Organic, Natural Pigments as Paper Coatings

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Web Surface Modification 5.2

TAPPI people resources solutions

PLACE

ICE

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Background: Biodegradable Fillers and Pigments for Paper Making

- Mineral fillers give paper opacity, brightness and better printability.
- When 1000 kg of paper is recycled, 50-80 kg of inorganic de-inking sludge is formed.
- In Europe 86.5 million tons of paper was consumed and 46.8 million tons were recycled, 22 million tons of paper ended up for final disposal (landfill, combustion) after primary use and 6.4 million tons to other recovery options (Incineration, composting, other treatments) (CEPI statistics, year 2004)
- Assuming that fillers and pigments were organic and they could be combusted, these could replace **8 million tons of fuel oil in energy production.**

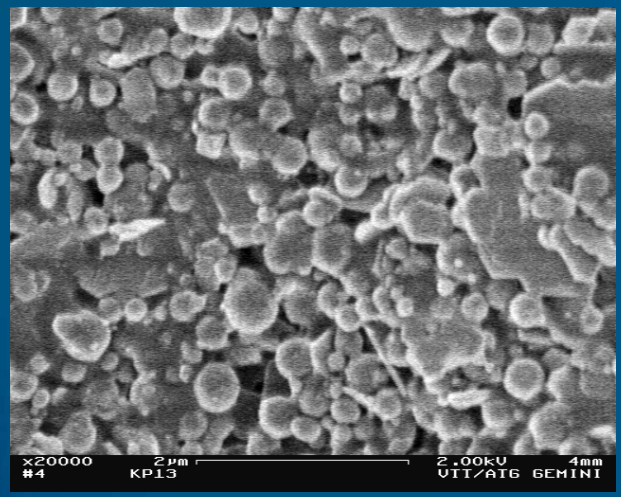
Background…

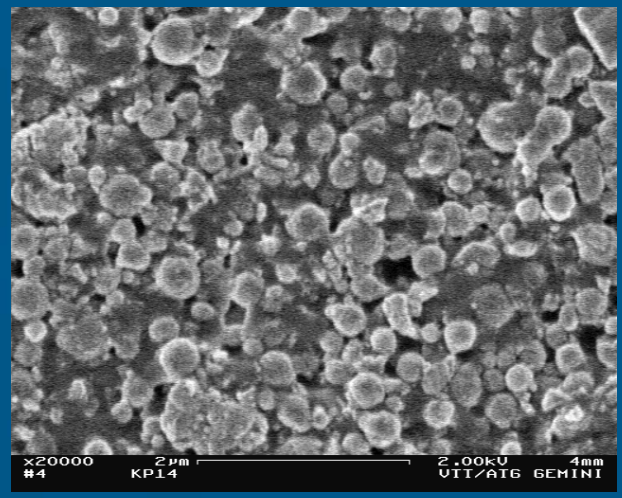
- High brightness and opacity are qualities needed for good fillers and pigments. The properties are based on effective light scattering of the material. Optimum size of a single round solid filler particle for ultimate light scattering is a half of the wave length of visible light (around 200 nm).
- **The objective** was to manufacture nanoscale pigments or stabilized porous filler structures of renewable materials, to be used in paper production instead of mineral materials.
- Manufacturing techniques for stabilized microcapsule filler foams and pigment particles of optimum particle size (Ø= 250 nm) with narrow particle size distribution was developed. Product properties were optimised by means of modelling.

