Journal of Korea TAPPI
Vol. 34. No. 5, 2002
Printed in Korea

Recent Developments in Kaolin-Based Paper Coating Pigments : Innovating to Meet Changing Industry Needs

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(Received on June 10, 2002; Accepted on December 10, 2002)

ABSTRACT

Kaolin has long been used in aqueous coatings to produce high-quality coated paper products. While the kaolin industry has always focused on innovation, the rate of new product introduction has never been greater than in the past five-to-eight years due to the cost, quality and other competitive pressures facing papermakers. After summarizing many of the performance benefits offered by the new generation of kaolin-based pigments, this paper reviews four specific pigment advances: a high-performance, ultrafine glossing pigment; an engineered pigment with a narrow particle size distribution; two products from a kaolin-based pigment family developed for metered size presses; and a novel class of inkjet pigments.

INTRODUCTION

Kaolin-based pigments have long been major raw materials in high-quality coating for paper and paperboard. Use of kaolin-based pigments in pigmented coatings continues to grow due, in part, to kaolin' s unique hexagonal-platelet structure, good color and brightness, and ability to undergo mechanical and chemical modification. These properties have enabled suppliers to innovate new products to meet the changing needs of the competitive global paper industry.

Given kaolin' s prominence in papermaking, it is not surprising that the many global market forces acting on paper companies also impact it. These forces include paper industry consolidation, cost and quality pressures, and competition among grades. Here are some ways this is affecting the kaolin industry:

- There is a continuing move from standard brightness pigments with an 86 to 88 TAPPI brightness to high brightness pigments above 90. This is driven in part by shifts in paper company ownership and the globalization of the industry, which is bringing the emphasis on brighter, whiter coated products from Europe and Asia to other regions.
- Kaolin suppliers must meet the contradictory demands for pigments that flow well at higher solids. For instance, the use of high solids coating formulations to maximize coated paper quality and reduce energy consumption during drying demand excellent high shear rheology as today' s blade coating speeds exceed 1,500 m/min..
- Suppliers are improving the optical properties of kaolin-based pigments to help papermakers limit the use of costly ingredients, e.g., titanium dioxide, optical brightening agents (OBA) and plastic pigments.
- Kaolin-based pigments are being improved to provide the opacity, coverage, smoothness and printability needed in lightweight sheets as coat weight decreases are required to make lower basis-weight coated products to offset higher postal rates.

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- Competition among paper grades has also driven new developments in these pigments. For example, new kaolin-based pigments have helped coated groundwood papers compete more effectively with lower-quality coated woodfree grades by allowing better brightness and printability in medium-weight coated (MWC) grades. Also, some of the newer kaolin-based pigments are lowering the sheet cost of ultra-lightweight coated (ULWC) papers through reduced use of titanium dioxide and plastic pigments.

The ensuing discussion looks at how the kaolin industry has evolved to be highly focused on applying innovative technology to develop and deliver products that help papermakers worldwide meet their increasing need for value and quality.

Kaolin grades and their evolution

Kaolin pigments have been traditionally grouped into three broad categories: standard hydrous, delaminated and structured. This grade structure is generally differentiated by particle size and shape, brightness and rheology. Engineered kaolins are a relatively new category of pigments, arising from the need for value-added performance in today' s competitive marketplace.

Standard hydrous pigments are beneficiated from kaolin crudes to remove impurities. Mechanical separation creates various particle size classifications from coarse No. 3 to an ultrafine, high-glossing fraction. Each grade has varied brightness subgrades, depending on the type and number of processing steps used to improve this property. Product cost generally increases with finer particle size and higher brightness.

Delaminated grades are processed via controlled mechanical grinding techniques, which reduce larger kaolin booklets to a combination of thinner booklets and individual platelets. Their higher aspect ratio (largest face dimension divided by particle thickness) provides excellent coverage at low coat weights. The largest use of these pigments by far is in lightweight coated (LWC) paper. They are also available in various particle size and brightness grades, but these are only two of several factors that determine final product cost. In evaluating delaminated pigments, their particle size should not be compared directly to that of standard hydrous kaolin-based pigments since aspect ratio affects how the measurement is made.

