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International Mechanical Pulping Conference 2009 : forte implication de FCBA et du CTP

Cette conférence biennale rassemble l'ensemble des chercheurs, industriels, équipementiers et fournisseurs travaillant dans le domaine des pâtes mécaniques. FCBA et le CTP ont largement contribué à cette manifestation au travers de leurs différentes présentations.

L'International Mechanical Pulping Conference s'est tenue cette année à Sudsvall en Suède au mois de juin. Cette conférence a lieu tous les deux ans et rassemble l'ensemble des chercheurs, industriels, équipementiers et fournisseurs travaillant dans le domaine des pâtes mécaniques. Les thématiques suivantes ont été abordées :

– Transfert de nouvelles technologies dans les usines
– Pré-traitement des copeaux et élimination des extractibles
– Développement de procédés, efficacité énergétique et technologie enzymatique
– Matières premières et recherche fondamentale sur les fibres
– Développement du procédé de mise en pâte de meule
– Optimisation du blanchiment
– Classage et fractionnement
– Qualité des fibres et des pâtes et propriétés des produits
– Développement de systèmes de récupération d'énergie et de chaleur
– Raffinage à basse consistance et efficacité énergétique associée

L. Savoye *(étudiante en thèse au CTP-InTechFibres)* a remporté le Keith Kirkpatrick Award 2009 qui récompense un jeune chercheur présentant pour la première fois à la conférence internationale sur les pâtes mécaniques des travaux innovants et faisant avancer l'industrie. Sa présentation concernait la réduction de l'impact environnemental du blanchiment au peroxyde de la pâte TMP, intégrant la DCO récalcitrante et de nouvelles sources d'alcali.

Michael Lecourt *(chef de projet FCBA, Pôle Nouveaux Matériaux-InTechFibres)* a présenté un poster sur l'influence de l'eau dans la fabrication des pâtes thermomécaniques (projet Orichip).

Valérie Meyer *(chef de projet CTP-InTechFibres)* a présenté un poster sur le traitement enzymatique des copeaux afin de réduire la consommation énergétique du procédé thermomécanique.

Michel Petit-Conil *(directeur du Pôle Nouveaux Matériaux de FCBA et Manageur de l'équipe Process – Pâtes et Fibres fonctionnelles du CTP)* a présidé la session sur le blanchiment des pâtes mécaniques.

Cette conférence a rassemblé 250 personnes représentant 16 pays. Les principales sessions étaient axées sur les thématiques suivantes :

– Mise en place de nouvelles techniques en usine
– Pré-traitement des copeaux et élimination des matières extractibles du bois
– Développement de procédé et efficacité énergétique
– Matières premières
– Développements dans la mise en pâte mécanique de meule
– Optimisation du procédé de blanchiment
– Classage et fractionnement
– Qualité des fibres et propriétés des produits
– Développements industriels – questions de récupération
– Développement de l'efficacité énergétique du raffinage à basse consistance
– Présentations des posters

La particularité de cette conférence était, qu'après les présentations orales, chaque poster était présenté pendant 5 minutes, ce qui permettait d'ouvrir la discussion auprès des posters.

Des informations concernant le programme peuvent être obtenues sur le site de la conférence.

Les notes suivantes, prises au cours de la conférence, présentent les résultats majeurs de chaque présentation.

Conference introduction

… *Welcoming (P. Engstrand, FSCN Mid Sweden University)*

… *The future of mechanical pulp based products in times of tough competition on products as well as regarding raw materials and energy (K. Eriksson, SCA)*

40% of the wood in Sweden is spruce. Thin, strong fibres with high brightness. Our region is unique with concentration of industry: Metso, pulp and paper mills (especially SCA), sawmills, research facilities at Mid-Sweden university and at SCA (90 researchers), plants nursery. SCA has no hydro-electricity plants but is building a wind power plant. Mechanical pulp has represented 20% of the total world pulp consumption in 2009, of which 53% is TMP, 20% CTMP and the rest SGW/PGW.

SCA: 11 bn € in 2008 in forest products, personal care, packaging and tissue, 893 m € operating profit, the largest forest owner in Western Europe.

Newsprint: 12 M tons in 1991 down to 6 M tons in 2008. Increase in Swedish energy cost: 20 to 40 €/kWh/t, representing 20% of the Swedish newsprint price; that is a problem.

LWC: the cost between companies can present a difference of 110%, indicating that only some of the manufacturers will survive.

SCA products: 1 M tons in 1998 representing < 4% versus 1.35 M tons in 2009 representing 35%. The development of mechanical pulp fibres into strengths and optical properties is an important issue, which allows the decrease in chemical pulp content.

Alternative uses of 1 M m^3 of wood could generate interest in economy: 3440 M SEK/y for LWC, 1850 for News, 950 for Kraft, 343 for biofuel heat, 226 for Fuel black liquor, 124 for bioethanol.

Future in mechanical pulping: lower SEC, higher brightness, higher opacity, improved printing surface, lower substance, optimal use of the fibre material. This is what we should do.

