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Impacts from using recycled pizza boxes in furnish: *TAPPI Journal's* runner-up to 2021 Best Research Paper

The runner-up to the 2021 *TAPPI Journal* Best Research Paper was “Incorporation of post-consumer pizza boxes in the recovered fiber stream: Impact of grease on finished product quality.” From Ashok Ghosh, Peter Hart, Adele Panek, Tran Nguyen, and Meredith Dooley of WestRock, the goal of this paper was to demonstrate how used pizza boxes can contribute to a circular economy where the industry recycles the products it makes as part of the overall manufacturing process. The paper was assessed as runner-up by the *TAPPI Journal* Editorial Board based on its scientific merit, innovation, creativity, and clarity.



Ashok Ghosh

The runner-up paper appeared in the March 2021 issue, which is available as an [open access download](#). In a recent conversation with *TAPPI Journal*, first author Ghosh discussed some of the rationale and approach for studying used pizza boxes as a viable furnish.

What prompted you to undertake studying the acceptability of post-consumer pizza boxes in the recycle stream?

We could see in the media that there were lots of opinion pieces about why the boxes aren't acceptable for recycling. These articles weren't based on a scientific approach, so we decided to take a deep dive. We started with a mass balance, looking at the assumption that 100% of pizza boxes were recycled and what percentage that would be of total OCC [old corrugated containers]. We found that this percentage is just 2.5%.

We knew that the fibers used to make pizza boxes are of good quality, as WestRock is a major producer of them. We then started studying where the grease is coming from in used pizza boxes, such as the base, or toppings, like cheese and meat. We undertook a huge

study looking at how to determine grease levels in the boxes. Once we had the average grease level and the percent pizza boxes in OCC, we went to the lab and designed a set of experiments.

The idea was always to get this information out to the public, but as a first step, we needed to get it out within the industry at large. We provided the study to AF&PA, where the various industry members were able to review it. After the industry peer-review, AF&PA issued a statement about the recyclability of pizza boxes. The next step was to submit the paper to a peer-reviewed journal, as we did with *TAPPI Journal*. We wanted to establish a rigorous scientific basis on which to draw conclusions rather than express opinions. We wanted to make sure the community at large, MRFs [material recycling facilities], paper manufacturers, converters, etc., knew the facts.

Are you surprised that no one has taken a more scientific approach to the subject until now?

I think the issue was down to resource availability, because it takes time to pull together a multi-faceted study and then address the questions brought up by the reviewers.

It took us around two months, working on and off, to gather the market data. Determining the average grease content involved setting up a lab methodology and finding the right people for pizza box collections, imaging, and so forth. Defining the percent of pizza boxes as part of OCC and average grease level ended up taking almost as long as the lab work.

Were the MRFs willing to participate in the study?

Yes, and some of them were part of Westrock, which helped. What we were trying to get from MRFs was independent confirmation of our findings on grease levels. We asked that, for a period of a couple of days, they

take out all the pizza boxes from the OCC bales and take pictures. Then we ran image processing to independently confirm our results from physical sampling.

The boxes used in your study had 8% by weight grease content. What was the significance of that number?

Paper strength comes from hydrogen bonding between fibers. We know that grease, like oil, is hydrophobic and disrupts the inter-fiber bonding. We added oil, at different contents, to fiber and studied the effect of oil versus strength reduction. We drew the curves for burst strength, short span compression, ZDT, and tensile strength with increasing ratio of greasy fiber, as shown in Figures 16-19 in the paper.

The market data informed us that pizza boxes account for approximately 2.5% of OCC, assuming 100% of pizza boxes are recycled. For grease content, we bought a lot of pizzas to determine the grease content in boxes. We also developed a correlation between grease content and images of the used pizza boxes. The average grease level in pizza boxes was found to be around 2%, with a high limit of 8% grease.

On average we can expect 2% grease level in pizza boxes, and the pizza boxes are about 2.5% of the OCC stream. We also reviewed the worst-case scenario of 5% pizza boxes in the

OCC stream, with 8% grease content. The data showed that the grease levels in question do not impact strength or other properties in significant enough amounts to be a huge concern.

Are there microbiological concerns with recycling pizza boxes?

Although our study did not address this, we do show that pizza boxes are a relatively small percent of OCC. Also, the pizza boxes become part of the overall board furnish. The pizza boxes will not all be recycled to only make more pizza boxes, so this is not a closed-loop buildup of grease.

For a recycle mill using low quantities of water, there is buildup of dissolved and colloidal materials, so we need to deal with biological growth. An example of food for bugs is starch, which is commonly used as a papermaking strength aid and as glue in the corrugation process. Grease content of pizza boxes in the overall OCC stream is a relatively small component. **TJ**

Ghosh is senior process specialist at WestRock in Richmond, VA. You can hear more from Ghosh about WestRock's pizza box study as part of TAPPI Connect's Ask the Expert series on Friday, September 9, from 10am to 12pm EDT. For a link to the event, visit the [Open Forum](#) page on September 9.

IN MEMORIAM

Darren Keith Swales, Ph.D., died Tuesday, August 16, 2022, surrounded by his loved ones after a short but fierce battle with cancer. He was born on June 17, 1966, in Clitheroe, England. For his entire professional life, Darren worked in the field of paper chemicals. Most recently, he was the Director of Sales with Plasmine Technology Inc., headquartered in Pensacola, FL. He was a graduate of Loughborough University with a Ph.D. in Colloidal Chemistry (1991) and a B.Sc. Hons. in Analytical Chemistry (1988).

Darren held a Licentiate from the Royal Society of Chemistry and was inducted as a TAPPI Fellow in 2016. Additionally, he held the roles of Secretary, Vice-Chair, and Chair of both the Papermaking Additives Committee and the Paper and



Board Division of TAPPI, as well as the Chair of the Technical Program Committee for two TAPPICon conferences. Darren was a published author whose body of work includes many patents, journal articles, and book chapters. He also was active as an instructor for many technical courses offered by TAPPI, including the "Introduction to wet end chemistry" course offered annually at TAPPI headquarters.

When he wasn't working and learning, Darren loved hunting, fishing, and the outdoors. He spent many hours sitting in a tree or out on the lake. He is survived by his wife Erika, of 25 years, and children, Ella, Hana, and L.J. Darren was dedicated to his family and friends, always the life and soul of the party, and he and Erika loved to entertain.