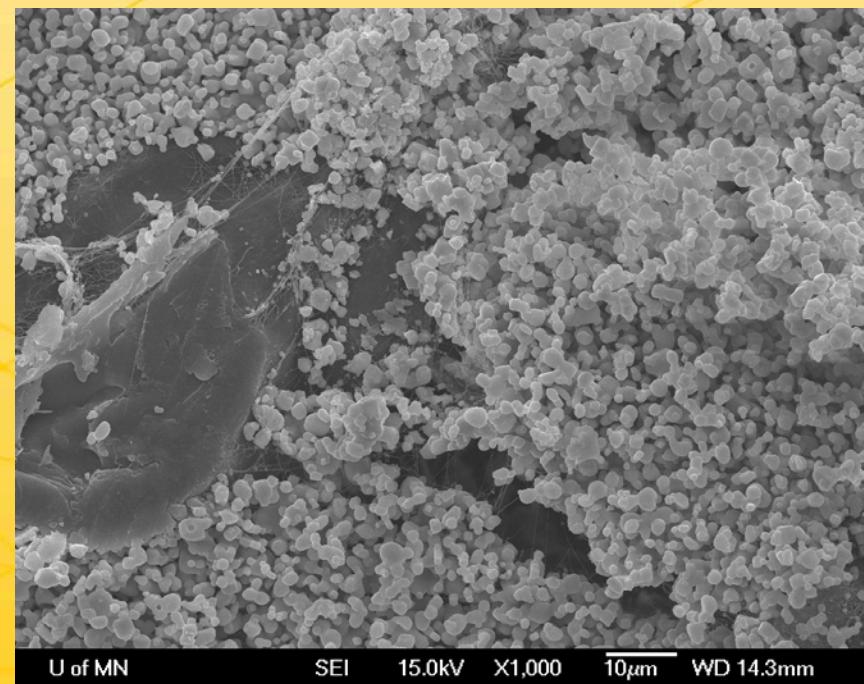


KCl

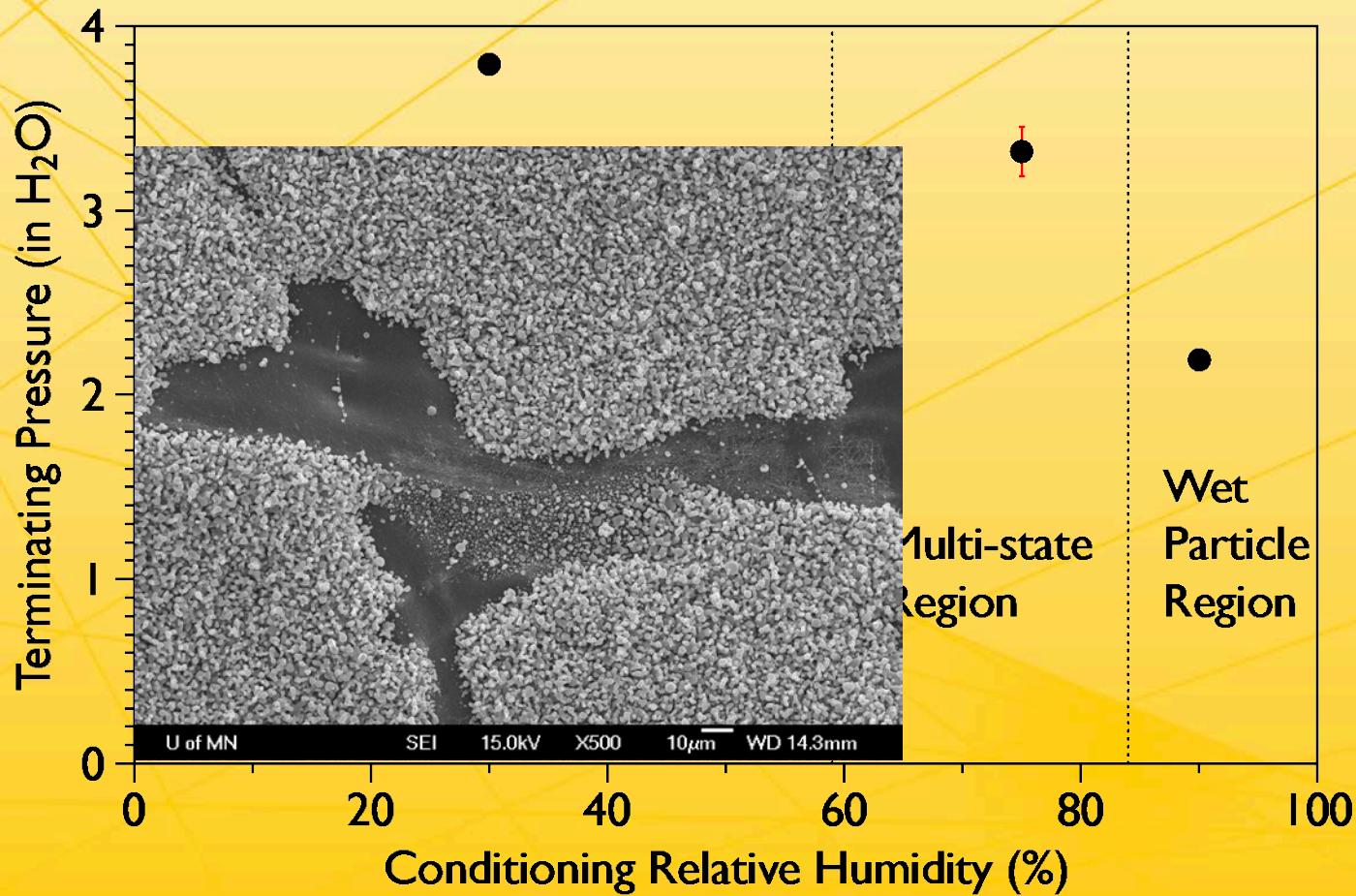
Dry@75%RH



Wet@75%RH

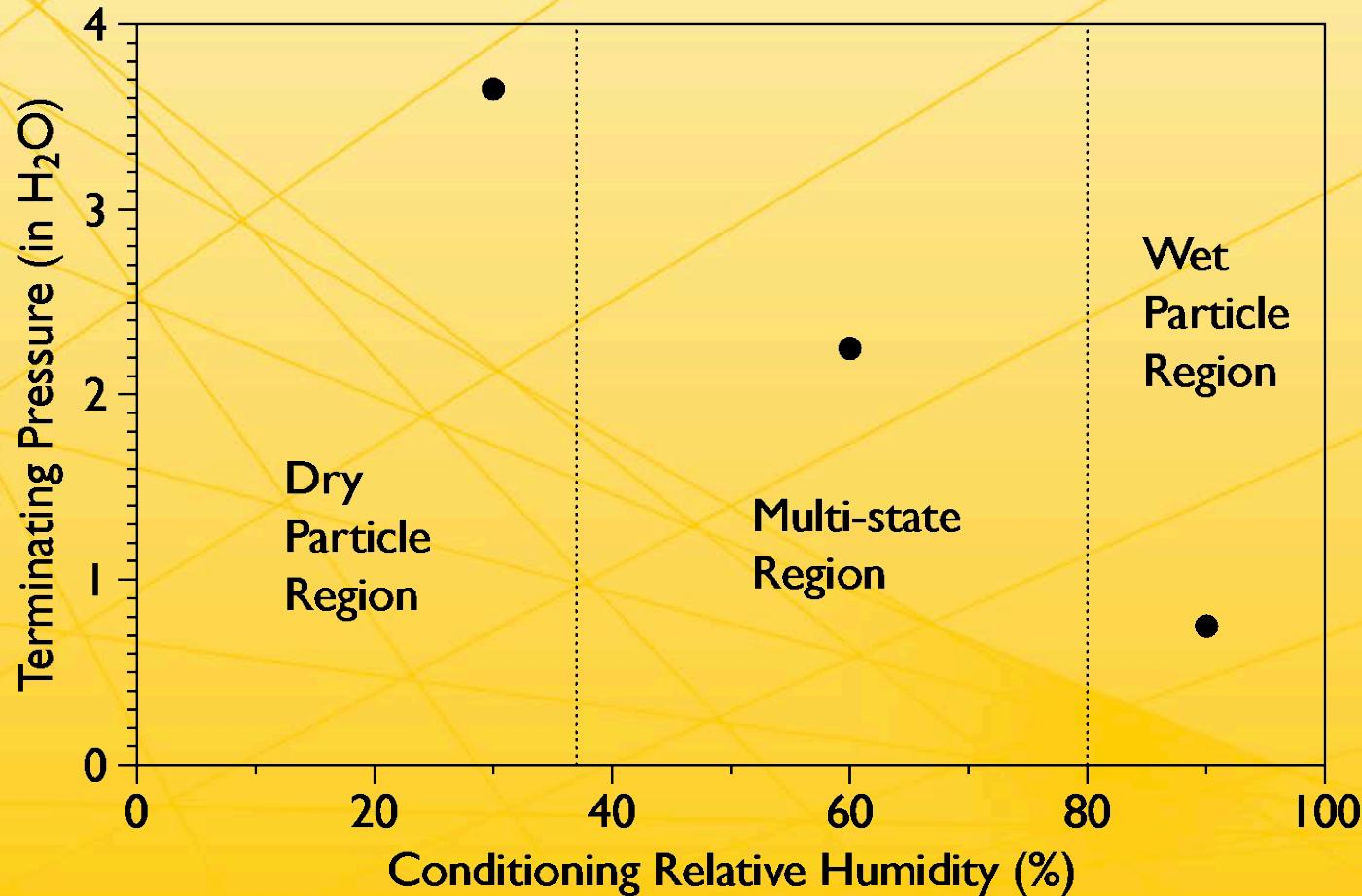


KCl Loading @ 90% RH

