QUALITY
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PRODUCTS

Product Training

VOLUME 1

SALES TRAINING

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PART I

WHAT IS PAINT?

Comprehensive knowledge of material used in the painting industry always has been vitally important for all of those concerned with the sales of our products.

This knowledge is now more essential than ever before. Why? - Because paint chemistry has made such revolutionary progress in the last fifteen years. This progress includes the development of new pigments and pigment combinations, the perfection of synthetic resins and oils to replace natural products, the introduction of new solvents and the creation of entirely new formulations based on synthetic chemicals, which simply means man-made, rather than natural chemicals. Examples of such synthetic chemicals used broadly in today's paints are epoxies, vinyls, vinyl alkyds, polyvinyl acetates, polyesters, acrylics and butadiene styrene types. There are more.

The purpose of this course is to aid in the preparation of new paint sales personnel for their territorial assignments by developing their greater understanding of paint, its functions, the many types of paint, Trade Sales products, and surface preparation and the application of paint.

In this first part we will define paint, discuss its functions, and its basic composition.

2

MATERIAL AND PROPS

SECTION I

The following material and props will be needed to demonstrate material covered in the following pages.

(Samples in Glass Jars - Labled - order from Regional Headquarters)

PIGMENTS

1. Basic Carbonate White Lead
2. Zinc Oxide
3. Titanium Dioxide
4. Titanium - Calcium Sulfate
5. Whiting (Calcium Carbonate)
6. Mica

BINDERS OR VEHICLES

1. Linseed Oil
2. Soybean Oil
3. Tall Oil
4. Alkyd Resin

SOLVENTS

1. Turpentine
2. Mineral Spirits
3. V. M. & P. Naphtha
4. Low Odor Mineral Spirits

DRIERS

1. Catalysts
2. Accelerators
3. Naphanate

DEMONSTRATION:

Arrange bottles in groups per type of Paint Formula being discussed.

DEFINITION OF PAINT

Paint in its simplest form is a white or colored material which is applied as a thin liquid coating on all types of surfaces, and which dries generally-speaking by oxidation or evaporation to become a solid, durable finish.

PURPOSES

Paint is intended to serve the following basic purposes, i.e., protection, beautification and decoration, and functional purposes.

A. PROTECTION

All structural materials are subject to the disintegrating action of the natural elements--rain, snow, ice, wind, ultraviolet rays of the sun, heat and cold. Resistance to moisture and the control of passage of moisture through a surface constitutes the greatest protective function of paint. Moisture causes wood to swell, rot, warp, decay. It corrodes metal. It ruins porous masonry. Protective paint coatings preserve the billions of dollars invested in all types of structures, transportation equipment, etc.

B. BEAUTIFICATION AND DECORATION

From the very beginning, mankind has aspired to self-improvement and the attainment of some form of beauty in the home and in working surroundings. Today, beautification of the home through painted decoration is a possibility and a reality for all, rich and poor alike.

The term "paint" comes down to us from Sanskrit, oldest known written language, and means "to adorn". In the ancient Greek language it meant "many colored".

C. FUNCTIONAL

Functional painting has become an essential in factories where scientifically selected colors for machinery, walls and floors are known to lessen eye and nerve strain, prevent accidents, improve worker morale and increase production. Functional painting applies, also, to homes by correcting architectural defects, improving interior lighting, conserving fuel costs, etc.

PART II

COMPONENT PARTS OF PAINT

Paint, again using the term in its simplest form, is made up of four principal component parts. These component parts are: The pigment, the vehicle or binder, the thinner or solvent, and the drier.

A. THE PIGMENT

A pigment may be defined as a substance in fine powder form which imparts color and opacity to a paint and largely determines its consistency and general character. Pigments may be divided into several groups, the most important of which is the opaque type. Opaque literally means "not transparent". This opaqueness (opacity) is the property which enables a paint to hide a surface. The next group is of pigments which do not necessarily have this capacity to hide but have other functional uses and are known as inerts, fillers and extenders. The third group is the colored pigments which impart color and beauty to a paint film.