Structured kaolin pigments are classified as either thermally or chemically structured, depending on how they are manufactured. [REJ1]Thermally structured grades are calcined at 550° to 1100° C to drive off the 14 percent water of hydration in the kaolin crystal. This forms a pigment structure best described as agglomerate. The air voids in this structure provide about three times better light scattering than standard and delaminated kaolins. The process is closely controlled to produce the desired particle size distribution and avoid an excessively abrasive product.

Chemically structured grades use a variety of chemical processes and chemical polymers to selectively aggregate ultrafine particles. This method also provides an air void structure that enhances optical performance and increases ink receptivity, both of which serve these pigments well in applications such as carbonless specialty coatings.

These three broad grades dominated the kaolin-based pigment field for years. More recently, engineered kaolin products were added to the mix. Engineered grades are not as easily classified as standard, delaminated and structured grades. In essence, they are hydrous kaolins segregated mechanically or chemically into narrow particle size distributions to enhance such properties as opacity, brightness, coverage and print gloss. Product offerings in this category continue to evolve to meet the industry' s need for higher-quality, cost-effective pigments.

Over the past decade, papermakers have adopted new pigments in each of these categories. This has shifted their focus away from a one-size-fits-all approach to a specialty kaolin-based pigment model. This is reflected in the demand curve, which now peaks at three particle sizes: the traditional peak at mid range and peaks for fine and coarse products. Fine specialty grades improve print and sheet gloss, while those with ultrafine particles removed improve opacity and brightness, reduce the need for binder, and aid smoothness and printability.

Advanced kaolin-based pigments give mills less costly ways to build brightness, opacity, gloss and other properties, while allowing them to replace more expensive ingredients. The savings can be significant through the extension and/or replacement of titanium dioxide, plastic pigments and OBA.

The new generation of kaolin-based pigments offers many optical, rheological and other performance benefits, including:

- Products that compensate for the drawbacks of calcium carbonate. This includes fine kaolin-based pigments that offset the inherent loss of gloss with higher usage levels of calcium carbonate, new co-pigments that overcome the yellowing and problems of many traditional calcium carbonate co-pigments, and products that have better rheology than previous offerings.
- Grades that enhance coverage to provide good hiding at low coat weight and improve smoothness and printability, especially in metering size press applications.
- Grades made by advanced production processes that have much lower levels of titanium compounds and other impurities and tighter particle size distributions. The higher purity improves brightness, and the more refined size aids opacity, sheet and print gloss, pick resistance and ink receptivity.
- Pigments that have greater whiteness and brightness, such as a 96 TAPPI brightness calcined pigment that advanced brightness in this category a full three points.
- Less abrasive calcined kaolin-based pigments that reduce the wear of blades during coating, slitters during conversion and plates during printing.
- Non-traditional chemically structured pigments that provide exceptional hiding, opacity, smoothness and ink receptivity.

The following sections review four of these advances in pigment technology: a high-performance, ultrafine glossing pigment; an engineered pigment with a narrow particle size distribution; two products from a kaolin-based pigment family developed for metered size presses; and a novel class of inkjet pigments.

Hydrous glossing pigment excels in brightness, viscosity

A relatively new family of ultrafine, hydrous glossing pigments made by a novel, selective extraction process includes a high-performance grade with a minimum TAPPI brightness of 91 percent, one or more points above other similar pigments. This grade can be dispersed at 74 to 75 percent solids, several percent above traditional glossing pigments. Its excellent low- and high-shear pigment viscosity translates into superior coating color rheology. The Brookfield and Hercules End Point viscosities of coating colors made with this pigment tend to be significantly better than that of competing premium glossing hydrous kaolin-based pigments (Table 1).

Table 1. High performance glossing kaolin - comparative coating color viscosity (1)

	High Performance Glossing Kaolin	Premium Brightness Glossing Kaolins A	Premium Brightness Glossing Kaolins B
Solids, %	67.2	67.2	67.2
Brookfield Viscosity, cP			
@20 rpm	8,160	14,800	11,260
@100 rpm	2,264	3,772	2,960
H.E.P. 4400 'E', dyne cm x 10^5 (2)	25.0	31.0	31.5

(1) All colors contained 70% ground calcium carbonate pigment and 30% kaolin-based pigment. The high-performance glossing kaolin is Miragloss(tm) 91 pigment from Engelhard.

