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PLAINTIFF'S EXHIBIT
UC-1016

File : Pigments

General Articles

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PIGMENTS, COLORANTS, AND EXTENDERS

PIGMENT

In general the term embraces not only the primary hiding and coloring pigments but also the extenders used to obtain the desired Pigment Volume Concentration (PVC). The correct selection and balancing of pigment combinations is essential to control hiding, chalking, tint retention, color and sheen uniformity, flexibility, gloss, scrub resistance, color development, corrosion resistance, blistering, touchup and leveling. Many other important properties, such as package stability and application characteristics also relate to pigment selection.

a) Prime Pigment

The most widely-used pigment for hiding in latex coatings is titanium dioxide. It comes in two crystalline forms, rutile and anatase. Rutile has the higher hiding power of the two and is more resistant to chalking. Anatase has a slightly whiter color and is about 10 per cent cheaper. Anatase is used in limited amounts (10-25 per cent of total titanium dioxide content) to produce controlled chalking in exterior paints and in some industrial coatings. Interior paints are usually formulated with only rutile to get maximum hiding. Titanium dioxide is available from the following major suppliers:

- American Cyanamid Company – "Unitane."
- E. I. duPont de Nemours and Company, (Inc.) – "Ti-Pure."
- The Glidden Company – "Zopaque."
- National Lead Company – "Titanox."
- New Jersey Zinc Company – "Horse Head."

Each company has a range of grades. In addition, there are both Federal and ASTM specifications that segregate the grades by function and by chemical composition.

Several other white pigments are used in oil-based paints and enamels. Some of these offer certain advantages in latex paints, but their chemical composition limits their general use.

(1) *Titanium dioxide – calcium sulfate.* An example is "Titanox" C-50 (Titanium Pigment Corporation), a combination of 50 per cent rutile TiO_2 and 50 per cent calcium sulfate.

This type of pigment offers hiding equal to and at appreciably lower cost than titanium dioxide alone. The presence of calcium sulfate, however, may introduce

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stability problems. Calcium sulfate has limited water solubility at room temperature. In plant-sized pigment grinding equipment, temperatures will typically be higher than in laboratory equipment. At these higher temperatures some calcium sulfate will dissolve. When the formulation cools, some calcium sulfate will crystallize. These crystals serve as nuclei for further crystal growth. The resulting paint will be unusable.

Satisfactory results with this type of pigment can, however, be obtained with careful formulation of selected ingredients.

(2) *Lithopone* is a useful, low-cost white pigment that contributes good leveling and flow properties. It has never gained much acceptance in latex paints in this country although it has merit. It should not be used with mercurial preservatives.

(3) *Zinc oxide* seems to offer promise as a combination white pigment and mildewcide in exterior paints. As with calcium sulfate pigments, stability problems can arise unless the latex and other ingredients are carefully selected and tested.

b) Color Pigment

Coloring of latex paints is usually accomplished with inorganic and organic pigments. The important properties in the choice of color pigments are as follows:

(1) Permanence to light.
(2) Durability in exterior exposure.
(3) Resistance to bleeding.
(4) Stability to heat.
(5) Resistance to acids, alkalies, and soap.
(6) Freedom from flooding and floating.
(7) Ease of grinding.
(8) High tinting strength.
(9) High hiding power.

There are several important differences between inorganic and organic pigments.

Organic pigments are usually higher in price, lower in hiding power and better in tinting strength. Some organic pigments will fade in strong light and some are sensitive to acids and alkalies.

The inorganic oxides are the most durable and the cheapest.

c) Aqueous Color Dispersions

A number of suppliers furnish complete lines of suitable pigments as aqueous dispersions. Most of these dispersions have been designed for use in latex paints and work well in the majority of formulations. Principal suppliers are duPont, Imperial Paper and Color, Harshaw, Holland-Suco, and American Cyanamid. Godfrey L. Cabot and Carbon Dispersions specialize in carbon black dispersions.

d) Tube Colors

Color pigments added at the time the paint is made are either pre-dispersed in water or specially treated to make them readily dispersible in water. Many paints are, however, colored at the point of sale by the addition of tube colors. Tube colors are added to a tint base in the store and the paint is mixed in a shaker. The tube colors are dispensed by hand from small tubes or by machines that automatically measure out the proper amount of each color.

The tube color consists of pigments dispersed in alkyd resin or other oil-based or oil-soluble vehicles along with suitable surfactants. Tube colors are made in three types:

(1) for use in oleoresinous paints,
(2) for use in latex paints and
(3) so-called universal for use in both.