Surface Topography of Coated Papers

Uncalendered CLC-6000 samples; AP = Starch pigment

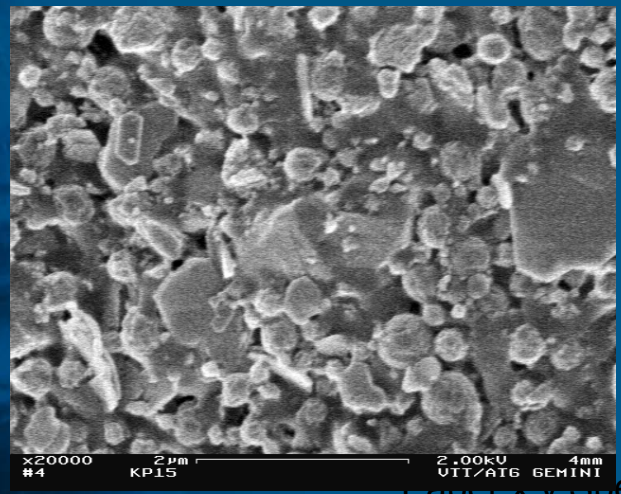
AP + Clay

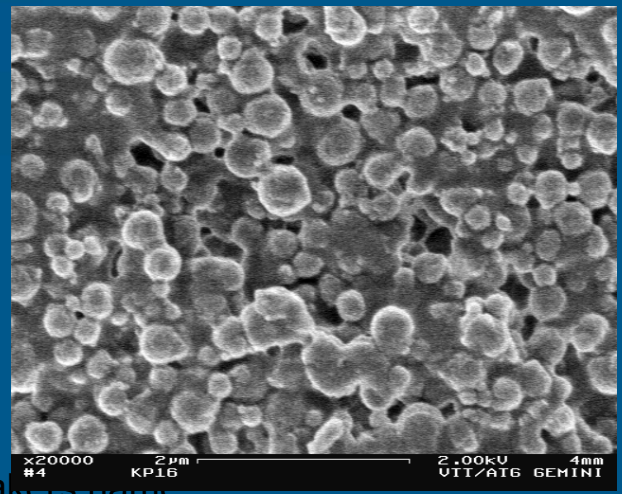




AP + GCC