… *The county of Västernorrland. The energy situation today and in the future (B. Källstrand, County of Västernooland)*

Forestry is the most important industrial sector. But electricity generation sector is also important, especially based on hydro-electricity. In the world, electricity production is covered by 80% by oil and natural gas. It is a risky situation to depend on oil and gas. Problem of increase in CO_2 emissions. Swedish government decides to build nuclear plant to face this issue. Opportunity for green power. Many initiatives can be seen, influencing the situation to evoluate.

Energy efficiency, carbon-free energy and good fibres production will play a role in the development of mechanical pulping.

… *Mechanical pulping, a challenge and an opportunity (U. Hellberg, Metso Paper)*

Mechanical pulp production is presently declining, due to mill closure and decrease in mechanical pulp content in paper furnish (recycled paper growth). Problem of increase in the costs of raw materials for a constant paper price. Return on investment has to be guaranteed by someone.

Development of new segments for CTMP: turbine segments allowing to reduce energy by 15%. LeanE is the market name for Metso's energy

saving concept for mechanical pulping (cf paper presented at the conference). AQC and multisimplex improved automation and process control. Metso has the most largest pilot plant: TMP & CTMP, PGW + paper and board machines. Collaboration with FSCN + Mechanical pulp industrial research college – Mid-Sweden University. The future of mechanical pulping is in our hands.

… *Mid-Sweden University, research today and tomorrow (A. Söderholm, Mid-Sweden University)*

Same size as Stanford University, sufficient for organising good education and research. University had also R&D strategy but the level is different compared to R&D for industrials: long term, curiosity, peer reviewed, public and published science for research; patents & IPR, applied, short/mid term, commercialisation for development. Both act together. Engineers are expected to spend 20% of their time working on a project of their own choosing, in order to involve all engineers to be engaged in the innovation process (Google Research). Different approaches for R&D depending on the company or organisation. R&D is more often than not, in successful cases, organised jointly by industry, universities and various facilitating organisations. It is necessary to be relevant. Any research may provide world class results that may, or may not, be possible to turn into industrial applications. Cooperation may build a world class industrial cluster.

Session: Implementation of new techniques at mills

… *On the carbon footprint of mechanical and chemical pulping, papermaking and power generation (H. Münster, Andritz)*

Mechanical pulping representing 12% of fibre input and 23% of total energy demand for papermaking. Awareness of PPI of its contribution to a low carbon, sustainable economy. It is important to establish a carbon footprint for PPI. Ten elements taken into account in CEPI's carbon footprint framework: carbon in forests, carbon stored in forest products, GHG emissions from forest products manufacturing facilities and associated with producing fibres and with producing other raw materials/fuels, with purchased electricity, steam, heat, hot air and cold water, transport related GHG emissions, emissions associated with product use, with product end of life and avoided emissions and offsets. Development of a calculation programme giving a versatile model of mechanical and chemical pulping, papermaking and energy generation. For mechanical pulping, carbon footprint of TMP (2000 kWh/t) is between 0 and 1680 kg CO2/t, depending on the method of power generation. This a general information.

One tone of wood equals 500 kg carbon, i.e. 1833 kg CO_2. If the product life is long (>100 years), carbon is removed the atmosphere. If the CEPI methodology is taken into consideration, in mechanical pulping, the pulping yield must be considered and the way how the energy is produced. At the gate of a paper mill, 1155, 766, 834 kg CO_2/t for TMP, NBSK (non integrated), DIP, i.e. 920 for the paper (33/33/33% of each pulp). It is high value of burning lignin in the boiler to generate the energy. If the wood quantity is considered, 418, 766, 0 kg CO_2/t for TMP, NBSK, DIP is obtained, i.e. 29 for paper sheet. If the wood is considered in building

products, 1155, 766, 834 kg CO_2/t for TMP, NBSK, DIP. The carbon footprint increases with specific energy in TMP production. In a paper composed of NBSK, TMP and DIP, the carbon footprint was minimum at 15% TMP in mixture with DIP and 33% NBSK. A key issue is to improve the energy efficiency of mechanical pulping and of black liquor conversion to energy.

… *Comparison between high and low consistency refining at Yueyang P-RC APMP mill (E.Xu, Andritz)*

Tiger Forest&Paper Group is one of the most important groups in China. The P-RC APMP line was started in 2003. Great flexibility of the plant to wood furnishes and paper products. Test LC refining for reducing energy and determining the impact of pulp properties. Two LC refiners on the industrial lines. 75% poplar + 15% unknown local hardwoods. Newsprint grade. LC refining in Twin Flo at 4.5% consistency. LCR had ~200 kWh/t less specific energy consumption (11%) associated with a slight increase in tensile index, that could be due to various in chemical impregnation in the mill. No effect on bulk, scattering and opacity and some decrease in tear (10%). LCR of poplar P-RC APMP could be used in some paper grades where tear strength was not important. Brightness reached is 65% ISO.

Due to wood supply which is difficult in China, even branches are used for the pulp production. Therefore, more bark is present in the pulp.

