PET recyclable polymer for making paper washbowls

YONG ZOU, JEFFERY S. HSIEH, AND JOHN KOKOSZKA

ABSTRACT: A paper washbowl made from recycled newspaper that can hold hot soapy water (70° C) for a minimum of 4 h was successfully developed by using EvCote® PGLR-25 added into the fiber slurry before the bowl was formed. We also studied other variables such as furnish, size (rosin and alkyl ketene dimer), and retention aids. In addition to the EvCote® PGLR-25, the results showed that the retention aid and rosin both are important ingredients in the fiber formulation.

Application: The role of retention aids and rosin in fiber formulations are important in the development of new technologies for high-temperature paper sizing.

Paper washbowls made from 100% recycled newspaper and telephone books without deinking are intended for a hospital environment. Such products eliminate the risk of contamination and infection from improperly sanitized items. Also, a paper washbowl that can still be repulped and recycled would eliminate landfill incineration costs and could lead to large labor savings, particularly when compared with plastic products [1–2]. To function in this hospital environment, a paper washbowl would require the ability to hold hot soapy water for an extended time. In other words, it would need to have properties similar to the standard plastic or metal bowls and still be recyclable and easily formed.

EvCo Research, LLC has developed a series of polyester resins from virgin or recycled polyethylene terephthalate (PET) polymers. The polyester resins have been successfully used as paper coatings and as internal sizes when applied from the wet end [3–5]. Our main objective was to develop wet-end technology to make a paper washbowl from 100% recycled newspaper capable of holding hot soapy water (70° C) for a minimum of 4 h.

EXPERIMENTAL

Materials

The following is a list of materials used in our study:

- Several strainers purchased from a local ACE Hardware;
- EvCote® PGLR-25 from EvCo Research, LLC;
- *Atlanta Journal Constitution* and *Wall Street Journal* newspapers;
- *Financial Times* newspaper;
- three types of retention aids;
- five kinds of rosin;
- two types of alkyl ketene dimmer (AKD); and
- AlCl3 supplied as a 17% solution.

The following is the basic formulation added to the pulp:

- 15 lb/ton of $AlCl_3$, as supplied, charge modifier;
- 40 lb/ton of PGLR-25, as supplied;
- 10 lb/ton rosin, as supplied;
- 3 lb/ton AKD, as supplied; and
- 1 lb/ton retention aid.

The furnish used for testing consisted of the *Atlanta Journal Constitution* and *Wall Street Journal* mixed (1:1). In some tests we evaluated furnish using the *Financial Times*.

Preparation of washbowls

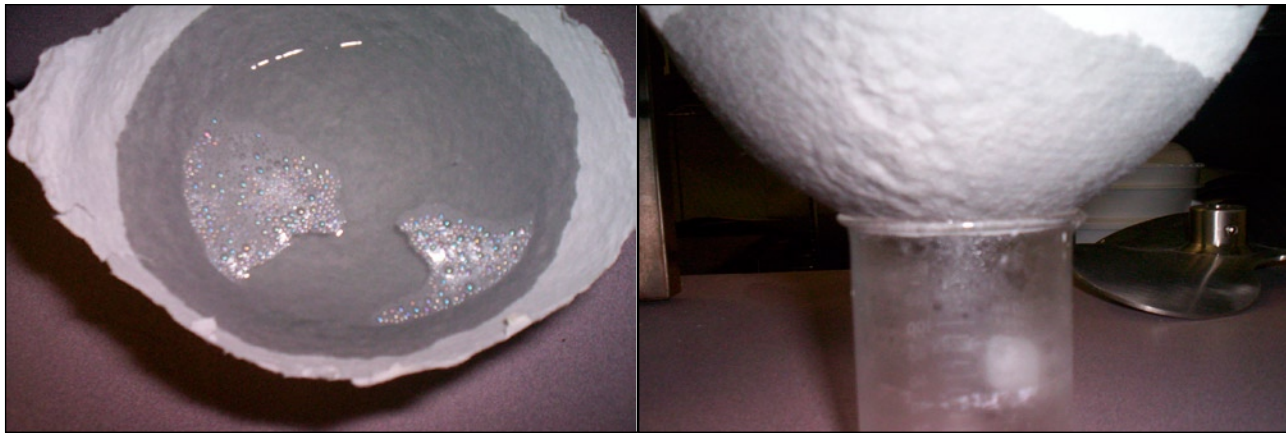
At first, newspaper was repulped with a British Disintegrator to a consistency of 3.5%–4.0% pulp, which was then diluted to 2.5%–3.0% solids. The chemicals were added into the pulp separately. Following chemical addition, the pulp was diluted to 0.9% solids to make washbowls by using two strainers (i.e., molding between two strainers that were used to form the shape and squeezing much of the liquid out). The wet washbowls were placed in a convection oven at 120° C for 2.5 h.