A universal color originally designed

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for oleoresinous paints can be the source of much trouble in latex paints. Universal colors such as California Ink Company's latex tinting colors, the "Tulip-Tone" colors made by Holland Color and Chemical Company, and "All Phase" colors made by All Phase Color Corporation usually disperse readily in paint formulations made with UCAR Latexes. Added surfactants are required to disperse other brands of tube colors.

e) Metallic Pigments

Tiny flakes of aluminum, bronze, and stainless steel are used in coatings for decorative purposes. Aluminum pigments are also used to provide heat-reflective properties and reduced permeability to moisture.

Aluminum pigments will react with water to liberate hydrogen. If this reaction occurs in a closed container, sufficient pressure can develop to bulge or rupture the container. A method of passivating the surface to prevent this reaction has been developed and patented by Metals Disintegrating Company. The formulation of aluminum paints using pigments prepared by this method is discussed in Technical Information Sheet F-40720, "Ready-Mixed Aluminum Paints Based on UCAR Latex 130."

EXTENDER

A wide variety of natural and synthetic, finely-divided inorganic materials are used as extenders for the prime pigment. Examples are calcium carbonate, talc, calcium silicate, silica, mica and clay.

a) Calcium Carbonate

Both dry-ground and wet-ground calcium carbonates (whiting) are used in latex paints. The calcium carbonates provide good brushing properties, good scrub resistance, high pH (useful for buffering), and low cost. They are the principal extenders in exterior paints because of their low chalking rates and superior tint retention.

Principal suppliers, east of the Mississippi River, are Thompson, Weinman and Company ("Snowflake," "Atomite," "Duramite") and H. T. Campbell Sons, Inc. ("Camelcarb," "Camelwhite," "Cameltex"). Since the cost of shipping is a high proportion of the cost of an extender pigment, local suppliers are often preferred. Occasional use is made of the fine particle size, precipitated calcium carbonates in gloss or semi-gloss paints.

b) Talc

Talc is an impure hydrous magnesium silicate. It finds limited use in latex paints because it is quite soft and, as a result, paints containing it will burnish readily. It is useful in wall patching compounds to provide easy sanding properties. Suppliers include R. T. Vanderbilt ("Nytal"), International Talc Company ("Asbestine") and Sierra Talc Company ("Mistron" and "Fibrene" grades).

Talcs in general have a rather high water demand, which must be taken into consideration when formulating.

c) Calcium Silicate

There are two types of calcium silicate sold for use as extenders: (1) a synthetic product made by Johns-Manville ("Micro-Cel") and (2) the mineral Wollastonite (calcium metasilicate) offered by

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Godfrey L. Cabot, Inc. Neither has found large use in latex paints.

Many formulations use a small amount of "Micro-Cel" to improve hiding. The water demand of "Micro-Cel" is, however, very high and can result in formulating problems and in high water- and stain-sensitivity in the dried film.

d) Silica

Four types of silica are of interest in the formulation of latex coatings.

(1) (2) Amorphous and crystalline silicas are obtained from the minerals quartz and tripoli. They are hard, abrasive substances that cause a high rate of wear on paint-making equipment. They are used primarily in trowelling compounds and in similar applications but find some use in wall paints. Producers are Tamms Industries ("Gold Bond") and Whittaker, Clark & Daniels.

(3) Diatomaceous silica was formed by the deposition of marine organisms in the distant past. The primary characteristic of this type of silica is its very efficient flatting effect. Diatomaceous silica is most useful, therefore, in providing flatness and sheen uniformity and in reducing glazing in interior wall paints. It is highly absorptive and cannot be used in high concentrations. Producers are Johns-Manville ("Celite") and Great Lakes Carbon Company ("Dicalite").

(4) Synthetic silica is costly and has a very fine particle size. It is used in small amounts as a flatting agent in clear coatings. This type includes "Santocel" (Monsanto Chemical Company) and "Cab-O-Sil" (Godfrey L. Cabot, Inc.).

e) Mica

The principal source of mica extender is the mineral muscovite, an orthosilicate of aluminum and potassium. It occurs in the form of sheets, which are reduced by either dry grinding or wet grinding.

Mica is used in exterior paints to reinforce the paint film and prevent checking and cracking. It also decreases the permeability of the paint to moisture vapor. Mica is useful in primer sealers and industrial coatings to improve holdout, but it is seldom used in wall paints because of the undesirable shiners or reflections from individual particles in the surface of the film.

f) Clay

Clay, sometimes called kaolin or china clay, is essentially a hydrated aluminum silicate. Both the product as mined and the calcined variety are used in latex coatings.

Clay is one of the most widely used extenders in latex paints. It imparts good leveling and brushing properties, shows little or no tendency to settle and features good dry hiding properties. The latter property is particularly marked in calcined clay. Clay is seldom used as the total extender because of color uniformity problems, especially where areas of varying porosity are to be painted. As might be expected, the calcined variety is higher in cost.

Producers of clay extenders are Georgia Kaolin Company, Southern Clays, Inc. ("Al-Sil-Ate"), Minerals and Chemicals Philipp (ASP series) and Burgess Pigment Company ("Iceberg").

g) Other Extenders

Several other materials are important as extenders.