… *Optimisation of TMP fibre properties for SC rotogravure – Full scale experiences from Norske Skog Saugbrugs (K. Mosbye, Norske Skog)*

550000 tons of SC on 3 machines. 600 employees. 2 TMP lines + 1 SGW line. SCA+ paper grade has been chosen because it is the only Norske Skog mill producing SCA grades. Important properties: surface roughness,

formation, calendering blackening, opacity and air permeability. After TMP rebuild, improvement of optical properties and more particularly of surface roughness. Reduction in porosity with less variations. Implementation of a fibre strategy: sorting and homogenisation of roundwood to reduce variation in incoming fibre properties, implementation of TMP process concept for SC, operating conditions. Process improvement impacts: increased production capacity, longer plate lifetime (1000 h to 2500 h), better quality and improved quality stability, operator focus on quality, improved heat recovery and reduced maintenance. Unplanned stops decreased from 7 per day to 1 per day. Doubling of the split fibres content. Increase the light scattering coefficient from 61 m²/kg to 67 m²/kg with lower scatter. Improved printability of the 52 g/m² paper.

Posters Presentation related to the session

- Better understanding of TMP refiner instrumentation (A. Fredrikson, KCL)
- Determination of freeness reduction by refining intensity definition based on fluid dynamical model (J.P. Huhtanen, Tampere University of Technology, Energy and Process engineering)
- Deterministic blow line consistency modelling and prediction (L. Ettaleb, FP Innovations Paprican) - *Cancelled*
- Refiner gap measurement (B. Akerblom, Dametric)
- Determination of moisture content in spruce woodchips by dual energy x-ray absorptiometry (M. Hultnäs, SLU)

Session: Chip pre-treatment and extractives removal

… *Reduction of energy consumption in refining through mechanical pre-treatment of wood chips (D. Gorski, FSCN Mid-Sweden University)*

Literature review. The material has no time to relax from the previous hit, less energy-efficient deformation (impact of frequency). Impact of strain amplitude, of temperature control. Consideration of different pre-treatments of wood chips, such as bivis process, MSD pressafiner, …

… *Mass balance of extractives around impressafiner in mill and pilot scale (M. Tanase, Norwegian University of Science and Technology)*

Resin canals after pre-treatment in the impressafiner are destroyed. 65% of resin acids were removed whereas the fatty acids stayed into the chips of loblolly pine. Trials with impressafiner at Braviken Holmen Paper mill. 15% of the extractives were removed from this pre-treatment: 14% of fatty acids, 35% of resin acids, 10% of sterols for Norway spruce. It is possible to use cationic polymers to flocculate extractives in the waters.

… *Design and operating experience of a press washing system at Inforsa newsprint mill (G. Harris, Andritz)*

Focus on dusting and not to linting, i.e. dust falling from sheet surface at the end of the papermachine. The mill correlated the intensification of the problem to the reduction in effluent volume. High pitch coincided to high dusting. Important causes are not well consolidated paper web and agglomeration of resin. Dusting was more important in winter than in summer. Before modification of the process: problem in TMP thickener with 3% feed consistency and 6-8% discharge consistency, good fibres were

sent to the reject refiner and fresh water was added without heating. The modification consisted of the installation of a disc filter and a screw press, which generate 3 effluents. The purge was increased to 8 m3/t composed of discfilter effluent and screw press filtrate. Screw press filtrate to sewer varies from 0.25 to 1 m3/t adjusted on the season. The total loss of fibres is 0.4%. After installation, dusting problem was solved, wet-end additive (bentonite) and cationic polymer stopped, retention aid dosage reduced by 50%, hydrosulfite charge reduced by 30% and papermachine efficiency increased by 1%. Development of a method to visualise the resin-rich particles in paper by using a fluorescent dye and a fluorescent microscope (BASF method).

Session: Process development and energy efficiency

… *Enhancing fibre development at reduced energy consumption using TMP sub-processes and targeted chemical application – Pilot and commercial scale results (J. Hill, Norske Skog)*

Norske Skog management will accept no investment with a ROI of 2 years, even if the reduction of energy consumption can have a return of millions €. Identification of pulp quality priorities: for newsprint and improved news, tensile strength and optical & surface properties set boundary conditions; for magazine, surface properties and other properties set boundary conditions. Interest in A-TMP process: impressafiner + Fiberizer + 1st stage RTS refiner + 2nd refiner. The pulp after the Fiberizer looks like a fluff pulp. Better results when the chemicals are introduced in the 1st stage refiner. Impregnation of white spruce with 3% bisulfite, energy reduced from 3142 to 2494 kWh/t (-20%) at the same tensile index. Decrease in tear from 9.0 to 7.7 mNm²/g. A little bit more shives. No effect on scattering and the brightness increased from 56 to 61.9% ISO. Comparison of different softwood species. When the impregnation is located after the impressafiner or Fiberizer or 1st stage for Norway spruce, 2604 kWh/t (press) to 2338 (1st stage) (-10%), increase in tensile (50.7 to 52.3), same tear. Increase in bisulfite charge for black spruce and radiata pine, decrease in energy (-26%), shives at the same tensile for black spruce; increase in tensile for radiata pine, decrease in energy (-28%). Depending on the wood species, the energy reduction is different. In general, less long fibre fraction, more split fibres in R50, higher specific surface area of long fibre fraction and fibrillation index.