AP + Clay + GCC

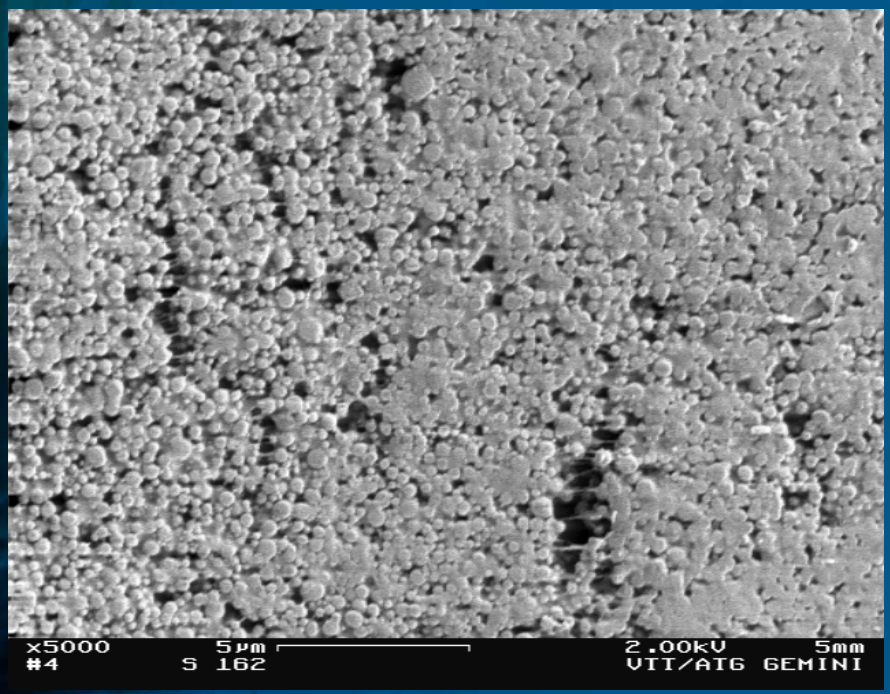


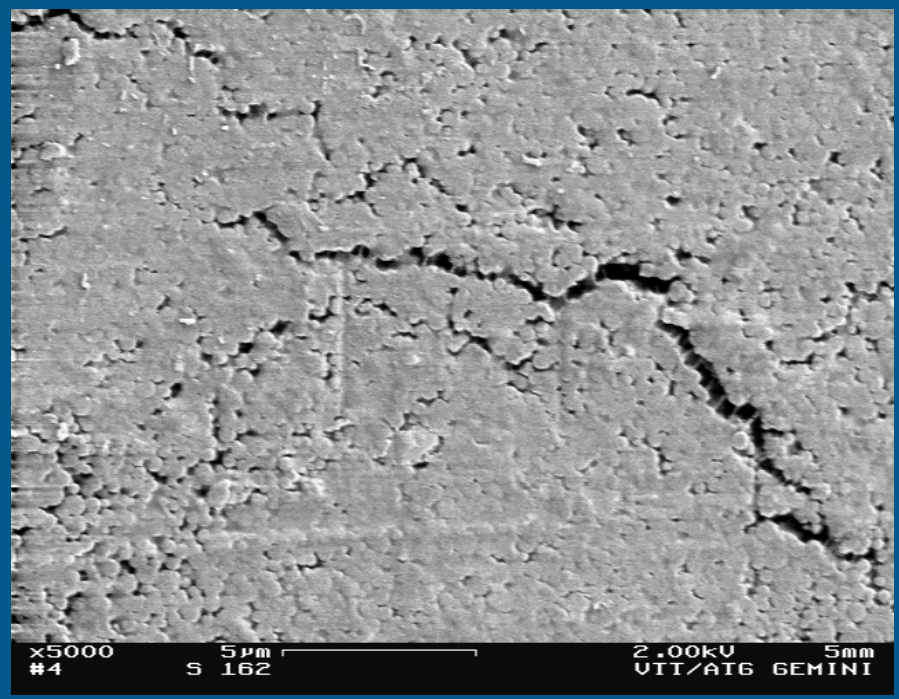


AP

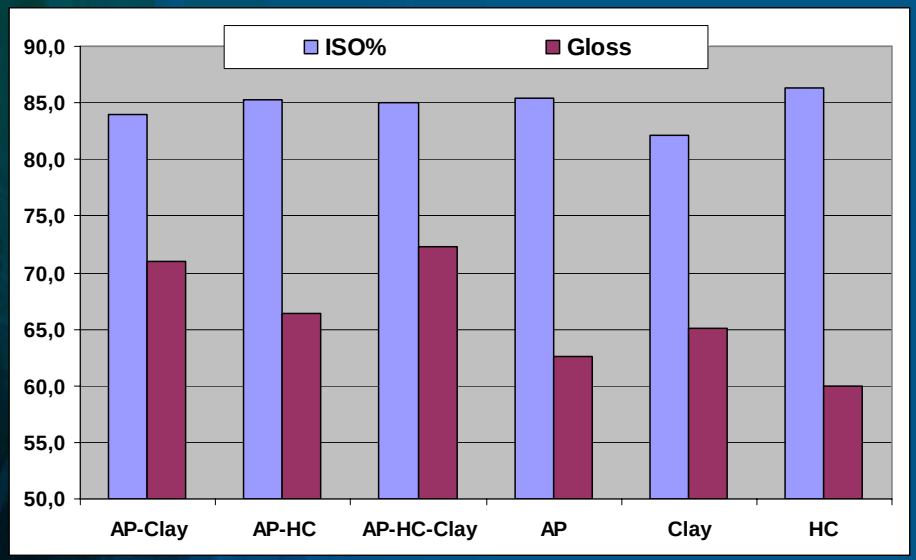
Surface Topography of Coated Samples

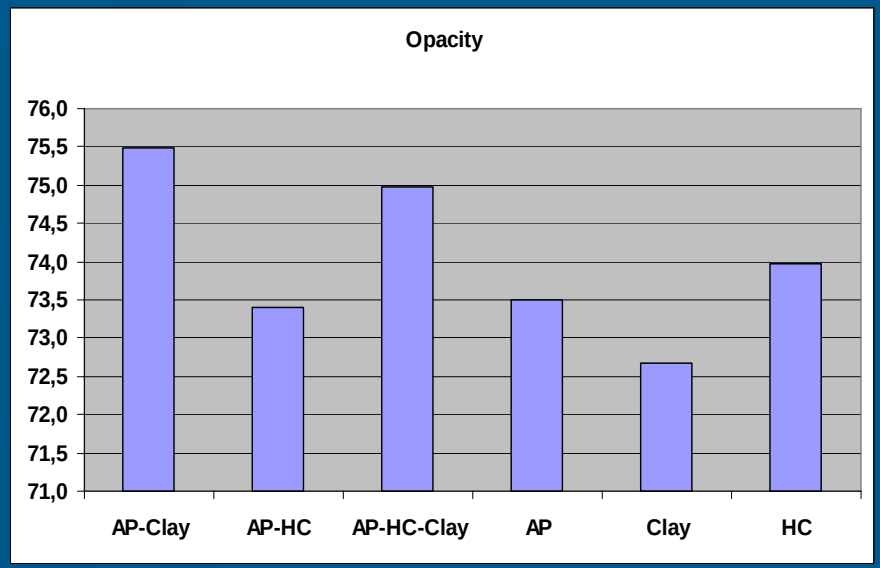