1. WHITE, OPAQUE PIGMENTS

a. White Lead. The oldest known white pigment and is mentioned in literature as early as 430 B.C. It is the "grand dad" of all white pigments. Straight white lead is no longer used to any appreciable extent. Instead, white lead is processed to produce Basic Carbonate White Lead and Basic Sulfate White Lead.

b. Basic Carbonate White Lead is a compound in the form of a white powder of metallic lead, acetic acid (strong vinegar) and carbon dioxide gas. It combines readily with linseed oil to make a smooth and easily brushable paint. It is subject to gradual disintegration, a process known as "chalking" in which the film loses its gloss and wears away in a fine powdery substance. It is used in such products as our Exterior Wood Primers wherein slower chalking rate of a pigment is required.

c. Basic Sulfate White Lead is a very fine, white lead powder, and because of its chemical composition, it has a high degree of opacity. It chalks more freely than Basic Carbonate White Lead and, therefore, is used quite widely in house paints. It is known for good elasticity and water resistance.

d. Zinc Oxide. One of the whitest pigments and one of extremely fine particle size. It is not used to any great extent in our current paint formulations.

e. Leaded Zincs. This is a widely used pigment and employs a large percentage of the above mentioned zinc oxide in its making. It is known for its hardness and mildew resistance and is employed in our Exterior House Paint.

f. Lithopone. Lithopone, first produced in the United States in 1906, was among the most widely used white pigments in the paint industry, but now is practically extinct. It has been replaced by the more efficient higher hiding Titanium pigment which will be discussed hereafter. Lithopone is mentioned here only to equip sales personnel to discuss it in its proper place with dealers and painting contractors who were impressed with its wide use in past years. Lithopone was employed in flat interior paints, emulsion oil paints, exterior house paints, industrial finishes and in a variety of formulations and combinations with other pigments, notably zinc oxide.

g. Titanium Dioxide. This is perhaps the most important of all white pigments, being used in almost every type of paint formulation used today. It is called "whitest of whites" pigment and it is produced from the "blackest of black" ores - ilmenite - which is found chiefly in India and also in various parts of the United States.

Titanium Dioxide pigment is an extremely fine powder of high refractive index and fairly high density, which gives whiteness and hiding power to white paints and clarity to lighter colors. There are two forms, "anatase" (chalking type) and "rutile" (controlled chalking type).

In addition to its value to the paint manufacturing industry, Titanium Dioxide is in great demand for use in making coated fabrics, linoleum, paper products, white rubber, white leather and even soap. Your Company is one of the major producers of Titanium Dioxide in the United States. The Adrian Joyce Works at Baltimore produces great quantities of Titanium Dioxide for the Paint Division as well as for other paint manufacturers.

h. Titanium - Calcium Sulfate. (Ti-Cal). This pigment is usually composed of approximately 30% Titanium and the balance Calcium Sulfate. It is less costly to use in paint formulations than straight Titanium Dioxide, it has good dry hide, and is an excellent pigment for interior paints such as flat wall paints. It is used in Alkyd Flat Enamel and in other interior wall paints.

2. OTHER PIGMENTS: EXTENDERS

Extenders once had a rather shabby reputation in the paint industry, having been classed by some people as mere adulterants, put into the paints as fillers whose only purpose was to cheapen the product and defraud the buyer. That is definitely not so, as extenders are now known to play an important part in the pigment volume concentration and durability of a material.

The principal extenders are:

a. BARYTES OR BARIUM SULFATE: It is practically colorless in oil and thus has no modifying effect on the color of a pigment. Used with white lead and zinc oxide and in production of certain colors. Used in Exterior Wood Primer.

b. <u>CHINA CLAY (Aluminum Silicate)</u>: This is a form of aluminum silicate. Inertness and practical absence of color are its chief properties. Used to a minor extent in some of our products.

c. <u>MICA, WATER GROUND</u>: Mica is the group name for a number of silicates, principally silicates of aluminum produced in many varieties. The water ground type is that used in the paint industry. Some benefits claimed are that it adds to ultra-violet ray resistance qualities of a coating, helps to prevent checking and cracking and improves tint retention. Used in our interior and exterior Latex Paints.