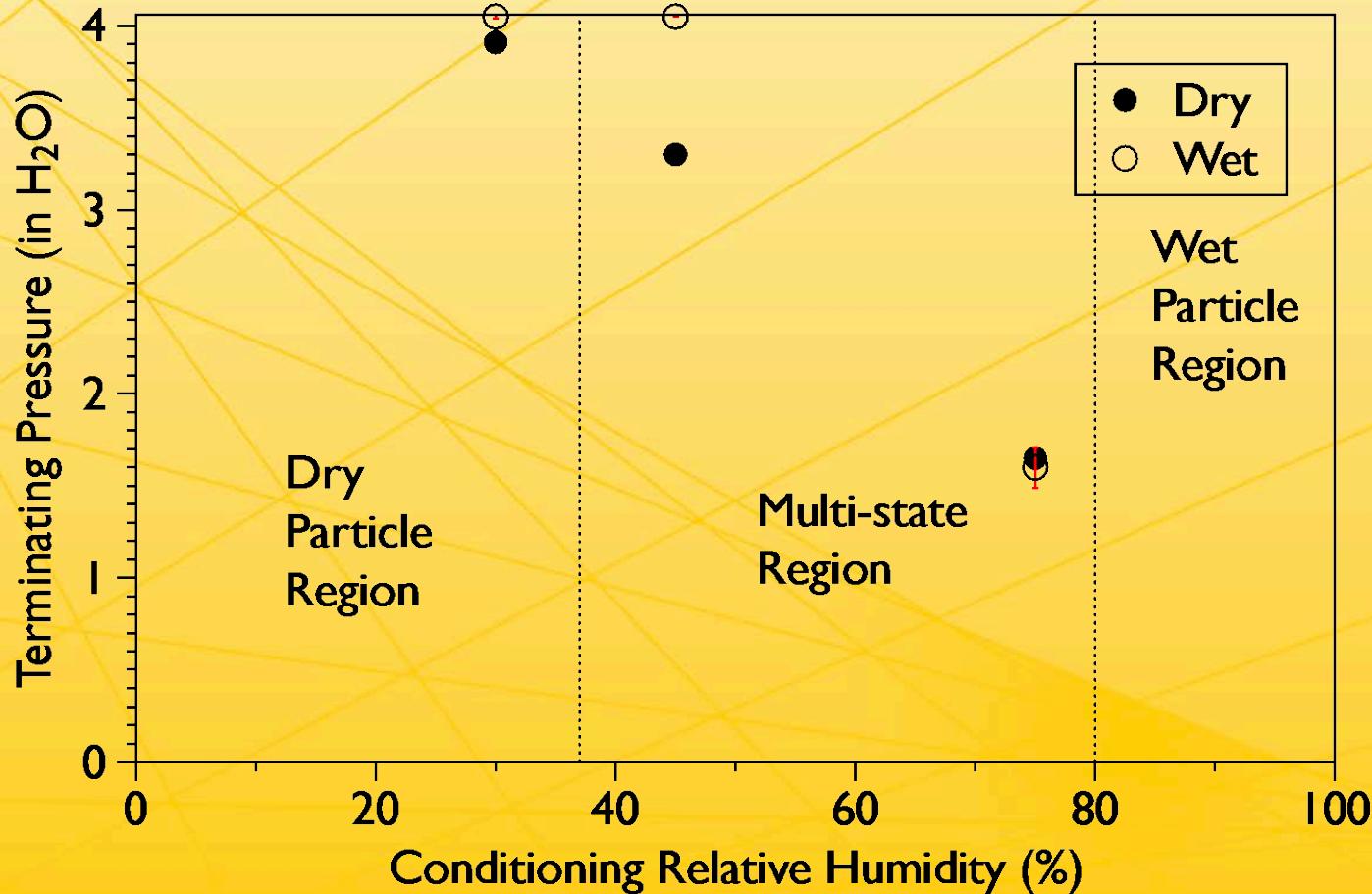


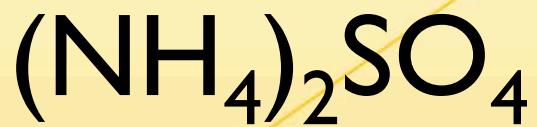


$(\text{NH}_4)_2\text{SO}_4$ Loading @ 30% RH

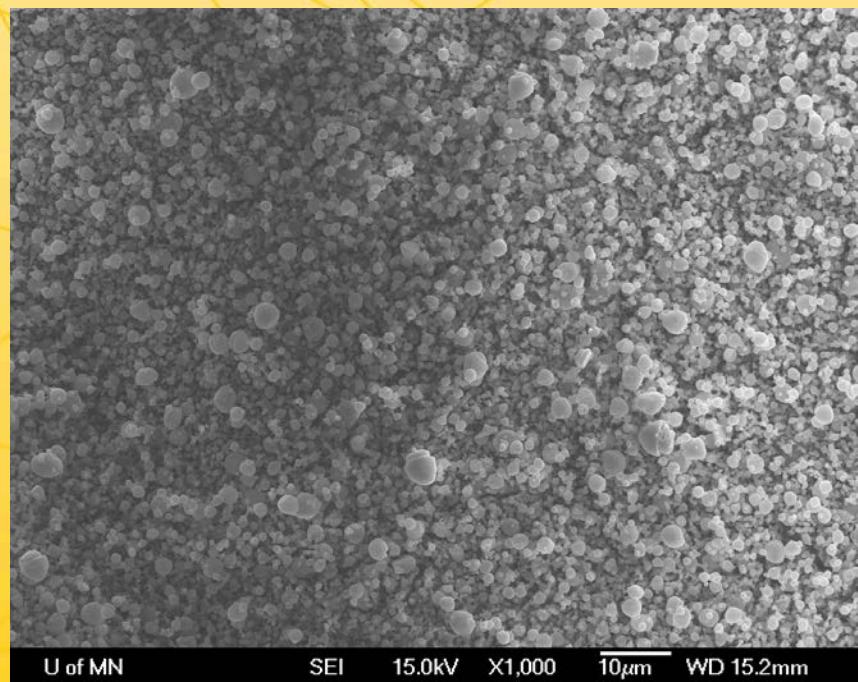


