COST Action E48
"The Limits of Paper Recycling"

Plenary Meeting
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Removing Stickies by Screening

Some results obtained at CTP

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Background

EU Project ScreenClean (2002-2004) aiming at optimising the removal of primary PSA stickies in deinking lines: CTP program focused on screening & cleaning

- BAT to remove macro-stickies: slot screening
- Fundamental aspects studied in cooperation with LEGI/CNRS Grenoble and ITM/TU Czestochowa
- Screening tests on pilot / industrial scale: cooperation with equipment suppliers: Kadant-Lamort and AFT
- Optimisation of screening systems with the help of simulation tools developed at CTP

On-going project focused on HC screening of PSA stickies: ScreenStic (2005-2006)

- Stickies fragmentation and optimisation of pulp consistency

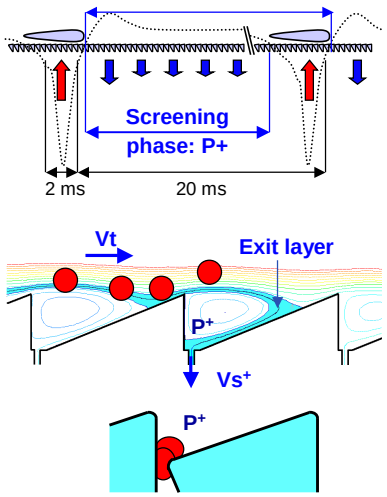
How did we proceed ?

Improve understanding of screening hydrodynamics

- Typical pressure pulse with foils: short-time phenomena
- CFD simulation with LEGI: exit layer thickness (∝Vs/Vt) determines fibre passage probability through slots, i.e. fibres pass easier at high Vs

Study stickies removal

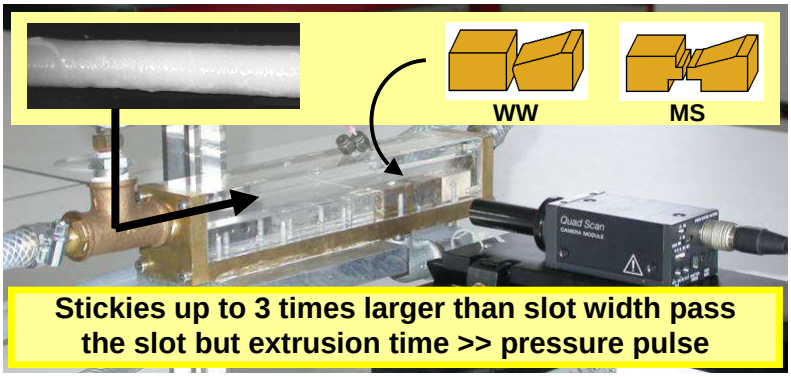
- Rejected by screen plate profiles ? → Pilot studies
- Soft PSA stickies are extruded through slots ? → Lab studies and numerical simulation at ITM



Lab studies
Stickies extrusion: Steady pressure

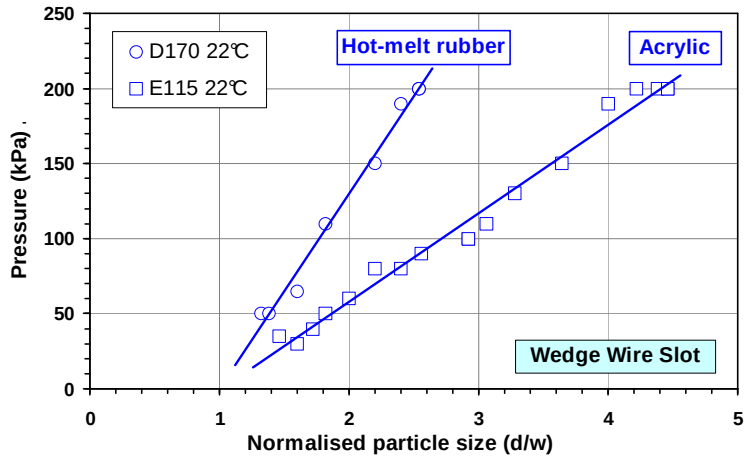
Visualisation of PSA stickies extrusion

- Single slot lab screen: first tests done under steady pressure
- Parameters studied: stickies size, pressure, °C, pH; type of slots



