REINVENTING KAOLIN TO MATCH FUTURE PAPER GRADES

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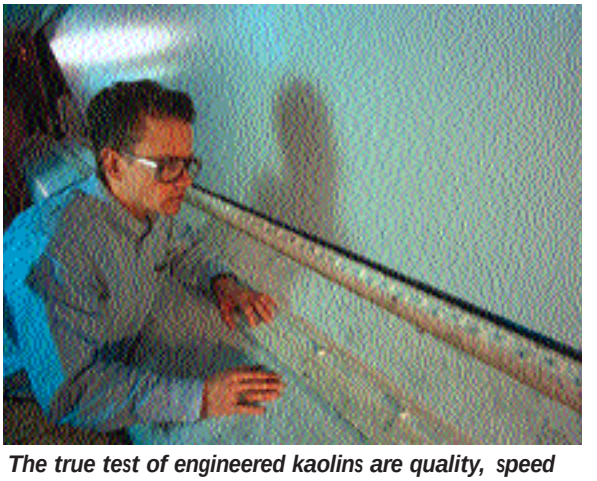
PROCESSING HELPS CUSTOMIZE PIGMENTS TO MEET PAPERMAKERS' NEEDS

CUMULATIVE ENHANCEMENTS IN DEVELOPING THE NEXT generation of kaolins suggest that paper and printing properties are key factors in kaolin's role in the future. Fundamental scientific understanding made possible by advances in the analysis of coating structure is driving the development of new coating kaolins whose benefits extend far beyond brightness, gloss, and opacity. These new kaolins will be designed to be interactive with other coating components such as ground calcium carbonate (GCC), precipitated calcium carbonate (PCC), binders, and coating additives to produce desired final sheet and print properties.



The true test of engineered kaolins are quality, speed on the machine, and operating condition flexibility.

For about 2000 years, paper essentially has been the same, a useful medium that allows people to communicate, transmit, record, and amplify ideas and emotions. For several centuries now, wood fiber has replaced rags as the principal ingredient of paper. For six decades, its companion, kaolin, has helped improve printability, smoothness, brightness, and affinity for ink. In more recent years, carbonates and process chemicals have enhanced paper qualities further, seeming to take something away from the traditional fiber-kaolin combination. But, now, the fundamentals are changing again.

In a marketplace where life-like color, sharp text, flexibility of the sheet, strength, lighter weight, and speedy commercial and home printing are expected with little or no premium paid for enhanced value, what can be done to meet all of these needs? One key factor is scientific advances in the understanding of particle shape and size, creating a new generation of kaolins that enhance print performance and combine with other minerals and chemicals to produce better formulations at lower cost.

New production and process control technologies allow for the commercialization of new coating kaolins to meet the needs of tomorrow's papermakers. Proprietary instrumentation that can measure the particle shape and size during on-line kaolin production has made it possible to commercialize a new generation of products.

Three new levels of coating kaolin products are emerging to meet the demands of the global paper industry. They are generally characterized by their degree of platyness or aspect ratio and their particle size distribution.

The first level, defined as standard engineered kaolins, can be characterized by steep particle size distributions and low aspect ratios. These products have been commercially available for the past 10 years. Benefits associated with their use are brightness, gloss, and print gloss.

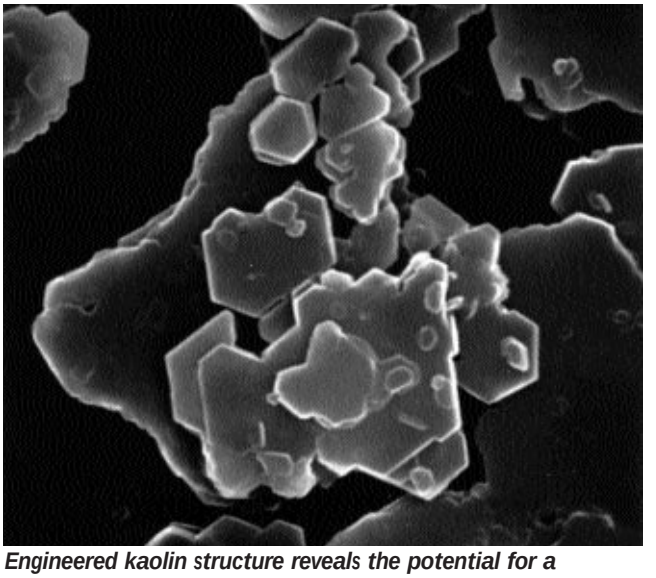
The second level is design engineered kaolins, which share similar characteristics to engineered kaolins but have been modified to provide additional benefits. These design engineered kaolins can be produced through additional processing that, when utilized in coating formulations with carbonate pigments, will provide unique coating structure. The pigments have narrow particle size distribution and a higher aspect ratio. These new products can be designed to boost specific coated surface properties, enhance printability, or lower coating costs. By leveraging the inherent platyness of kaolin, for example,

