Editorial

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TAPPI Journal 2018 Best Research Paper delves deeper into press section rewet to address drying efficiency

TAPPI and the *TAPPI Journal* (*TJ*) Editorial Board would like to congratulate the authors of the 2018 *TAPPI Journal* Best Research Paper Award: J. David "Dave" McDonald and Richard J. "Dick" Kerekes. Their paper, "Rewet in wet pressing of paper," appeared on p. 479 of the September 2018 issue. This research was recognized by the Editorial Board for its innovation, creativity, scientific merit, and clear expression of ideas.

Dave McDonald is president of JDMcD Consulting Inc. and an adjunct professor in chemical engineering at McMaster University. Previously, he worked at FPInnovations as vice-president, University Programs and Strategic Partnerships; at Paprican, as vice-president, Research and Education; and at Abitibi-Price, as a research associate/mathematician. He also served as the senior advisor of FIBRE, the umbrella organization for the eight Canadian forest industry university networks. McDonald is a fellow of both TAPPI and PAPTAC and has received many awards, including the highest technical awards from PAPTAC, the John Bates Gold Medal, and from TAPPI, the Gunnar Nicholson Gold Medal.

Dick Kerekes is a professor emeritus of the University of British Columbia (UBC). He was the founding director of UBC's Pulp and Paper Centre and served as its director from 1983 until his retirement in 2005 as Paprican Professor of Pulp and Paper Engineering. Kerekes is a Fellow of TAPPI and PAPTAC, as well as the Canadian Academy of Engineering. He has received numerous awards, including the John Bates Gold Medal from PAPTAC and the Gunnar Nicholson Gold Medal from TAPPI. Kerekes was inducted into the Paper Industry International Hall of Fame in 2018.

Recently, McDonald spoke with *TJ* about the origins of research in rewet during wet pressing and how his and Kerekes' research may influence developments to mitigate its occurrence in the future.

J. David McDonald (left) and Richard J. Kerekes, winners of the* TAPPI Journal *2018 Best Research Paper Award for their paper on "Rewet in wet pressing of paper."

In your author notes, you indicated that rewet in wet pressing of paper is a "controversial subject." Can you elaborate on why this is the case?

It's controversial in the sense that many people have opinions on what causes it and what the mechanisms involved are, but there hasn't been good experimental evidence to confirm one hypothesis over another. That's why we were trying to clarify those mechanisms by modeling. We've scoured the literature to find all evidence needed to support this.

Some of the references in your paper date back to the 1960s. Was that when rewet became a hot topic for scientific research? Has it been an ongoing topic of research, or in the back of researchers' minds since that time?

The 1960s are when you first see it in the literature, and then in the 1970s and 1980s, there were measurements of what is called post-nip rewet, which happens outside the nip. I guess you could say it's been in the background since then, though. I became involved again in rewet research with Agenda 2020 and later APPTI [Alliance for Pulp and Paper Technology Innovation] as part of its Drier Web project looking for ways to make a dryer sheet coming out of the press section so less energy is used in drying.

APPTI met in Atlanta a few years ago to explore rewet and other topics and from that came a project with Lawrence Livermore Labs using its supercomputer. However, from the paper industry side, we couldn't provide the material parameters or specifications that would allow the lab to run its models on the computer. We just don't know those things or can't measure them, so this made me think there's a different way to approach the issue, and that's what spawned the idea of this paper.

My colleague and co-author of this paper, Dick Kerekes, and I thought about the rewet topic for a year or two, considering how best to model it. I think the result offers a fairly good understanding of the rewet mechanism, and points to ways for mitigating it. Most of them have been done empirically, but the other side it points out is what things *aren't* going to work. There are certain things people might pursue that really wouldn't be productive, so this work offers them a picture and set of equations to show what might—or might not—be possible.

How did you come to your proposal of combining the mechanisms of flow rewet, which is water flow from the felt back into the paper, and separation rewet, which is water remaining on the paper surface after separation from the felt?

