

Carboxylic Acid Groups and Fibre Bonding

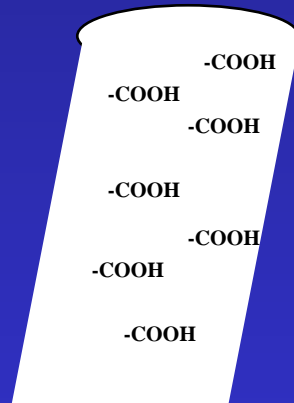
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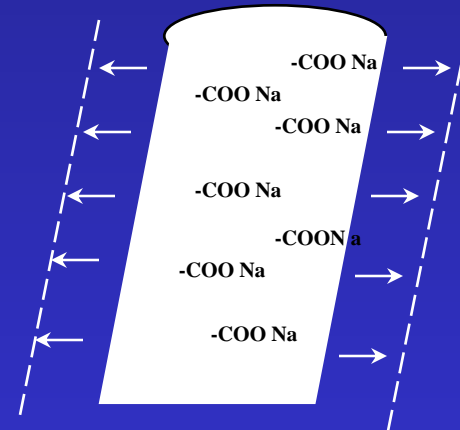
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Effect of Acid Groups on Swelling

Fibre 1
Random Acid
Location



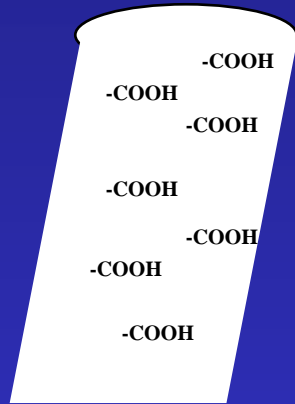
Hydrogen Form



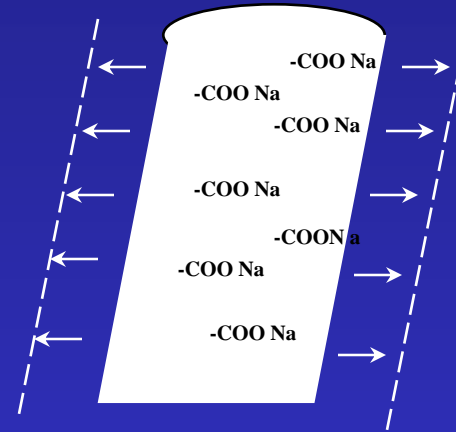
Sodium Form
(bulk fibre swelling)

Effect of Acid Groups on Swelling

Fibre 1
Random Acid
Location

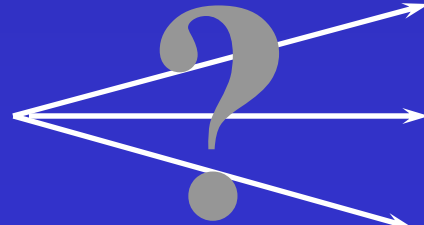
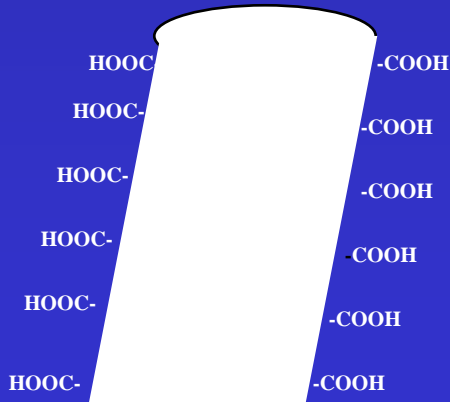


Hydrogen Form



Sodium Form
(bulk fibre swelling)

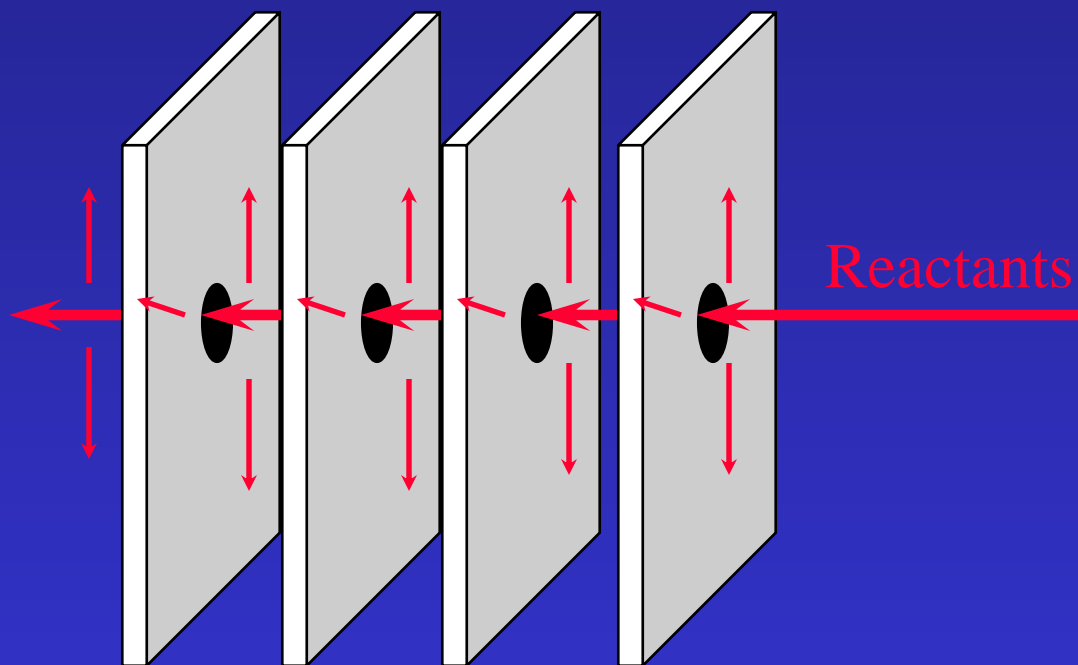
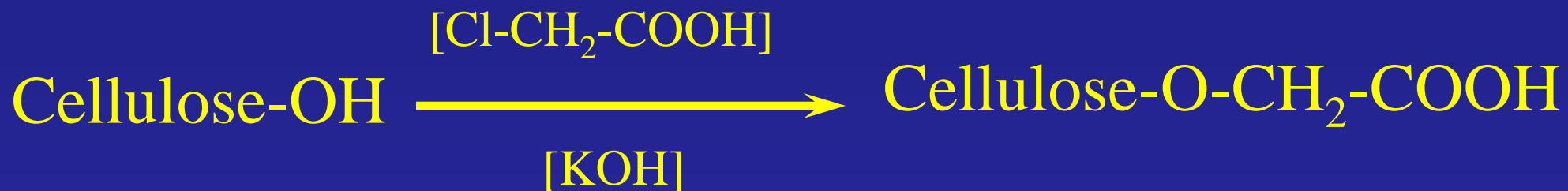
Fibre 2
Surface Acid
Location