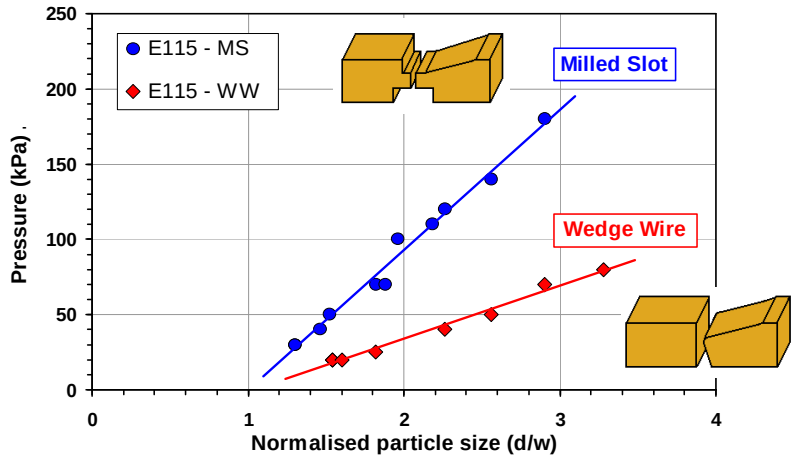
Stickies extrusion: Steady pressure
Effect of adhesive material

- Water-based acrylic adhesive E115 is extruded through the slot at lower pressure than hot-melt rubber adhesive D170 ☛ E115 is softer



Stickies extrusion: Steady pressure
Effect of slot inlet design

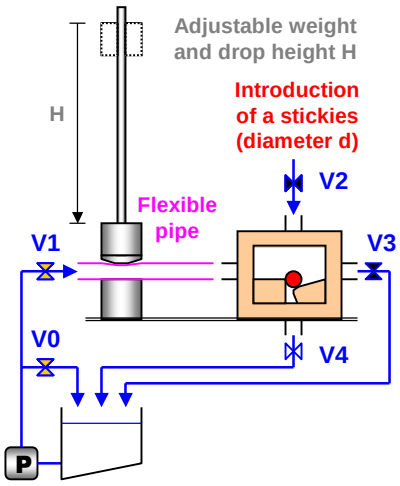
- Less pressure with WW slots, i.e. larger adhesive particles (E 115) are extruded through WW slots compared to milled slots, at given pressure



Lab studies
Stickies extrusion: Unsteady pressure

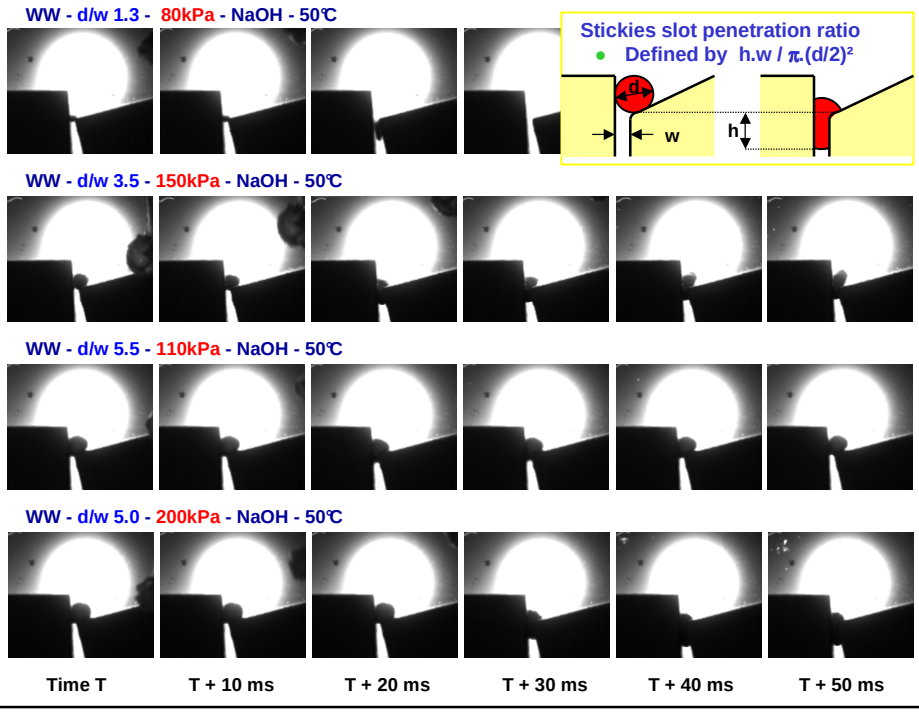
Tests at unsteady pressure

- Pressure pulse: 15 ms



Resul

- d/w < 1.2 : stickies pass
- Since larger stickies can pass: several rotor revolutions



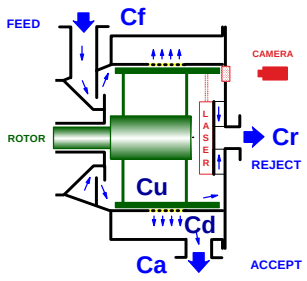
Pilot stickies screening tests
Experimental equipment and methods

Preparation of the pulp and adhesive particles

- Adhesive labels stuck onto fresh newspaper to produce dark particles
- LC lab. pulper with 2% adhesive, 50% newspapers / 50% magazines
- 30 min. pulping at 55℃ with standard INGEDE deinki ng chemistry
- Mixture of the adhesive containing pulp with bleached pulp: contrast

