



2007 PITA COATING CONFERENCE

ABSTRACTS

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Coating machine rebuilds - A tool to enhance quality and efficiency

Lauri Korhonen, Metso Paper

The efficiency and profitability of a paper or board making line can be significantly improved, not only through major capital investments, but also by various limited scope rebuild and upgrade solutions.

Minimized waste, improved overall efficiency, better quality and increased speed potential are among the many benefits which can be obtained with a range of process improvements.

For instance:

- The productivity as well as quality potential of a coater can be enhanced by modifying and upgrading existing coating stations in many ways. For example, the coating stations can be equipped with new blade beams and automatic CD-controls.
- The automatic roll cleaning device reduces waste and improves safety in the coater area.
- A more functional tail threading system enhances the overall efficiency of the coating line.

This paper presents practical mill experiences of making these - and other - limited scale rebuild projects.

Blade Technology – a tool for improved print quality

Kenneth Fagrelius, BTG Eclépens SA

In today's competitive world, the print shops require higher and more even paper quality. The requirements differ from print process to print process but in general the demands are increasing.

Parameters to improve are:

- Runnability in the print process
- Paper roughness/smoothness
- Ink absorption
- Print gloss
- Visual defects

Blade technology has made vast progress during the last 3-4 years; traditionally the material used was steel enhanced with aluminium oxide-based ceramics but increased demands for better coating quality, longer lifetimes and increased productivity, already at the paper/board mills, have pushed the development forward.

Today there is a wide range of different blade materials at our disposal, suitable for different processes in the industry:

- Chromium-based ceramics
- Metal-based materials
- Elastomer-based materials



In this paper it will be shown that by simply changing the coating blade material quality can be improved when it comes to streak frequency, gloss increase and roughness decrease. The materials have different characteristics but one common denominator is that the wear rate is much lower than that of a standard steel blade, which gives the papermaker the freedom to work with the tip geometry.

It will also be shown that modifications in tip geometry can change the quality aspects of the finished paper; e.g. with small modifications the papermaker can simulate bent mode when running in stiff mode.

Free jet coating - Recent Experiences with Closed Heads

Paolo Rabito, P.M.T Italia SPA

The advantages of the free jet coating application are well known, the report aim is to discuss the free jet coating application characteristics through the “S-flow” closed head, developed by Mitsubishi Heavy Industries.

The used concept, different from the “conventional” open type, assures a more stable, homogeneous and repeatable in time jet structure; in addition it is very flexible and reliable for the different production requirements, such as different coating types, machine speeds, basis weights and sheet surface characteristics.

In the introduction, the closed body structural characteristics necessary to prevent obstructions and coating wastes will be examined. Then, the advantages linked to a functional installation, with reduced cleaning time will be discussed.

Case history: recent PMT experiences in Italy and in Belgium. In these cases, for production requirements, different and sometimes not compatible coatings were applied with the closed head. The potential contamination during the coating change and the proper chamber flushing procedure will be carefully discussed.

At last, the past experiences of the customers mentioned above with conventionally open free jet coating systems will support this report.

New technology to measure the parallelism of rollers

K. Twigg, PRÜFTECHNIK Ltd., M. Hummel, M. Ecker, PRÜFTECHNIK Alignment Systems GmbH,

The alignment of rollers is referred to as a special art. Well aligned rollers are vital to avoid wrinkles or tears in the materials involved in the coating or converting process. In addition, rolls in printing machines, used in a possible further production step, need to be parallel, if passers should fit. - Production speeds have been continuously risen over the years, material thicknesses are decreasing: there's an ever greater need for well aligned rolls.

This lecture presents a completely new procedure to measure the parallelism of rollers: It is based on the ring laser gyroscope technology as used for navigation in the aerospace industry. The measuring system developed by PRÜFTECHNIK Alignment Systems GmbH is called PARALIGN®.

Conventional optical systems as e.g. theodolites require a lot of time to perform a measurement. The necessary optical line of sight from the machine axis to the rollers to be



measured can sometimes only be obtained by means of additional mirrors and prisms. The repeatability of measurements is thus limited or the measurement is even impossible.