$(\text{NH}_4)_2\text{SO}_4$ Loading @ 45% RH

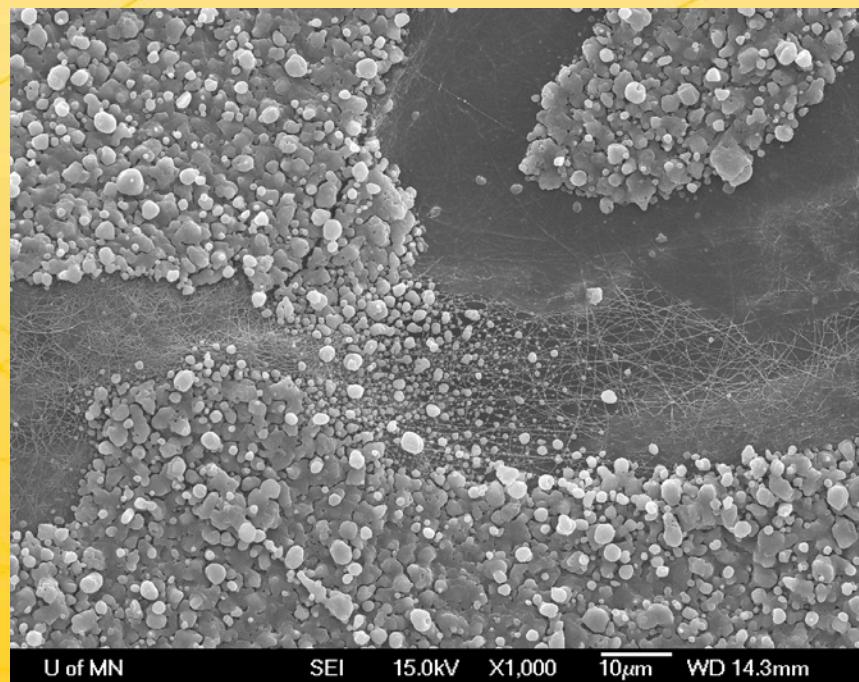




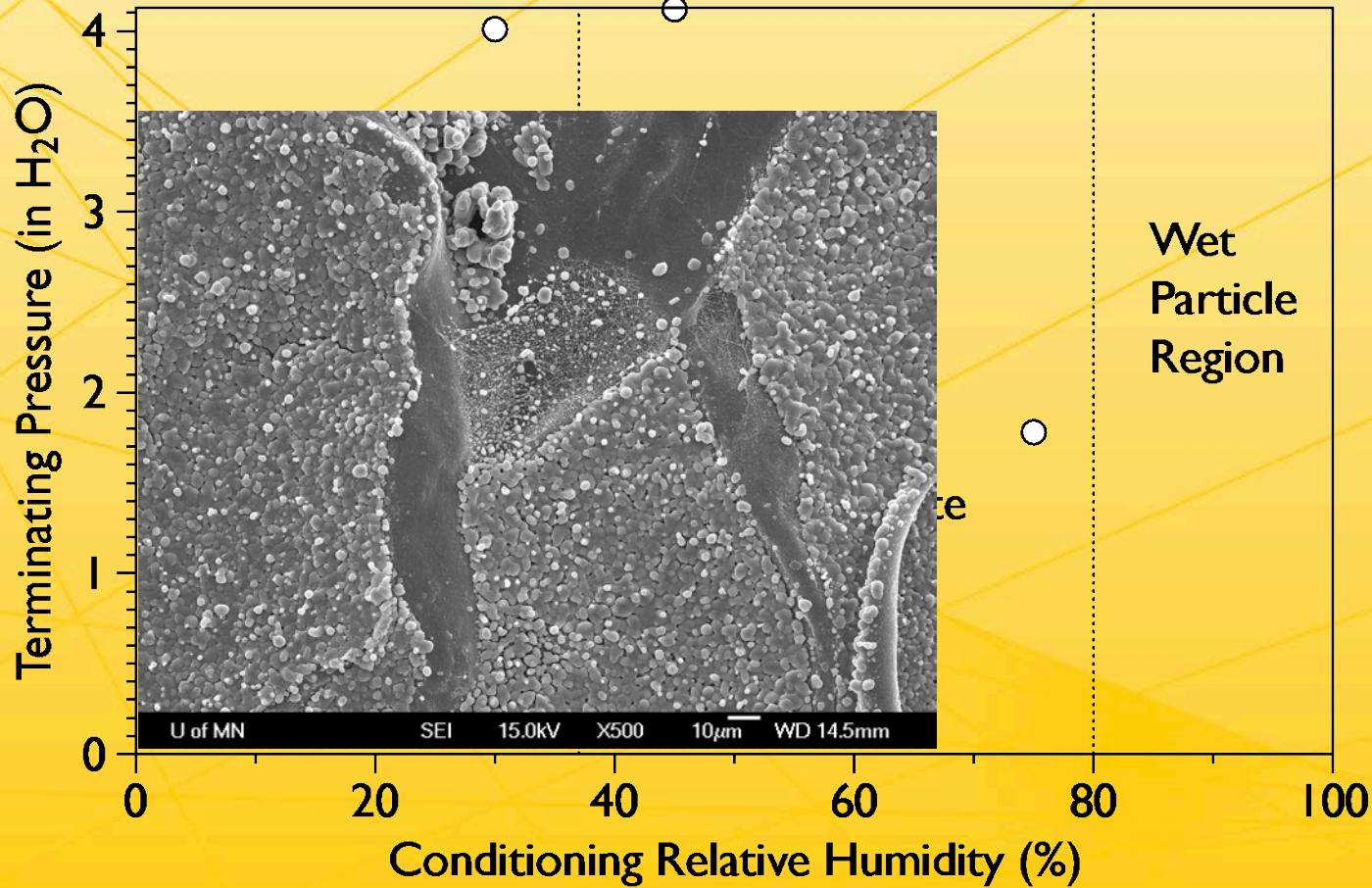
Dry@45%RH



Wet@45%RH



