



COST Action E48 “The Limits of Paper Recycling”

Working Group 2 Treatment Technologies and Future Recycled Pulp Quality

2nd WG2 Meeting
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Overview of the European Project ScreenClean

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ScreenClean Project Outlines / Partnership

European Project “ScreenClean”: Contract n° QLK5-CT-2001-00619
Title: Optimisation of Screening and Cleaning Technology to Control Deinking Pulp Cleanliness

Partnership

Person month

1. CTP	Papermaking Research Institute	France	4 Co + 55
3. AFT	Equipment supplier: screen plates	Finland	5
4. ADJ	Chemical supplier: adhesives	Germany	10
5. ICP	Papermaking Research Institute	Poland	50
6. PTS	Papermaking Research Institute	Germany	53
7. LEGI	Fluid mech. Research Institute	France	15

192

Total budget

1.6 M€

Duration

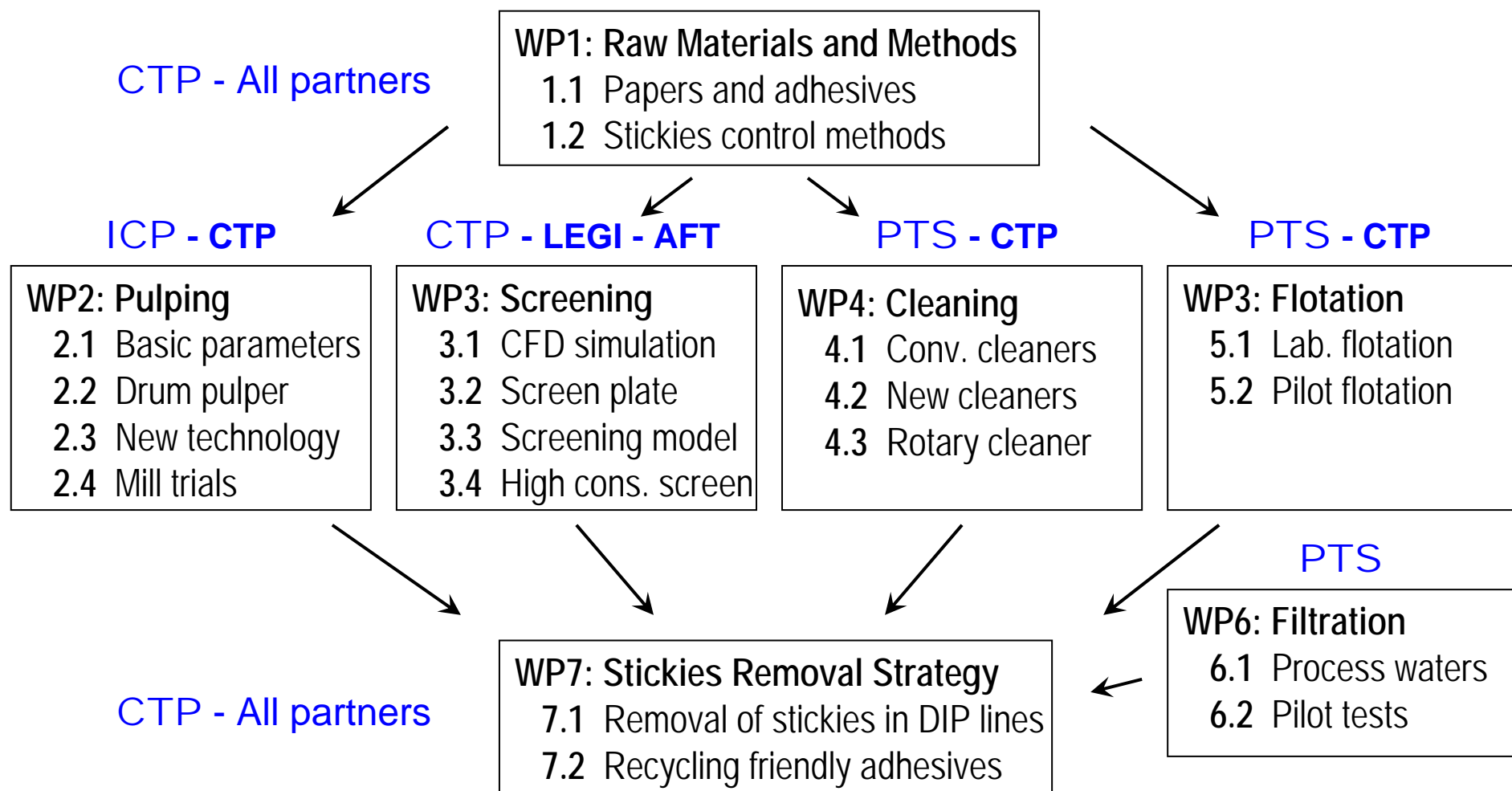
3 years : April 2002 to March 2005

3. **CAE** → **AFT**

4. **Jackstädt** → **Avery Dennison Europe**



Project Management Structure WorkPackages & Sub-WorkPackages





New Project Planning WP List / Responsible Partners

WorkPackages / Sub-WorkPackages	Year 1		Year 2		Year 3		Partners *
	Months						
WP1: Raw materials and methods							Leader: P1
1.1: Papers and adhesives	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■		P1 (P3 - P6)
1.2: Stickies control methods	■ ■ ■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■		P1 (P3 - P6)
WP2: Pulping							Leader: P5
2.1: Study of the basic parameters	■ ■ ■	■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■				P5