Rebuild of Pisa mill: installation of a MSD pressafiner. Test of A-TMP and LC refining. Decrease in energy consumption when RT pre-treatment + bisulfite is installed, increase in tensile index. It allows the mill to recover the properties obtained previously with Aracauria species which is now forbidden.

… *LeanE. Improved energy efficiency (J. Lauritzen, Metso Paper)*

It is a combination of products, cooperation and experience. It is a Metso concept regarding how to work with energy optimising in mechanical pulp mills. Steps: collect the baseline data, perform benchmarking, prioritise and suggest solutions, implementation, verify results. Understanding all the building blocks and how they interact. Introduction of segment design in the reject treatment line.

NSI Skogn, Norway: new recovery system, new segments in 1st stage refiner. Results: energy reduction, reduction in freeness variation, brightness improvement, line availability improvement, increased strength properties.

Sodra Cell Folla, Norway: pb of increased operating costs, use of turbine segments. Results: increased production, reduced chemical consumption, increased availability, decreased energy consumption, higher bulk and lower shives content.

Stora Enso Fors, Sweden: objectives: reduce operating costs, feedmax, plugscrew, heat separation. Results: chip dewatering improvement, production increase, reduced fibre carryover, refiner dilution decreased, increased strengths.

Steam recovery varies from 0 to 1.1 tonnes per MW applied refining energy. Auxilary energy can vary from 4 to 15%. Opportunity for LeanE application.

Time is for cooperation, even between competitors.

… *Targeting enzyme formulations at selective wood components for optimised thermomechanical pulping of spruce (M. Sabouring, Andritz)*

Increasing fibre surface area for a better enzyme penetration. Use of the Fiberizer. Evaluation of individual and multiple enzymes on spruce fiberised chips.

2 pectinase treatments: Novozymes Pectinex (720 g/t) Novozyme 863 (pectinase + hemicellulases, 830 g/t). Destructuration of chips in pressurised chip press, than in Fiberizer, coolin of the pulp for 30 minutes before enzyme application in HC mixer, 2.5 h, 47°C.

SD refiner (1500 rpm) + DD refiner: 200 kWh/t energy reduction with water or enzymes, increase in tensile and tear. Pectinex is the most interesting enzyme. Bisulfite is more interesting for energy reduction but lower tensile and tear indexes are obtained compared to pectinase treatment. Drastic decrease in shives content, increase in scattering. Same brightness. Slight increase in COD and decrease in extractives. If a given tensile is considered, Pectinex allows to save 200 kWh/t (8%) compared to water and higher scattering. Peroxide bleaching: enzyme-treated pulp is better bleached than TMP but less than with water control for Pectinex. For the other enzyme solution, higher bleachability.

Multiple component blend (pectinase, laccase, lipase, glucanase, 840 g/t, 40-50°C), SD (2300rpm) + DD : increase in tensile index and tear index,

reduction in shive content. Higher COD. At similar tensile index, 200 kWh/t energy savings with higher tear index. Better bleachability.

Posters Presentation related to the session

– Energy efficient refining and screening control at SCA graphic Sundsvall, Ortviken mill (J. Brive, Metso)
– Why the economical impact of both pulp quality and applied energy must be considered to reduce operating cost of TMP (N. Wild, BD Hydro)
– How will water management in refiners impact on pulp quality and refining ? (ML, FCBA)
– Bio-TMP process to save energy: comparison of enzymes efficiency (ML, FCBA)

Session: Process development and energy efficiency

… *Saving energy is no longer a dream, just remove the steam (O. Johansson, J&L Fiber Services)*

E-max plates to better evacuate the steam generated during mechanical pulping. Energy savings of 25% for a given pulp quality, resulting in 7% reduction in production costs.

… *Refining zone temperature control: a good choice for pulp quality control ? (K. Eriksson, Chalmers University of Technology)*

Experiments on a SD refiner in primary position. Modelling approach of the refiner. Specific energy should not be used for controlling the refiner. The motor load is not as easily modelled. Dynamics in the refining zone should be considered. Temperature sensors in this zone can provide information about the local refining conditions, but not specific energy. Conditions in defibering zone and in fibrillation zone should be also considered. Secondary refiner will be considered in the project.

… *Study of energy balances and flow conditions in blow lines in two-stage mill scale refiner line (T.Huopana, University of Jyväskylä)*

Cancelled

Session: Raw material aspects

… *Energy consumption in refining of Scots pine and Norway spruce TMP is governed by fibre morphology and ultrastructure (G. Daniel, WURC)*

Pine demands more energy to specific strength. Wood anatomy, fibre microstructure, ultrastructure and topochemical analyses would help understand this fact. It was observed 2 groups between spruce and pine during mechanical pulping for main pulp properties but also fibre characteristics.

Wood anatomy: Slightly higher late wood content in pine. Higher cell wall thickness for mature wood. Totally different fibre morphology in the annual ring for pine: smaller lumen, less collapsible fibres in the wood. Difficulty to detect mild compression wood. More lignin.