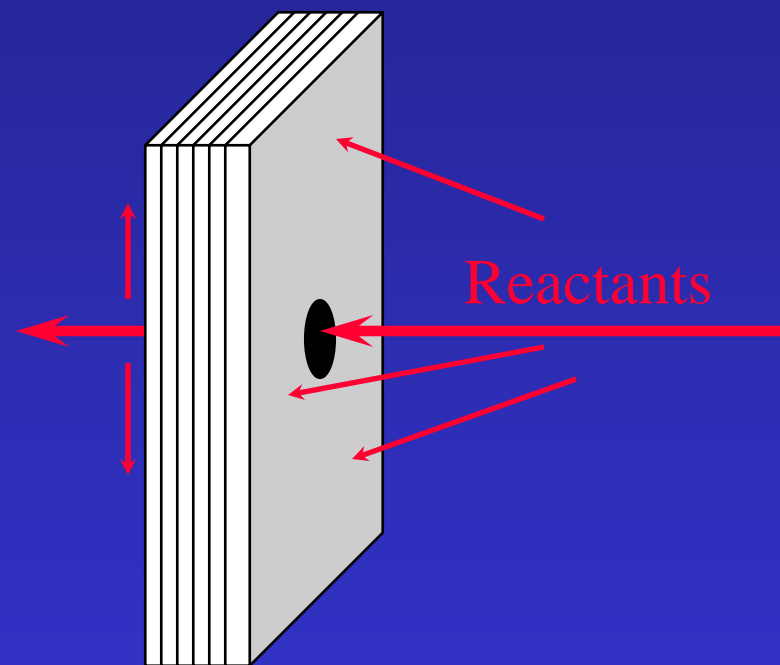
Bulk Fibre Swelling

Surface "Swelling"

No Effect



Solvent Exchange Dried
Fibre Cell Wall



Water Dried
Fibre Cell Wall

Conductometric Titration Results

Blank = 72 meq/kg

fibres dried from water
no chloroacetic acid added

Bulk = 144 meq/kg

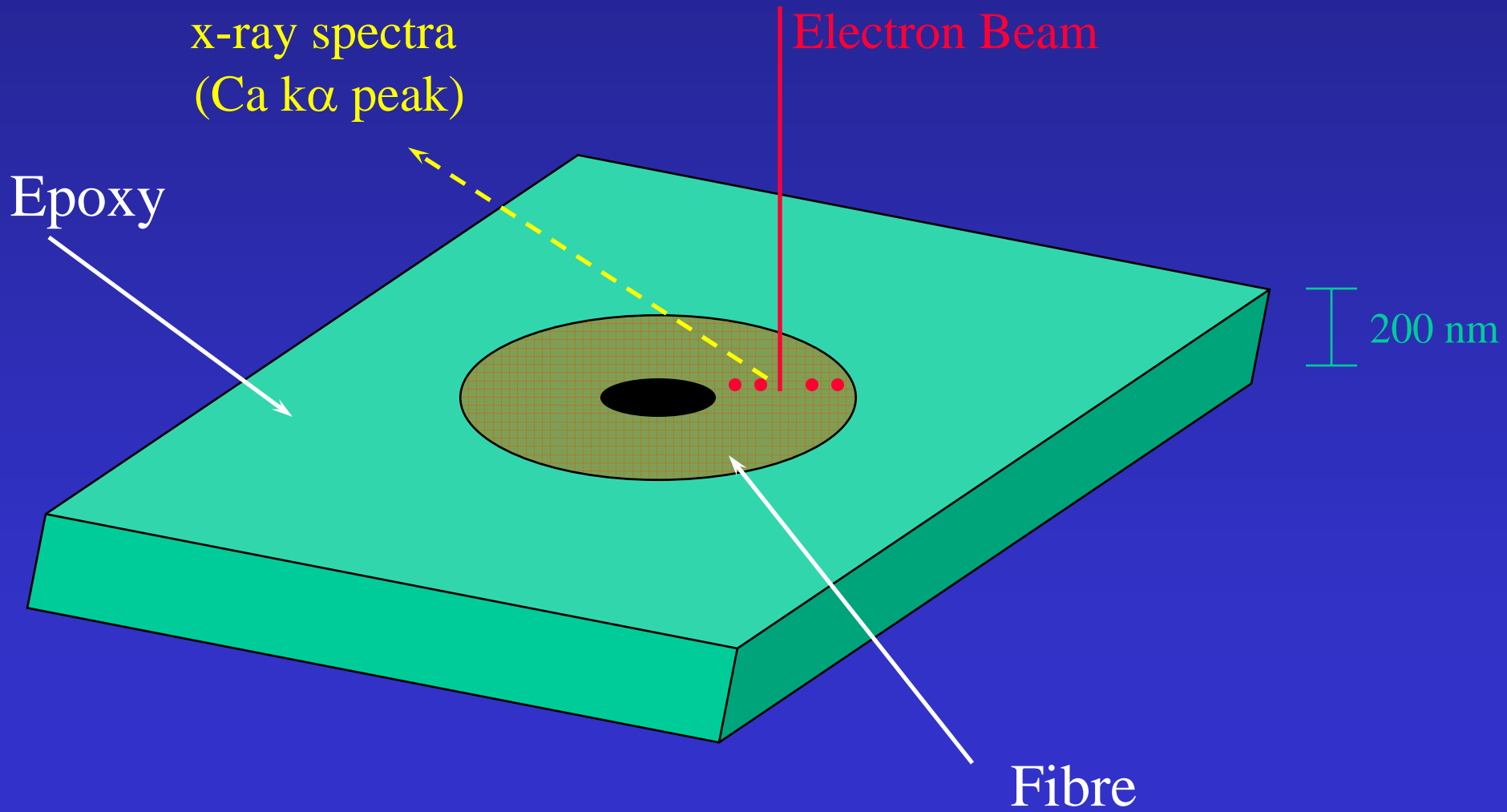
solvent exchange dried fibres
chloroacetic acid imbibed by fibres prior to reaction