Exploration technology allows for targeting of the range particle size distribution, ending up in the finished sheet.

processors can control the shape and size of a paper coating's pore structure in a way that directly influences printing ink interaction.

One surprising feature of design engineered kaolins is their ability to provide improved ink holdout together with improved heat set offset blister resistance as a result of pore dimension, and more importantly, pore shape. Pigment performance can also be structured for optimum light scatter by controlling coating pore volume through the shape of the pigment and through particle size distribution.

The third and highest level is functionally engineered kaolins, which have been chemically modified to provide additional functionality to deliver desired print qualities or production efficiency.



Engineered kaolin structure reveals the potential for a smoother sheet.

A market segment review of grades with the greatest potential to benefit from the next generation of kaolins follows.

COATED FREESHEET

Even with the current economic turmoil in Asia, an estimated 3 million tons of coated freesheet from that region alone is still scheduled to come onto the market over the next few years. Since most of the production is coming from new machines, the coating technology is advanced. European and American producers are already responding by improving productivity and quality and adapting their processes to develop new grades to compete in or to move toward niche markets. With operating rates producing a quality sheet at speeds well beyond design capacity of equipment, coupled with significant new capacity over the next few years, producers are repositioning their product lines, developing new grades, and pushing publication grades to lower basis weights—a direct threat to the groundwood coated market. In North America, coated freesheet No. 3 is becoming lighter, which gives it more appeal for magazines and catalogues.

Other challenges facing producers are the growing demand for matte and dull finish grades, digital printing ,and faster, hotter web-offset printers. Matte and dull finish grades will require higher brightness, improved smoothness, and increased print gloss. Digital grades can require expensive silica coating pigments, and increased blister resistance is needed for heat-set web offset printing papers. Coated freesheet producers are responding with mechanical changes like the use of film presses, on-machine soft nip calendering for No. 4 and No. 3 production, and double coating for No. 1 and No. 2 production with film press pre-coats and blade topcoats.

With investment capital remaining tight for many producers, other innovative solutions must be developed to remain competitive. To meet these challenges, standard and design-engineered kaolins can be used in conjunction with coating carbonates to improve sheet smoothness and sheet gloss. These pigments can be used to reduce coat weights for lighter basis weight production, for improved coverage (smoothness), or to reduce the use of expensive glossing pigments such as titanium dioxide. The unique particle packing of engineered pigments leads to coating structure development, which improves blister resistance and print gloss, critical for web and sheet grades, respectively. For matte/dull production, engineered pigments can also aid print gloss development and smoothness improvements with the introduction of higher carbonate levels. Recognizing the increasing need for faithful color rendition, the shade and brightness of these papers is becoming increasingly

more important with the consequential emergence of higher brightness, lower yellowness grades of kaolin. The type of engineered pigment the coated freesheet producers turn to will be based on the paper properties they want most.

Finally, producers now have alternatives to expensive silica-based coatings in the form of functionally engineered pigments that have been mechanically and chemically modified.