2.2: Pilot test with the drum pulper			■ ■ ■ ■ ■ ■ ■				P1
2.3: Optimisation of a new technology				■ ■ ■ ■ ■ ■ ■	■ ■ ■		P5 (P1)
2.4: Mill trials					■ ■ ■ ■ ■ ■ ■	■ ■ ■	P5
WP3: Pressure screening							Leader: P1
3.1: Numerical flow simulation	■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■					P7 (P1)
3.2: Optimisation of screen plate design		■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■				P1 (P3, P7)
3.3: Development of a screening model			■ ■ ■	■ ■ ■ ■ ■ ■ ■			P1
3.4: High consistency screening				■ ■ ■	■ ■ ■ ■ ■ ■ ■	■ ■ ■	P1 (P3, P7)
WP4: Centrifugal cleaning							Leader: P6
4.1: Tests with conventional cleaners	■ ■ ■	■ ■ ■ ■ ■ ■ ■					P6 (P1)
4.2: Tests with new cleaners			■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■	■ ■ ■		P6
4.3: Tests with the rotary cleaner			■ ■ ■	■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■	■ ■ ■	P1
WP5: Flotation							Leader: P6
5.1: Laboratory flotation tests			■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■			P6 (P1)
5.2: Pilot flotation tests				■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■	■ ■ ■	P6 (P1)
WP6: Pressure filtration							Leader: P6
6.1: Preparation of process waters			■ ■ ■ ■ ■ ■ ■				P6
6.2: Pilot pressure filtration tests				■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■	■ ■ ■	P6
WP7: Stickies removal strategies							Leader: P1
7.1: Removal of stickies in deinking						■ ■ ■ ■ ■ ■ ■	P1 (P5, P6)
7.2: Recycling friendly adhesives						■ ■ ■	P4 (P1,5-6)
Milestones		*		*		*	*
Project Management Meetings	☒	☒	☒	☒	☒	☒	☒