Surface = 144 meq/kg

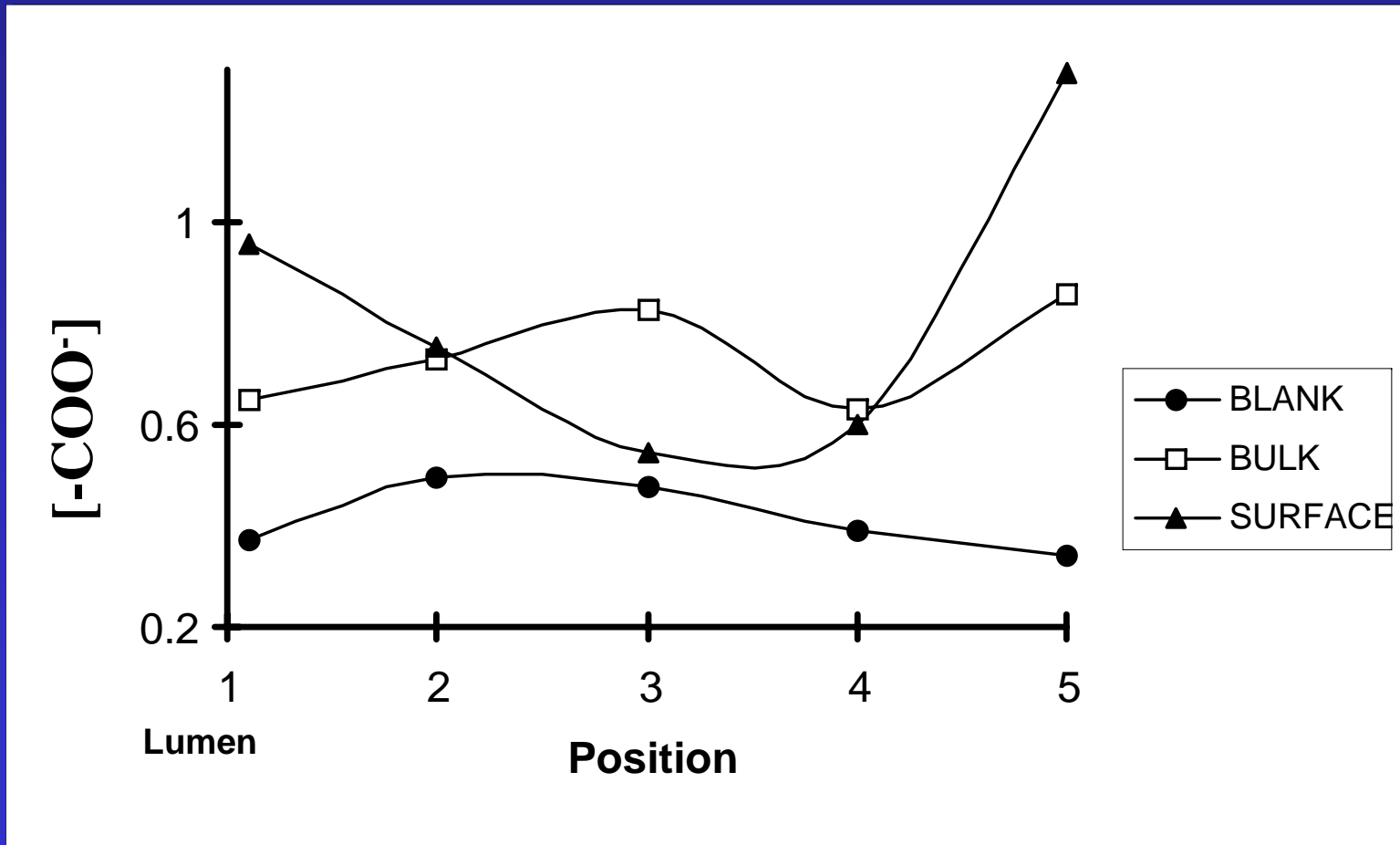
fibres dried from water
chloroacetic acid and potassium iodide added to reaction
mixture after fibres

SEM-EDS

Acid Group Location in Fibre Cell Wall



SEM-EDS Results



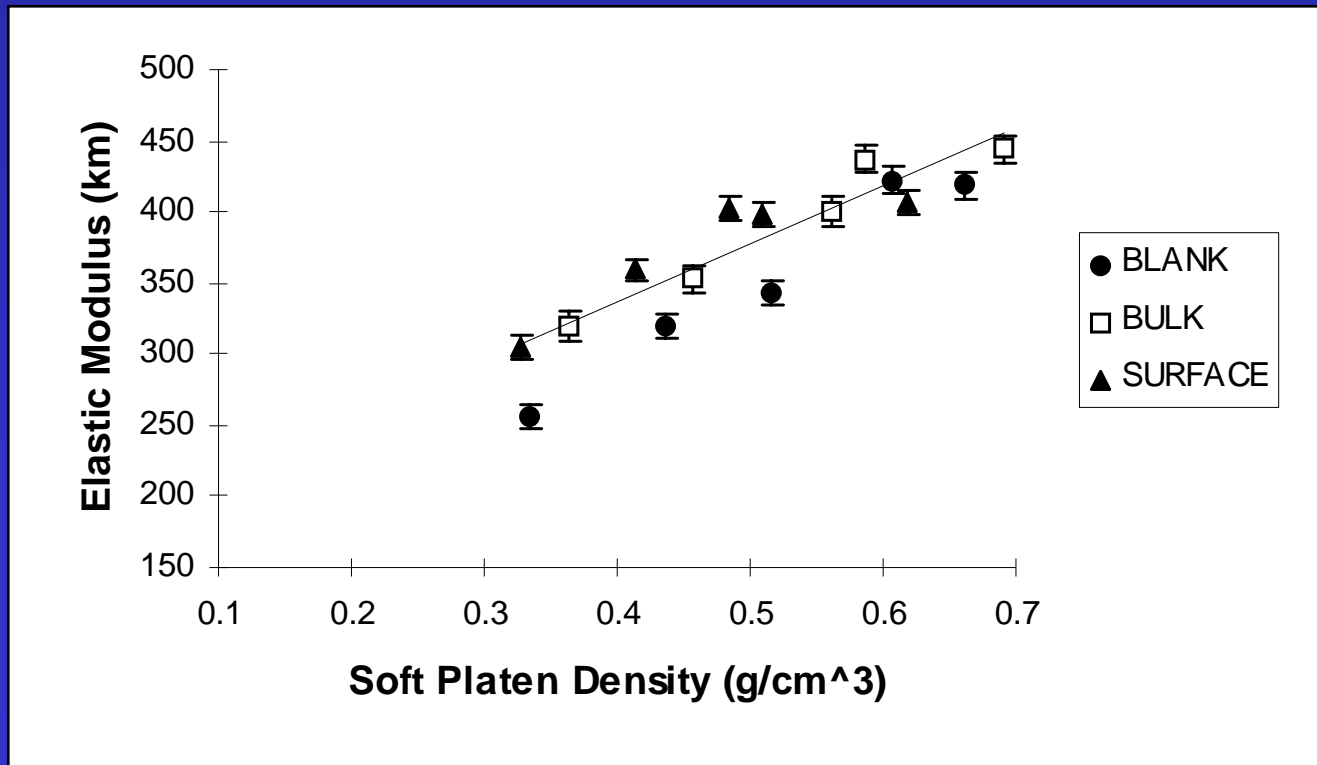
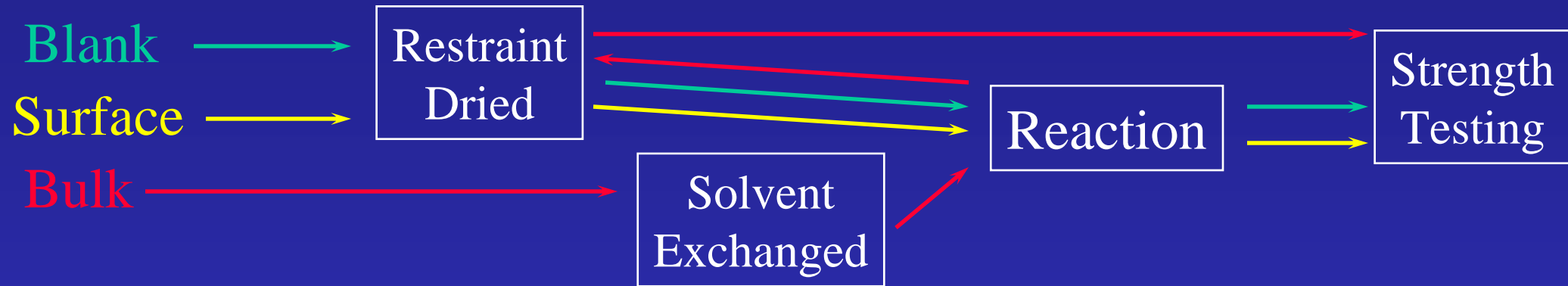
Polyelectrolyte Titration Results (Acid Groups Accessible)

