



Repulpability assessments of Hydropol coated papers

Objectives

1. To confirm repulpability of Hydropol coated papers
2. To determine the impact of solubilised Hydropol coating on paper sheet properties (strength etc)
3. To assess the impacts of solubilised Hydropol coating on process water quality and secondary biological treatments which are currently used by papermills

Test samples



Control 'base paper' (L) – chemical pulp, 72gsm coated on one side with modified starch.

Hydropol 33100 (R)- 30 μ m coating applied on 'base paper' – sample cut to 10cm x 5cm for repulping tests

1) Laboratory scale repulpability assessments



- ISO 5263-1 *Laboratory Disintegration of chemical pulps*
- Temperature 20°C, 40°C and 50°C (temperatures typical of 'open' and 'closed' pulper systems)
- pH 7.1
- Disintegrator revolutions 10,000 and 50,000
- Hydropol coated paper tested as 100% of fibre furnish
- Fibre dispersion - Y/N
- pH measured after pulping

Laboratory scale repulpability assessments



Laboratory disintegrator, temperature checks and charging pulper with test sample

Fractionation

- Samples fractionated using a Bauer McNett fractionator (Tappi T233 cm-06) equipped with 8/16/50 and 100 mesh screens (slot size- 2.5mm/1.5mm/0.31mm and 0.15mm)
 - Weight of fraction retained by each mesh measured
 - Examination for presence of Hydropol coating retained by each mesh
- Undispersed fibre/coating is retained by mesh 8, while softwood and hard wood fibres are retained by mesh 50 and 100 respectively
- Material passing through 100 mesh would be lost to drain/effluent



Results – impact of temperature and repulping duration

	Temperature	Disintegrator Revs.	pH (start)	pH (end)	Fractionation				
					Percent Retention				
	°C	K			8	16	50	100	>100
Uncoated control	20	10	7.1	8.89	2.82	18.64	1.97	32.02	44.55
Hydropol coated	20	10	7.1	8.84	2.21	6.82	1.28	9.11	68.72
	20	50	7.1	8.86	0.55	0.14	1.13	10.03	88.15
	40	10	7.1	8.11	0.90	4.90	1.30	14.10	78.80
	40	50	7.1	8.45	0.20	5.30	1.20	12.30	81.00
	50	10	7.1	8.92	0.74	8.06	1.55	17.22	72.43
	50	50	7.1	8.91	0.50	10.06	1.25	21.16	67.24

- Uncoated control – after 10,000 revolutions, 2.82% of control material was retained by mesh 8 indicating good fibre dispersion. 32% retained by mesh 100 suggesting high hardwood fibre content. pH increased to 8.89
- Hydropol coated samples - at **20°C** and 50,000 revolutions only a small amount of Hydropol was detected on mesh 8 with complete fibre dispersion. At **40°C** and **50°C** and 10,000 or 50,000 revolutions, **NO** Hydropol was noted on mesh 8 with complete fibre dispersion.
- pH increases noted to be similar to uncoated control

Summary: Hydropol coating is repulpable with complete fibre dispersion at 40°C and above with complete solubilization of coating.

2) Impacts of Hydropol coating on paper sheet quality parameters

1. Could Hydropol-coated packaging papers be used in CCM and other packaging grades
2. Does Hydropol impact on recycled paper sheet properties?
3. Could Hydropol serve as a 'strength enhancer' enabling mills to use lower quality recovered fibre?
4. Could Hydropol-coated papers be used in fine papers (if segregated) so that products can qualify 'recycled fibre content'?

1 Grey board	1 Virgin fibre
2 Greyboard + uncoated control (20%)*	2 Virgin fibre + uncoated control (20%)
3 Greyboard + uncoated control (50%)	3 Virgin fibre + uncoated control (50%)
4 Greyboard + Hydropol coated paper (20%)*	4 Virgin fibre + Hydropol coated paper (20%)
5 Greyboard + Hydropol coated paper (50%)	5 Virgin fibre + Hydropol coated paper (50%)

**Samples of effluent tested by AquaEnviro for effluent treatability*

Impacts of Hydropol-coated paper on greyboard

		Fibre type	Furnish					
		Greyboard	100	80	80	50	50	
		Uncoated		20		50		
		Hydropol coated			20		50	
Test		Units						Change-compared with inclusion of uncoated control
Bulk		cm ³ /g	1.966	1.908	1.911	1.810	1.881	No change
Porosity		mls/min	1109	1308	1277	1788	1792	No change
Roughness	Glazed top	µm	4.49	4.52	4.59	4.93	4.96	No change
	Bottom	µm	6.95	7.03	6.96	7.44	7.10	No change
Burst Index		Kpa/g	1.18	1.20	1.19	1.41	1.35	No change
Tear Index		mNm ² /g	4.83	4.93	4.70	5.17	5.17	No change
Tensile Index		Nm/g	25.59	27.89	28.06	29.94	28.15	No change
Drainage		secs	8.29	8.06	8.36	6.17	6.95	No change
Freeness		Csf	337	318	340	337	332	No change
Schopper		°SR	36	38	36	37	37	No change

Inclusion of either the uncoated control or Hydropol coated papers @20 or 50% w/w imparted the same changes to the paper sheet properties.