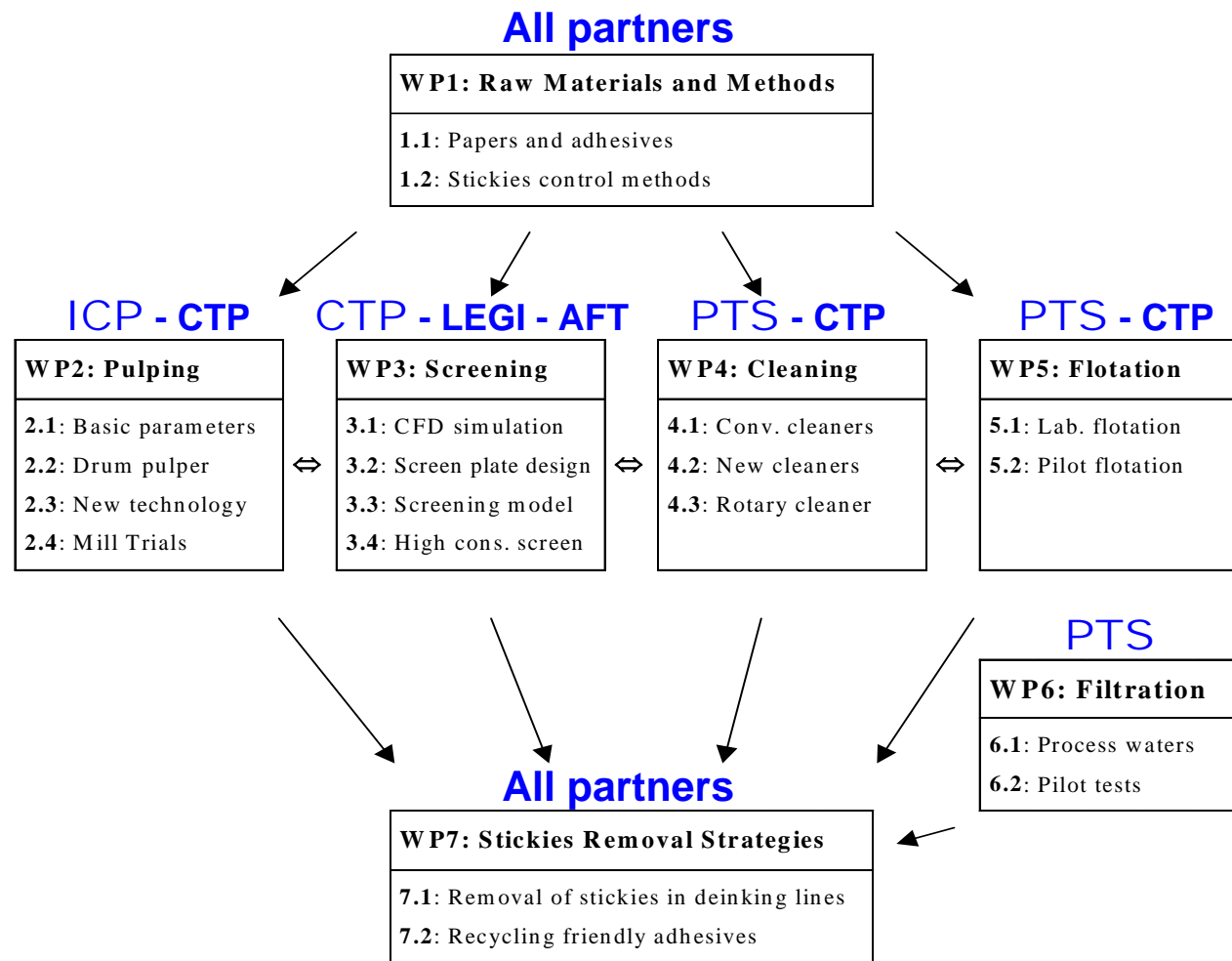
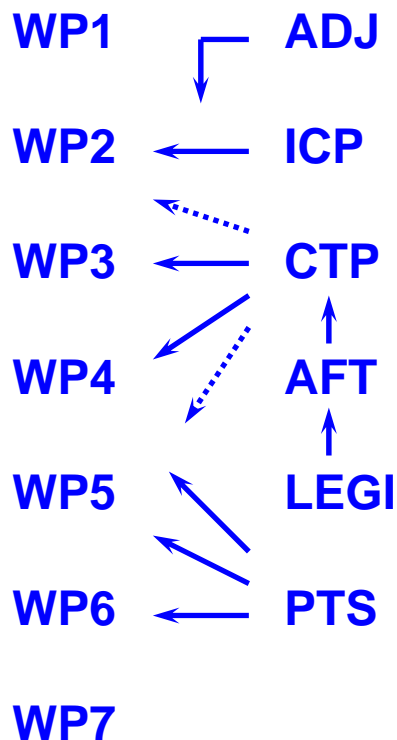
Partners

1. CTP
3. AFT
4. ADJ
5. ICP
6. PTS
7. LEGI



Role and Cooperation of Participants

Main contributions:





Overview

Some Main Project Results



Synthesis

WP1: Raw Materials and Methods

- **1.1: Paper and adhesives**

- Use of reference adhesives from ADJ



- Water-based acrylic adhesive much softer than hot-melt rubber adhesive, especially after soaking (about 50 % water)

- **1.2: Stickies control methods**

- **Macro-stickies:** INGEDE method n°4 used as a common method with better correlation: same lab screen plate (0.1 mm slots, AFT)

- Handsheet analyses also used (at CTP) for macro/visible stickies because less time consuming

- Attends (ICP, CTP) to develop new methods to determine stickies particle size and shape: solutions but too much time consuming

- **Micro-stickies:** DCM extraction (CTP) and DMF extraction (PTS)



Synthesis

WP2: Pulping



- **2.1: Basic parameter - ICP**

- ➔ Lab studies to develop a new pulping process with agglomeration chemistry: agglomeration of stickies → co-agglomeration with ink

- **2.3: New pulping process - ICP**

- ➔ Patent application registered in January 2005

- ➔ Addition of proper mixture of hydrophobic agglomeration products: New product registered under brand-name “De-Stic-Ink”

- ➔ Requires “laminar like” pulp motion in the pulper

- ➔ Should improve stickies removal by slot screening (for the large agglomerates) and by flotation (more hydrophobic adhesive surface)

- **2.4: Mill trials - ICP**

- ➔ Positive effect of De-Stic-Ink concentration in the pulper on stickies agglomeration and pulp brightness, though optimised De-Stic-Ink mixture has not yet been tested



Synthesis

WP3: Screening (1)



- **3.1: Numerical flow simulation - LEGI**

- ➔ First CFD simulation step: flow at the feed side of screen plates
- ➔ Second step to simulate the extrusion of soft viscoelastic particles through slots.