Calendered CLC-6000 AP (100pph) coating





ISO-brightness,gloss and opacity values, calendered CLC coated papers



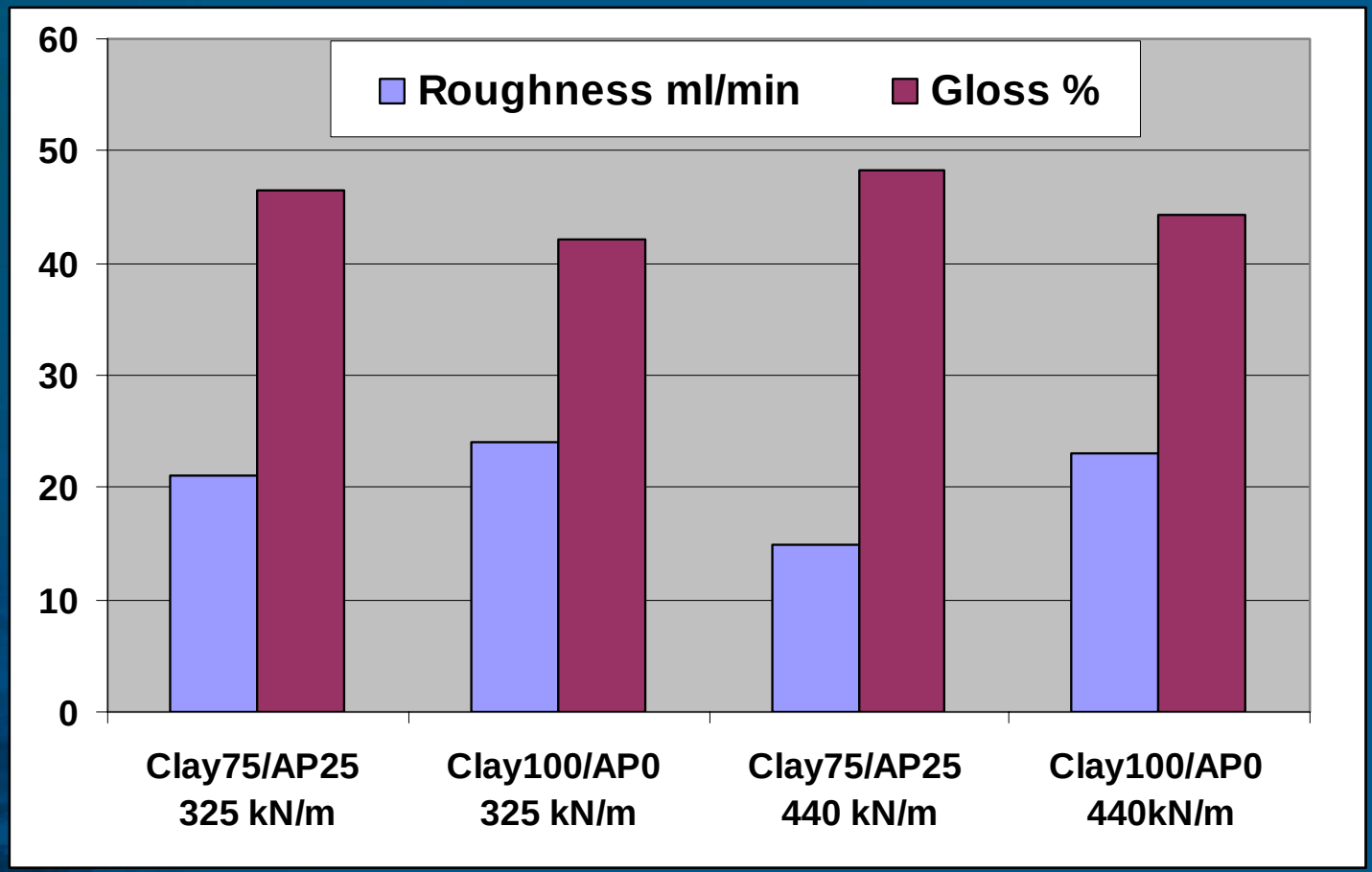


Starch based pigment (AP)

