



IMAGE BANK ABTCP / SERGIO SANTORIO

The International Symposium on Recycled Paper gathered big names in this area all over the world

High technology and researches are allied to recycling

Demand for consumption cycle closure and material reutilization will cause the recycled paper market to continue on the rise. In parallel, technologies try to cheapen costs, facilitate processes, and impart more quality to the paper grades made from secondary fibres

By Marina Faleiros

Concepts like conscious consumption and recycling gained strength in the last years. In spite of the acknowledged role played by the afforestation practiced by the pulp mills towards atmosphere carbon sinking, and the sustainability of the virgin fibre based processes, the development of technologies for manufacturing a recycled paper of higher quality and taking most advantage of the available fibres is more and more valued.

The United Nations Conference on Climate Change, which took place in Denmark in December, gained space in the press and in the political world agenda, evidencing the tendency of the consumption relations to focus more and more on the capacity of the mills to prepare themselves to reutilize their products. And, as far as paper is concerned, besides searching for environment friendly solutions, recyclers must care about selection of materials – which cannot contain certain contaminants –, equipment cleaning, and better fibre reutilization, among other challenges. “Contrary to popular opinion, to produce paper from already used fibrous material and to achieve a quality comparable to that of virgin fibre products, requires high technology and deep process knowledge”, stresses Song Won Park, Pulp and Paper Technology coordinator at the Engineering School of the University of São Paulo (USP).

Considering this promising paper recycling scenario, the International Symposium on Recycled Paper, organized by ABTCP (Brazilian Technical Pulp and Paper Association) and Riarrec (Ibero-American Network for Cellulosic Recycled Material Revaluation), took place during ABTCP-PI 2009. The event gathered big names in this area all over the world, conducting a debate on the great challenges for this segment in the next years, as well as on the way

machines and processes can become still more efficient.

Martin Hubbe, professor of the Department of Wood and Paper Science of the University of North Carolina, is one of the most acknowledged specialists in recycling all over the world and proposed during the event that the virgin fibre paper manufacturers should produce their products already thinking how to make them more easily recyclable. For him, the quality and cost of the fibres that can be obtained from postconsumption papers critically depend on how the paper was manufactured and converted. “In the last decades, printing paper recycling has been affected in a positive manner by the transition to alkaline paper manufacturing conditions, as pulp fibres tend to break if the material is exposed to acid conditions and the paper becomes fragile during storage, especially in hot damp places”, he says.

Furthermore, the professor states that researches already prove that the fibre recyclability can be extended by means of refining strategies emphasizing external fibrillation and preservation of bulk, i.e. fibre volume. “Conventional drying agents, like cationic starch, were also considered to be compatible with

recycling”, he signals in his paper, presented on that occasion.

For Park, one of the Symposium coordinators, this kind of research is aligned with the present spirit of environmental sustainability, where as important as the final destinations is the environmentally friendly, sustainable, and adaptable manufacture. On the paper machine, for instance, there are other processes that can be thought of to facilitate recycling, like the drying stage. “In Hubbe’s work, he shows that the heating and wet swelling cycles a recycled paper is subject to will cause the fibre bonding capacity, besides their flexibility and conformability, to be lost”, he says.

Some other trends, evaluates Hubbe in his work, tend to be unfavourable to recycling, such as technologies used for hemicellulose removal. “If this extraction is carried out prior to pulping, fibres more susceptible to breaking may be obtained, especially when they are recycled, besides the fact that high levels of fillers, wax, high-strength resins, and some forms of curable inks will go on challenging paper recycling.” According to Park, the problem exists due to the fact that these contaminants



BY VOITH

Stock paper ready to be used: manufacturers should produce their products already thinking how to make them more easily recyclable



Bignardi's mill in Brazil: there are processes on the paper machine that can be thought of to facilitate recycling, like the drying stage

interfere beyond the microscopic structure of the fibres: "The elements gradually migrate to the surface, causing the fibres to gradually lose quality for recycling purposes."