The concept of separation rewet and flow rewet was first proposed by Peter Wrist in 1964. The flow rewet measurements in this paper are from pilot machine experiments carried out by Mike MacGregor and later by me and Ivan Pikulik years ago to examine what happens outside the nip if the felt and paper stay in contact. You can exactly measure and control that on a pilot machine. You can control contact, distance, or time, which gives you the flow term. In fact, you can extrapolate back into the nip. You're saying that if this happens outside the nip, it also begins inside the nip, which is a very short distance.

The separation term was work that Dick and I did about five or six years ago where we looked at felts of different construction. In fact, my son Eric was hired by Dick as an undergraduate student for his summer term to do some of the experiments, so it was certainly neat to actually work with my son on this.

There were two papers Dick and I published that examined different felt structures where the flow rewet term was the same, with the only difference being separation rewet. This let us isolate the separation rewet term. So, we conceptually had the idea that two terms were involved, which was really the most important part of it. And then the next part was to express it mathematically.

Press section design from paper machine suppliers offers the most opportunity for reducing rewet. If you leave the felt and paper in contact outside of the nip, water that's in the felt is going to transfer back to the paper, so it's very important not to leave the paper and felt together.

You also noted it was difficult to quantify each contribution separately.

That's true. When you're looking at it as a final result, if you just measure moisture after the press, you have no idea how big the flow rewet and separation rewet components are. The model was one way of separating them, but when we looked back at experimental results, we could also show relative contributions. In most circumstances, you have two contributions and one single result, so you can't guess as to the size of each component. That's what we did in the model as well—look back in hindsight at the experimental results.

Ultimately, how do you see the industry using the results from this study to minimize press rewet? Would it be something mills can do operationally? Or, is it more from the supplier standpoint in designing more efficient felts or presses?

Press section design from paper machine suppliers offers the most opportunity for reducing rewet. If you leave the felt and paper in contact outside of the nip, water that's in the felt is going to transfer back to the paper, so it's very important not to leave the paper and felt together.

The second thing that can be done is for shoe presses. Unlike roll presses, you can engineer the shape of the pressure pulse by modifying the shape of the shoe that's pressing against the backing roll. You can then move the pressure profile towards the nip exit, because the flow rewet starts in the expanding nip once the pressure is released. So, you can reduce the amount of the time the pressure is being released and basically push that profile closer to the exit of the nip, reducing flow rewet.

In terms of felt design, suppliers reach a limit with the current structure because as you go to finer fibers, it's harder to hold them in the surface. They pull out and the felt wears out too quickly. The other issue is cleanliness. The finer you make the surface, the harder it is to clean, and the felt clogs.

There's been a lot of work in modifying felts by changing the surface chemistry so the felt would be more likely to contain the water and not give it back to the paper. We really didn't emphasize that in our paper, but the equations are there to show you that you would have to change the properties, the surface chemistry by so much, that it's unlikely that you would see any effect. So, from a positive side, our work points out that there are some things that probably aren't worth using resources to try. You'd have to change the surface properties by two orders of magnitude, which is virtually impossible.

There have also been discussions around one-way felts that are like a valve where water goes in and can't come out. In many cases, the biggest contribution to rewet isn't water in the body of the felt coming back to the paper. It's the water at the surface that's neither in the paper or in the felt, because the two surfaces have texture and aren't perfectly flat, so they don't perfectly mate. There are cavities containing water between the felt and paper. When you separate the two, this water remains with the paper rather than staying with the felt, so a valve won't help.

It sounds like there have been many different ideas about how to address rewet in pressing, but not many feasible ones?

If you look empirically, a number of these things have been done already, but not done universally. I think what our work can do, for those contemplating changes to help with rewet, is quantify what benefit they're going to get before they make an investment. It both illuminates and eliminates areas for improvement. **TJ**