Measurements with PARALIGN[®], however, can be performed within a fraction of time compared to traditional measurements – indeed for all rollers to be measured as no optical line of sight from the machine shaft to the rollers is necessary. Consequently the time required to measure rollers within housings – e.g. drying sections – is the same as for accessible rollers.

The fourth P; Power and how to use it sparingly to save money

Tim Klemz, Compact Engineering Ltd

A look at the advances in infrared drying technology from Compact Engineering's Titan dryers and associated energy efficiency improvements.

The paper will touch on the physics of infrared drying and examine some of the unique features available from the Titan dryer and when combined deliver exceptional energy efficiency. The paper will use as a case study, the recent replacement of an existing infrared system with the Titan dryers after the first and second base coaters on the off-machine coater at M-real Äänekoski in Finland.

The paper will view the installation from the mill's perspective and will seek to determine whether the decision of the mill management to invest in a new technology was worth the inherent risk of such an undertaking.

If possible, the presentation will be a joint presentation between a representative from the mill and Tim Klemz from Compact Engineering.

Design of Coating Structure for Flexographic Printing

Janet Preston, Imerys Minerals Ltd

In flexo printing, advances in plate making technology and pre-press have improved the quality greatly and allow flexo printing to compete effectively with rotogravure and offset quality. Substrate requirements include the correct surface topography and porosity to enable good transfer of the ink to the surface, without any reticulation. The surface energy of the substrate may need to be adjusted to ensure good wetting by the ink.

This study investigates the influence of different pigment types, binder levels and calendering conditions on the structure of board coatings. Specifically the influence of calendering conditions on surface binder content, surface porosity and absorbency are considered. The board samples were then printed using a laboratory flexo printing unit and the print characteristics studied.

Selected samples have been submitted for sectioning using a Focussed Ion Beam technique (FIB). This will enable the penetration of the ink into coating layers to be visualised.

Use of a Steric Stabilizer as Water Retention Aids for Maximising Calcium Carbonate Use in Glossy Coated Paper

Francois Dupont, Coatex SAS



Over the last few years the use of clay in glossy coated paper has declined. This has been driven by the need to produce brighter papers and the increasing cost and reducing supply of clay. This paper describes the use of a steric stabilizer as water retention aids to decrease the aggregation of particles in coating structure. Improved coating structure order has been found to improve gloss and thus reduce the need for clay. Traditional water retention aids function by increasing the viscosity of the dispersing medium. However, as the solids increase during coating application and drying the pigments can aggregate causing a non even structure to form, which reduces gloss. This new class of water retention aids are polymers with a structure of steric stabilizers. These improved water retention by decreasing the amount of free water in the system. The polymers also prevent aggregation during coating application and drying so a good state of dispersion of the particules is kept causing improved gloss. Examples of this technology in pilot and full scale mill application are given.

Comparison of Different Pigments for Paper Coating

Jorg Hocken, Sachtleben

In paper coating various pigments like calcium carbonate, titanium dioxide or barium sulphate are used today: new member of this collection is zinc sulphide. Within the presentation pros and cons with respect to brightness, opacity or colour will be given. The use of optical brighteners and the effect of pigments on these will be discussed.

Choice of nano-fine products opens a door towards speciality papers with novel properties and application like transparent papers with optimized printability or uniformity.

The Replacement of Latex in Pigment Coating

Frederic Bouvier, Roquette

Some of the points to be covered:-

- Reasons: Economic and Environmental
- Coating rheology
- Latex replacement in pre-coat recipes, including industrial examples
- Latex replacement in top-coat recipes, including industrial examples
- Effect on printing properties

Aqueous Dispersions of Polyolefins

Ronald Wevers, Dow Benelux BV

Polyolefins are used extensively in many industries due to a combination of attractive attributes. To date, these attributes can only be incorporated into finished articles through conventional thermoplastic forming processes such as extrusion, thermoforming, injection molding and blow molding. Polyolefins have not been available for use via low viscosity application techniques due to the difficulty in polymerizing polyolefins, especially polypropylene, in an aqueous environment.

