



NEW PRODUCT DEVELOPMENT

Key to Success of Pigment Producers

Pigment producers face challenging times, with competition from emerging regions forcing prices downward while raw material and energy prices continue to climb and regulatory requirements become more restrictive. In addition to taking such actions as increasing their own product prices and reducing production costs where possible, pigment manufacturers are also looking to improve their product development processes, decrease time-to-market, and identify opportunities for providing higher value to their customers.

The market for pigments used in paints and coatings is growing at an overall rate of 1% per year, both in the U.S. and globally. In 2006, the value of pigment sales to the coatings industry in the U.S. was approximately \$3 billion based on a volume of about two billion pounds, according to Steven Nerli, a consultant with Kusumgar, Nerli & Growney (KNG). White pigments, which are 99% titanium dioxide-based, accounted for nearly 62% of the total dollar sales and 83% of all pounds.

Most types of pigments are experiencing minor growth in the U.S. Organic pigments tend to be the most expensive type used in coatings because they are highly complex compounds requiring multiple synthetic steps to produce. However, they generally provide more brilliant colors than their inorganic counterparts and are attractive for high-end applications. Metallics and specialty effect pigments are experiencing growing demand but are facing dramatic price increases in raw materials, largely as a result of the growing consump

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tion of metals in China and other emerging economies, according to Nerlfi. **Complex inorganic coloring pigments**, many of which include nickel or zinc, are facing similar raw material challenges.

Anti-corrosive or reactive pigments are experiencing growth of about 3% per year, with some specific types of corrosion-inhibiting pigments seeing demand rise at 8% per year. Chromate-based products are generally in decline in response to regulatory restrictions. Organic corrosion inhibitors are receiving attention as alternatives. "Sales of these products, which were negligible just five years ago, now total \$20 million," notes Nerlfi. One example of such a product is Heubach's organic corrosion inhibitor Hencorin RZ, which it acquired from BASE.

There have been new inorganic corrosion inhibitors introduced recently as well. These calcium ion exchangers remove aggressive ions by two different methods. HALOX 430 from Halox relies on a high pore volume to scavenge the reactive species. SHIELDDEX® anti-corrosive pigment from W.R. Grace & Co. affords a high surface area for capturing ions. It is a non-toxic, white powder with a refractive index very close to coatings resins, and therefore has no impact on color.

The Freedonia Group, an industry research firm, estimates that U.S. demand for color pigments (inorganic, organic, and specialty) in the paint and coatings industry totaled \$1.0 billion in 2006 and will grow 5% annually to \$1.25 billion in 2011. The firm forecasts that the entire market for color pigments for all applications will grow 4.4% per year to \$3.8 billion in 2011, with pigment pricing projected to moderate somewhat over this period. Paints and coatings are the largest end-use sector, followed by printing inks and plastics.

The largest growth in all application areas will be in specialty and high performance organic pigments, while inorganic pigments will be the slowest growing segment, except for certain products such as CICPs (complex inorganic coloring pigments), which offer superior lightfastness and chemical resistance. Total U.S. sales of specialty pigments such as metallic and pearlescent types are projected to grow at an annual rate of 5.5% to \$640 million in 2011, or 16.8% of all dollar sales, according to Freedonia.

In 2006, the global sales volume of pigments used in paints and coatings was estimated to be 2.59 million metric tons, valued at just over \$9.2 billion, according to Dan Murad, president and CEO of the ChemQuest Group, a consulting firm located in Cincinnati, OH. White pigments, which experienced a decline in dollar value in 2006 compared to 2005, accounted for the largest volume of sales by far at 83%, but only half of the total dollars. Colored inorganic pigments were the second largest pigment type by vol-

2006 U.S. Pigment Sales

Pigment Type	Sales Millions (U.S.\$)	AGR* 2006-2011
White (largely TiO ₂)	\$1900	+1%
Black (largely furnace black)	\$40-45	+1%
Inorganic coloring ^b	\$130-140	+1%
Organic coloring	\$350-375	+1%
Anti-corrosion	\$110-120	+3%
Pearlescent	\$100	+1%
Metallic	\$330	+1%
Magnetic	\$20	-2%
Total (rounded)	\$3000	+1%

(*) AGR = Annual Growth Rate.