(2) Hercules End Point determined at 4400 rpm using "E-bob", 400,000 dyne cm springs.

This pigment was the first 91 minimum brightness, kaolin-based glossing pigment to provide good sheet gloss development at high ground calcium carbonate (GCC) levels. In one evaluation, its use as a GCC co-pigment was compared to a premium-brightness No. 1 kaolin at 20 to 60 parts of the total pigmentation. Coated paper made with these formulations and supercalendered under equal pressure and temperature conditions showed that the high-performance glossing kaolin provided 2 to 4 points better sheet gloss depending on GCC level (Table 2). The data also demonstrate the pigment' s ability to deliver good ink gloss, a property for which glossing clays quite often fall considerably short. Even with its finer particle size, the pigment provided comparable coated sheet opacity and brightness. The lower Hunter b value of the high-performance glossing kaolin indicates a less-yellow, more-blue-white shade, a highly desirable characteristic that makes it more color compatible with the GCC. The pigment' s coloration also can potentially lower OBA use while achieving the desired coated-paper shade.

In another test, coated sheets made using the high-performance glossing kaolin and a premium brightness No. 1 kaolin were supercalendered to the same sheet gloss. The glossing kaolin formulation required less calendering pressure than the premium brightness No. 1 kaolin pigment to achieve the 79 sheet gloss target (Table 3). The test results show that the high-performance glossing pigment provided better print gloss, opacity, brightness and Hunter b value, all desirable features for high-quality woodfree papers. Commercial experience with this pigment has shown that similar benefits can be achieved in coated paper-

Table 2. High performance glossing kaolin vs. premium brightness No. 1 kaolin coated sheet properties[1]

High Performance Glossing Kaolin	60	40	20	--	--	--
Premium Brightness No. 1 Kaolin	--	--	--	60	40	20
Ultrafine GCC (95% < 2 μ(m)	40	60	80	40	60	80
75° Sheet Gloss, %	78	75	70	74	72	68
Prufbau Print Gloss						
75°, %	86	86	84	85	87	86
20°, %	44	44	40	45	45	43
K&N Ink Receptivity, % change	13	13	13	13	14	14
TAPPI Opacity, % change	92.5	92.5	92.4	92.8	92.9	92.6
Brightness, %						
ISO	82.1	83.0	84.0	82.2	83.2	84.0
TAPPI	85.2	86.0	86.9	85.0	86.1	86.8
Hunter color values						
L	91.1	91.4	91.7	91.3	91.6	91.8
a	0.65	0.80	0.84	0.57	0.71	0.80
b	0.83	0.52	0.23	1.09	0.67	0.38
Parker Print Surf, (m	1.08	1.10	1.13	1.08	1.08	1.05
IGT dry pick, vvp	41	46	45	46	47	48
NPA tests [1]						
Passes to fail (strength)	3	4	5	4.33	5	6
Slope (ink tack build)	33	19	12.5	15	13	10

Notes: (1) Coated paper properties shown are at 16 g/m^2 coat weight. Coating solids 66, 67.5 and 69% for increasing levels of ultrafine GCC, respectively. Coatings were applied at 850 m/min. Binder level was constant at 12 parts acrylic latex per 100 parts pigment. Calendering conditions were the same for all coating formulations. The high-performance glossing kaolin was Miragloss(TM) 91 pigment from Engelhard.

(2) NPA = Nancy Plowman Associates print test for strength and ink absorption tendency. Higher passes to fail indicates greater strength and higher slope indicates greater ink absorption rate and ink tack build.