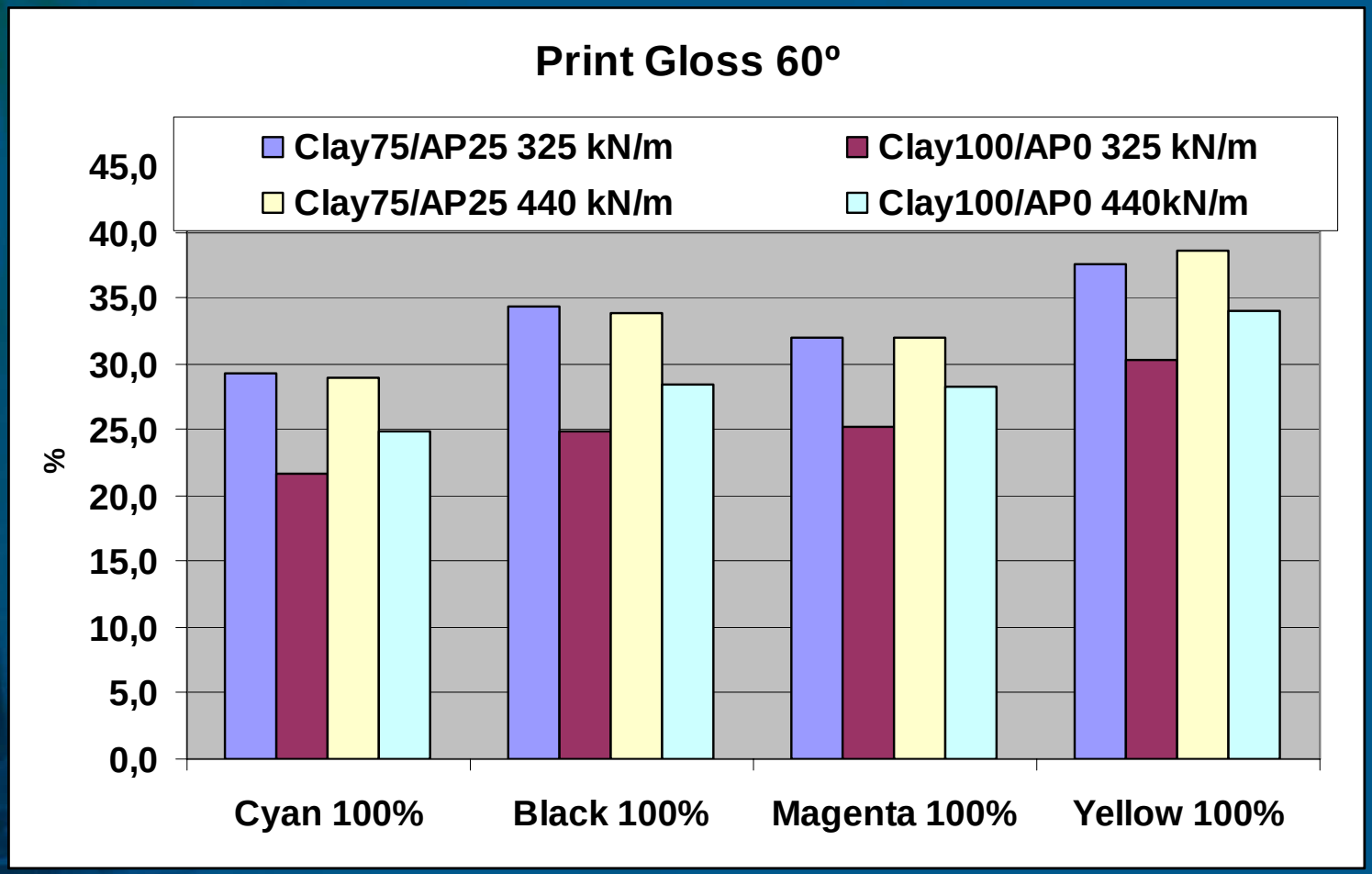
- improves brightness and it
- increases gloss when used together with mineral pigments
- adds opacity when used together with clay and mineral pigment mixture

(HC = GCC = Carbonate)