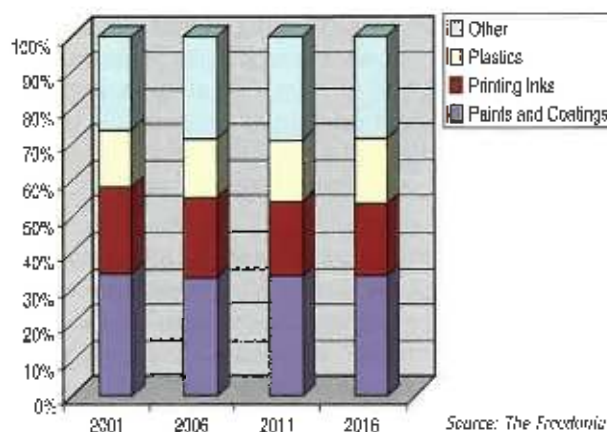
(b) Includes Complex Inorganic Coloring Pigments (CICP).

Source: Kosun, Nerlfi & Growney

ume (13.3%) and represented 10% of sales in dollars. Colored organic pigments, which made up only 3.1% of the sales volume, accounted for over 39% of the dollar value of global pigment sales. Black pigments accounted for 0.6% of the volume and under 0.5% of the dollar value. Geographically, the Americas and Europe together represented three quarters of the 2006 sales volume.

All of the possible types of pigments can be found in different paint and coating applications in the architectural, industrial, and special purpose sectors of the industry. The type of paint, desired appearance, and performance requirements will determine the choice of pigment. The amount of pigment used in a paint formulation is determined by its intensity and tinctorial strength, opacity requirements, required gloss, and the specified level of durability. Generally, lower cost commodity pigments will be used for lower-end paints and

U.S. Colored Pigment Demand by Market Segment



2006 Global Market for Pigments Used In Paints and Coatings

	NA/SA	Europe (million metric tons)	Asia/ROW (million metric tons)	Total	Value (millions U.S.\$)	Var % '06 vs. '05
Whites	834	755	557	2146	\$4,622	-2
Blacks	7	4	4	15	\$41	-15
Colored inorganics ^a	119	160	66	345	\$930	+6
Colored organics	30	28	22	80	\$3,618	+5
Total	990	947	649	2586	\$9,211	+1

(a) includes specialty effect pigments

Source: The ChemQuest Group

coatings, while higher cost and specialty pigments will be found in high end products where superior performance, enhanced appearance, and/or consumer appeal are critical.

To ensure that paint formulators have access to the pigments that will enable them to differentiate their products, pigment manufacturers invest heavily in research and product development efforts. Current market dynamics often significantly impact these activities. Those companies that can adapt and respond to the current environment and predict trends for the future will be most successful.

Some of the economic trends occurring in the marketplace are creating a challenging situation for pigment manufacturers. "Products from emerging markets are establishing very low price ceilings for pigments in mature markets. These products today do not meet quality standards, but they will eventually," Murad states. "At the same time, raw material prices, along with healthcare, personnel, and administrative costs, are rising. This combination is squeezing margins."

The U.S. is also facing a softer economy and the continued move offshore of much of its manufacturing base. European producers can offset some of their losses with sales to growing markets in Eastern Europe. Asian economies in general are growing rapidly.

Energy prices will keep climbing as well. Some are predicting the cost of oil will reach \$100 per barrel as soon as the second half of 2008. "Pigment manufacturers, particularly those located in and serving the U.S. market, are going through a troubling period when all of these factors are considered together," remarks Murad.

Not surprisingly, one consequence of these conditions has been a general increase in pigment prices. CICI prices have risen about 5% over the last 18 months in reaction to the volatile and consistently rising prices of metals used in these products. Price increases for other inorganic pigments of 4-8% were in-

troduced at the beginning of 2007. Carbon black prices have risen as much as 10-18% during the last year and a half. Only TiO_2 , which is experiencing overcapacity, has seen prices decline slightly.

Activities by the Chinese government will likely have an impact on the pigment market, but to what degree is yet to be determined. "The Chinese government's reduction of VAT rebates, which took place in July, is already

affecting both raw materials and pigment products being exported from the country," says George Pilcher, a vice president with ChemQuest. Price increases ranging from 7% to more than 10% are being reported. "At this early stage it is difficult to predict what the long-term effects will be on the global pigment market, and on regional markets, too, but there will be some level of impact."