Table 3. Calendering to equal gloss[1]

	High Performance Glossing Kaolin	Premium Brightness No. 1 Kaolin
Calender pressure, kN/m	158	210
Sheet gloss, %	79	79
Print gloss, %	91	89
Opacity, %	87.5	86.7
Brightness, %	83.2	81.9
Hunter b value	1.7	1.9

(1) Coatings contained 40% kaolin-based pigment. Study done at constant temperature on a pilot coater. The high-performance glossing kaolin was Miragloss(TM) 91 pigment from Engelhard.

board where high sheet gloss and print gloss are required.

Engineered pigment boosts paper quality

An innovative, chemical-fractionation process combined with other unit operations is used to create a narrow particle size (NPS) engineered kaolin-based pigment. This pigment differs from earlier engineered kaolin-based pigments in that it does not use energy-intensive mechanical separation to create its narrow particle size distribution. The pigment has a minimum TAPPI brightness of 90 percent. Its narrow particle size and larger aspect ratio relative to standard kaolins produce an excellent combination of fiber coverage, sheet and print gloss and coated sheet optical properties, especially at low coat weights.

The superior performance of this NPS pigment is evident in a comparison with a premium and a standard brightness delaminated grade, plus a blend of standard delamin-ated and standard brightness No. 1 kaolin-based pigments (Table 4). The coatings were formulated using a latex-rich, starch co-binder system and applied by blade applicator[REJ4] to a low-brightness, wood-containing base sheet. While the coating color rheology of the NPS engineered pigment was slightly higher than the delaminated / No. 1 blend formulation, its flow characteristics were not significantly different than the delaminated clays despite its narrower PSD. The excellent fiber coverage this pigment gave is evident in its lower coated smoothness (Parker Print Surf in Table 4), 5 to 6 points higher sheet gloss, and 3 to 4 points higher print gloss. The pigment also had better opacity, brightness, blue-white shade, and K&N ink receptivity than the other pigmentations.

The NPS engineered pigment often outperforms other high brightness kaolin-based pigments in coated woodfree applications. Mills can use it to boost sheet quality or retain performance while replacing expensive opacifying pigments such as titanium dioxide and other costly ingredients. This pigment can be used as either a primary pigment or a calcium carbonate co-pigment. In tests with woodfree coated paper using 50 percent GCC as the pigment, the premium-brightness NPS engineered kaolin was compared to both a high brightness kaolin-based pigment from Brazil and a high brightness glossing kaolin. At coat weights in the 12 to 15 g/m^2 range, the NPS engineered kaolin produced 1 to 2 points higher sheet gloss than the Brazilian kaolin and comparable performance with the glossing kaolin (Table 5). In terms of print gloss, the coating containing the NPS engineered pigment performed better than the other two pigments. The three kaolin pigments had equivalent coated brightness and opacity.

Metering size press pigment aids coverage and gloss

Given the growing use of metering size press (MSP) technology, papermakers

have an increasing need for economical MSP coatings that provide high-quality results. These coatings

Table 4. Coating viscosity and coated LWC sheet properties[1]

	Premium Brightness NPS Engineered	Premium Brightness Delaminated	Standard Brightness Delaminated	Standard Brightness Delaminated / No. 1 Blend
Coating Properties				
Solids, %	58.6	58.5	58.1	58.0
pH	8.5	8.5	8.5	8.5
Brookfield Viscosity, cP				
20 rpm	2060	2120	2140	2190
100 rpm	670	712	708	704
H.E.P @ 1100 rpm, 'E' bob				
End Point, dyne-cm x 10^5	31.8	33.2	30.1	25.5
Apparent Viscosity, cP	55.2	57.6	52.3	44.3
Paper Properties				
75° Sheet Gloss, %	56	51	50	50
ISO Brightness, %	67.8	67.5	67.0	66.3
TAPPI Brightness, %	69.0	68.5	68.0	67.1
TAPPI Opacity, %	92.3	92.0	92.0	91.5
Hunter Color Values				
L	84.0	83.9	83.7	83.3
a	0.47	0.44	0.37	0.37
b	2.68	2.85	3.03	3.05
75° Print Gloss, % @ 1.4 o.d	65	62	61	62
Parker Print Surf, 10 kgf, soft	1.14	1.26	1.25	1.36
K&N Ink Receptivity, % change	22	21	20	19

Note: (1) The formulation tested contained 85 parts hydrous kaolin , 10 parts calcined kaolin and 5 parts solid-sphere plastic pigment; binder system was 6 parts starch and 10 parts SBR latex. Coatings were applied at a coat weight of 7.5 g/m^2 to a low-brightness (59% G.E. brightness), mechanical fiber basesheet. The coated sheets were supercalendered at equal temperature and pressure conditions.