To address this gap, a novel process has been developed to disperse conversional polyolefins in water. Dispersions of ethylene and propylene based resins have been produced at scale with high solids content and with submicron particle size. When applied to a substrate, these dispersions combine the typical attributes of polyolefins, namely heat sealability, low temperature flexibility and water and chemical resistance with the attributes typical of



aqueous systems, adhesion to polar substrates and the ability to accept inorganic fillers. Polyolefin dispersions (POSSs) can be applied via traditional low viscosity application techniques including printing operations such as rotogravure. This combination of properties makes these materials ideal for use as a laminating adhesive and as a heat sealable coating.

Optimisation of the Coating Colour Kitchen in the New Environment of the Paper Mills

Thierry Leduc, ABB Process Industrie – Cellier Division

The paper mill like any company must constantly adjust to the constraints of its market and its environment. In a globalized economy, the industrialist faces fierce competition and often has an out of date production tool which is more and more difficult to maintain. The rise in the costs of raw materials and energy necessitates the industrialists to constantly optimise their processes. To ensure its production with a stable margin is one of its major pre-occupations.

Coating kitchens in paper mills are concerned. Projects for new kitchens in Europe become exceptional but modifications, optimization and revamping are increasing. The engineering business evolves quite rapidly towards a service business where the advice becomes as essential as the supply of equipment.

For the industrialist, the technico-economical justification of an adaption of the production tool is not always simple. How can we replace what is functioning? What is the return on investment of the expected change? All these questions require a detailed assessment of the pertinence of solutions provided on the market.

Cost Reduction through optimization of Coating formulations

Mariela Gauto, Clariant UK Ltd

The coated paper market is diversifying rapidly. However, coating formulations are becoming simpler, the search for performance and economy.

The paper will demonstrate how to achieve those objectives through a careful selection and addition of coating slurry ingredients, combining novel and traditional technology.

Points to cover:

- Wet End vs Coating process control
- Secondary binder selection
- Additives role

Effect of Water Retention and Rheology Modifier (WRRM) Chemistry on Paper Coating Structure

Tamal Ghosh, Ciba Specialty Chemicals

Synthetic water retention and rheology modifiers (WRRM's) are gaining increasing acceptance in the paper coating industry. Their intended function is to provide an optimum rheological behaviour in a range of shear rates and water retention of the coating color. In principle, it would be possible to provide the best runnability of the coating colors on the machine, just with optimized viscosity function and water retention. However, it is crucial to



understand the influence of the WRRM's on the relevant physical and chemical properties of the coated sheet.

Recently it was demonstrated that the synergistic effects induced by WRRM chemistry could influence the coating structure of the coating color, particularly the distribution of the coating ingredients along the z-direction¹. Optimal interaction prior to immobilization is thus a critical phenomenon to avoid strong particle co-aggregation or depletion, which can occur on both the lateral (X-Y) plane as well as along the depth (z-direction).

These findings enable new opportunities to tailor coating structures, indirectly through the control of interactions between the various coating ingredients, primarily between pigments, latex and also pigment-latex.

In our continuing efforts to improve our fundamental understanding of mechanisms dominating the formation of coating structure, the coating formulations evaluated earlier¹ were applied on a pilot coater (CTC, Raisio, Finland) on a woodfree base stock. In this study we examine the distribution of latex and pigments in the x-y plane and along the z-direction of the pilot coated papers.

¹Backfolk, K et al "The Effect of Water Retention and Rheology Modifiers (WRRM's) on the Formation of Coating Structure and Migration of Particles" Proceedings 2006 TAPPI Advanced Coating Fundamentals Symposium, Turku, Finland (2006)

Material Retention: A Novel Approach to Performance of Pigment Coating Colors

Jaana Ahtikari, CP Kelco

Continually increasing machine coating speeds together with new coating color components have put more emphasis on the importance of the correct rheology and water retention of the coating colors to achieve good runnability and end product quality.

In the coating process, some penetration of the aqueous phase, to the base paper or board must occur to anchor the pre-coating to the base or the topcoat to the pre-coat. The aqueous phase acts as a vehicle not only for the binder but also for the other components. If this water or materials penetration is not controlled, there will be excessive material shift from the coating color to the base, before immobilization of the coating color will stop this migration. This can result in poor machine runnability, unstable system and uneven coating layer, impacting print quality.