Experimental equipment and methods

- Industrial sized “slice screen” (500 mm screen cylinder diameter)
- Tests at 50% reject flow rate to simulate a slice of industrial screen
- Characterisation of the behaviour of probability particles (fibres, stickies) by their **passage ratio**: **Cd /Cu** (probability screening theory)



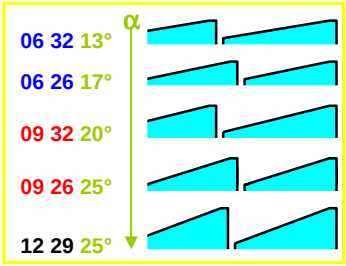
Pilot stickies screening tests
Optimisation of screen plate design

Effect of slot inlet design (milled vs. WW)

- **Cleaner accept pulp with milled slots ➔ lower stickies passage**
- **Higher reject thickening with milled slots ➔ lower fibre passage**
- **At given reject rate: only slightly better efficiency (& lower capacity) with milled versus wedge wire slots**

Effect of profile height and angle (comparison of WW slots)

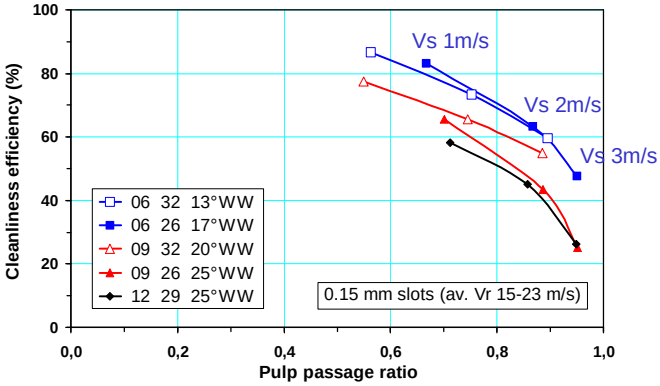
- **Slot width: 0.15 mm**
- **Profile height: 0.6 - 1.2 mm**
- **Wire width: 2.6 - 3.2 mm**
- **Profile angle: 13 - 25°**



Optimisation of screen plate design

Results with acrylic PSA stickies (0.3-1mm²) – Rv = 50%

- Best screening selectivity with low profiles (0.6 mm)

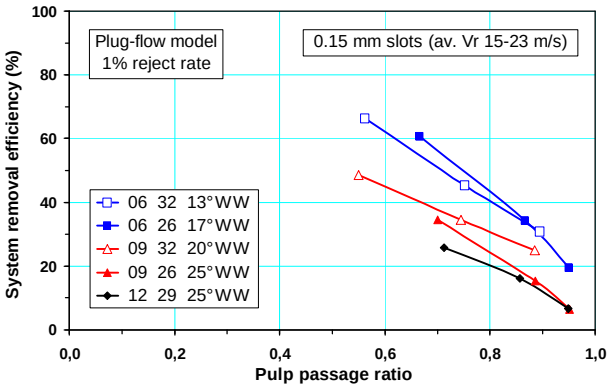


- Higher cleanliness efficiency at reduced slot velocity (Vs)

Results: effect of screen plate design

Simplified simulation using plug-flow model – Rw = 1%

- Best screening system efficiency with low profiles and low Vs



- Same conclusion with advanced screening system simulation

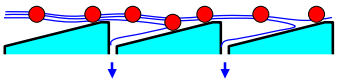
Synthesis on LC stickies screening

Extrusion of stickies through slots

- Both experimental and numerical studies showed more extrusion with:
  - softer adhesives (soaked acrylic adhesive at high temperature)
  - wedge wire slots compared to milled slots
- High stickies extrusion time (>> P+)
  - **Multi-step extrusion process**

Optimisation of screen plate design

- The first pilot tests confirmed that less extrusion improved efficiency:
  - better results at low temperature and with a milled screen plate
- Much higher efficiency gains were obtained with optimised contours:
  - 1) low contours (0.6 mm height)
  - 2) low angle (20°and less)



- **Particle slip over contours** (contacts) should have more impact on the removal of stickies than the extrusion phenomena, at least at low consistency

Synthesis on LC stickies screening and perspectives

Optimisation of screen operating parameters

- **Slot velocity**
  - relevant parameter: effective slot velocity during screening phase
  - higher efficiency at reduced slot velocity, but
  - higher costs (lower screening capacity and more reject thickening)
- **Consistency**
  - possible to increase long fibre consistency, i.e. R14+R28 McNett fractions, up to about 1% without hindering the screening process
  - opportunity to optimise screening costs (equipment and energy)

Optimisation of stickies removal

- **Keep them large !**
  - optimisation of pulping to produce large stickies in order to remove them as early as possible in the deinking / recycling line
  - minimize stickies fragmentation at the first screening steps
  - eco-designed adhesive products