Microscopy: for pine, defibration is easy generating less shives. Shives trap the initial information on the defibration. Separation through CML/S1 whereas separation occurs in between S1 and S2. 2 stages of fibre development in pine are not concurrent as observed in spruce. Immunolabelling of glucomannans: more in S1 layer in pine. Stiff fibres remain uncollapsed even after $2^{nd}/3^{rd}$ refining stages.

Extractives: Most of them are localised in the rays. A lot of triglycerides and unsaturated fatty acids. Extractives are strongly associated to the fibre surface.

… *Use of dry wood chips for thermomechanical pulping (I. Omholt, FP innovation Paprican)*

General issue: long time storage, fire killed trees, beetle killed trees or sawmill residues. What is the critical moisture content ? is it possible to rewet the chips in the process ? Are there permanent effects ? Use of whole logs from black spruce, balsam fir and grey-stage lodgepole pine. The wood used is 98% solids content.

Energy begins to decrease at 85-86% solids content at 100ml CSF. Same pattern for fibre length, for strength properties. With atmospheric steaming, solids content decreases with time, but 80% solids content could be reached after 30 min. It is possible to reach a 5% rewetting with atmospheric steaming. Soaking in barrels for 15 min after steaming decreases to 50% solids content. Press impregnator allows to reach 35%. Dried chips consume the lowest SEC. Drying+rewetting reincreases the SEC and allows to recover the fibre length, especially for balsam fir and partly for black spruce. Similar trend for strengths. No significant effect on scattering, not due to more fines. The explanation is a better bonding.

Possible explanation: loss of permanent bound water? Some fibre hornification ?

… *The influence of fibre wall thickness and microfibril angle on fibre development in the TMP process (M. Rusu, NTNU)*

The reduction in fibre wall thickness from wood to pulp increases. Larger reduction in cell wall thickness for spruce than pine. Cross sectional compactness (Z parameter varying from 0 to 1): decrease in the first refining stages indicating a removal of raw material and resulting in more thin-walled fibres. Similar trend for fibre wall thickness. For pine pulps, the

Z parameter distribution reveals two distinct peaks after refining. This is not the case for spruce. More fines are produced during pine refining, because of higher fibre cutting. External fibrillation seems to be slightly higher for spruce but at higher SEC, the difference is very small. More split fibres are present in spruce pulps than in pine ones. Spruce pulp fibres have a higher internal fibrillation.

Posters Presentation related to the session

- Quantifying wood fatigue generated in cyclic loading (A. Salmi, University of Helsinki)
- On the importance of fatigue for the rheological properties of wood (B. A. Engberg, Mid Sweden University)
- Strain distribution in annual rings under compression by high speed photography (T. Björkqvist, Tampere university of technology)
- A device for studying wood chipping under realistic conditions (L. Hellström, Mid Sweden University)
- Multi-rate optimal control of the TMP refining process (A. Karlström, Chalmers Science Park)

Session: Groundwood developments

… *The potential of EES (energy efficient grinding surface). Concept in SC paper production (E. Saharinen, KCL)*

It is possible to produce a good SC paper with mechanical pulp made with 30% lower SEC. The EES is flat compared to conventional surface, but higher amplitude. Evaluation of EES-PGW in SC paper. 30% energy savings are observed (500 kWh/t). Higher feed rate and similar fibre length at a given freeness. Evaluation of paper quality on dynamic sheets produced with different pulp compositions (PGW, chemical pulp, 25% filler). Calendering of the sheets in 3 nips. No impact of EES-PGW on paper bulk. Increase in tensile index and Scott bond and decrease in tear index. Opacity decreased more during calendering. Slightly higher roughness and lower brightness. Closer paper sheet, which could be important for ink absorption reduction and print through reduction.

… *Wood and fibre properties of Norway spruce. Impact on quality of mechanical pulp and wood-containing paper grades (G. Martin, Institute of forest utilisation and work science, Albert Ludwigs university)*

Analyses of 7 stands in Germany. 6 trees per stand and samples taken at different locations of the stem. Grinding trials at lab scale at Darmstad and at mill scale with a Voith grinder.

Wood properties: Cell wall thickness of latewood is significantly higher (4x) than of earlywood (SilviScan). Forest stands with slow growth have thicker cell wall thickness. Cell wall thickness increases from bottom to log top. Fibre width is roughly constant but latewood and earlywood fibre diameters differ. Fibre diameter is influenced by growth characteristics. A model was

developed based on cambial age and radial position in the stem: fibre diameter = 3.13 – 0.0045xcambial age + 0.134 ln(distance to pith). R^2=0.58.

Pulp properties: variation of brightness between forest stands and between sub-montain and planar stands. Higher brightness than the mill desired level is reached for both stands categories. Brightness shows correlation with moisture content. High lignin content content has a negative impact on brightness. Metal ions have to be taken into account. Good tensile strengths. Important variations between stands. Slow growing materials give higher strengths. Bad correlation between wood properties and pulp tensile strength. Measurement of some logs in each truck (ring width, diameter) allows to sort the logs to predict tensile strength, based on the developed model, but difficult to implement at mill scale. No sharpening is necessary for this new surface stone.

