TJ SUMMARIES

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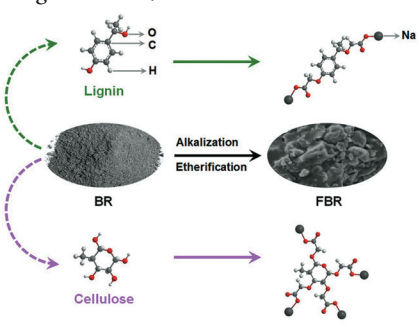
MARCH

BIOGAS

Synthesis of filtrate reducer from biogas residue and its application in drilling fluid

Wenjun Long, Huize Luo, Zhen Yan, Chunliang Zhang, Wenshuai Hao, Zhongjin Wei, Xialei Zhu, Fengshan Zhou, and Ruitao Cha



Researchers synthesized filtrate reducer from biogas residue and characterized the structures.

Biogas residues (BR) containing cellulose and lignin are produced with the rapid development of biogas engineering. Biogas residues can be used to prepare the filtrate reducer of water-based drilling fluid in oilfields by chemical modification.

The BR from anaerobically fermenting grain stillage was alkalized and etherified by caustic soda and chloroacetic acid to prepare filtrate reducer, which was named as FBR. The long-chain crystalline polysaccharides were selected as dispersing agents (DA), and the water-soluble silicate was used as the cross-linking agent. After the hot rolling of FBR in saturated saltwater base mud for 16 h at 120°C, the filtration loss was increased from 7.20 mL/30 min before aging to 8.80 mL/30 min after aging. Compared with the commercial filtrate reducers, FBR had better tolerance to high temperature and salt, and lower cost.

Filtrate reducer from biogas residue showed promising prospects to be used as an environmentally-friendly natural polymeric filtrate reducer of drilling fluid.

RECOVERY CYCLE

Fate of phosphorus in the recovery cycle of the kraft pulping process

Maryam Sadegh Mousavi and Nikolai Demartini

The accumulation of non-process elements in the recovery cycle is a common problem for kraft pulp mills trying to reduce their water closure or to use biofuels in their lime kiln. When non-process elements such as magnesium (Mg), manganese (Mn), silicon (Si), aluminum (Al), and phosphorus (P) enter the recovery cycle, the main purge point for these elements is green liquor dregs and lime mud. If not purged, these elements can cause operational problems.

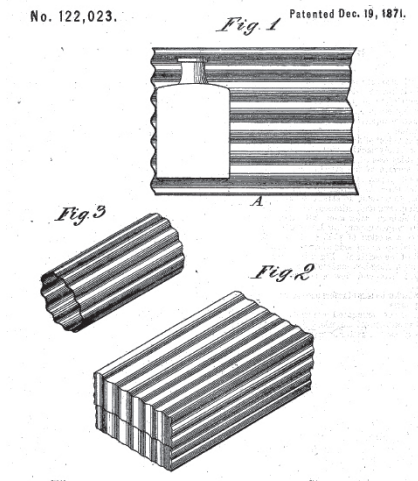
Phosphorus reacts with calcium oxide (CaO) in the lime during slaking; as a result, part of the lime is unavailable for slaking reactions. The first part of this project, through laboratory work, identified rhenanite (NaCa(PO4)) as the form of P in the lime cycle and showed the negative effect of P on the availability of the lime. The second part of this project involved field studies and performing a mass balance for P at a Canadian kraft pulp mill.

This research provides mills with an overview of P in one mill, as well as some new experimental data, to help understand the P distribution in kraft pulp mills. This can be useful for mills evaluating P inputs and purges.

CORRUGATED PACKAGING

Historical perspectives of corrugated box testing for 2020

Douglas W. Coffin



First packaging produced from a fluted board found in an 1871 US patent.

In the age of e-commerce, corrugated packaging is experiencing a resurgence; consumers are receiving more corrugated boxes today than ever before. The corrugated box has been the main package for transporting goods for more than 100 years, and has been the focus of scientific study for about as long. For the last 50 years, box compressive test strength value (BCT) has been the main focus of research and testing. That was not always the case. In addition, many of today's boxes experience a different end-use life than their predecessors.

This review examines some of the findings and insights found in the early days of corrugated research and places them in perspective of the performance expected of a box in 2020.

PAPER PHYSICS

Understanding extensibility of paper: Role of fiber elongation and fiber bonding

Jarmo Kouko, Tuomas Turpeinen, Artem Kulachenko, Ulrich Hirn, and Elias Retulainen

The tensile tests of individual bleached softwood kraft pulp fibers and sheets, as well as the micromechanical simulation of the fiber network, suggest that only a part of the elongation potential of individual fibers is used in the elongation of the sheet. The stress-strain curves of two actual individual pulp fibers and one mimicked classic stress-strain behavior of fiber were applied to a micromechanical simulation of random fiber networks. Both the experimental results and the micromechanical simulations indicated that fiber bonding has an important role not only in determining the strength but also the elongation of fiber networks. Results also

indicate that the shape of the stress-strain curve of individual pulp fibers may have a significant influence on the shape of the stress-strain curve of a paper sheet. A large increase in elongation and strength of paper can be reached only by strengthening fiber-fiber bonding.