In preparation for the 2008 Olympic games in Beijing, the Chinese government is also evaluating the environmental performance of manufacturing facilities in the city and surrounding areas, as well as throughout the country. Many proposed projects have been cancelled and several hundred plants have already been closed, with more expected closures in the future. The goal of the government is to improve the quality of the air and waterways before the international community arrives. Some of the plants affected have been pigment producers, and the removal of these suppliers will likely have repercussions in the pigment market.

Counteracting these economic trends are positive social drivers and opportunities for advanced technologies that help solve customer problems. "Color today has a much higher influence in styling decisions than it ever did in the past," asserts Murad. "It provides a significant form of differentiation in this challenging market environment, and this differentiation can be leveraged by the pigment producer, paint formulator, and downstream customer as well." Appliances, for example, now come in a wide range of colors, not just neutral white or almond.

Today's younger generation also embraces much more vivid and vibrant shades and iridescent colors, many of which are reminiscent of those popular in the 1960s in the United States. New and different combinations of colors are also becoming more common. The trend is likely to continue, according to ChemQuest, as these young people mature and shift their buying patterns to more expensive items. Special effect pigments, in particular, will benefit.

On the technology front, development of stir in pigments and pigments that are more easily dispersible is a major growth area. For paint companies, the cost of grinding pigments before they can be incorporated into the formulation is significant. The process also results in variations in color concentration from batch to batch. "There is a real opportunity for pigment manufacturers to increase their margins by offering technology that can have a direct impact on the bottom line of their customers," says Rick Jones, a vice president with The ChemQuest Group. "Paint manufacturers can save significant money with improved dispersant technology and will likely be willing to share some of those savings with their pigment supplier by paying a higher price for the greater value and service they receive."

The trend toward increasing the multi-functionality of paint and coatings products also provides potential areas for growth in the pigment market. "Pigments are no exception to this trend," comments Jones. He lists as examples heat (infrared) and solar reflectivity, FMI shielding, photocatalytic compounds for self-cleaning, and corrosion protection as examples of the additional properties pigments can bring to coating formulations. "This aspect of pigment technology is a wide open field and offers plenty of opportunity for pigment manufacturers to differentiate themselves and provide real solutions to their customers," Jones adds.

Developments from pigment manufacturers often follow the identification of problem areas—either with handling issues or color performance. The level that customers are drawn into the process depends on the pigment producer and sometimes the type of pigments. Manufacturers of more specialized pigments, for example, generally collaborate extensively with customers because the end-use market is a very focused sector of the industry with specific applications.

Wayne Pigment Corp. is involved in joint development projects with potential customers and third parties where both advanced expertise in corrosion-inhibitor pigment chemistry and paint chemistry is needed, according to Dr. John Sinko, technical director of the company. "In such cases, there is a significant level of exchange of information between the contributing parties." In recent years the company has entered into cooperative agreements aimed toward competing for outside funding offered for R&D. "This strategy results in sharing of both R&D and marketing costs for the development of new corrosion inhibitor pigment technologies," he adds.

According to Don McBride, COO of Heubach Ltd. (a Heubach company), customers must communicate with technical specialists during the development process. "Their desired color window may require a drop-in pigment with respect to hue, but needs better

dispersion characteristics so as to decrease content in order to lower cost. It may also be performance driven where a higher level of thermal and chemical resistance is necessary and we may have to encapsulate the pigment, with an example being Vanadur bismuth vanadates," he explains.

Flex Products, a business of JDSU, has established strong relationships with key brand makers and works with designers to predict trends. "We also seek feedback from key customers when we are developing a product based on new chemistry or when we are entering a new market," explains product line manager Tom Hughes. "Factors that are evaluated include optimization of design effects, application technology requirements, and cost minimization."

"Intellectual property issues may come into play for the other pigment categories, because customers are looking for technology to differentiate themselves and thus want exclusivity, while pigment producers prefer to offer the technology to the entire industry," Jones notes.