(1) *"Lorite"*, made by the De Lore Division of National Lead Company, comes from a natural deposit containing about 80 per cent calcium carbonate and 20 per cent diatomaceous silica. "Lorite" com-

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bines the good flatting characteristics of diatomaceous silica with the low oil absorption of calcium carbonate. This combination is particularly useful in exterior latex paints where it helps contribute good tint retention.

(2) *Asbestos*, a fibrous mineral silicate, is used for special purposes in latex coatings. The very short fibers serve as reinforcing extenders in block fillers and in mastics used as insulation coatings. Asbestos is fire-resistant. It introduces thixotropy. UNION CARBIDE sells a Resin Grade of asbestos.

(3) *"Metro-Nite"* is a naturally-occurring mixture of calcium and magnesium silicates and carbonates. It has very low water demand and is especially useful in very high solids, highly pigmented compositions for patching.

h) Influence of Particle Size

The particle size of an extender pigment has certain general effects on paint properties. These are summarized in the table above:

Properties	Coarse	Fine
Stain Removal	Poorest	Best
Polishing (glazing)	Best	Poorest
Scrubbability	Best	Poorest
Hiding	Lowest	Highest
Gloss	Lowest	Highest
Sheen	Lowest	Highest
Color Uniformity	Poorest	Best
Viscosity	Lowest	Highest
Brushability	Poorest	Best
Flow and Leveling	Best	Poorest

These generalizations are valid, providing particle shape and hardness and the advantages claimed for a distribution of various particle sizes in paints are neglected. For example, talc (Hardness 1 on Mohs scale) polishes readily compared to calcium carbonate (Hardness 4-4.5), regardless of particle size. Such considerations account for the use of combinations of two or more extenders.

PIGMENTS AND EXTENDERS FOR LATEX PAINTS

Pigments	Suppliers	Pounds per Gallon
Aluminum Powders	Metals Disintegrating	21.3
Iron Oxides	C. K. Williams	
Chrome Oxides	C. K. Williams	43.3
Gold Bronze Powder	Metals Disintegrating	6.7
Monastral Greens, Blues, Etc.	DuPont	9.6
Rutile Titanium Dioxide	Various	35.0
Anatase Titanium Dioxide	Various	32.5
Silicate of White Lead-45X	National Lead	53.3
Silicate of White Lead-EP202	Eagle Pitcher	53.0
Zinc Oxide AZP-222-55	American Zinc Sales	46.7
Zinc Oxide-"Horsehead" ZnOXX	New Jersey Zinc	46.7
Titanium Dioxide R-911	DuPont	33.0
"Aquablack"	Columbian Carbon	

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PIGMENTS AND EXTENDERS FOR LATEX PAINTS (Continued)

Extenders	Suppliers	Pounds per Gallon
"Al-Sil-Ate"-W	Freeport Kaolin Co.	21.7
"Al-Sil-Ate"-LO	Freeport Kaolin Co.	21.7
"Al-Sil-Ate"-NC	Freeport Kaolin Co.	21.7
"Asbestine" 3X	International Talc Co.	23.3
"Asbestine" 325	International Talc Co.	23.7
ASP-100	Minerals and Chemicals Phillip Corp.	21.5
ASP-400	Minerals and Chemicals Phillip Corp.	21.5
ASP-170	Minerals and Chemicals Phillip Corp.	21.5
"Atomite"	Thompson, Weinman & Co.	22.6
"Camel-Carb"	H. T. Campbell Son's Corp.	22.6
X-10-R	De Lore Div. – National Lead Co.	37.15
"Cellite" 281	Johns-Manville	19.2
"Dicalite" L-5	Great Lakes Carbon	19.4
"Duramite"	Thompson, Weinman & Co.	22.6
"Gold Bond" R	Tamms Industries, Inc.	22.05
"Hi Sil" 422	PPG	21.5
"Iceberg" Clay	Burgess	21.65
"Lorite"	De Lore Div. – National Lead Co.	21.1
"Metro-Nite" No. 6	Felch Quarry Co., Neguanee, Michigan	24.0
"Micro Cel" C	Johns-Manville	18.9
"Micro Cel" T-38	Johns-Manville	18.8
"Minex" 4	American Nepheline Corp.	21.7
"Nytal" 300	R. T. Vanderbilt Co.	23.75
"Red Slate" Flour	Tamms Industries, Inc.	22.0
"Silversheen" Mica	Richmond Mica Co.	23.5
"Snow Flake"	Thompson, Weinman & Co.	22.6
"Sparmite"	Pfizer	36.6
"Satintone" No. 1	Minerals and Chemicals Philipps Co.	21.5
"Zeolex" 80	JM Huber Corp.	17.5

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