Roughness of Coated Papers

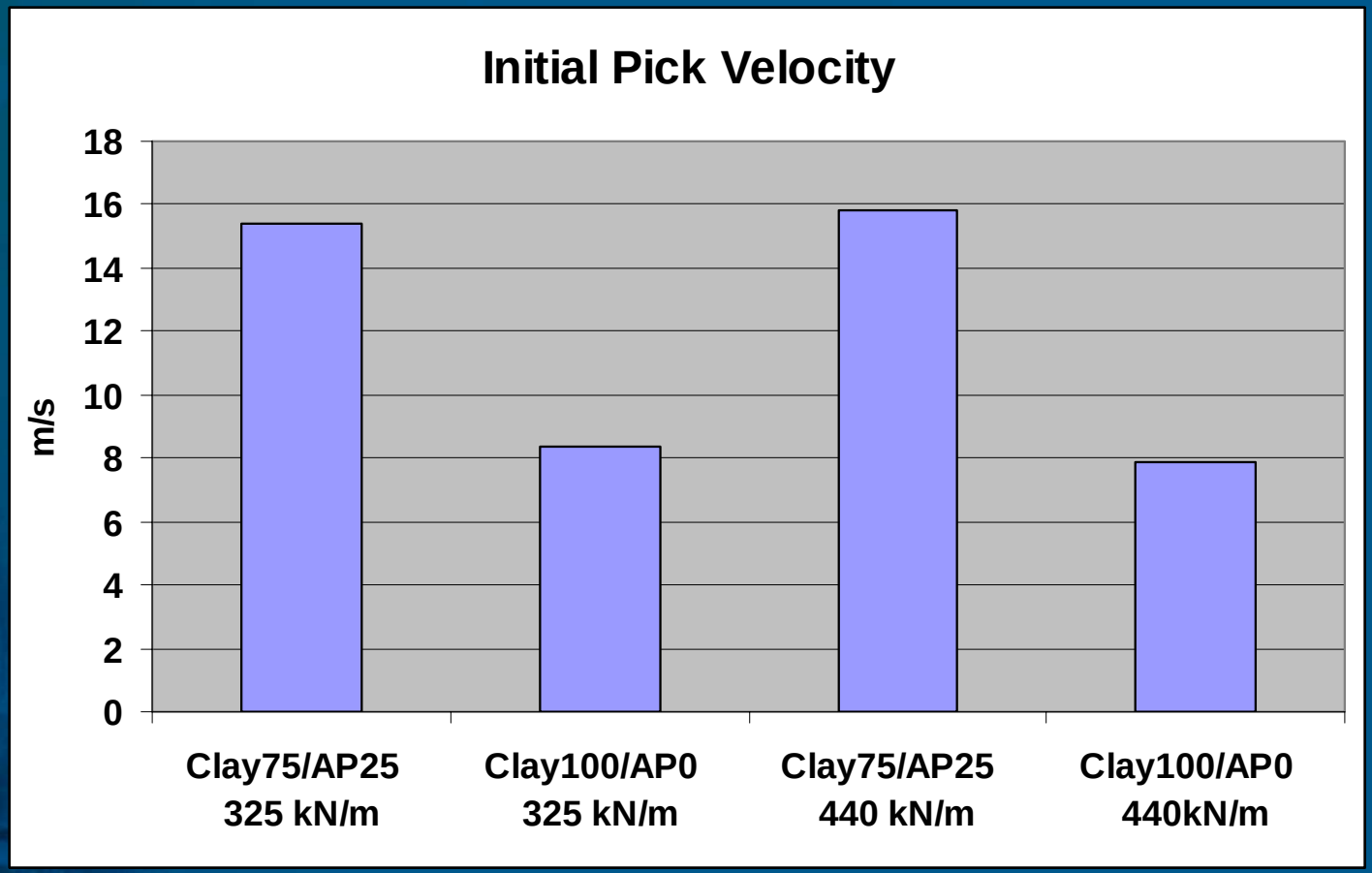


- mixture of pigment AP and clay improves gloss and smooths roughness with lower calandering pressures than pure clay



- improves printed gloss for all sub-colours with AP pigment
- improved color strength with lower amount of printing colour