Clariant includes customers in some joint projects, and places a very high value on listening to customers and turning their needs into development projects, according to technical manager Romesh Kumar. Ciba Specialty Chemicals also identifies unmet market needs through discussions with customers. "Those unmet needs, when applied with our technical expertise, transform into potential product development ideas," notes coatings industry manager Andre Bendo. The company also relies on customers to sample new products throughout the commercialization process.

Within the Performance Pigments division of Sun Chemical Corporation, a "Solutions Tailor Made" approach has been taken with product development programs, according to Peter Carey-Yard, director of marketing—Global Coatings. "In a tailor-made approach, the customer is key in defining R&D. Their input to both define needs and test our own ideas drives the programs."

As with the level of customer involvement, there is significant variation in the actual processes pigment manufacturers rely on for developing new products.

LANXESS develops new products in a market-oriented way, focusing on pigments and formulations of pigments that help the coatings producers to develop new ecologically friendly products, according to Axel Schneider, Marketing Colorants in the Functional Chemicals Business Unit at LANXESS Deutschland GmbH. Clariant, too, responds to market needs, creating pigments that provide performance: high opacity, high durability, high chroma, no flocculation, for example—while meeting global environmental needs and maintaining low processing costs for its global cus-

tomers. "Today, the developments have to match customer needs to be successful," stresses Kumar.

Heubach has established a global R&D presence that provides the company with the necessary resources for innovative technology and new product development, according to McBride. "An example would be our highly specialized laboratory for anti-corrosive pigments with capability for cyclic testing salt-spray, humidity, and other criteria for all types of paints for our Heucophos product line. Both our inorganic and organic pigments can be tested for color, lightfastness, thermal stability, and chemical properties in coil, powder, industrial, architectural, and automotive coatings. This investment in our customers is necessary for us to provide technical service as well as provide the impetus for development work that provides value through technology."

Other companies follow a more formalized process. "Globalization, increased customer requirements, an increased focus on environmental issues, and ever-increasing costs in combination with the need for speedier development have made the product development process approach more systematic and more organized than, let's say, 5-10 years ago," notes Susanne Kuehne, global marketing manager, Coatings, for W.R. Grace & Co.

Grace and JDSU Flex Products both use the systematic stage gate process, where product ideas are evaluated according to technical and commercial feasibility, cost, and other criteria. "We also explore opportunities across our full range of material science advances including colloidal silica, precipitated silica, and silica gel, as well as other materials such as zeolites and aluminas," comments Kuehne. JDSU Flex Products, too, complements its formal process by providing its scientists the freedom to initiate projects they feel have market potential and relevance, according to Hughes.

Whether using a more or less formal process, pigment manufacturers seem to agree on the critical factors that must be considered when developing new products for the paint and coatings industry. "R&D planning is driven by environmental regulations, periodic raw material price increases, permanent demand for price reduction by the paint and coatings industry, and global competition for market share," asserts Sinko.

Color trends are followed by most of the pigment manufacturers, but some utilize them to a greater extent than others. At Ciba, the automotive color trend studies of the large paint manufacturers (PPG

Industries, BASF Corporation, and DuPont, etc.), as well as color trends in other industries, are utilized to assess the company's current offerings and initiate new projects into its development pipeline, according to Bendo. Color trend predictions help Sun Chemical to plan for future pigment demands, and to

some extent determine where R&D efforts should be directed. "Our main focus is on how we can add value by expanding the available color space and making it easier and more cost effective for our customers to get what they need," asserts Carey Yard.

JDSU Flex Products has its own color stylist and laboratory and develops its own styling guide in addition to reviewing paint industry reports. "We need to be aware of trends in the broader consumer market and must consider color trends in each of our customer segments. We also have been able to assist our customers by tracking color trends," notes Hughes.

Timing of a new product launch must also be considered. "Before embarking on an extensive new product development program, we evaluate the marketplace very carefully to determine whether or not the need we have identified will be relevant at the time we expect to launch the new product," remarks Hughes. "The process to commercialize new pigments takes some time, and that time is often extended because customers have lengthy development processes as well. We need to be sure that the timing of a new product launch will be appropriate."

Improving the ease of handling of pigments has always been a focus for manufacturers. Recently, with the heavy emphasis on cost reduction throughout the supply chain, the importance of improving ease of processing has become more important. "Along with meeting performance requirements such as a brighter color palette, high durability, higher processing temperatures, and global environmental issues, improved handling characteristics are a major area of investment for Clariant," Kumar says. Earlier in 2007 the company introduced a line of easy dispersing (ED) pigments that can be high speed mixed for solvent-based industrial coatings, saving customers the high cost of new mills and milling time, and results in higher plant output.