d. <u>SILICA</u>; This is silica, a quartz rock, one of the most common parts of the earth's "crust." Known for its extreme hardness and colorless properties. Widely used as a paint inert and in making paste wood fillers. Used in Exterior Wood Primers.

e. <u>TALC (Magnesium Silicate)</u>: A combination of silica, magnesium and oxygen. Has various forms, one of which is know as soap-stone. Is inert and very fine which makes for a smoother paint and is said to retard settling. Magnesium silicate is the most widely used extender in house paints. Used in Exterior Primer and Exterior House Paints.

f. WHITING (Calcium Carbonate): One of the oldest paint materials known to man, and one of the most widely used pigments in today's formulations. It was used by the ancients to adorn their private and public buildings. It is an earth product in various forms -- limestone, marble, stalactite, chalk, etc. One of the very best varieties is obtained from the famous chalk cliffs of Dover, England. The chalk is prepared by grinding in water, drying and regrinding. Used in paint, it imparts mildew resistance, non-settling properties, is a good flatting agent, and has good tint retention. It is widely used in interior paints such as Interior Wall Sealers, Enamel Undercoater, Alkyd Flat, Alkyd Semi-Gloss and it is used in our exterior non-chalk house paints and Tinting Whites.

3. COLOR PIGMENTS

In the realm of color, there are many pigments used in the production of exterior and interior paints, some of which are as ancient as the industry itself and some of which are, as the saying goes, as new as today's newspaper.

These pigments are principally the reds, blues, yellows, browns and greens. It is in the field of blues that the most modern development has been recorded. This is known as "phthalocyannine blue," and, as mentioned in the Introduction, it is hailed as the greatest color advance in nearly two hundred years. It is an organic blue pigment which is outstanding for the clearness and brightness of its tints with white pigments, and its outstanding fade resistance. The base of this remarkable product is the miraculous "Phthalic Anhydride", which is described in the Section on "Synthetic Resins". There is also a "Phthalocyanine green", and paint chemists are hoping to develop reds and yellows with the same properties.

Color pigments may be generally divided into four groups: (1) the Earth Colors, which are those obtained from natural mineral deposits in the ground and prepared for use by various purification processes; these Earth Colors constituted the paints used in pre-historic times. (2) Chemical Colors, which as their name implies are made through the action of one chemical on another to produce special compounds. (3) Vegetable Colors, made by extraction of normal or decayed vegetable matter. (4) Animal Colors, derived from burnt animal bones, bone black being an example.

B. BINDERS OR VEHICLES

The binder or vehicle portion of paint composition may be described as "A Liquid Medium which binds the pigment particles together and to the surface, contributes to the spreading and covering properties, and, with the pigments, gives strength and life to the paint".

Today's paints are usually classified according to the type of vehicle employed, since it is the vehicle which determines the performance characteristics of a paint more so than the pigment.

Accordingly, it will be found that a rather "standard" group of pigments are used in all types of formulations, whereas the types of vehicles are highly varied.

Pigmented interior and exterior coatings are divided into three general classifications. (Clear, or unpigmented coatings will be discussed separately in a later chapter.)

<u>OIL PAINTS</u>. Wherein the vehicle is entirely a combination of certain drying oils as in the case of most exterior House Paints, or a combination of such oils and certain varnishes, as in the case of interior and exterior enamels.

<u>LATEX PAINTS</u>. Wherein the vehicle is composed of various synthetic rubber or plastic resins suspended in water (emulsified) as in the case of interior and exterior "Latex Paints", or, as in the case of the original, simpler type water paints wherein the vehicle portion is an oil, an oleo-resinous varnish (oil and resins) or a straight resin, each emulsified.

<u>CHEMICAL COATINGS</u>. Wherein the vehicles are composed of very special synthetic resins, eliminating oils and varnishes to achieve the highest order of performance, as in the case of coatings for use in chemical plants, industrial plants, etc.

The oil paint group can be further described as paints that dry by oxidation (absorption of oxygen) which is hastened by using driers. Oil paints are thinned for easier application with turpentine, mineral spirits or naphtha.

Water paints dry by evaporation of water, with the individual particles of the vehicle squeezing together with the pigment particles to form a continuous film as the water leaves. Water is the only thinner for these paints.