Table 5. Advanced engineered NSP pigment aids gloss in woodfree paper[1]

Coat Weight (g/m^2)	75° Sheet Gloss: Advanced NSP Engineering Pigment	75° Sheet Gloss: A	75° Sheet Gloss: B	20° Print Gloss: Advanced NSP Engineering Pigment	20° Print Gloss: A	20° Print Gloss: B
10.4	70.6	70.9	71.4	23.5	23.0	22.8
11.8	73.0	72.5	73.7	28.4	26.6	26.9
13.3	75.5	74.2	76.0	33.3	30.2	30.9
14.8	77.9	75.8	78.3	38.2	33.8	35.0

(1) Tests performed on a 50% fine ground calcium carbonate coating pigment containing one of three pigments: The advanced NSP engineered pigment was Miraclipse(TM) PG pigment from Engelhard; Pigment A was a high brightness Brazilian kaolin-based pigment having a narrow particle size distribution; Pigment B was a standard brightness, high-glossing kaolin-based pigment. Opacity measurements for the pigments varied from 88.1 to 90.3%, depending on coat weight. All coatings received the same level of calendering.

Table 6. Typical MSP kaolin pigment properties

	Economy MSP	Premium
MSP		
TAPPI Brightness, %	87.5	90.0+
Particle size distribution, % < 2μm	85	88
Surface area, m^2/g	16-17	14
Brookfield Viscosity, cP, @ 20 rpm(1)	450	350
H.E.P. "A" bob, rpm / dyne cm x 10^5 (1)	490/16	750/16

(1) At 67% solids.

should provide excellent runnability at high speeds without patterning in a broad range of paper grades such as machine-finished coated, lightweight coated, Bitokoshi, and film-coated offset, to mention a few. They also should have excellent coverage at low coat weights, high opacity to minimize expensive pigment use, and good sheet and print gloss for attractive aesthetics in end-use printing applications.

A new family of kaolin-based pigments developed for MSP coatings meets these needs. The grades in this product family meet varied end-user' s cost performance requirements. An economy MSP kaolin and a premium MSP kaolin (Table 6) from this family were compared to a 90 TAPPI brightness delaminated kaolin. The brightness of these two MSP products varies from a typical standard kaolin brightness of 87.5 to a minimum 90 brightness generally associated with premium kaolin-based pigments.

Pilot coater MSP trials were conducted using a wood-containing, offset basestock. Both premium and economy MSP pigments gave excellent MSP runnability at the conditions used. Coated paper made with them had better properties than the premium brightness delaminated control pigment (Table 7). Both improved opacity and brightness by about the same amount compared to the control. Sheet gloss, print gloss and snap (difference between print gloss and sheet gloss) improved significantly, with the premium MSP kaolin providing the greatest enhancement.

The premium MSP pigment raised sheet gloss eight points and print gloss 13 points above the control, somewhat better than the economy MSP grade (Figure 1). In addition, the two pigments improved coated sheet smoothness, i.e., lower Parker Print Surf values (Figure 2). Overall, the MSP pigments gave outstanding improvements versus the delaminated kaolin control formulation.

This pilot coater data has been corroborated in commercial mill applications. The two pigments provide good runnability, fiber coverage and smoothness at low coat weights needed for MSP use. They also give better optical and printing properties than conventional, delaminated kaolin-based pigments in film-coated paper.