… *Initial fiber effects in pressurised grinding as analysed by SEM (O. Tuovinen, Metso Paper)*

1st phase is elastic and plastic compression in grinding. 2nd phase is fibre peeling. Fibre deformation also occurs during this peeling phase. At least, 80% of grinding force is carried by limited grit-to-wood contacts. Energy is dissipated into heat. 1000 grits contacts before the fibre release from wood. Effective grits cause plastic deformations and defibration of wood. Ineffective grits produce heat, elastic deformations of wood and abrasion of wood. Test and visualise the initial fibre effects during fibre peeling in realistic grinding conditions after the first interactions between the grit and wood fibres in order to design new grinding surfaces. Design of a new system for evaluating these effects. Preheated wood gives scattered results because the wood is flexible after heating. Dominating effects mask the

fibre deformations expected, which can not be quantify. Some release of fibre fragments, fibres and fibrils are observed by SEM at low wood pressure. At higher wood pressure, the grits have worked more in the wood structure. Cutting of fibres is observed. At higher grit speed and low pressure, more superficial effect.

Session: Bleaching process optimisation

… *The influence of process conditions during pulp storage on the optical properties of Norway spruce high-yield pulps (S. Enberg, Mid Sweden University)*

Decrease in brightness during pulp storage. A pulp composed of 93% TMP and 7% SGW, bleached at mill, was well washed before simulating the storage conditions. Brightness loss and k coefficient increase when the temperature during storage and time increase. Temperature and time should be keep low. S coefficient increase at the beginning masks the formation of chromophores, revealing some change in paper structure. Pulp consistency and pH have minor effect. Colour change to yellow and sometimes to red.

… *Magnesium hydroxide based peroxide bleaching of mechanical pulps: process chemistry and industrial implementation (Y. Ni, University of New Brunswick)*

The use of magnesium hydroxide generates a decrease in COD, an increase in bleaching yield and a decrease in anionic trash and oxalate formation and a cleaner pulp. Compared to NaOH, higher content in soluble oxalate than precipitated one. With SEM, it is possible to see oxalate crystals with NaOH and not for Mg(OH)2. About 50-60% less anionic trash formation, even with the increase in magnesium hydroxide charge. The increase in anion trash is constant. Much less lignin and extractives are associated to anionic trash. Pulp properties of maple CTMP: decrease in tensile, increase in bulk with magnesium hydroxide when high alkali charges are applied (> 5%). For

TMP: similar tensile at low alkali charge and decrease in tensile (10-15%) with magnesium hydroxide for high alkali charges.

… *Reduction of the environmental impact of TMP peroxide alkaline bleaching (L. Savoye, CTP)*

Posters presentation related to this session

– Bleaching process improvement through sustained technical partnership (J. Blanc, Arkema)
– Peroxide bleaching of mechanical pulps, TMP and TGW, with different amounts of fines (A. Karlsson, Mid Sweden University)
– Activation attempts of mechanical pulp peroxide bleaching (T. Liitiä, KCL)
– Using HYP for the production of uncoated paper and its impact on its brightness stability ((Y. Ni, University of New Brunswick)
– Lignin removal from wastewater by adsorption (K.A. Andersson, Mid Sweden University)
– Energy efficient refining of black spruce TMP by using acid hydrogen peroxide (K. Walter, Mid Sweden University)

Session: Screening and fractionation

… *Selective refining of TMP long fibre fraction (R. Lanouette, CIPP)*

Primary pulp from Papier Masson mill. Fractionation with pressure screen with 0.25mm smooth holes. 2 stages in cascade. Short fibre fraction: 15 ml CSF, mainly composed of flake-like particles. Long fibre fraction: 723 ml CSF, 1.74 mm. Refining of this fraction with 1 HC stage, 2 HC stages, 2 LC stages.

Less energy is consumed with LC refining. More cutting effect at the same peeling effect on the fibre wall for the R28 fraction. More cutting and more fibre development for the R48 fraction. Higher peeling and cutting for R100 fraction. The shorter the fibres, the better the LC refining. Good bonding potential of these long fibres. Some loss in tear with LC refining. The association of short fibre fraction and 2 stage HC refined long fibre fraction, the same relationship is obtained between tensile and tear, whereas higher scattering is reached. 28% energy consumption

… *Mechanical pulp quality and fractionation. Part 1: upgrading newsprint TMP for value-added grades (R. Amiri, FP Innovation Paprican)*

Fractionation technology: pressure screen or hydrocyclone. Alkaline peroxide treatment of rejects has an interest by reducing the energy consumption and improving the pulp properties. The objective is to apply fractionation and AP pre-treatment of rejects to improve the pulp quality and to demonstrate the potential of the developed technologies in upgrading a typical newsprint TMP for use in value-added grades. To preserve the long fibre content. Designated grade: LWC based on newsprint TMP made with black spruce and balsam fir (185 ml CSF, 1800 kWh/t).