Testing conditions

The charge and pH value of the 2.5%–3.0% solids pulp slurry before and after chemical addition were determined using the Electrokinetic Charge Analyzer Model ECA 2000P by Hemtrac System Inc. (Norcross, Georgia, USA) and a pH Meter, Model 8005, from VWR Scientific (West Chester, Pennsylvania, USA). We placed 150 mL of hot water (70° C) with 0.2% antimicrobial soap into the washbowl and checked the bowl periodically to determine if it could hold the hot water for the required 4 h.

RESULTS AND DISCUSSION

The wet end is a very complex system [6]. In the current project we focused on the effect of PET recyclable polymer, furnish,



1. Control after 1 min.

size, and retention aids on formation and performance. The results presented in the following tables show that a paper washbowl can be made from non-deinked newsprint with the proper composition of furnish and the selection of the proper wet-end chemistry.

Table I shows that PGLR-25 is very important for making the special washbowl. **Table II** shows the effect of furnish. Although it was not analytically determined, we assumed that the dyestuff in the pink *Financial Times* caused rewetting. **Tables III** and **IV** show the effect of the standard sizing chemistry. Rosin and AKD are typical sizes, but different kinds of AKD and rosin have different compositions even if the compound is the same. Also, the molecular weight and dispersion chemicals may be different and result in different product properties [6]. **Table V** shows that the retention aid is a key to the wet-end system, although the dosage used is very low, because it will determine whether other chemicals can stay with the fiber [6].

2. Basic formulation after 45 min (top view).

	Charge	pH	Hot water (2% antimicrobial cleansing wash)
PGLR-25	-0.57	6.1	Pass (18 h)
No PGLR-25	-0.54	5.8	Failed

I. Effect of PET recyclable polymer.

Furnish	Charge	pH	Hot water (2% antimicrobial cleansing wash)
Atlanta Journal Constitution and Wall Street Journal mixed	-0.57	6.1	Pass (18 h)
Financial Times	-1.22	5.9	Failed

II. Effect of furnish.

CONCLUSIONS

We studied a paper washbowl made from recycled newspaper using wet-end technology. After determining that such a bowl could be made from non-deinked newsprint and hold hot (70° C) soapy water, we studied in detail the effect of various factors such as PET recyclable polymer, furnish, sizes (rosin and AKD), and retention aids, which have the main impact on the wet-end process. It is known that the wet end is a very complex system with many variables. Our report addresses some of those variables, and additional work will address other variables such as the mold for the bowl, the bowl density, the pulp's pH, and the mechanisms of formation.

	Charge	pH	Hot water (2% antimicrobial cleansing wash)
Cationic AKD	-0.57	6.1	Pass (18 h)
Anionic AKD	-2.97	6.7	Failed
No AKD	-0.49	5.5	Failed

III. Effect of AKD.

	Charge	pH	Hot water (2% antimicrobial cleansing wash)
Rosin	-0.57	6.1	Pass (18 h)
Rosin 1	-1.14	7.1	Failed
Rosin 2	-1.29	7.1	Failed
Rosin 3	-1.28	6.7	Failed
Rosin 4	-1.89	5.5	Failed

IV. Effect of rosin.

	Charge	pH	Hot water (2% antimicrobial cleansing wash)
Retention aid	-0.57	6.1	Pass (18 h)
Retention aid 1	-0.72	6.1	Failed
Retention aid 2	-1.10	6.4	Failed

V. Effect of retention aid.

Received: August 31, 2007
Revised: November 25, 2007
Accepted: November 27, 2007

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INSIGHTS FROM THE AUTHORS

We chose this topic for reseach in order to develop a secondary fiber suitable for printed paper applications. High-temperature paper sizing technologies is a new area for development. It is difficult to find good rosin sizing agents and retention aids. We addressed this challenge based on our experience with these chemicals as well as wet-end technologies.

We developed some formulations using special rosins and retention aids that were have particular application in high-temperature paper sizing. Mills can use this information to develop high-temperature paper sizing technologies such as liquid packaging. Our next step is to study the mechanism in detail.

Zou

Hsieh

Kokoszka

Zou is a fellow and Hsieh is professor, pulp and paper engineering, School of Chemical and Biomolecular Engineering, Georgia Institute of Technology, Atlanta, Georgia, USA. Kokoszka is vice president, EvCo Research LLC, Pendergrass, Georgia, USA; Email Hsieh at jeff.hsieh@chbe.gatech.edu.