Finding the right balance between all these factors can be difficult in a challenging environment. "No doubt new regulations will be the main driver for changes in the coatings landscape, creating new requirements on the side of the customers in the coatings industry," states Schneider. "At the same time the consumer side is expecting price consistency in the



stores. So the challenge is to offer ecologically friendly products at a cost rate in formulation that is practically on today's level," Bendo adds. "The initial development idea usually arises from consumer trends, but the cost or financial impact to produce and meet regulatory issues will dictate whether it proceeds to commercialization."

New global regulations could have a major impact on new product development in the coming years. "Regulatory issues must be considered at the earliest stage in any new product development project," states Carey-Yard. "It is important to understand what the upfront costs will be in order to register the product. In particular, the European REACH program will have a significant bearing on the potential profitability of new product developments."

Globalization in the paint and coatings industry goes well beyond regulatory issues, as many leading formulators seek to establish leading positions in all major regions of the world. Pigment manufacturers have responded in kind, locating R&D facilities where their customers are. "Despite this globalization, though," notes Schneider, "the markets themselves so far have proved to be rather regional, if not local. It is important to respect these regional/local needs and therefore they must be considered when developing new products for different parts of the world."

Increasing competition from emerging regions of the world has increased the emphasis on cost reduction as well as resulted in efforts to reduce time-to-market for new products. Due to the ever-changing global market, quicker development of products is crucial. "Decreasing the time-to-market can vastly increase the chances of commercial success. To remain profitable, the established suppliers must quickly develop improved value products through product development to shift the markets towards higher performance," Bendo says.

IDSU Flex Products is placing an emphasis on getting to market first, which can only be achieved by streamlining the development process, agrees Hughes. "We are looking to eliminate within the various stages of the process, checklists that aren't truly relevant to our specific products." The company has also created product line manager positions to serve as a connection between the sales and technical teams.

Sinko adds that strategy adjustments have also been made by Wayne Pigments, with more R&D efforts directed towards optimization of manufacturing processes aimed toward productivity increase and improvement of process control with the goal of developing a more competitive position on the global market.

LANXESS, which concentrates on inorganic and organic pigments, has changed its development focus largely away from creation of new pigments to creation of advantageous pigment presentation and formulation. "The variety of existing products is immense, and therefore the secret will be to offer our pigments in an advantageous way," says Schneider. "This approach, of course, reflects a shift away from synthesis towards surface treatment, and we have invested extensively in developing the know-how of our R&D staff accordingly."

The growth of the special effect pigments market is also seen as providing opportunities for the pigment industry. "In addition to concentrating on developing and improving high performance pigments for the coatings industry, Sun Chemical will be focusing on effect pigments as we recognize that these products are now an important part of the equation," remarks Carey-Yard. He also predicts that this new effort will account for a significant share of the company's future R&D activities.

The challenges posed by increased regulations and ever higher costs can also be a source of potential growth. "We [Heubach] have been able to develop new products to fill a need created by new regulatory restrictions and rising costs for certain raw materials," explains McBride. For example, HCO was developed as a replacement for lead chromates and as a cost effective preparation to attain specific color spaces traditionally formulated with high priced pigments. Heubach has also developed alternative technology for basic materials such as zinc that are experiencing significant pricing volatility to mitigate the cost and still provide the same performance in most applications.

Also in the corrosion inhibitor segment, recently promulgated OSHA regulations on the Permissible Exposure Limit (PEL) value for Cr(VI) have prompted R&D work aimed toward elimination or drastic reduction of the inherent dustiness of some well-established corrosion inhibitor pigments. "It is anticipated that by minimizing dust exposure hazards throughout the industry, the service life of well-established valuable pigments will be extended," Sinko notes.

That pigment manufacturers continue to invest heavily in R&D and new product development indicates that, despite the current challenging market conditions, they are committed to the paint and coatings industry and to advancing technology to address customer problems, improve performance, and create completely new products. "Providing value through lower cost and differentiation from the competition are the key factors that dictate business success," states Carey-Yard. 