$(\text{NH}_4)_2\text{SO}_4$ wet Loading @ 75% RH

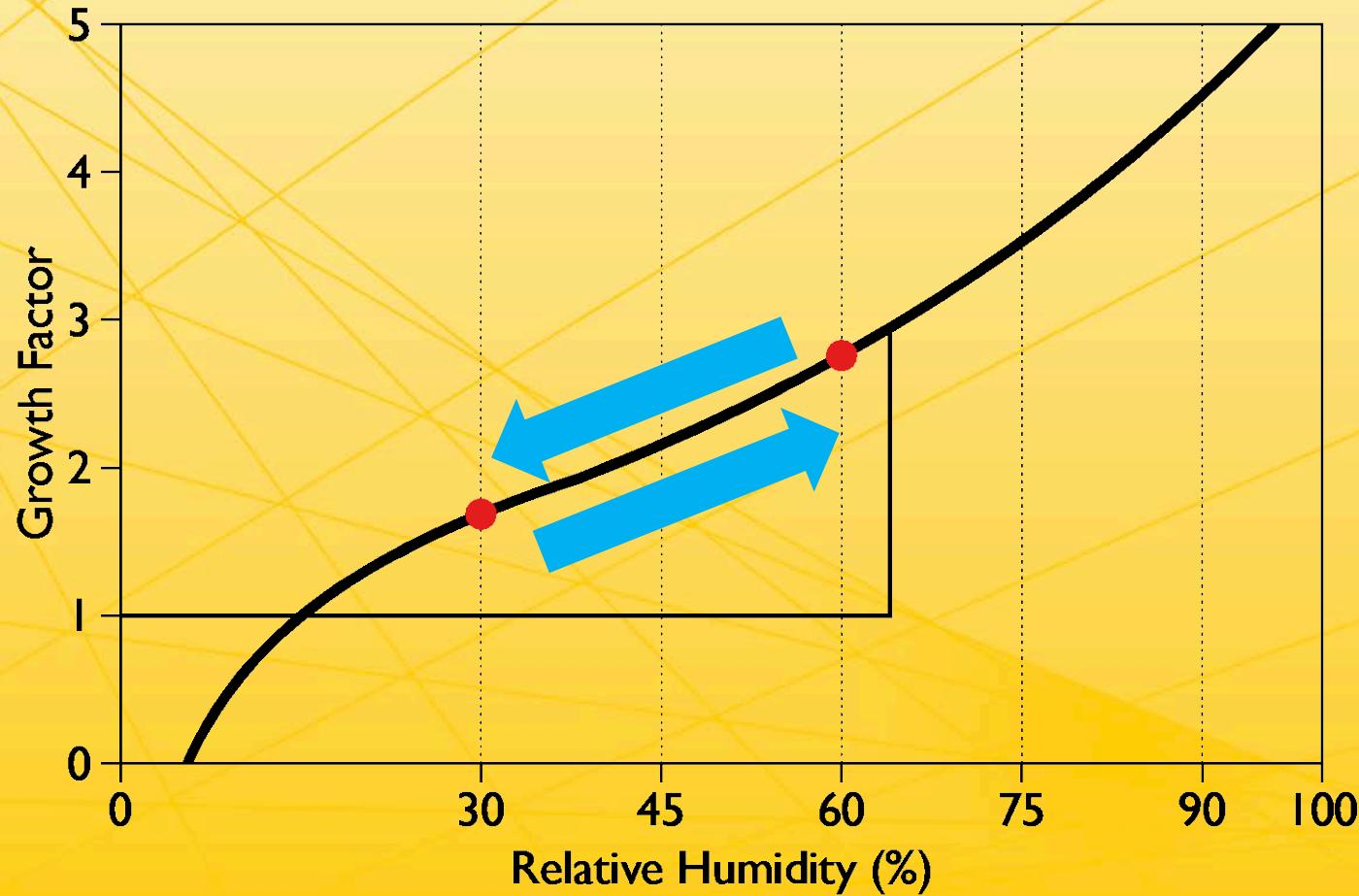


UNIVERSITY OF MINNESOTA



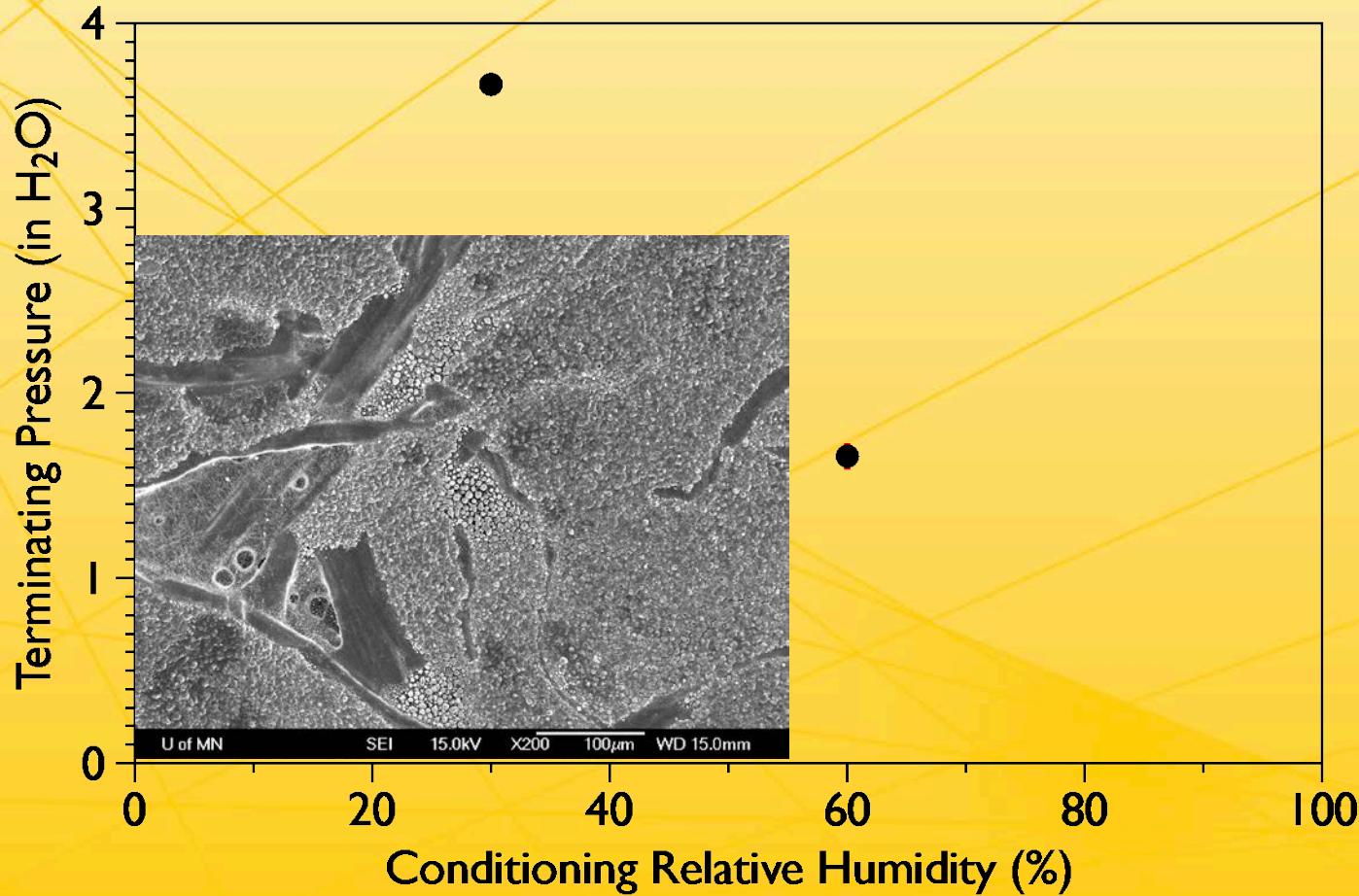