Blank = 3%

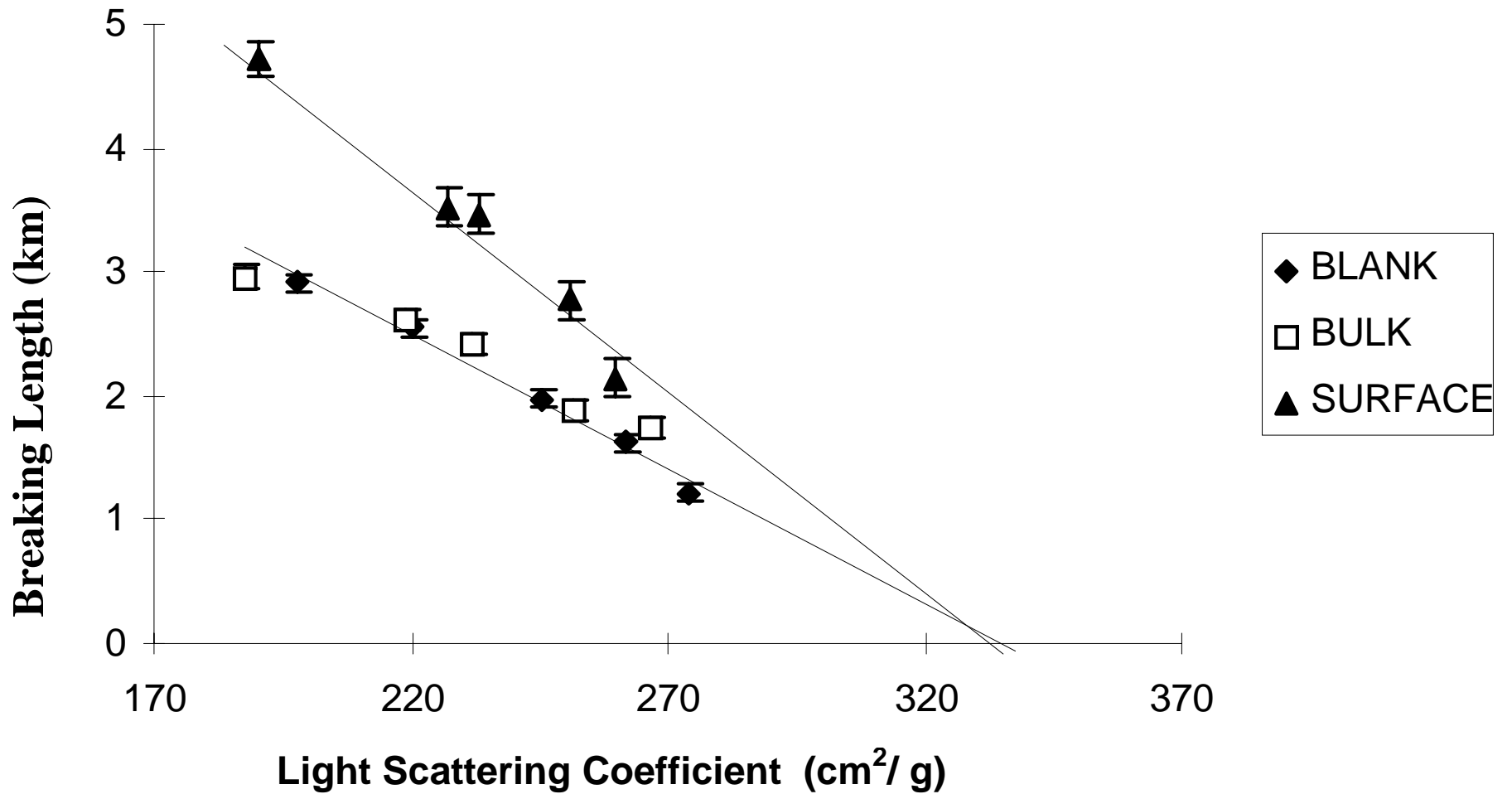
Surface = 35%

Bulk = 5%

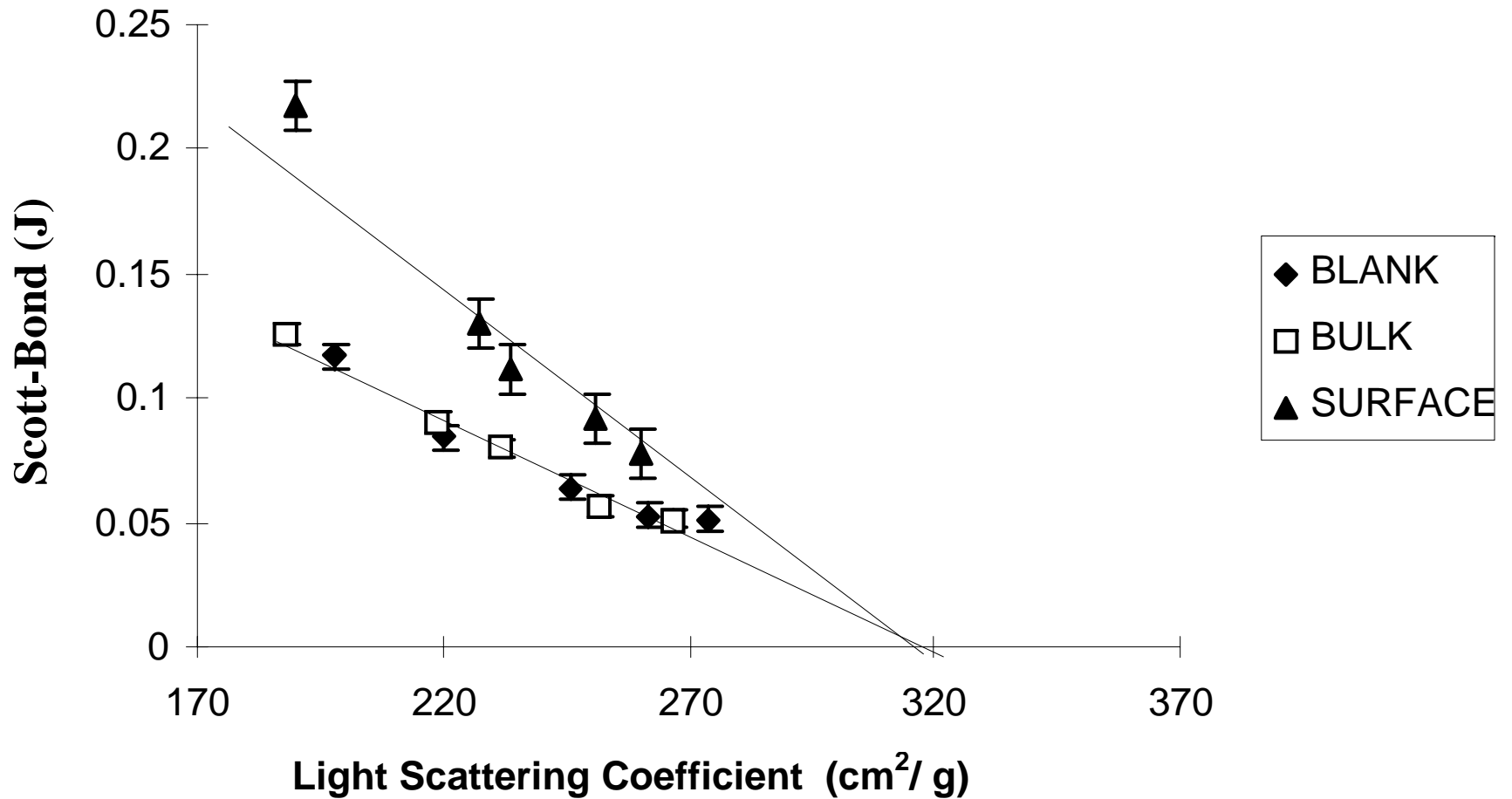
Fibre History



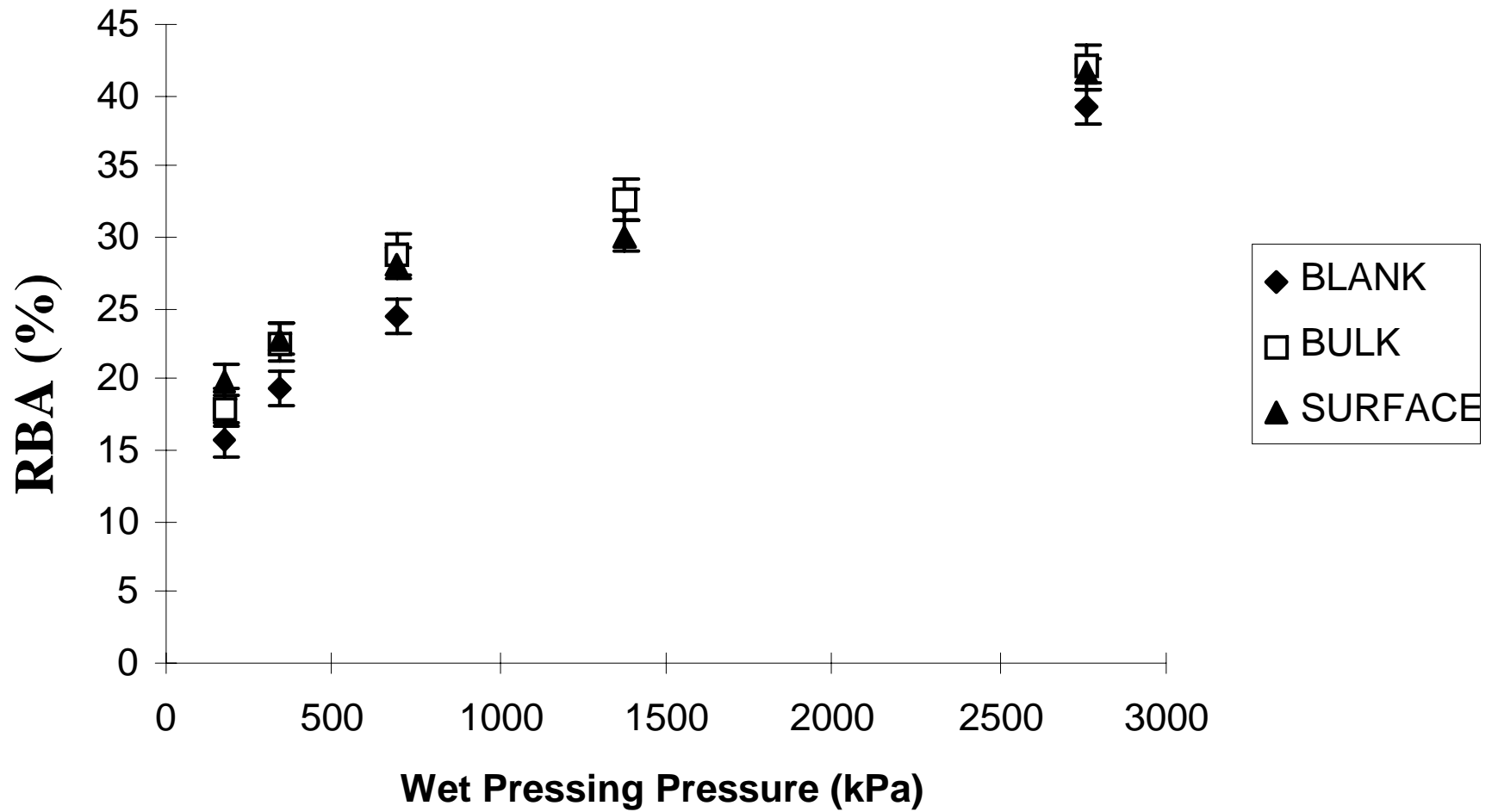
Sheet Strength



Bond Strength



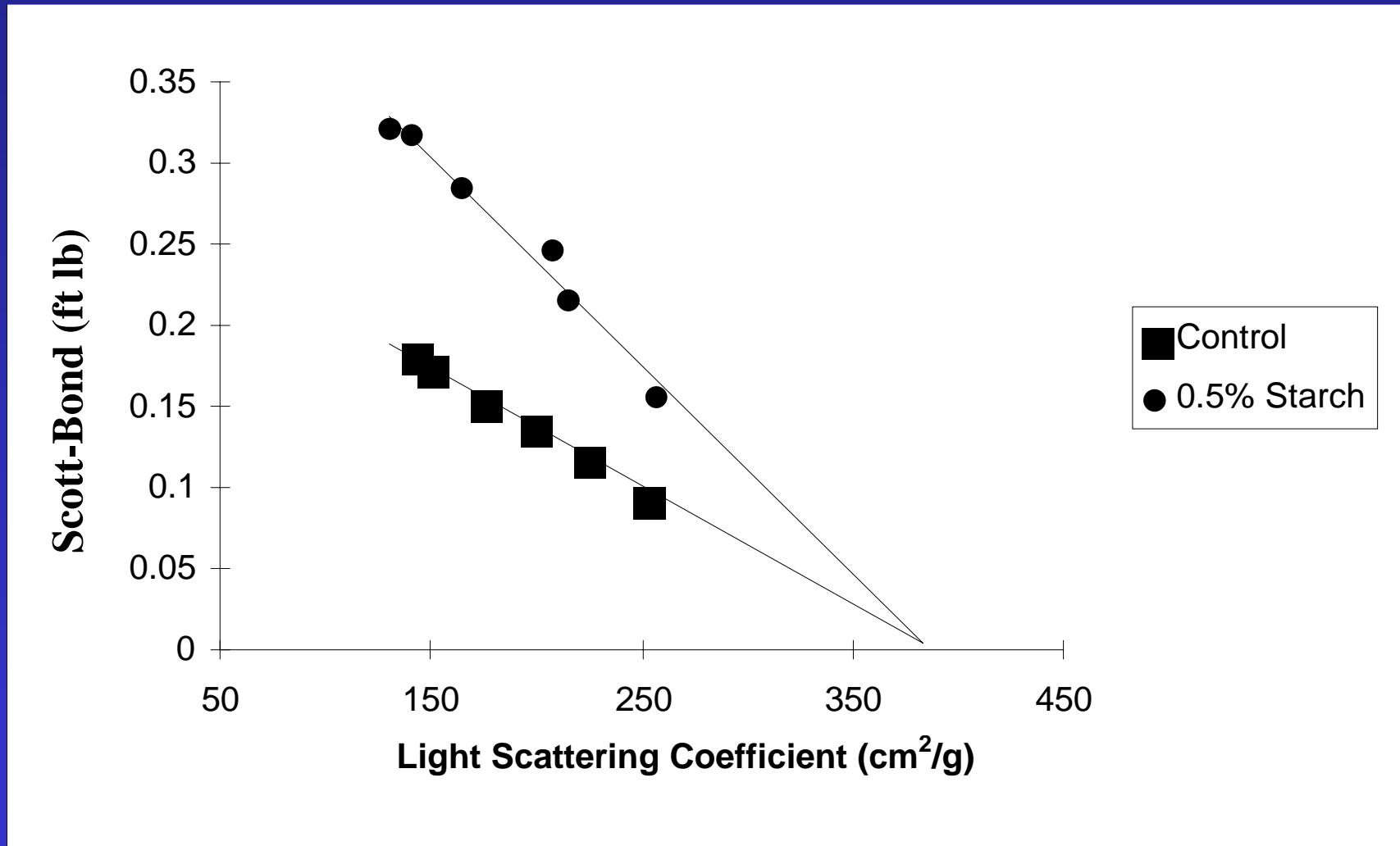