Impacts of Hydropol-coated paper on virgin copier paper

		Fibre type	Furnish					
		Virgin copier paper	100	80	80	50	50	
		Uncoated		20		50		
		Hydropol coated			20		50	
Test		Units						Change-compared with inclusion of uncoated control
Bulk		cm ³ /g	1.888	1.815	1.872	1.829	1.773	No change
Porosity		mls/min	3405	3487	4376	3897	4372	Slight increase in porosity
Roughness	Glazed top	µm	5.03	5.08	5.30	5.07	5.27	Slight increase in roughness
	Bottom	µm	7.06	7.03	7.04	7.01	7.07	No change
Burst Index		Kpa/g	1.34	1.65	1.35	1.51	1.38	Slight strength decrease
Tear Index		mNm ² /g	4.53	5.57	4.70	5.07	5.03	No change
Tensile Index		Nm/g	30.08	32.42	29.69	32.11	29.51	Slight reduction in tensile index
Drainage		secs	5.26	4.87	5.09	5.04	5.04	No change
Freeness		Csf	392	407	428	392	443	Increased freeness
Schopper		°SR	32	31	30	32	29	No change

Inclusion of uncoated control or Hydropol coated papers @20 or 50% w/w imparted the same changes to bulk, roughness (bottom), tear index, drainage and Schopper. Slight changes were noted for porosity, roughness (top), burst index, tensile index, and freeness.

Impacts on paper sheet quality parameters

1. Could Hydropol-coated packaging papers be recycled into CCM and other packaging grades ? *YES. Uncoated control and Hydropol coated papers imparted the same paper sheet properties to greyboard*
2. Does solubilized Hydropol impact on recycled paper sheet properties? *NO. Uncoated control and Hydropol coated papers imparted the same paper sheet properties*
3. Could solubilized Hydropol impart strength to fibre/sheet properties enabling mills to use lower quality recovered fibre? *NO*
4. Could Hydropol-coated papers be used in fine papers (if segregated) so that products can qualify 'recycled fibre content'? *YES*

3) Impacts of solubilized Hydropol on mill process waters and etp systems



Generic example:

Test liner manufacturer (Furnish – OCC and selected Mixed Papers)

1 Primary treatment – Dissolved Air Flotation – recovers fibre, cellulose fines and ash back to the mill

2 Secondary biological treatment -mineralises dissolved organic load:

- i. anaerobic digestion (AD)
- ii. aerobic activated sludge (AS)
- iii. sludge settlement (SS)
- iv. Treated effluent discharged to river

3) Impacts of solubilised Hydropol coating on process water quality and secondary biological treatments which are currently used by papermills – Final results expected June 2019

Test Tech:

- conductivity, charge demand and pH (ensure no changes above those observed with uncoated control)

AquaEnviro:

1. COD fractionation
 - OECD 301B BCOD Test (Zahn Wellens) – quantify the biodegradability of soluble organic material within effluent. Measures percentage mineralization of COD in aerated activated sludge over time
2. Carbonaceous and nitrification inhibition test – provides a measure of the treatability of the effluent samples and if is inhibitory to aerobic activated sludge bacterial respiration – NO INHIBITION OF BACTERIAL RESPIRATION RATE (ie no acute toxicity)
3. Biochemical methane potential testing – determines treatability by anaerobic digestion

Summary

- Hydropol 33100 coated paper disintegrates with complete dispersion of fibres when repulped at 40°C and above (coating is almost non-detectable when repulped at 20°C) - meets criteria outlined in ISO 5263-1 *Laboratory Disintegration of chemical pulps*
- No evidence of Hydropol coating on mesh 8 with Bauer McNett fractionation- indicates complete polymer dissolution and fibre dispersion
- Solubilised Hydropol at high loading rates appears to have no effect on paper sheet properties in the case of recycled grey board furnish. For virgin copier paper furnish, no effects were noted for bulk, roughness (bottom), tear index, drainage and Schopper. Slight changes were noted for porosity, roughness (top), burst index, tensile index and freeness.

At a mill:

1. Hydropol coated paper would repulp and release valuable fibre for paper and board manufacturing
2. Hydropol coating would dissolve and would NOT form part of 'mill rejects stream' (Note: valuable fibre is entrained and lost with mill rejects (yield loss); rejects are costly to dispose for mills without wte)
3. Hydropol coating appears not to be substantive to fibre and unlikely to contribute either positively or negatively to paper sheet properties
4. Hydropol coated paper could be recycled with Mixed Paper or OCC at packaging mills
5. Segregated Hydropol coated paper eg coated white food board could be recycled at virgin-fibre based mills
6. Effluent from Greyboard + Hydropol coated paper (20%) did not inhibit activated sludge bacterial respiration rates (ie no acute toxicity)
7. Treatability of Hydropol by mill effluent treatment systems (DAF, AD and activated sludge)-[final results expected June 2019](#)