Test Matrix

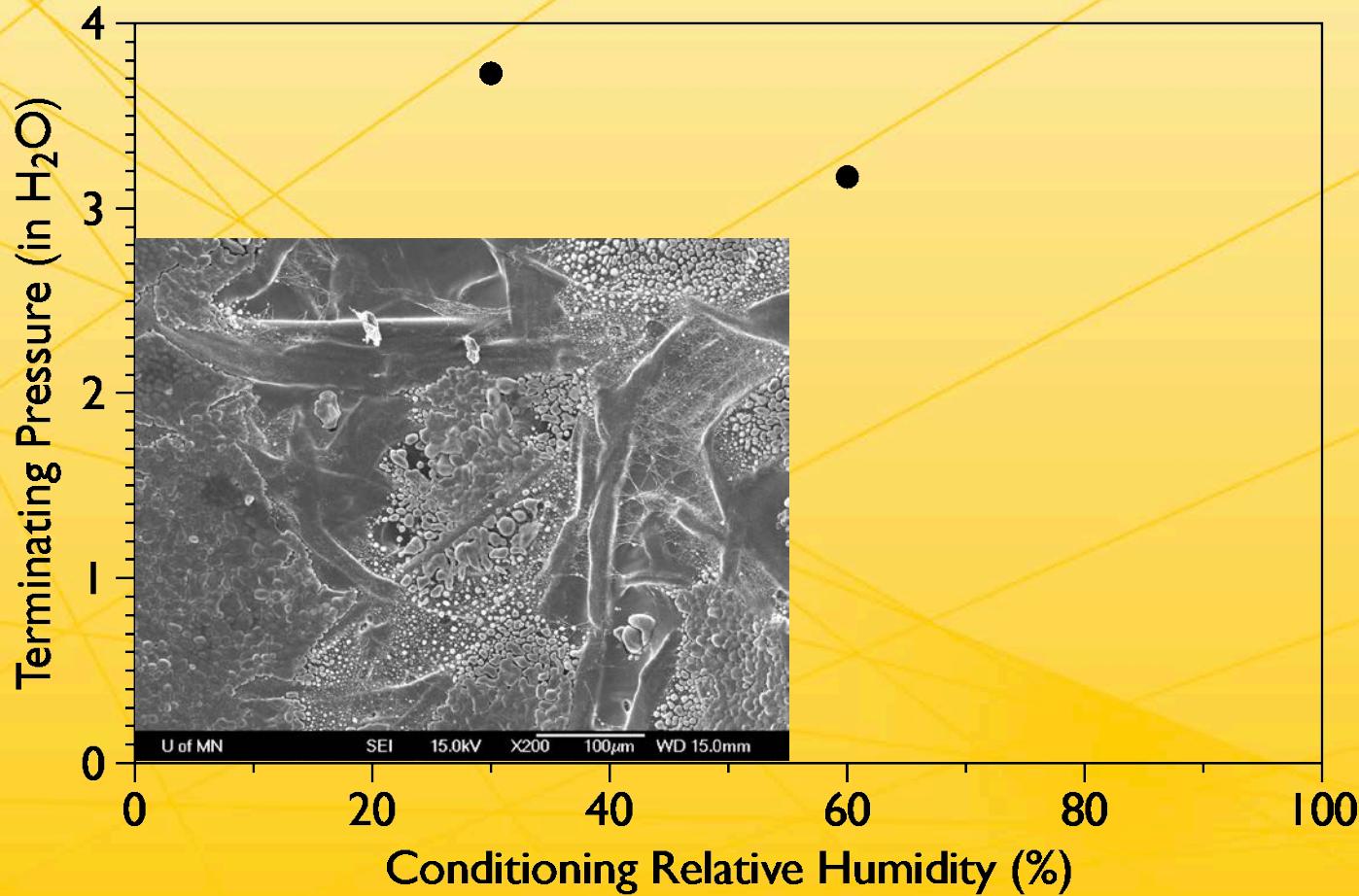


30

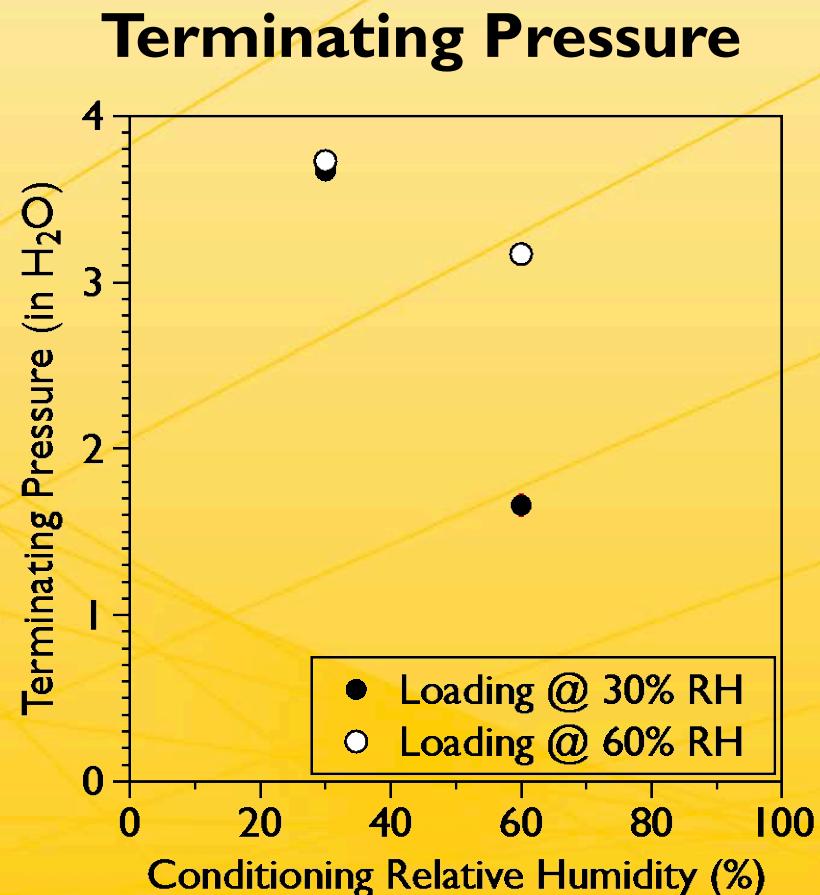
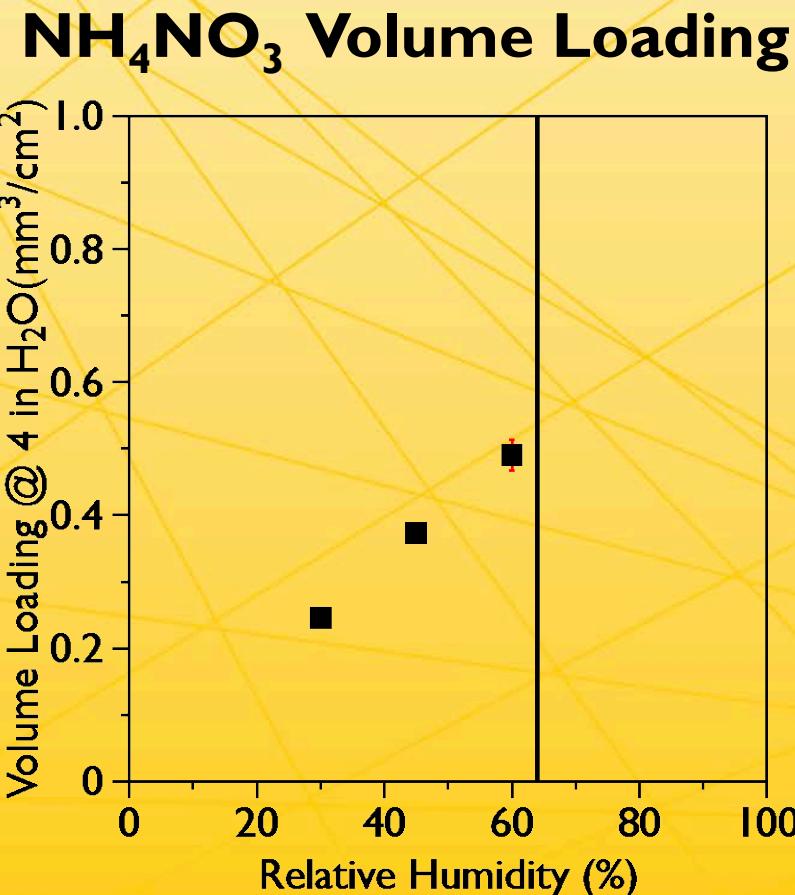
NH_4NO_3 Loading @ 30% RH



NH_4NO_3 Loading @ 60% RH



The amount of the deposits affect the terminating pressure drop at 60% RH



Summary

- Filters loaded by hygroscopic salt could have different pressure drops under different environmental relative humidities after loading.
- Generally, the higher the conditioning RH, the lower the terminating pressure. The possible explanation is that the particles could absorb more water by capillary condensation at the higher conditioning RH to change the morphology of the dendrites.