TECHNICAL CHALLENGES

While much has been developed in the recycled paper manufacturing process itself, the equipment and broke treatment have not been forgotten either. Park evaluates that among the main challenges posed at present to recycled paper manufacturers is the elimination of contaminants of all sorts, from sand to plastics and adhesive glues, in addition to the search for a reduction in the negative impacts of stickies, and the improvement in the use of water. "We also need more pulp pumping technologies for contaminant elimination, as well as for pulper operation", he enumerates.

And it was precisely about these pieces of equipment that Ricardo da Quinta, from Voith Paper, spoke during his presentation at the Symposium. "The developments aim at reducing power consumption and the size of the

equipment, while maintaining the final quality of the product", he says. As equipment supplier, he explained, it is also important to minimize the amount of flakes left in the process. "There is already a new generation of pulpers with a much higher pulping efficiency, contriving to homogenize the fibre without so many losses in the process." Relatively simple solutions in terms of equipment design have also increased the efficiency of the process, indicated Quinta, such as adding spoilers, a kind of flap, to the helical pulper helix.

As far as contaminants are concerned, several researchers and universities all over the world go on occupying themselves with the so-called stickies, adhesive substances forming deposits in the recycling process. "Everyone is concerned about this matter, as they go on causing significant problems for the industry, they reduce productivity and the quality of the recycled paper", says Mahendra Doshi, another worldwide acknowledged researcher and president of the American consultancy Doshi & Associates, who presented a paper at



Oliveira: "Colloidal substances in the paper recycling process may lead to several operating problems, generating financial and productivity losses"

the event. He explains that the various denominations given to the stickies lead to much confusion in the scientific environment itself, and that it is necessary to focus on a more elaborate classification. "To classify is important for us to know how to deal with them and to do different kinds of monitoring", he says.

Benjamin Fabry, researcher of the Center of Paper Technology of the University of Domaine (France), also concentrates on the search for classification of the various types of stickies, in order to understand better ways of controlling them in the process. "The recycling units suffer from organic deposits on the machine, which, besides generating defects in the paper, also cause a runnability problem, leading to frequent cleaning shutdowns", he points out.

At the Federal University of Viçosa, Brazilian researchers used a biphasic aqueous system to extract colloidal stickies. Professor Rubens Chaves de Oliveira, who presided at a session of the Symposium and also had a paper of his presented, stated that colloidal substances in the paper

Potential source of stickies in mill using recycled paper

Adhesives	Coating binders	Ink residues	Deinking chemicals	Wood resins, rosins and wet strength resins
SBR	SBR (carboxylated)	Minerals oils	Resins	Resin
PVA	PVA	SBR	Fatty acid	Fatty acid
PBD	PVA _{OH}	PVA	Metal soaps	Rosins
PIP	Starch	Styrene acrylate	Non-ionic surfactant	Alum
EVA	Casein	Polyacrylate	Polycrylates	Urea-formaldehyde
Polyacrylate	Clay	Epoxy-acrylates	Hydrocarbon oils	Melanine-formaldehyde
PE	TiO ₂			
PP	CaCO ₃			
Waxes				
Tackifying resin				

SBR: styrene-butadiene / PVA: poly(vinylacetate) / PBD: polybutadiene / PIP: polyisoprene / EVA: ethylene vinyl acetate copolymer
PE: polyethylene / PVOH: poly(vinylalcohol)

Source: Douek M. "Overview of research on stickies at Pulp and Paper Research Institute of Canada (PAPRICAN)"

recycling process may lead to several operating problems, generating financial and productivity losses. "A way of minimizing these damages would be to reduce the concentration of these particles in the industrial white water, by using biphasic aqueous systems", he evaluates. For this purpose, the influence of the type of salt and of the temperature on the extraction of colloidal particles from white water in biphasic systems prepared with proper amount of tribloc copolymer (bifunctional bloc copolymer surfactant, with primary hydroxyl groups at its end), Na₂SO₄ or Li₂SO₄ and industrial white water.