Wet Pressing



Results

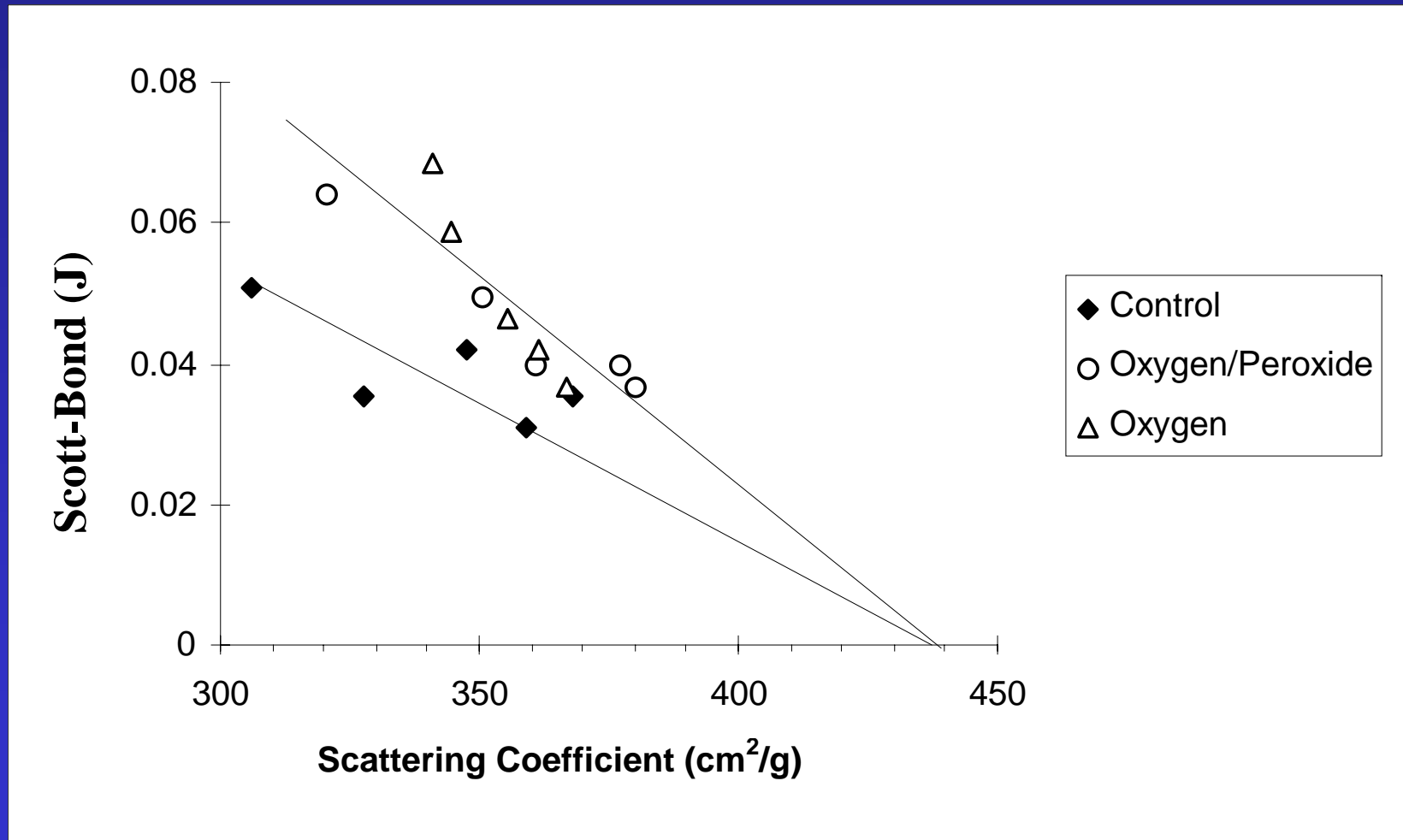
- additional acid groups on or near fibre surfaces increased specific fibre-fibre bond strength
- additional acid groups within fibres did not contribute to specific fibre-fibre bond strength
- relative bonded area did not account for changes in breaking length or internal bond strength

Starch and Bond Strength: Gaspar*



*Gaspar, L.A. Intrinsic Bonding of Cationic Starch and Applications of Cationic Starch with Recycled Fiber. Tappi Annual Meeting 1982.