Rheology modifiers or thickeners have tended to be evaluated on the performance of the coating color by the term "water retention". This simple term is not sufficient to explain performance changes during coating. In this paper we are introducing a new concept of "material retention" considering the control of all the movable materials including water in the coating color. Controlled material retention leads to uniform z-directional distribution of coating color components. The changes that can be made to z-directional uniformity will have positive effects on print quality as measured by ink setting properties, ink gloss, mottling tendency, surface strength, optical properties, such as light scattering, whiteness and light fastness delivery should be improved.



Today's Trend Lines in Coating Kitchens, Supply Systems and Coating Effluent Treatment

Ilkka Roitto, Metso Paper Inc

The basic principles of coating color systems have stayed quite similar for years. Need for proven reliability together with sound conservatism has prevented too “radical” solutions from entering the market. However, there are a lot of new processes and equipment that are becoming industrial standards. This paper is a short presentation of the latest improvements.

Pigment dispersing and coating mixing is understood to have a vital impact on final coating color quality. Pigment slurry is the biggest component in the coating color. It brings most of the impurities and thus inadequate processing can cause defects that cannot be corrected in the following process steps. Higher and higher solids content and viscosity of the coating color requires special capability from the mixer in use. The fact is that there is a lot of equipment running with inadequate shear and mixing properties. Instead of installing a new mixer there are also mixer retrofit packages in the market to improve the performance without a major investment.

Continuous coating color preparation is gaining new market. It has benefits in processes where only a few coating color grades are needed at the same time and recipes are close to each other. The pros are related to investment costs, space demand, fast grade changes and small losses.

Batch Process is still the main alternative and will keep its top position in the future. The development has been seen for example in dosing systems, recipe handling and automation. There are also new dosing processes that make usage of dry components feasible.

Most of the problems in the **supply system** are related to **screening**. Today there is a good choice of concepts that better take into account special features of each application, like multistage screenings, automated strainers, return line pressure screening or a new screening element with round holes. Centrifugal **deaeration** is today a must in some applications but offers benefits to all coating methods. **On-line measurement** of color properties like solids, air content, rheology, pH and temperature is today a common practice.

Coating methods without return flow have made it possible to pack the supply system in a compact rig saving space and start-up time.

Ultrafiltration is one of the main methods for **coating effluent treatment**. It is also the only method that makes the re-cycling of pigments and chemicals possible with full value. The concentrate is utilized as a part of the new coating color. In some applications the limiting factor has been the concentrate solids, 25-30%. Adding a small second stage filter solves this problem. In this process solid content up to 50% is possible fulfilling all possible needs.

Design and engineering of performance pigments for barrier coatings

*David Gittins, * Hannah Howard, Robert J Pruett, D R Skuse
New Technology Group, Imerys Minerals Ltd.*

Water based barrier coatings are increasingly being used to replace fluorocarbons and extruded polymers. Water based barrier coatings are amenable to existing paper and board coating equipment including size press, blade and curtain coaters. Imerys have developed a premium pigment specifically designed to give optimum performance in barrier applications when applied as part of a water-based coating. Improved barrier to moisture, water, oil and



grease can be achieved by the use of such pigments provided they are formulated in the correct manner. This presentation will illustrate the effects of pigment surface chemistry, size, shape, size distribution and volume concentration on barrier performance in a wide range of water-based polymer coatings.

New Developments in Print Receptive and Barrier Coatings

Robin Cooper, Michelman SNC

This paper will describe two recent developments.

- A size press treatment for uncoated papers to improve digital ink adhesion to the substrate.
- Recent developments in the application of moisture vapour and grease resistant barrier coatings both on-line and off-line at the blade coater will also be discussed.

Print Packaging and Product Uniformity -

Performance issues through the Production Cycle

Nigel Jopson, Pira International

Paper-based packaging combines two attributes:

- Providing a medium for the display of advertising, brand and consumer information
- Protection for the pack contents.