Table 7. MSP kaolin pigments pilot coater data(1)

	Sheet Gloss K&N (%)	Print Gloss (%)	Snap (%)	Parker Print Surf 10 kgf	Brightness (%)	IGT Opacity (%)	IGT Opacity (vvp)	IGT Pick (% change)
Control	39.2	54.1	14.9	2.03	70.7	81.1	20.1	15.3
MSP Economy	44.2	61.1	16.9	1.94	71.5	82.8	27.1	13.1
MSP Premium	48.3	67.4	19.1	1.89	71.8	82.9	27.3	11.7

(1) The Control pigment was a 90 brightness delaminated kaolin. The MSP Economy pigment was Mirafilm(TM) 300 pigment and the MSP Premium was Mirafilm(TM) 600 pigment, both from Engelhard. The coatings were applied to a 43 g/m^2 LWC basestock at a weight of 6 g/m^2 per side. The coater, which operated at 900 m/min., was a rod pre-metering size press with 42 P&J hardness backing rolls and a smooth 12 mm rod. Calendering was done using two on-line, soft-nip calenders at 325 kN/m and 170° C. The coating formulation was 90 part kaolin, 10 part ground carbonate, 4 part starch, 12 part SBR latex, LWC offset formulation. Coating colors were applied at 58% to 60% solids; 100 rpm Brookfield viscosity ranged 500-800 cP.

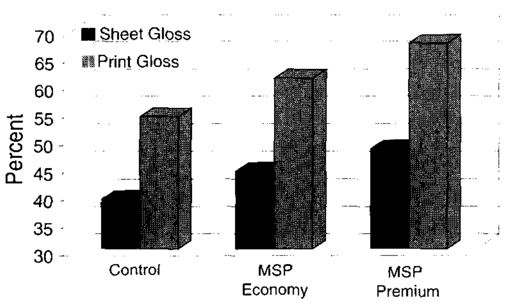

Figure 1. Sheet gloss and print gloss

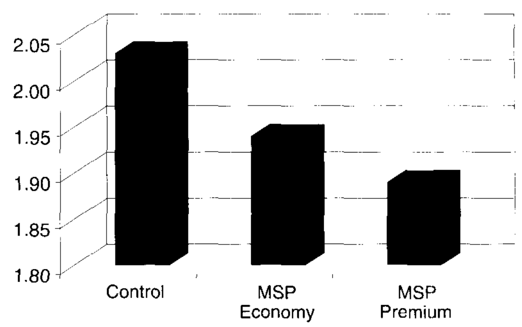

Figure 2. Parker Print Surf at 6gsm per side in units of ㎛. Tested under conditions of 10 kgf clamping pressure with soft backing.

These cost-effective products help papermakers gain more from their modern high-speed roll coaters. They are the first pigments that work alone at commercial MSP speeds while resolving the glossing deficiencies of other MSP pigments. They also promote gloss development better than other kaolin-based products in MSP systems at commercial film coater speeds.

Opening inkjet coatings to kaolin

In opening new markets for kaolin, suppliers have turned to matte coated inkjet papers, a market segment growing at about 30 percent per year. Uncoated, surface-sized bond paper dominates low-end home and office, color inkjet printing, while high-end users require a premium, glossy, photo-quality sheet. The gap between the two is filled by matte coated papers which have traditionally used silica-based formulations. These silica-based inkjet coatings usually are applied off-machine at relatively slow speeds given their relatively low solid levels (20 percent or less). Now, new technology allows kaolin to replace silica pigments.

The new kaolin-based pigment is referred to generically as a surface-enhanced aluminum silicate (SEAS) pigment. It offers the comfort of a more traditional coating ingredient altered to provide sufficient pore volume to dry inkjet inks rapidly. Its pore volume is comparable to that of precipitated silica, and its surface area is high enough to dry inkjet inks without causing the makedown problems of silica (Table 8). It disperses easily in water at 50 to 53 percent solids and dispersion solids can reach 58 to 60 percent with the use of a cationic dispersant. The SEAS pigments commercially available today have a TAPPI brightness of 92 or 94 and excellent blue-white color values.

Work done with SEAS-based coatings shows that they run well on MSP, blade, rod and airknife coating equipment at normal operating speeds. They also provide high color and black ink density, sharpness and definition when used in inkjet printers. Their lower surface area compared to silica pigments gives better surface strength at significantly lower binder levels.