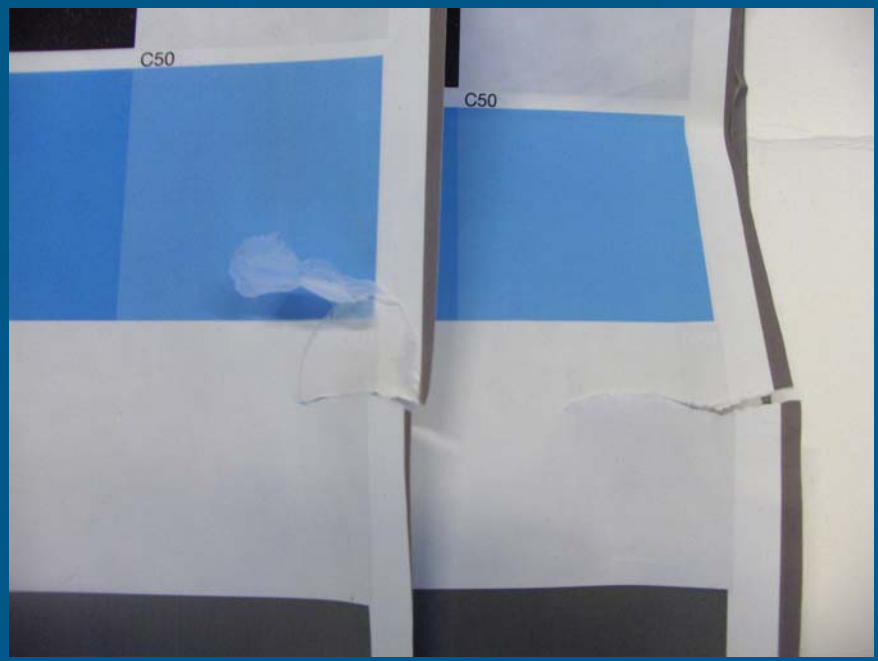
Surface Strength



- better pick resistance, better surface strength even with low calendering pressures with AP addition

Adhesion Promotion

Clay 100 %



75 % Clay
25 % AP

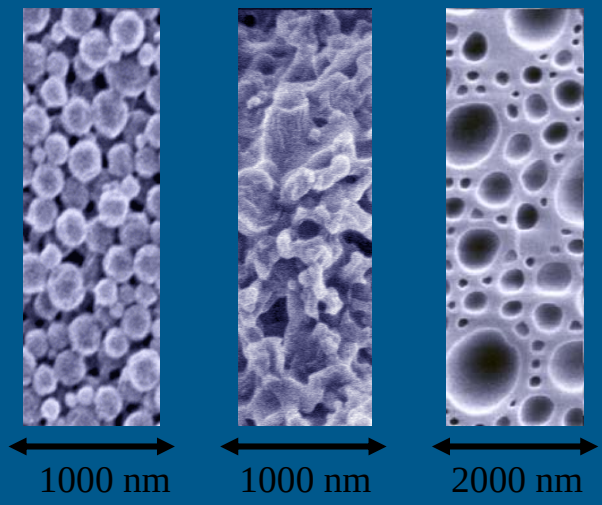
- improved surface properties (gloss, smoothness, brightness)
- improved surface strength
- improved offset printability (print gloss and density)

→ adhesion promotion as coated surface in extrusion coating

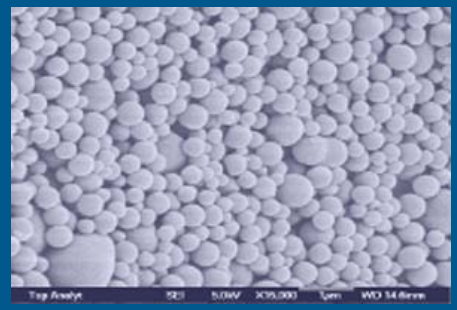
Conclusion

Products
Nanoparticles or nanoporous structures or foams based on acetylated starch with varying molecular weight and substitution degree. Preparation in pilot scale.

Properties
- Mathematical models show that optimum light scattering with spherical starch pigment morphology particles is obtained with particle diameters between 250-400 nm.
- Low packaging density (0,35) gives better light scattering than high (0,6).
- Non-mineral spherical pigments in coating give good:
  - improved surface properties (gloss, smoothness, brightness, surface strength)
  - improved offset printability (print gloss and density)
  - adhesion promotion as coated surface in extrusion coating



Acknowledges



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