This entails compromise between an ideal base for coating, print performance and image quality and the ideal protective structure, a compromise not made in graphic printing grades to the same extent. In addition to the end-use requirements, other performance aspects are important due to the requirements of the converting process.

This paper will give a concise review of recent developments in coated papers and board for packaging purposes, including coated linerboards for standard corrugated and microflute packaging, coated unbleached wraps and water based barrier coated materials. The sources and effects of sheet non-uniformity will then be reviewed in the context of both end-use properties and converting performance.

Future developments will then be considered in terms of down gauging and lightweighting issues, digital print for packaging, smart packaging and useful applications of nano technology. The review will show that the requirements for product uniformity will be increased by these developments, and consider the options open to a mill for reducing product and process variability and minimising waste.



Measuring and Evaluating the Surface Quality of Gravure Papers

Harald Grossman, Technische Universität Dresden

Although nowadays a number of paper properties are determined using measurement technology, printers are still not always in a position to reliably predict the quality of a print. This is due on the one hand to the interaction of paper, printing ink and printing-related parameters and, on the other hand, to the fact that paper properties cannot be measured under practice-oriented conditions in the laboratory. An important fundamental paper property that greatly influences print results is the surface structure of the paper. This quality is also termed smoothness (roughness). Nowadays, smoothness is usually determined in the paper industry as surface smoothness using indirect measuring methods (air stream measuring methods). In addition to surface smoothness, the measurement of printing smoothness is very important, i.e. the determination of the surface structure of the paper under converting conditions.

Together with the rapid developments in computer technology, a number of topographical instruments have been developed that are capable of non-contact, direct measurement. These instruments are designed so as to be at least non-sector-specific, which means that they must be made useable for the applications in the paper industry on a case-to-case basis. The possibilities these instruments offer in describing surfaces will be discussed based on analytical results. One drawback of this technology, however, is that the surface topography is not determined under actual converting conditions (under applied pressure). This is only currently possible by using contact area testers that make it possible to operate at pressures ranging from 2.5 MPa to 7.5 MPa. As originally designed and built, however, these devices provide only an integral measured value for the surface finish. In order to remedy this disadvantage, an existing FOGRA contact area tester was therefore equipped with a high-precision distance measurement system and connected to a digital image processing system. The result of measurement is the development of the surface structure as a function of paper deformation under compression load.

This technology was used to measure eight natural gravure papers (SC papers) that had been gravure printed in a large print shop. The results were assessed by both direct visualisation and image analysis. The results of smoothness measurement were correlated with the print assessments. It was established that there is a strong relationship between surface structure, the deformation behaviour of the paper under load and the quality of the printed image. The best correlations were obtained for a newly defined parameter termed the $\text{Grad}(\text{CA})_p$.

A Re-evaluation of Factors Controlling Print Rub on Matt and Silk Coated Papers

Patrick Gane, Omya Development AG

Print rub, or ink scuff, remains one of the greatest challenges for the successful development of matt and silk matt offset coated papers. Using a recently proposed method for evaluating print rub, involving a non-slip pressure and friction-induced stress contact between a printed and unprinted sheet, this work seeks to test a newly-formulated hypothesis that the ability to improve print rub resistance is a function of coating surface capillarity (absorption and adsorption properties, in combination with the roughness and compressibility/conformability of the basepaper-coating composite of the fibre-floc scale. A series of coated papers have been tested, ranging from woodfree single to multicoated grades, including the evaluation of compressibility and stretchability under pressure and shear both individually (pre-rubbing), to simulate external reel-up, calendaring and converting processes, and in combination with the age and conditioned printed surface. The findings are used to illustrate the corner points of an hypothesis, from which is deduced that the most resistant surface to print-rub is a combination



of high capillarity and high surface area of the pigmented coating, aiding absorption and adsorption, together with a uniformly compressible basepaper-coating composite structure, such that contact shear forces are minimised. Under conditions of compromise, such as coating surface exhibiting low capillarity, an incompressible/non conforming sheet can help reduce print rub due to minimised contact area. The evidence tends to suggest that a too rigid coating-basepaper combination, such as developed by many modern paper machines together with multi-coating, is exacerbating performance difficulties in this paper sector.