Chemical coatings dry by evaporation of special solvents or by chemical reaction created by converters or catalysts.

We will now study the various major oils, varnishes and synthetic resins to learn how each contributes to the performance properties of the various paints and coatings. Thinners and driers will be discussed separately.

1. OILS

   Much of the progress in the paint industry has stemmed from new developments in drying oils. For example, alkyd resins have widely replaced Chinawood or tung oil, for years an industry standby. Alkyd has the advantages that it is odorless and that it retains its clear color without yellowing with age -- a vital factor in a decorative finish.

   a. LINSEED OIL: Of the oil bases, the most widely used in the paint industry is linseed oil, which is obtained by crushing the seed of the flax plant. There are five principal kinds:

      1. Raw Oil.
      2. Heat bodied oil.
      3. Oxidized oil, that is "blown" or purged with air causing oxidation which increases viscosity.

4. Refined oils, with color bodies and other impurities removed.
5. Boiled oil, is raw or refined oil to which a drier has been added.

The following analysis of a typical exterior House Paint vehicle, is an excellent example of the use of Linseed Oils.

Bodied Linseed	75%
Raw Linseed	25%
Total Oil	77%
Mineral Spirits	20%
Drier	3%

b. TUNG OIL: Although tung oil, which is known for its waterproofing properties, is still used in making certain types of quick-drying oil paints, its importance appears to be diminishing. Consumption of this oil by the paint industry has fallen off in recent years as the domestic oils and synthetic resins have increased in popularity.

c. SOYBEAN OIL: Soybean oil is classified as a semi-drying oil. Soybean oil (which has in no way been treated to change its chemical nature) is extensively used in coatings today. Alkali-refined soybean oils are widely used in the manufacture of oil modified alkyd resins. The use of soybean oil is particularly advantageous in this application because of the oil's non-yellowing characteristic; in this manner soybean oil is frequently a component of the gleaming white-baked finishes on modern appliances such as refrigerators, stoves and washing machines.

Improved soybean drying oils are usually made from alkali-refined soybean oil. They are finding extensive application in varnishes and enamel vehicles. Such oils are also used with further chemical and heat treatment in the formulation of outside house paints. As a matter of fact, outside house paint has been formulated from 100 per cent improved soybean oil vehicles and has been found to show excellent weathering characteristics, very comparable to those obtained when using pure linseed oil vehicles.

An example of use of Soya Oil modified with an alkyd resin in a typical interior - exterior type enamel follows:

Soya Alkyd	53%
Mineral Spirits	45%
Driers	2%

d. <u>TALL OIL</u>: Tall oil comes from the pine trees of the South as a by-product from the manufacture of paper. It is acid refined and distilled to improve its color and odor. The major uses of tall oil in the paint industry are:

(1) <u>General Purpose Varnishes</u>:

The esters or meleic modifications generally extended to longer oil lengths with any of the drying or semi-drying oils, are blended with other oleoresinous vehicles or alkyds for the manufacture of grinding liquids, flat wall paints, interior gloss enamels, barn paints, core oil, freight car paints and primers, wood finishing liquids, floor varnish, sanding sealer, porch and deck enamels and baking enamels.

(2) Tall Oil Alkyds:

Tall oil used in conjunction with semi-drying oils such as soya or fish are employed in the manufacture of architectural enamels, metal primers, dip tank coatings, cabinet finishes and one coat non-penetrating flats. Melamine or urea blended with tall oil alkyds are used in metal outdoor furniture finishes, machinery and implement enamels.

An example of the use of a soya oil, tall oil alkyd combination in a typical flat wall paint vehicle follows:

Soya, Tall Oil, Modified	28%
Mineral Spirits	70%
Drier	2%

e. FISH OIL: Even the fish of the sea contribute a share toward the making of paint. Fish oils, mainly extracted from the menhaden, pilchard and sardine, are soft drying. The paint made with them is particularly satisfactory for covering smoke stacks or other hot surfaces where a hard-drying paint would not be suitable. After treatment to remove the soft-drying components, fish oil becomes important for other uses.