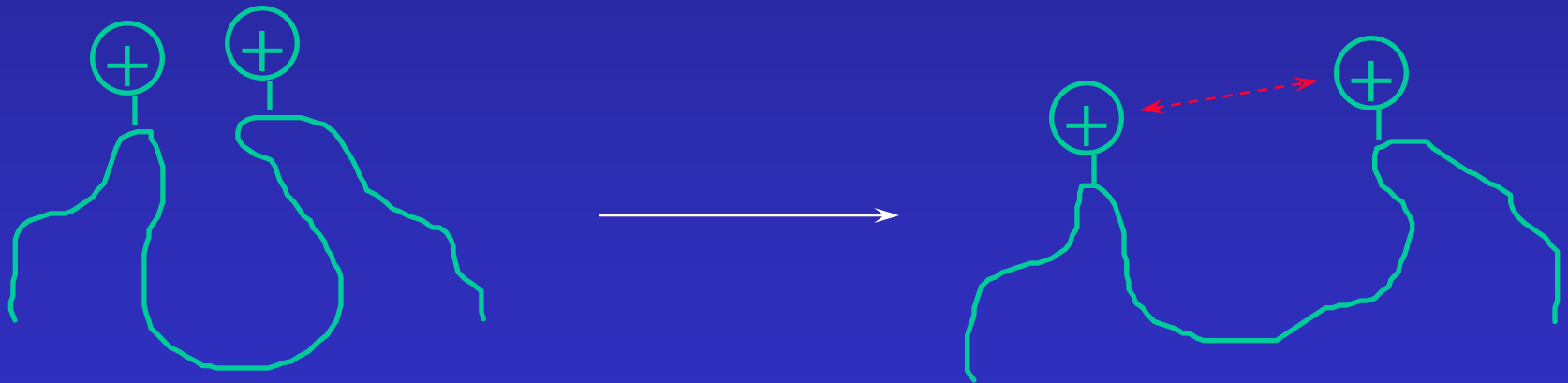
Practical Application - Bleaching



Acid Content increased ~50%, zero span tensile decreased

IMPLICATIONS

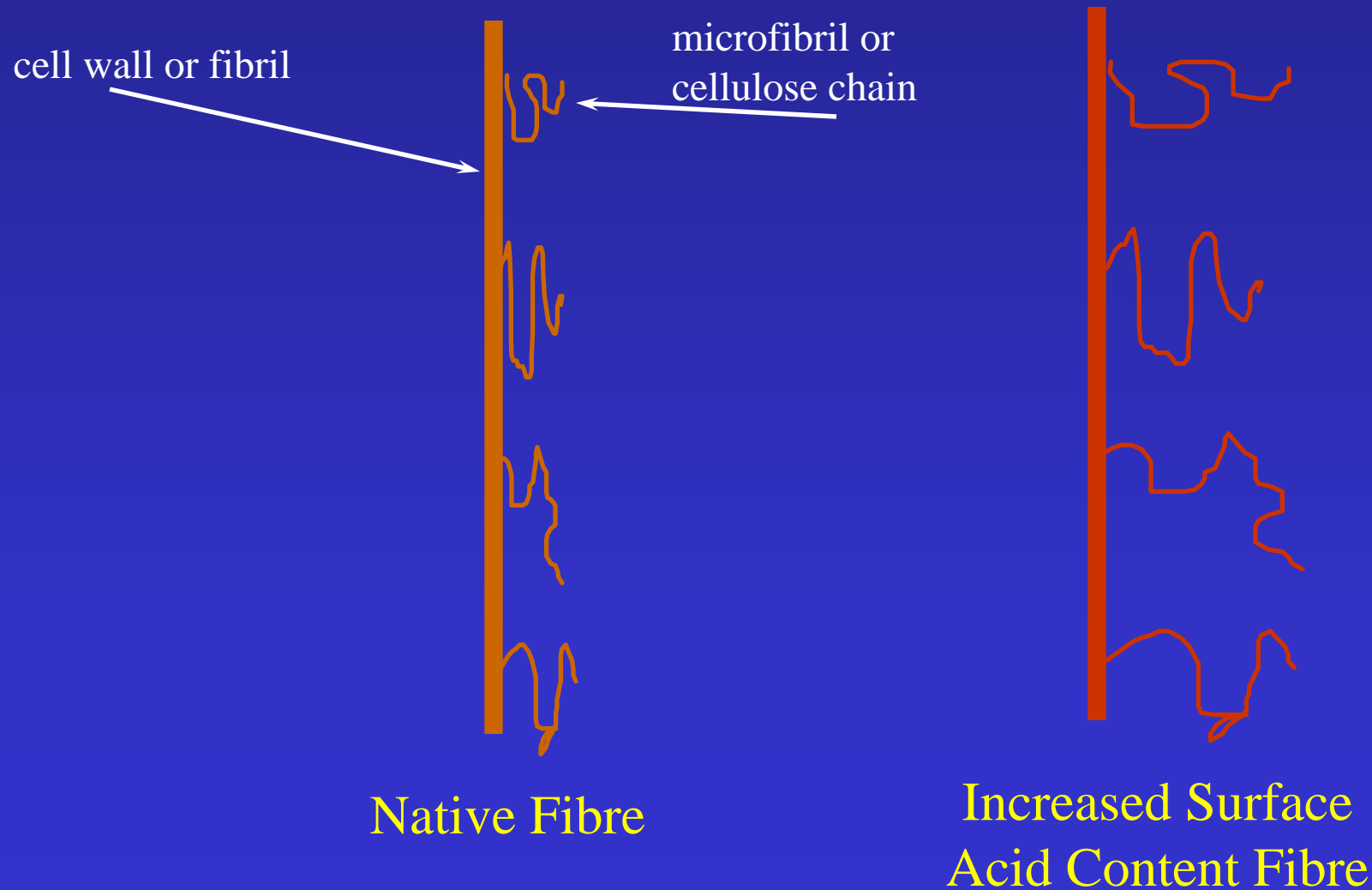
intermolecular diffusion could be mechanism for increase in bond strength