- ➔ Simulations showed the effects of:

- Screen operating parameters
- Adhesive size and rheological properties
- Slot design parameters



- ➔ Work continues at ITM

(Institute of Thermal Machinery, University of Czestochowa)

- **3.1/2: Visualisation of stickies extrusion - CTP / ITM**

- ➔ Experimental results consistent with simulation results
- ➔ Stickies up to 2 or 3 times the slot width can be extruded, but time needed implies multi-step extrusion process for stickies larger than maximum 1.2 times the slot width



Synthesis

WP3: Screening (2)



- **3.2: Optimisation of screen plate design - CTP / AFT**
 - ➔ Pilot tests with 0.15mm slotted screen cylinders delivered by AFT
 - ➔ Evaluation of the effects of most important screening parameters
 - ➔ Consistent with stickies extrusion results (e.g. reduce temperature)
 - ➔ Best results with low profiles, which means particle slip phenomena over contours more important than stickies extrusion phenomena
- **3.3: Development of a screening model - CTP**
 - ➔ Powerful tool to simulate and optimise screening systems
 - ➔ Limited by input data precision regarding stickies size and shape
- **3.4: High consistency screening - CTP / AFT**
 - ➔ Stickies fragmentation in HC screens exists, but seems limited to relatively small stickies
 - ➔ Work continues on HC stickies screening



Synthesis

WP4: Cleaning



- **4.1: Conventional cleaners - PTS / CTP**

- ➔ Both reference adhesives are / become high-density particles (acrylic adhesive / hot-melt rubber adhesive with adsorbed fillers)
- ➔ Poor stickies removal efficiency due to close to neutral buoyancy

- **4.2: New cleaners - CTP + New process - PTS**

- ➔ Best results with a new small head diameter cleaner: possibility to remove some small macro-stickies not removable by screening
- ➔ No significant efficiency improvement with the addition of talcum to increase stickies density (fillers already adsorbed during pulping)

- **4.3: Rotary cleaner - CTP**

- ➔ No significant significant stickies agglomeration in mills (OCC, DIP) to promote subsequent stickies removal with slot screening despite published mill results and theory



Synthesis

WP5: Flotation



- **5.1: Laboratory flotation tests - PTS / CTP**
 - ➔ Extensive study of the effects of flotation parameters: paper and adhesive raw materials, consistency, dilution water, stickies size and flotation collectors including fatty acid (soap) and inorganic collectors
 - ➔ Good floatability of adhesive dispersions in pure water
 - ➔ Better results with small than large macro-stickies and detrimental effect of consistency increase
 - ➔ Basic research work continues

- **5.2: Pilot flotation tests - PTS**
 - ➔ Negative effect of consistency and stickies size on efficiency: micro-stickies > small macro-stickies > large macro-stickies
 - ➔ About 50% lower stickies removal efficiency with process water than with dilution tap water used for the pilot tests



Synthesis

WP6: Pressure Filtration



- **6.1: Preparation of process waters - PTS**
 - ➔ Model process waters from pilot plant (drum filter and screw press filtrates) do not have the required characteristics
 - ➔ Mill process waters were used for the pilot pressure filtration tests

- **6.2: Pilot pressure filtration tests - PTS**
 - ➔ Extensive study of the effects of the main parameters: filter plate (100 to 200 μm holes, 40 to 100 μm slots), reject rate, rotor speed, feed flow rate and consistency, addition of flocculants
 - ➔ Pressure filter works like pressure screen fractionation between fibres and fine elements
 - ➔ No tool for micro-stickies reduction (as micro-stickies $< 100\mu\text{m}$)
 - ➔ Effective in fibre and macro-stickies reduction from process water (but both in one step)



Synthesis

WP7: Stickies Removal Strategies

- **7.1: Optimisation of stickies removal in deinking lines**
CTP / PTS / ICP
 - ➔ Two main strategies:
 - New ICP Pulping process
 - Minimise stickies fragmentation (and DCS) in the pulper
 - ➔ Optimise stickies removal steps, mainly
 - Screening
 - Flotation
- **7.2: Guidelines for the development of recycling friendly adhesives - ADJ / CTP / PTS / ICP**
 - ➔ Document established by Avery Dennison Europe (Leiden, NL)



Dissemination of the Results

- The final ScreenClean project report will be available on the Action web site: www.cost-e48.net