2. SYNTHETIC RESINS

The story of synthetic resins, not only as related to the paint industry but practically to all American industries, is really dramatic; we might almost say romantic. These man-made materials used in today's highly specialized protective, decorative and functional coatings are, of course, of equal importance in the far-flung plastics industry and there is scarcely anything now in daily use in which they do not have a prominent part; the furniture in your homes and offices; the accessories in both places, from major installations to the smallest bits of equipment such as pens and pencils; costume jewelry, buttons, shoes, hats, all kinds of wearing apparel; essential parts of automobiles and all forms of transportation; toys and gadgets --- in fact, everything and all things.

Although there are many synthetic resins, the most widely used in the painting industry are the alkyds, the epoxies, the phenolics, silicones, the vinyls and the rubber types which are chlorinated rubber and pliolite. These are widely used in industrial applications and are the major vehicle component in almost all trade sales finishes except exterior house paints. Even in this case linseed oil is being hard-pressed by synthetics since the development of such exterior paints as stain and blister resistant house paints and flat alkyd house paints in which linseed oil is not used as such.

a. ALKYDS: Without any doubt, the most important development in the paint and painting industries in recent years has been the perfection and extensive use of resins known as Alkyds. Vital ingredient in an Alkyd Resin is Phthalic Anhydride. Phthalic Anhydride is a white powder, made from Naphthalene (known to you in its familiar form of moth balls) and plain, ordinary air that we breathe.

At first, Alkyd vehicles had to be sprayed and required baking at high temperatures in order to dry; also they required extremely strong solvents such as alcohol, xylol, etc. New methods have been found, however, to produce Alkyd resin varnishes so that they will brush and air-dry in a normal manner and at the same time permit reduction with turpentine or mineral spirits without loss of their remarkable properties.

Synthetic Alkyd vehicles are tremendous improvements over the older oleo-resinous vehicles made of natural gums and oils.

Examples of paints made with Alkyds (modified with oils) has already been given under "Oils". These paints have better chemical resistance, better water and wear resistance, better odor, etc., than their oleo-resinous predecessors.

b. EPOXY RESINS: The Epoxy resins are chemical synthetics derived from petroleum. Epoxies were designed to have properties of adhesion, toughness, elastic resilience and abrasion resistance and to be resistant to chemicals and solvents. With epoxy resins, coatings can be produced that protect against corrosion of equipment, structural steel, machinery, concrete, masonry, etc. Many industries such as the pulp and paper, petroleum and petro-chemical, food processing, steel, distilleries, textile, chemical, etc., which have the problem of protecting metal and other surfaces from attack of water and corrosive chemicals, have found epoxy coatings to be their answer.

In over-all painting and maintenance work the epoxy resin coatings used fall into two types. These types are pure epoxy or catalyst cured epoxy and the modified epoxy ester which does not require a catalyst to cure.

Catalyst cured epoxy or pure epoxy coatings are developed for and should be used in the areas subjected to the most severe exposure. They should be used in areas where there is chemical spillage or extreme fume conditions and in certain instances in immersion. These products contain no oil, therefore, are more resistant than other types of chemical resistant paints containing oils and other components that are subject to attack by acid, alkali, solvent and moisture. They do not dry by oxidation as normal paints do, but by polymerization (except for evaporation of solvent). The polymerization or chemical reaction causing the drying and curing of the film takes place when the catalyst or converter (which comes in a separate package) is added to the pure epoxy just before its use. The pure epoxy coatings give excellent film build and are very versatile in methods of application. Most catalyst cured epoxy coatings can be applied by brush, conventional spray, hot spray or roller. Catalyst cured epoxy coatings can be baked, force dried or will air dry. Our

Modified epoxy or epoxy ester coatings should be used in areas where the maximum resistance is not needed but where normal finishes such as alkyds or oils are not satisfactory. The epoxy ester is formed by reacting the epoxy resin with oil fatty acids. Modified epoxy coatings have the following general properties:

1. Fast dry.
2. Unusual toughness and abrasion resistance.
3. Good resistance to ultra violet light.
4. Good resistance to mild alkalies and mild acids.
5. Dense films.