like charged groups on polymers repel, increasing size of polymer in solution

IMPLICATIONS

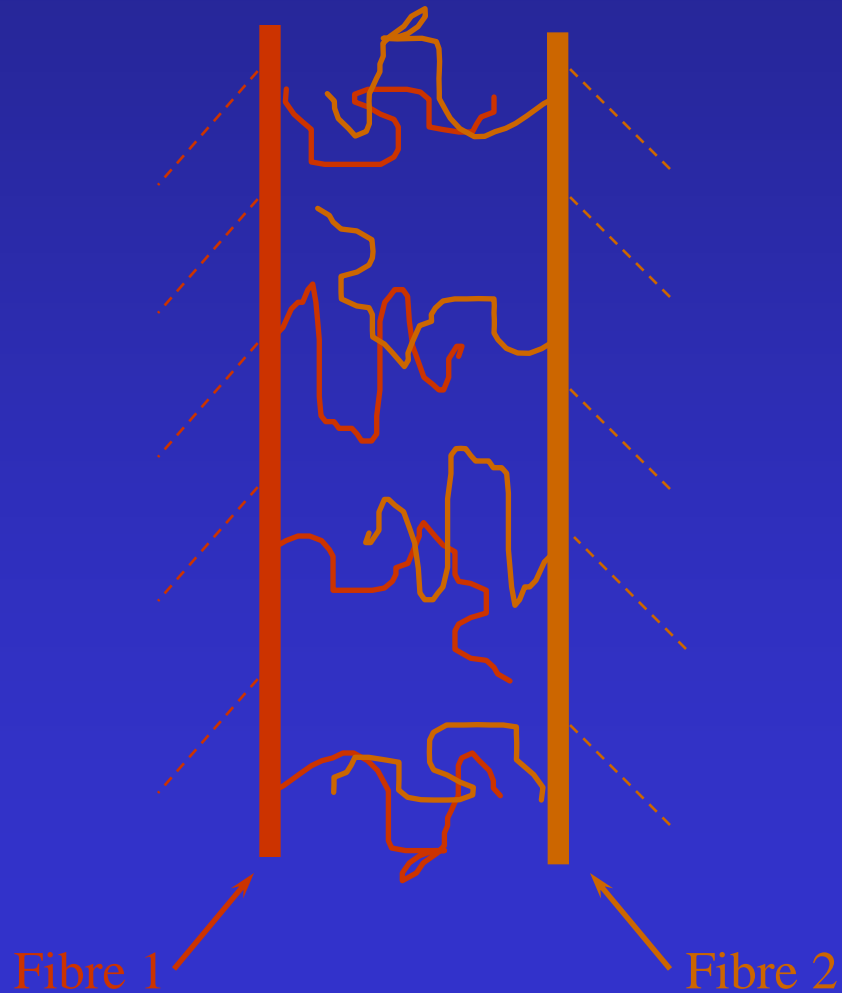
intermolecular diffusion could be mechanism for increase in bond strength



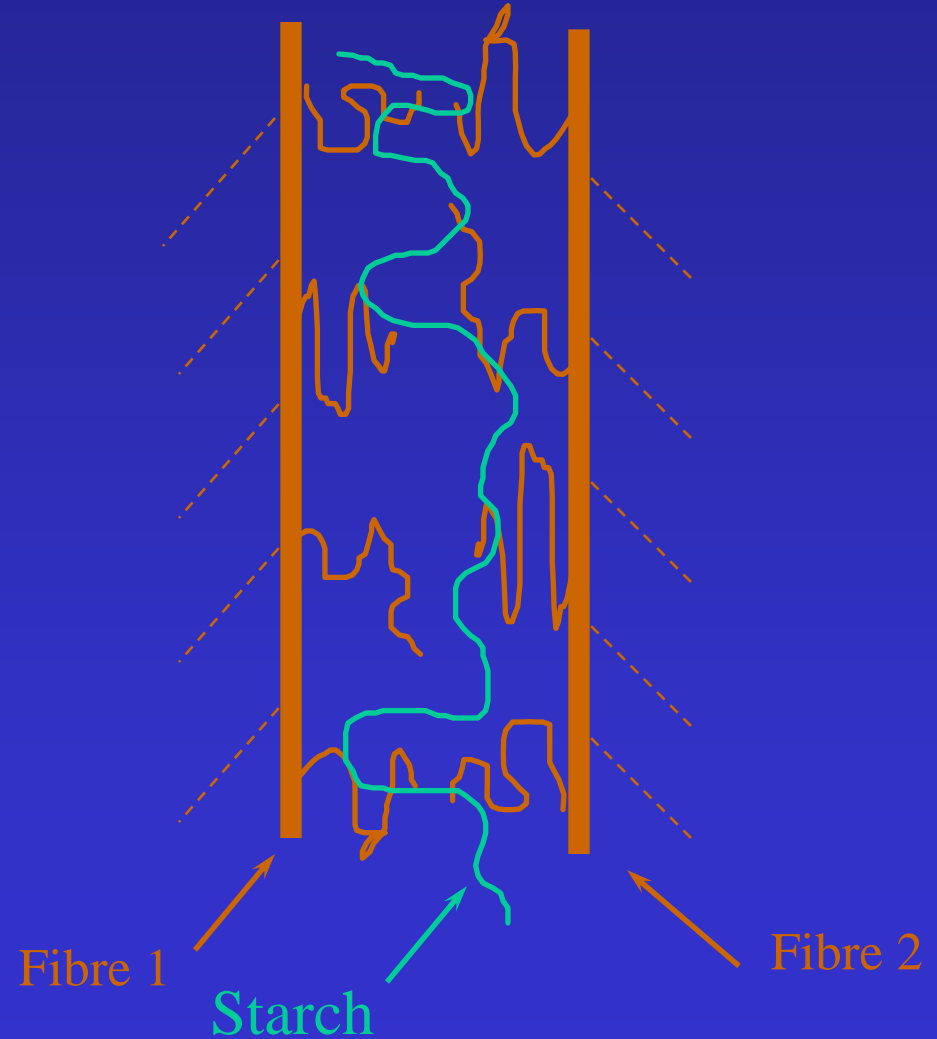
IMPLICATIONS

intermolecular diffusion could be mechanism for increase in bond strength

increased surface acid content

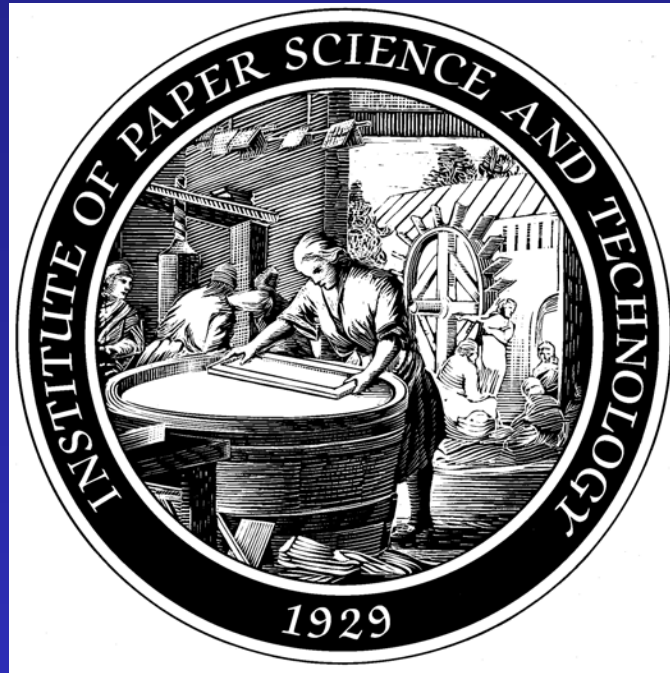


added starch



CONCLUSIONS

- additional acid groups on or near fibre surfaces increased specific bond strength
- the mechanism is not known, but could be intermolecular diffusion
- the possibility exists to produce stronger, bulkier sheets than by conventional processes



Acknowledgements

Member Companies
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