The key conclusion was that simulated uniform inter-fiber bond strength does not influence the shape of the stress-strain curve of the fiber network until the bonds fail, whereas the number of bonds has an influence on the activation of the fiber network and on the shape of the stress-strain curve. Understanding the roles of fiber elongation and bonding is highly significant for the development of new fiber-based packaging products, particularly those intended for 3D forming.

APRIL

NANOCELLULOSE

Papermaking properties of bacterial nanocellulose produced from mother of vinegar, a waste product of classical vinegar production

Gregor Lavrič, Daša Medveščeк, and Matej Skočaj

Bacterial nanocellulose (BNC) has gained a lot of attention in recent years due to its nano-size-derived properties. Although it is essentially chemically similar to plant-derived cellulose, it has smaller size and is enriched in free hydroxyl groups, which greatly improve mechanical properties of reinforced paper. However, BNC comes at a high price. In this study, researchers introduce a new solution for BNC production. They directly isolated bacterial nanocellulose from agro-industrial waste—mother of vinegar—and used it to make paper sheets. The results showed paper sheets made with the addition of only 10 percent BNC from mother of vinegar substantially improved basic mechanical, as well as printing properties of paper.

RECYCLING

A novel unit operation to remove hydrophobic contaminants

Carl Houtman, Salman Aziz, Robert De Jong, and Mahendra Doshi

For mills making paper with recovered fiber, removal of hydrophobic contaminants is essential for trouble-free operation of paper machines. Significant cost savings on paper machine operation can be achieved by reducing deposits, which results in better quality, reduced downtime, increased fiber yield, and reduced energy consumption.

Bubble nucleation separation (BNS) is a relatively new process for removing hydrophobic particles. When vacuum is applied to a slurry, dissolved gas bubbles nucleate on hydrophobic particles and drag them to the surface for easy removal. Researchers constructed a 16-L batch unit to evaluate the effect of operating parameters on removal of hydrophobic particles, using statistical design of experiments. These results were used to guide their design of a 16-L continuous unit. Researchers then tested this unit on laboratory and mill samples. They achieved removal of 60—80 percent of hydrophobic particles, with a low reject rate of < 2 percent.

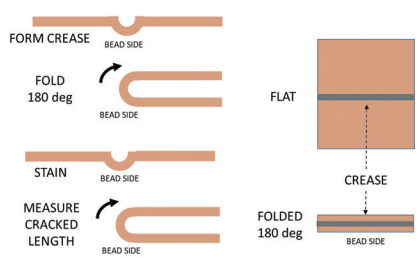
Following on this success, the researchers built a 200-L pilot unit and tested it in their pilot plant. After promising results, the pilot unit was installed at a commercial paper recycling mill. Over the course of several mill trials, the researchers showed it was possible to remove a considerable amount of suspended solids from paper machine white water with less than 2 percent rejects.

If implemented in a paper machine white water loop, this technology could provide a way to control stickies and dirt without adding any chemicals.

PAPERBOARD

Creasing severity and reverse-side cracking

Joel C. Panek, Swan D. Smith, and Douglas W. Coffin



Cracking was evaluated by folding the crease 180° opposite to the bead side, folding back to flat, applying stain to the crease, and then refolding back to 180°.

Crease cracking can be detrimental to the functionality and appearance of paperboard-based packaging. Researchers investigated the effect of creasing severity on the degree of reverse-side crease cracking (bead-side of the crease) of paperboard. Samples were creased with a range of rule and channel geometries, and the cracking degree was quantified as the percent of cracked length relative to the total length of the crease. The cracking degree was typically below 5 percent at low crease penetration depths, but was exponentially higher beyond a critical penetration depth. A rule and channel combination with a wider clearance shifted the critical depth to larger values. The creasing severity parameter, termed the creasing draw, converged the cracking degree data from different rule and channel combinations to a single curve. The critical draw is a material/system parameter that defines the level below which cracking is minimal.

For mills, the creasing operating window plot gives guidance on the tooling and penetration depth combination that will maintain creasing at an acceptable level. Paperboard converters can then choose a penetration depth that is deep enough to give an acceptable relative crease strength (RCS), without going too deep to produce cracking.

PULPING

How to use total dissolved solids measurements to evaluate the performance of diffuser washers—A mill study

Riku Kopra, Anna Pesonen, Jari Käyhkö, and Olli Dahl

Various types of pulp washing equipment are available. Each washing device has a unique mechanical construction, and the washing principle is often a combination of dilution, thickening, and displacement washing. This work examines the performance of the pressure diffuser washer.

In stepwise trials, researchers studied the effect of the feed and discharge consistencies on the performance of the diffuser. The effect of the downward velocity of the screen on the pressure diffuser's washing efficiency was also studied. The measurement of total dissolved solids (TDS) by a process refractometer was used as a wash loss measurement unit, and the refractometer's results were used in the calculations of standardized Nordén efficiency (E10) values. The chemical oxygen demand (COD) and conductivity values were also measured and their results compared to the TDS results.

The results indicated that feed consistency has a significant effect on the performance and effectiveness of the diffuser washers in the mill. As a conclusion from the mill tests, even small process parameter changes can provide enhanced diffuser washing at the beginning of the washing line, which has a direct effect on post-oxygen washing performance.