Modified epoxy coatings are applied by conventional means such as brush, spray and roller. They can be applied over most old paints. Epoxy resins are finding new uses in paint coatings every day -- in mastic type coatings which can be applied at 10 to 15 mils thickness in one coat, products which can be applied directly over damp masonry surfaces, products to keep concrete floors from dusting and absorbing oil and grese, and clear varnishes. When epoxy resin coatings are used, extreme care should be taken in the preparation of the surface.

c. PHENOLICS: The most important type of phenolic resin used today in the painting and decorating field is the thermoplastic oil-soluble variety. Resins of this type are often called "varnish" resins. They are manufactured by reacting formaldehyde with any of several types of phenol.

Of the phenolic varnish resins, those based on butyl phenol have shown the best coating characteristics in recent years. Butyl phenol resin-based varnishes are comparable in cost per pound to alkyd-based finishes. Butyl phenol resin-based varnishes have excellent drying speed, through-dry, hardness durability, solvent tolerance, pigment stability, water resistance, and alkali resistance.

d. <u>VINYLS</u>: Vinyl resins for surface coatings are permanently thermoplastic, non-oxidizing, and non-heat-reactive. They are designed to be carried in solution in a volatile solvent mixture and to form a protective film by evaporation alone.

Most vinyl resins for surface coatings are copolymers of vinyl chloride and vinyl acetate. This means that these two constituents are blended chemically during manufacture, and produce a single resin combining the best features of each of the two components. The new resin combines the strength, toughness, and chemical resistance of polymerized vinyl acetate. Other outstanding properties of the vinyl copolymer resins are:

1. Complete absence of odor when cured, taste, and toxicity.
2. Extreme chemical inertness.
3. High water resistance.
4. Water-white color, good clarity, relatively high refractive index. These properties make possible

clean whites and tints in pigmented coatings, and brilliant films in clear finishes.

5. Ease of application.
6. Resistance to aging.
7. Resistance to weathering. Properly formulated copolymer resin coatings exhibit excellent durability on exterior exposure.

Because of their general resistance to chemicals, greases, oils, alcohol, abrasion, and moisture, finishes based on these resins are used for protecting Chemical Plants, Petroleum Equipment, Marine Installations, Ship Bottoms, Storage Tanks and Steel Pools.

e. CHLORINATED RUBBER: Chlorinated rubber is another type of film-forming material which is unaffected by acids, alkalis, salts, moisture and fungus growth. Useful coatings are made only on compounding with resins (for adhesion and gloss) and plasticizers (for flexibility and toughness).

Chlorinated rubber is classed as a thermoplastic. It may be applied over metal, masonry, and in some cases, asphalt. The applied films are tough, exhibit good abrasion resistance, and are resistant to a range of corrosive chemicals. We use this resin in Traffic Paint and in our Swimming Pool Paint.

f. PLIOLITE: The other rubber base paint widely used in the industry is pliolite. This product is made from styrene and butadiene, the same ingredients used in synthetic rubber. The resin is tailored through chemical research to answer the problem of effective masonry coating. The resin itself is essentially inert, which simply means it is unaffected by the alkali found in all types of masonry construction. Since it is incapable of reacting chemically with the alkali, the problem of "burning" is eliminated. This material also provides a highly water resistant film and when properly formulated with the appropriate pigments, fillers and inert materials, the finish is microscopically porous and highly abrasion resistant.

We use Pliolite in products for floors, walls, machinery, etc., in moist and light chemical environments.

C. PAINT THINNERS

Modern paints occasionally require "thinning" at the time of use to adjust the viscosity (thickness) for best application. The correct thinner added in the proper amount as specified in the manufacturer's directions permits easier and smoother application of the paint.

It is extremely important that the proper thinner is chosen to suit the method of application. Thinners that evaporate slowly should be used when brushing or rolling paints, since these methods involve rather lengthy "working" of the paint film to attain a uniformly thick and level coating.

D. DRYING AGENTS

Drying agents are used in many types of coatings to hasten the drying, curing or hardening of the film. Particular driers for particular purposes are determined by the manufacturer in accordance with specific formulas. The improper or excessive use of any drying agent can easily ruin a good protective coating.