A commercial trial using the 92 TAPPI brightness SEAS inkjet pigment produced a premium, matte inkjet C1S paper on a MSP coater with a TAPPI brightness of 92.0 and an opacity of 91.7 (Table 9). These values compare well with commercially available silica-coated matte papers. When printed in a

Table 8. Physical properties of silica and kaolin inkjet pigments(1)

Pigment	Particle Size, μm	Pore Volume cm^3/g	BET Surface Area, m^2/g	Bulk Density, lb./ft.^{3}
Precipitated silica	1.0-10.0	1.58	700-730	7
Kaolin-based pigment	1.0-2.0	1.24	85-110	25

(1) Average qualities. The kaolin-based pigment was Digitex(TM) pigment from Engelhard.

Table 9. MSP inkjet commercial trial: finished paper qualities[1]

TAPPI brightness, %	92.0
TAPPI opacity, %	91.7
75° sheet gloss, %	5.1
Basis weight, g/m²	90.0
Coat weight, g/m²	5 - 7
Moisture, %	2.9 - 3.2

(1) The formulation used had a kaolin-based pigment dispersed to 58% by 1.5% poly-DADMAC. Another 3.5% poly-DADMAC was added to aid waterfastness. To meet the customer' s requirements for ink drying time, the coating color also contained 15% precipitated silica as a co-pigment, an amount that did not hinder runnability or significantly compromise coating solids or rheology. The coating color was applied at 37% to 39% total solids, Brookfield viscosity of 340 cP (100 RPM, 64° C) and a H.E.P. of 50 (4400 RPM, E-bob). Coat weight applied was 5 to 7 g/m². MSP coater speed was 1050 m/min. The kaolin-based pigment was Digitex(TM) pigment from Engelhard.

Table 10. MSP commercial trial print color densities[1]

	Kaolin-based Coated Sheet	Silica-based Coated Sheet
Cyan	2.06	1.32
Yellow	1.15	0.93
Magenta	1.66	1.22
Black	2.00	1.98

(1) Printed on a HP 690C inkjet printer; ink densities measured using a Cosar densitometer with a polarized filter. The kaolin-based pigment was Digitex(TM) pigment from Engelhard.

Hewlett-Packard 690C inkjet printer, the kaolin-based sheet had CYMK color density values that compared favorably with those from commercial silica-coated paper (Table 10). Further testing with this paper showed it produces good color results in commercial thermal and piezo inkjet printers (the major types), because it has an optimum contact angle of 80° to 100° across a wide range of ink surface tensions.

Conclusion

The paper industry' s need to bring cost down and maintain or boost quality continually challenges kaolin producers to enhance their products. Market-focused kaolin suppliers have responded by providing an array of improved pigments based on technological innovation using processes and methods unavailable five to 10 years ago. This has expanded the range of specialized kaolin-based pigment options, which is moving this class of products out of the commodity arena.

These options range from novel, standard hydrous to highly engineered grades that meet the needs of new papermaking technologies, e.g., soft-nip calendering, metering size presses, high-speed coaters and lower-energy systems, while retaining such essential paper properties as gloss, opacity, print gloss and brightness.

The malleable nature of kaolin allows producers to modify their products far more than many other mineral suppliers to meet increasingly demanding end-use requirements. These requirements include: improving pick resistance in highly structured coatings; balancing runnability at high solids with smoothness; and ensuring that, as water is driven off or absorbed in high-speed machines, the coating does not move into the sheet.

Much is demanded of kaolin suppliers in today' s market. They need a large manufacturing base to satisfy demand fluctuations, as well as diverse kaolin reserves, research depth to solve tough problems, and flexible production systems that can adapt to making advanced products. They also need to be able to work with those who supply other minerals to develop integrated ways to use them in concert. This, in turn, has led to strategic alliances in which mineral suppliers seek to tailor the benefits of complex formulations to specific mill needs.

While commodity-grade, kaolin-based pigments still play a major role in the paper industry, their growth is nil. The fastest growing and most exciting segments are those specialty grades that meet the demanding performance standards inherent in emerging papermaking technologies and market trends.