ENSURING RECYCLABILITY AND EFFECTIVE MATERIAL REUSE

How dispersion barrier coated boards repulp?

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The repulpability of dispersion barrier coatings is the key to fiber-based packaging material recyclability and effective, circular material reuse. This study deepens the understanding of how barrier coated board behaves in the repulping process and what happens after repulping.

Brand owners, fast-moving consumer goods (FMCG) companies, and retailers are seeking sustainable, renewable, and safe packaging alternatives to replace plastics, driven by urban consumer demand and global regulatory action. Fiber-based materials, such as paper and board, have in recent years gained strong interest due to their excellent recycling properties.

Fiber-based packaging materials need additional functionalities to protect the packaged goods from the environment and vice versa. These barrier properties are often achieved with extrusion coatings and laminated structures, which make for poor end-product recyclability and take away from the renewable nature of paper and board. Material producers are thus seeking barrier solutions with better recycling properties. As a global chemicals supplier to the paper and board industry and part of the fiber-based packaging value chain, Kemira is actively contributing to the development of sustainable and safe packaging alternatives.

New dispersion barrier coatings, such as Kemira's FennoGuard™ GO, have provided a solution to the demand, replacing PE extrusion coatings and harmful fluorochemicals used in paper and board packaging and enabling recyclable fiber-based packaging. With a recent study, we examined the recyclability of dispersion barrier coated boards. Repulping properties are the key to fiber-based material recyclability and effective, circular material reuse. With the study, we wanted to deepen the understanding of how dispersion barrier coated materials behave in the repulping process.

Key questions on recycling of barrier coated boards

The aim was to find out answers to some of the key questions relating to the efficient recycling of dispersion barrier coated materials: how barrier coated boards can be repulped, can repulping be enhanced, and what happens in the process after repulping. The study covered both coated broke fiber and water phases at the board machine: repulping, screening, and disc filter as well as the wastewater treatment process.

The purpose of an in-machine broke system is to form broke that is suitable for reuse in paper and board production. To ensure production and material efficiency, this means firstly that the amount of fibers, fillers, and other raw materials, e.g. chemicals, that get rejected from the broke system needs to be minimized. Secondly, the contaminants in the reused broke need to be correctly managed or they can cause problems with machine runnability or issues with paper or board quality. Thirdly, the hydrophobic or colloidal particles of the repulped material need to be prevented from ending up in wastewater or, worse yet, being discharged in environment.

We studied five different coated packaging boards. The coatings used were commercially available dispersion barrier coatings, including Kemira's FennoGuard™ GO, and as a comparison, a PE extrusion coating. Repulping was carried out with laboratory disintegrator and the broke reject percentage was determined. After slushing, the repulped stock was used in sheet forming, with the basis weight of 80 g/m^2, and the uniformity of the sheet was evaluated.

Repulpability depends on used chemistries and components

The repulpability of barrier coated packaging material is highly dependent on the used dispersion barrier chemistries and components. Base sheet properties also play a key role: e.g. wet strength agents used in the base paper can have a negative effect on repulpability. Base paper properties and holistic end-to-end understanding from furnish components to formation, surface smoothness, and strength are crucial in the creation of optimized dispersion barrier coating, and this insight is valuable also when repulping the dispersion barrier coated boards.

Based on the results of the study, Kemira's FennoGuard GO dispersion barrier coating can be easily repulped in water and the repulped material has a low reject rate from the broke system – in the two studied sample boards the reject percentage were 0% and 1.7%. The other studied dispersion barrier coatings proved to be more difficult to repulp, having reject rates as high as 8.2% and 14.1%.

Repulping can be chemically enhanced, which remarkably reduces the amount of reject in the process and improves the recirculation of the repulped material.

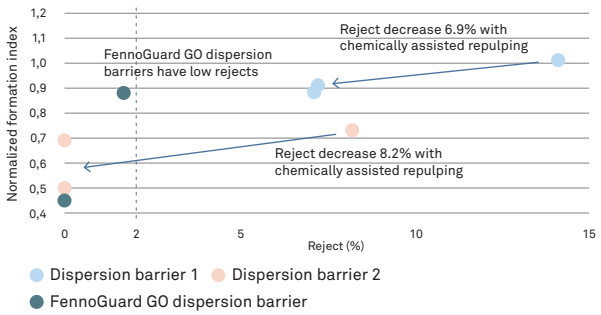

Table 1. The repulpability of barrier coated boards is highly dependent on the used chemistries and components. Chemically assisted repulping can significantly reduce the amount of reject.

Up to 98% of hydrophobic particles removed

After repulping, we studied the usability of the repulped material. A common concern related to the repulping of barrier coated boards is that the hydrophobic and colloidal particles originating from the coating to the repulped material would end up in the water phase and remain there after fixation, or even pass the wastewater treatment process, causing poor effluent quality.

Efficient and sustainable circulation of repulped barrier coated broke requires focus on both fixation and wastewater treatment processes. Firstly, the goal is to efficiently catch dispersion barrier particles from the filtrate and attach them to fibers, preventing the particles from ending up in the wastewater treatment plant in the first place. Secondly, the goal is to remove any possible residual hydrophobic particles from the wastewater before discharging.