1. DRIERS for conventional paint systems are principally compounds made with oil and metals, such as lead, manganese and cobalt. They assist the drying action by promoting absorption of oxygen.

   A new type of drier has been on the market for several years known as the "naphthanate" type, which is a combination of naphthenic acid made from petroleum products, and lead, cobalt, manganese, etc. The use of this new type has become quite widespread in the manufacture of modern paint coatings.

   It is rarely necessary to add driers to modern paint coatings. In fact, the addition of driers is actually a rather dangerous practice.

2. CATALYST. A catalyst, such as used in conjunction with a polyester coating system is a chemical agent which initiates the hardening process. The catalyst is usually added to the polyester material in fractional amounts, such as one or two liquid ounces per gallon.

3. <u>ACCELERATORS</u>. An accelerator is a "naphthanate" of the cobalt type similar to that mentioned previously under paint driers. It serves to activate the catalyst thus promoting the hardening process. Cobalt accelerators are often added to the polyester product at the time of manufacture, but in some cases the cobalt accelerator must be added at the time of use.

<u>NOTE</u>! Extreme caution is to be exercised when adding cobalt accelerators and the catalyst materials at the time of use. These materials must never come in direct contact with one another, or otherwise a violent reaction will result.

4. <u>CONVERTERS</u>. A converter is a liquid solution type catalyst which reacts chemically with the epoxy resins, producing the hardening action. Converters are used in much greater quantities than either accelerators or catalysts. In most cases the materials are mixed equal parts by volume with the converter.

It must be made clear that there are several converters manufactured, each tailored to meet the specific needs of the various materials. They are not interchangeable.

Typical brushing and rolling thinners used broadly today are:

1. GUM SPIRITS OF TURPENTINE, which is obtained from living pine trees. The tree trunks are slashed open and a substance termed oleo-resin oozed from the wounds and is collected in cups. The oleo-resin is hauled in barrels to a large copper still, where water is added and the distilling process begins. Liquid turpentine is obtained by the distillation; the residue becomes the rosin of commerce.

2. STEAM DISTILLED WOOD TURPENTINE. Pine wood stumps are ground up and the turpentine is produced by live steam being turned on the pieces. Steam distilled wood turpentine is much cheaper than gum spirits of turpentine and has a much stronger odor. Turpentines are known technically as "terpenes".

3. MINERAL SPIRITS. Mineral Spirits is a petroleum product intermediate between kerosene and gasoline. It has largely replaced turpentine as a thinner by virtue of its being cheaper and equally efficient. It is known technically as a "petroleum naphtha" (aliphatic hydrocarbons).

4. ODORLESS MINERAL SPIRITS. Odorless Mineral Spirits is a by-product of the aviation gasoline industry. It is used in all odorless solvent thinned vehicles and paints since its odor disappears as evaporation begins, permitting the application of paints in occupied areas where "painty odors" would be objectionable.

5. LOW ODOR MINERAL SPIRITS. Low Odor Mineral Spirits are regular mineral spirits from which a high proportion of the Aromatics is removed. It is used to improve the odor of paints.

A fast evaporating thinner is required when spraying paints to prevent running and sagging when the atomized paint particles rejoin upon reaching the surface. There are numerous naphthas, some for household uses, but V.M.&P. Naphtha (Varnish Makers and Painter's Naphtha) is used for spraying. Like mineral spirits, it is a petroleum naphtha but one with much faster evaporation than mineral spirits.

The thinning of shellac requires the use of alcohol. There are many types of alcohol, but the type with the best dissolving power in shellac is "methyl alcohol." Today it is manufactured synthetically, being a by-product of coal and natural gas.

Lacquers require the use of the proper grade of "lacquer thinner" for thinning. These thinners are made by treating certain alcohols with organic acids.

Certain synthetic resin coatings require special thinners having great solvent power. These are to be found in the "hydrocarbon" class and are known as toluol and xylol, which are chemically extracted from petroleum.