Fractionation of this pulp with pressure screen and 3 hydrocyclone stages. The rejects from pressure screen and the 3rd hydrocyclone are treated (AP) or not before refining. Potential of energy savings and lower furnish cost by reducing the kraft content. Production of an improved TMP pulp.

… *Screening of TMP is essential key process in SCA Ortviken mill (P. Asplund, SCA Graphic)*

Presentation of the different modifications of the screening room at the mill for reaching the new requirements in the paper grades produced.

Session: Pulp fibre quality and product properties

… *Solving printing problems in a mechanical pulping process (I. Nurminen, KCL)*

The increase in the refining intensity by increasing the speed or changing the plate pattern in the 1st refining stage enhances the pulp properties of the long and middle fibre fractions. If the intensity is decreased, the properties of the long fibre fraction decrease but the bonding of the middle fibre fraction improves. When the bonding and the conformability is changed, the proportions of the fibre fractions changed. For printing papers, long fibres are not desired. It is important to define the fraction that causes the printing problem.

Fibre roughening: effect of stiff short and flexible long fibres: tensions in fibres are released and fibres tend to rise, weakening of wetting and opening printing nip pulls fibres out. In drying, the fibres do not draw back and ink prevents fibres to draw back. It is necessary to reduce the thick micro shives, which are located on the paper surface from the short fibre fraction. The long fibre fraction must be modified to be more flexible. But some wavening problems occur. This is due to the higher amount of bonding fines.

Picking and linting case: due to small shives, fragments of fibres, ray cells and fines. Cutting-type pulp production makes picking higher. Solutions: do not produce poor bonding particles (higher temperature and low intensity defibering, low intensity refining), bind poor bonding particles (higher pulp strengths, starch), remove poor bonding particles (hydrocyclones better than screening).

Mottling: more fines, the long fibres the most flexible

Missing dots: more fines with not too high bonding, long fibres the most flexible

There are some conflicts between fibre characteristics and paper properties to solve all the printing problems.

… *Effect of fibre dimensions on moisture induced roughening of paper produced from Norway spruce and radiata pine thermomechanical pulps (K. Murton, Scion)*

Pulp samples are collected from New Zealand and Scandinavian TMP mills at different stages of the process. The radiata pine has longer fibres than spruce with larger perimeter. The cell wall area is considerably greater and is constant with freeness, except for the low freeness level. The cell wall thickness is also higher. Radiata pine TMP fibres have higher coarseness.

Dynamic sheets are produced and analysed on the top side but the tendency was the same for the wire side. Roughness of radiata pine TMP sheets is higher. Similar responses to wetting. Calendering the sheets at the same smoothness: more nips are required for radiata pine TMP sheets. Low coarse earlywood and latewood fibres are fewer for radiata pine TMP.

… *The influence of process design on the distribution of fundamental fibre parameters (O. Ferritsius, Poyry, S. Reiyer, Mid Sweden University/Stora Enso)*

How do we wish to develop the fibres in the refiner ? How do the fibres develop in the refiner ? It is necessary to start from the products and go forward to the fibres for a good design. Characterise the pulp with 5 parameters: fibre bonding, long fibre influence, shives, colour, resin.

Bonding indicator (BIN) distribution is important. This is the fingerprint of the pulp. The average value is not sufficient. The wideness of the distribution is defined when removing the 5% extreme zones. The more the energy, the higher the wideness. If wideness is plotted with BIN, refining increases the bonding.

Focus on the products, recognise the pulp fingerprint, consider the fibres themselves and not only the pulp.

Posters presentation related to this session

- BIN, a method to measure the distribution of fibre bonding ability (S. Reyier, Mid Sweden University/Stora Enso)
- Using acoustic emission monitoring to evaluate the through the thickness and in plane strength properties of TMP rejects fractions (S. Norgren, Mid Sweden University)
- Wet and dry adhesion in fiber-fibre joints and chemical topographical mapping of lignocellulosic fibre surfaces (B. D. Brandner, Institute for surface chemistry)
- Measurement and prediction of dewatering characteristics for mechanical pulps using optical analysers (L. Nordin, Mid Sweden University)
- Low consistency refining of wood shavings (T. Kang, University of British Columbia)

INSTITUT
TECHNOLOGIQUE

Intervenants, participants et documentation remarquables

Objectif : Identifier les interlocuteurs et les sources documentaires pouvant présenter un intérêt pour le CTP et FCBA

Beaucoup de présentations ou posters de Mid Sweden University qui est très active dans le domaine des pâtes mécaniques. Les informations émises par cette université sont à suivre et des collaborations sont certainement possibles.

