Paper or Plastic? Yes, but Not as a Mixture

Martin A. Hubbe

As expressed by the chorus lyrics of a song by Dan Einbender, "it really isn't garbage 'til you mix it all together. It really isn't garbage 'til you throw it away. Separate your paper, plastic, compost, glass and metal. Then you get to use it all another day." It's worth paying attention to these lyrics once again in the face of yet another type of product that is starting to show up in stores. Extruded sheets of polyethylene (no. 2 plastic) with as much as 80% ground calcium carbonate content are being sold as "paper". Calcium carbonate is widely used as a component of real paper. However, it rubs me the wrong way when the word "paper" is being used to refer to something that has no fibers in it and is not formed on a screen and dried. My more serious concern is that such materials, if they become widely used, have the potential to contaminate paper recycling operations.

Keywords: Paper recycling; Plastic contamination; Stone paper; Extrusion; Recyclability

Contact information: North Carolina State University, College of Natural Resources, Department of Forest Biomaterials, Campus Box 8005, Raleigh, NC 27695-8005, USA, E-mail: hubbe@ncsu.edu

Intriguing Promotional Items

Early this year I received my first inquiry about something called "stone paper". Someone whom I had met at a conference wanted to know what the stuff was and whether their paper company ought to consider producing it. More recently, while on a train from Beijing to Nanjing, in China, I happened to be sitting next to a Chinese college graduate, and he independently brought up the subject of "stone paper" as soon as I mentioned my background. Then, in early April I was contacted by a UK television producer working on a story about "stone paper". Based on those three data points, maybe this qualifies as a "hot topic" that merits an editorial in *BioResources*. You might have seen a YouTube video showing a guy in scuba gear writing a note on such a product while under water (https://www.youtube.com/watch?v=20IknIvamJk).

The PDF information that was forwarded to me by my first contact began with the question "What is stone paper?" Closer inspection of the concept quickly revealed the misleading nature of the promotion. The most misleading aspect was misuse of the word "paper," which refers to a sheet-like material formed by dewatering a suspension of renewable, biodegradable cellulosic fibers on a screen. Rather, it appears that the promoted product consists of about 80% calcium carbonate (limestone) powder, which is extruded together with recycled high density polyethylene (HDPE) and at least one undisclosed proprietary component.

Why I Am Concerned

Papermakers, for many years, have tried very hard to exclude meltable plastics such as polyethylene from the stock supplied to their process. Thermoplastic materials can easily adhere to drying cylinders and calender stacks of a paper machine, thus damaging the efficiency of the process. Or they can show up as flakes in the paper product, causing customers to complain.

Though information coming from the producers of these extruded products claim lower costs in comparison to a conventional papermaking, such claims merit cautious examination. The crushing of limestone requires a lot of energy, *e.g.* 100 to 1000 kWh/t (He *et al.* 2006; Wang *et al.* 2007). Extrusion can be regarded as a relatively slow process, lacking the economies of scale of a typical modern paper machine (Butler and Veazey 1992). Costs of extrusion are likely to be further elevated due to wear of the die surfaces by abrasive mineral (Mobley *et al* 2002). Large-size or agglomerated mineral particles could lead to blockages or scratch-like marks of the product, requiring down-time for cleaning the nozzle areas of the equipment. Due to chemical incompatibility between the $CaCO_3$ mineral surfaces and the polyethylene, results are likely to be highly dependent on the use of compatibilizing agents, making it possible to achieve a uniform distribution of the mineral in the plastic matrix, which would be needed to meet requirements for appearance, uniform opacity, consistent printing, *etc.* Finally, if the extruded plastic requires a coating to provide a printable surface or the desired performance attributes, as described in some of the promotional material, the cost will be further elevated relative to that of ordinary paper.

How can society protect itself from unsound practices that threaten sustainable technologies, such as conventional papermaking? Two remedies come to mind: boycott and legislation. It seems that a lot of the initial sales of "stone paper" products may have been prompted by misleading claims, *i.e.* "greenwashing". Publication of this editorial probably cannot by itself provide enough publicity to make a difference. The next step may be to apply stringent regulations, ensuring that planned or unplanned recycling of such products does not raise havoc in recycling operations for either plastics or paper. According to the lyrics of a song by Dan Einbender (1989), "it really isn't garbage 'til you mix it all together". Rather, we need to keep the waste streams for paper and plastic separate from each other so that we can "get to use it all another day".

References Cited

Butler, T. I., and Veazey, E. W. (1992). *Film Extrusion Manual. Process, Materials, Properties*, TAPPI Press, Atlanta, GA, 768 pp.

Einbender, D. (1989). Song lyrics, chorus: "It really isn't garbage 'til you mix it all together. It really isn't garbage 'til you throw it away. Separate your paper, plastic, compost, glass and metal. Then you get to use it all another day."

He, M. Z., Wang, Y. M., and Forssberg, E. (2006). "Parameter effects on wet ultrafine grinding of limestone through slurry rheology in a stirred media mill," *Powder Technol.* 171(1), 10-21. DOI: 10.1016/j.powtec.2005.08.026

Mobley, B., Boutelle, T., Garrett, S., Joinder, L., and Calhoun, A. (2002). "Effect of calcium carbonate on the abrasive wear of melt processing equipment in filled systems," *J. Vinyl Additive Technol.* 8(4), 271-277. DOI: 10.1002/vnl.10374

Wang, Y., and Forssberg, E. (2007). "Enhancement of energy efficiency for mechanical production of fine and ultra-fine particles in comminution," *China Particuology* 5(3), 193-201. DOI: 10.1016/j.cpart.2007.04.003