In deinking, another important process for secondary fibre recovery, Doshi also suggests further investments to understand how to avoid contaminant recirculation within the process, as well as technologies to remove inks from the washing water. "It is very difficult to remove ink from an ink jet printing and there are not many stud-

ies available into using cationic surfactants and detergents, in addition to enzymes, in deinking", he says.

José Turrado, from the Pulp and Paper Department of the University of Guadalajara (Mexico), also spoke about details of the deinking process in an alkaline environment, which allows pigment separation and elimination, but because of its own nature causes dissolution of fibre components. "Then we researched deinking by a flotation process in a neutral condition, with application of such biodegradable surfactants as ethoxylated fatty alcohols (EFA), which resulted in an increase in efficiency in terms of gloss, colour, and dirty particle counting, besides ash elimination", he reports.

For the future, much more should be still thought in terms of recycling. According to Park, researchers will better understand the phenomena and challenges associated with recycled paper manufacturing on a nanometric scale, where the forces resulting from

the physical and chemical aspects become mixed up, integrate with each other, and are equally scaled. Citing the paper presented at the Symposium by Pedro Fardim, professor at the University of Åbo (Finland), Park states that researchers will have to know how to use and to interpret results obtained by nanotechnology instruments, such as AFM (Atomic Force Microscopy), XPS (X-ray Photoelectron Spectrometry), ToF-SIMS (Time-of-Flight Secondary Ion Mass Spectrometry), SEM-EDXA (Scanning Electron Microscope with Energy Dispersive X-ray Analysis), and FTIR (Fourier Transform Infrared Spectroscopy). "Not only these instruments are expensive, but also the training of specialists who know how to use them. To analyze the surface chemistry of secondary fibres and how to interpret it to achieve technological improvements represents one of the research-related challenges for the future", says Park.

For Fardim, these monitoring



Recycling across the world

Brazil is still far from the first world countries, as far as its recycling rate is concerned. Alfredo Leon, coordinator of the Technical Commission on Recycled Paper of ABTCP, presented some figures during the Symposium, which show this reality in the country; where only about 45% of the consumed papers are recycled. "Approximately 40% of the papers manufactured in Brazil use broke as raw material, the highest concentration of which is represented by corrugated board", he says. To have an idea in comparative terms, Germany recycles 75% of its paper, closely followed by Japan, with 73%.

In Europe, paper and board recycling has a long history. The collection rate is 65% for the countries constituting the European Confederation of Paper Manufacturers, causing the continent to be the leader in collection and recycling, according to Harald Grossmann, professor of the University of Technology of Dresden (Germany) and one of the lecturers at the event. "Used papers and boards compete in the same proportion with virgin fibres as raw material for the industry, and there is no doubt that all efforts will be made to further increase this utilization", he points out.

He signals that one of the factors that should develop most the use of recycled material are the initiatives connected with the impact of the industry on global warming, and that European companies must grow at present without increasing the use of natural resources. "The optimization of the product life cycles became one of the fundamental goals of the industrial production, which demands a highly qualified workforce, capable of operating and managing sustainable production systems", he states.

For Song Park, from USP, it is necessary for the manufacturers to be attentive to the changes in the concepts of consumption, lest market opportunities are lost. "In Brazil there is still an incipient market in the area of deinking for writing and printing paper recovery, because we are a great producer of virgin fiber. If we become excellent also in the quality of this recycled paper, we would be able to win a big market share, considering that we have one of the best conditions in terms of availability of water, heating energy, and electricity all over the world, which gives us a great advantage in the future of this segment", he concludes.



instruments are very important, as several chemical residues from both printing and paper manufacturing process get firmly bound to the surface of the fibres. "And they may affect interaction in the recycling process, and

reduce fibre bonding in the recycled paper". The researcher believes that better understanding the surface of the fibre is one of the ways to know more precisely, for instance, how many times a fibre can be recycled. "Moreover,

ToF-SIMS and XPS tools used together provide a great power of determination of the recycled fibre composition, which can be used to solve practical process problems that are not yet solved at present", he concludes.

*** Check all the papers presented during the International Symposium on Paper Recycling Research and Technology in the website of the magazine: www.revistaopapel.org.br.**