Session: Mill developments – recovery issues

… *Operating experience with a eucalyptus CTMP system and MVR effluent evaporation at Klabin Monte Allegre (, Andritz)*

CTMP is used in boards. In 2005, expansion of production to 1100 000 tpy with a new papermachine, new CTMP line, new recovery boiler, line kiln, wood preparation. Largest CTMP in Brazil 140 000 tpy and the largest CTMP in the world from eucalyptus. Alkaline peroxide impregnation provides low SEC, low extractives and COD, bulk/tensile flexibility. Evaporation of the CTMP effluent in order to recover the caustic soda in combination with kraft mill. Pilot plant trials have been carried out in Andritz Springfield to define the chemical conditions to reach the requirements for CTMP in boards. Up to 4.7% NaOH are used for impregnating the eucalyptus wood chips. No silicate use in the plant. Only one impregnation stage based on a MSD. One bleaching stage. Bulk: 3.2-3.9 cm3/g, tensile 18-24 Nm/g, brigtness: 44-45%ISO, freeness: 200-450 ml CSF. 0.01% shives on final pulp. Extractives: 0.09%. Clean condensate from the evaporators is reused in the CTMP line to replace fresh water. Mechanical vapour recompression unit installed at the mill.

… *P-RC APMP system with effluent evaporation at Sun Paper, Yanzhou (P. Brauer, Andritz)*

Sun Paper Group: 7000 persons. Shandong Sun Paper Industries: largest privately owned and managed paper business in China, 23 papermachines, 2.5 million tpy, products exported in Asia, South Africa and USA. The mill is using NBSK, LBKP, APMP, straw pulp, imported wastepapers for different board grades. The objective is to become more independent. New P-RC

APMP line started in 2008. Trials at pilot plant with 50% poplar 50% aspen: 375 ml CSF, 80% ISO, 2.8 cm3/g, 18 Nm/g. Requirements for lower shives content (<0.08 %) and higher tensile index (>20). Capacity 100000 tpy.

The chip washing is very important because chips contain a lot of stones, sand, … Only one impregnation stage followed by primary refiner and bleaching stage before the secondary refiner. Cleaning/screening is very efficient to remove the contaminants (stones, sand). After startup, 800-850 kWh/t, 480 ml CSF, 75% ISO, 3.2 cm3/g, 23 Nm/g, 0.04% shives. Total alkali used by the mill: 4.6%. High bark content and discoloured chips inducing low bleachability and high chemical consumption, stone cells. Bark and stone cells are removed in the chip washing and MSD. Final COD of the treated effluent is below 80 mg/l because the constraints are important in China.

A second line has been ordered by the mill with a startup in May 2009 in order to reduce furthermore the purchase of market APMP.

… *Recovery boiler for BCTMP process (T. Niemi, M-real)*

Chemical recovery is used in Kaskinen and Joutseno mills. Evaporation to 45% dry solids and introduced in the black liquor before burning in the kraft recovery boiler. The new idea is to collect and evaporate the process water, burn the concentrate in a dedicated combustor and recover both the heat content and the sodium chemicals. With this concept, the kraft pulp mill recovery boiler and chemical recovery are not needed. Some sodium carbonate is recovered and used in the CTMP mill. The demonstration plant is now at the start-up phase in Kaskinen mill. Sodium carbonate is used as an alkali source in chip impregnation and bleaching.

Session: Low consistency refining – energy efficiency development

… *The effect of process conditions on pulp quality development at low consistency refining of mechanical pulp – TMP (L.A. Hammar, Inventia)*

LC refining as a second stage for TMP refining. STFI concept: defibration HC, dilution, LC refining. Design of a mobile rig to be connected on an industrial main line and composed of a conical refiner. Use of an experimental design on SEC, specific edge load, temperature and pH as parameters. Use of PulpExpert and PQM as analysers. Faster development of the freeness and tensile index, especially at higher temperature and pH for lower SEC when the LC refining is used. No impact on fibre length.

Tensile index development is depending on SEC (+), pH (+), temperature (+) and SEL (-). No double interactions

Fibre length depended on SEL (-), SEC (+), pH (+) and SEL*SEC (-).

Optimum at 88°C, 0.13 Ws/m and pH 9;0

If a part of the pulp is recirculated to the feeding, more than one passage is needed. Fibre length is preserved and tensile index increased.

… *Potential of low consistency refining of TMP. Mill evaluation (C. Sandberg, Holmen Paper)*

Holmen Paper: 1940000 tpy on 8 paper machines for newsprint, magazine, SC and book paper. Braviken mill: 570 tpd of TMP and 280 tpd DIP, 3 paper machines

LC refining started some years ago: now 7 LC refiners on TMP and 2 on DIP.

Start up of a new TMP line with a 72” LC refiner.

First LC refiner as a second stage reject refiner, then 2 refiners on 3rd main line an reject and 3 on 3rs main line. The new reject line is composed of one stage at HC and one at LC.

Trial with feeding of secondary refiner TMP to the reject LC refiner. Enhancement of the pulp quality and protection of the screens. Decrease in SEC, increase in tensile. Energy savings of 50% at 15 Nm/g tensile increase. Decrease in scattering.

LC refining on rejects induced 4% energy savings and on 3rd stage main line 7%. The plate pattern is no so much important for tensile = f(SEC) but important for fibre length. Increase in the plate life significantly.

New TMP line composed of MSD, DD refiner as 1st stage, wash press, retention tank and LC 72" refiner. 600 kWh/t can be saved.

… *Concepts of steam recovery from LC-refining by increased temperature (O. Björqvist, Mid Sweden University)*

HC + LC with new steam recovery system in HC.

Michel Petit-Conil