Fixation aims to minimize the amount of repulped material that gets discharged as reject from the broke system. Our study shows that up to 80–85% of the hydrophobic particles in the dispersion barrier coated broke were attached back onto the fibers with a fixative, enabling efficient recirculation of the repulped material.

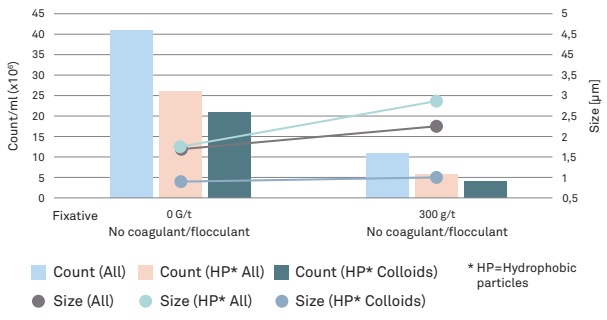

Table 2. Efficient fixation removes 80–85% of the hydrophobic particles in the dispersion barrier coated broke

Additionally, chemically enhanced wastewater treatment process helped to remove 75–80% of the remaining particles from the water phase. The wastewater process consisted of screening and filtering and a further coagulation and flocculation step.

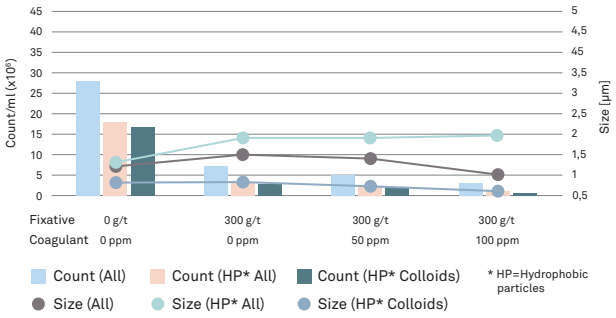

Table 3. With chemically enhanced wastewater treatment, 75–80% of the hydrophobic particles that remained in the water phase after fixation can be removed.]

As a result, a very high performance was achieved. The total removal rate of hydrophobic particles from the coated broke process was up to 95–98%. Most of the hydrophobic particles can be efficiently removed with the help of chemicals, and the removal can be further optimized by selecting correct chemicals and dosage.

Online monitoring and control optimize performance
Digital solutions can have a key role in improving hydrophobic particle removal in the paper and board making processes that use coated broke. Online, up-to-date visibility to the presence of hydrophobic particles in the system enables optimized chemical dosing, improves process control and performance, and helps stabilize production quality.

For mill scale operations, Kemira provides KemConnect™ digital services that build on chemistry and application expertise, real-time monitoring and control capabilities, and advanced data analytics to enable a data-driven way of managing the papermaking process. In this study,

the hydrophobic and colloidal particles in the coated broke filtrate were analyzed online with Kemira Flyto™ measurement device, developed over decades for the needs of paper and board manufacturing. Kemira Flyto is a modified flow cytometer that detects and monitors the amount, size, and hydrophobicity of small particles in the system. The collected data is further analyzed on the KemConnect monitoring and control platform and can be utilized for proactive performance control and smart chemistry management.

Summary: Efficient recycling of barrier coated boards can be carried out

Brand owners continue to be under intense pressure to package their products sustainably, even more so as the previously set goals for phasing out plastics and introducing renewable or reusable packaging alternatives start to draw closer.

Repulping properties are key to fiber-based packaging material recyclability and play a crucial role in the overall sustainability and circularity of the packaging solution through ensuring raw material and production efficiency. This study has deepened the understanding of the behavior of dispersion barrier coated boards in the repulping process.

Barrier coated boards behave differently in the repulping process depending on the used coating chemistries and components. Some commercial dispersion barrier coatings are easily repulpable in water, such as Kemira FennoGuard GO. Other formulations are more difficult to repulp, but repulping performance can be enhanced chemically, which significantly reduces the amount of reject in the process.

Dispersion barrier coated materials disintegrate into small particles that can be efficiently attached to the fibers with fixatives in the board making process. With chemically enhanced wastewater treatment process, the total removal rate of hydrophobic particles in the process reaches up to 95–98%. The process performance can be further improved with online monitoring solutions and advanced data analytics.

Efficient repulping and recirculation of repulped broke, and thus, recycling of dispersion barrier coated materials, can be carried out in the current paper and board making processes.

PORTFOLIO FOR DEMANDING FOOD PACKAGING APPLICATIONS

Kemira provides a variety of dispersion barrier solutions for the demanding food packaging applications. FennoGuard™ barrier coatings can reduce and replace plastics and fluorochemicals and enable the development of recyclable and safe packaging alternatives.

Kemira's end-to-end expertise covers the whole process from pulping and microbiological control to base paper production and coating, enabling the creation of fully optimized barrier performance in end-product.

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