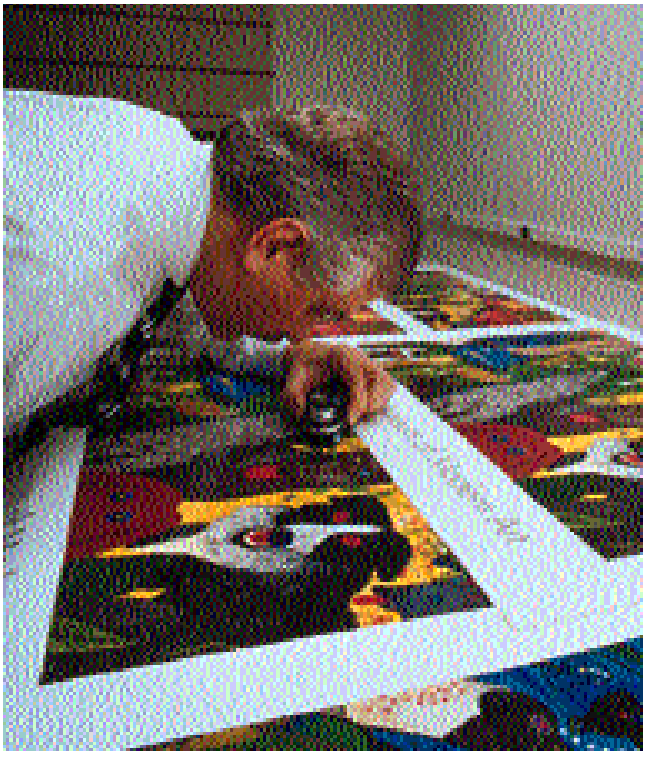
COATED GROUNDWOOD

If ever a market were at a crossroads, coated groundwood is it. Though capacity utilization remains at historical highs, lightweight coated (LWC) groundwood papers are under siege from the upward mobility of supercalendered (SC) grades and downward movement of coated freesheet papers. Europe's highly filled SC coated papers are competing successfully with coated papers, nearly matching quality and performance in some areas. Stora's new SC machine at Port Hawkesbury, NS, is expected to compete directly with ultra-lightweight coated grades.

At first glance, the coating changes in LWC appear to affect carbonates, but, in fact, the future will see combinations of carbonates and kaolins to produce desired results. Sheet brightness, smoothness, and print quality will be improved, especially in the basis weights around 40 lb. Both GCC and PCC will be used to achieve brightness demands at the lowest cost. For many mills this will require a significant change, as they will be required to convert to neutral papermaking to incorporate calcium carbonates into their coatings.

Increased competition in the ultra-lightweight range (less than 32 lb) will come from uncoated groundwood producers looking to move up the value chain by using film coating technology. These mills can have a significant cost advantage over the coated groundwood mills using traditional blade coating technology.

Future LWC coating formulations will use different pigments depending on basis weight. LWC or MWC formulations will likely contain either PCC or GCC at levels of 20% to 50% with the remainder being a form of engineered kaolin to achieve the required sheet properties at the lowest cost. The design engineered kaolin required by LWC producers will vary with the basis weight of the paper they produce. As these producers move to lighter basis weight papers (primarily by reducing coat weight), light scatter and coverage (smoothness) will become more of a concern. Platey engineered pigments will fill the need for coverage and gloss.



Three levels of engineered kaolins are raising print quality and reducing overall costs through new formulations of coatings.

WHICH ENGINEERED PIGMENT IS RIGHT FOR YOU?

There are many ways to respond to market demands and opportunities. Sometimes a heavy investment in capital equipment can be the right move. Another approach—short and long term—is to first address goals in the way of properties in the sheet and on the surface. If you are going alkaline based on groundwood, that's one direction. But if you choose to stay acid, that's another. In either case, kaolin and carbonates can play a role in better quality, new grade development, and the economics.

Because of the ability to customize kaolins today for specific paper grades and machines, and of the range of opportunities available with on-site PCC and custom GCCs, it depends on what you are aiming for.

Whatever you have on-site, the ability to move toward lower basis weights will be important. The idea of lighter weight paper applies to the thickness of the coating, as well as the caliper of the base sheet. What happens when you can achieve equal or better quality coating spread more like electrostatic paint than paint applied with a brush?

The new engineered kaolins today are finding their groove as value added tools for a variety of grades that are changing to meet market needs and improving papermaking and coating efficiencies. TJ

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