SECTION V

PART I

Exterior Paint Failures

a. There is a booklet available from The National Paint, Varnish and Lacquer Ass'n., Inc., 1500 Rhode Island Avenue, N.W., Washington 5, D.C., titled "Menace of Moisture." Cost is about 25 cents each. Also Keckel Publishing Co., Inc., Philadelphia 7, Pennsylvania, publish a book, "Why Paint Peels." Cost, 25 cents each. There is also a movie film available from The National Paint, Varnish and Lacquer Ass'n.--"Moisture-The Hidden Menace to Homes." This can be had on a loan basis by writing to the Ass'n. Better allow two weeks for delivery.

SECTION V

PAINT FAILURES

Only a thorough understanding of the different types of paint failures will prevent their occurrence. Paint failures are due chiefly to four factors:

1. Improper surface preparation.
2. Improper application and incorrect selection of a paint for the surface.
3. Use of poor quality paint.
4. Application of paint to a surface not suitable for painting, such as a wall that is constantly wet internally due to water entering from a leaking roof or water pipe.

PART I

EXTERIOR PAINT FAILURES

CHALKING: The gloss (or sheen) of a paint is due to a layer of oil on the surface. Light, especially ultraviolet light, destroys the oil binder and leaves loosely bound particles of pigment which are called "chalk" on the surface. In slight amounts within a year or two, this is desirable. It aids in keeping the paint clean. Heavy chalking that rapidly washes away to leave an unprotected surface is highly undesirable.

Paints of suitable composition may chalk mildly and still maintain a good surface, free from cracking, and retain good moisture and weather resisting properties, for many years.

Before a heavily chalked surface is repainted, the chalk should be removed by scrubbing or by wire brushing. Otherwise, uneven gloss and poor durability may result.

NOTE: In protected areas of structures where chalking is not assisted by exposure to the elements and particularly where non-chalking paints are used in such area, lasting adhesion of new application of paint may be questionable. Further it is believed that certain pigments used in some modern house paints may react on ageing to form a contaminative salt on the surface of the film. Chalking and exposure to the elements help eliminate this contamination. Where this occurs in protected areas, such as under the eaves, it must be removed by scrubbing under the eaves and down the sidewall to a point past the width of the eaves if the proper adhesion of the new application of paint is to be successful. If soap is used in cleaning this area, it must also be completely removed.

ALLIGATORING AND CHECKING: Checking and alligatoring of exterior paints is usually due to the application of relatively hard finishing coats over soft priming or underlying coats. Such conditions occur when the priming or other undercoats are too rich in oil, when not enough time has been allowed for the undercoats to dry properly, or when the finishing coat lacks elasticity. Under the influence of changes in temperature, the paint film contracts or expands. If the top coat is not elastic enough it will crack. Obviously the remedy is to allow the priming and other undercoats to dry thoroughly hard and firm before applying the finishing coats. In warm, dry, clear weather a shorter time may be allowed than in cold, moist, cloudy weather. Additional points to remember in order to avoid checking and alligatoring are as follows:

A. The longer the priming coat is exposed to the air, the greater the oxidation and the harder the surface. Up to a certain limit, this is most desirable for a primer.

B. Undercoats should always be harder than outer coats.

c. The amount of oil in priming coats should only be sufficient for the filling of the surface pores and the binding of the pigment. Do not add oil to primers except as directed on label.

FLAKING, CRACKING AND SCALING: These pronounced defects that too often occur with certain types of widely used lumber, have been studied for some time. Some of the conclusions are summarized as follows:

a. These defects are caused by films which are not sufficiently elastic to adapt themselves to the volume (size) changes which take place in the wood.

b. Paint usually flakes most rapidly over knots in yellow pine. The resin in the knots may bleed into the paint and make it too hard and brittle. The treatment of these knots with shellac is satisfactory for exterior work. The best means of treating the knots is to apply a thin coat of aluminum powder paint or special knot sealer, and allow firm drying before the priming coat of paint is applied.

c. When wood dries, the greatest shrinkage occurs at right angles to the grain. For green pine this is about 3 inches per 100 inches. For other woods, such as spruce, cedar and cypress it is about 3 to 4 inches. Paint shrinks equally in all directions. Thus the difference in shrinkage of the paint and the wood are responsible for some effects that may appear later. These conclusions would suggest that cracking and scaling may occur most often with thick films. The thicker a film is, the stronger it is and the less is its ability to conform to the changes that take place in the shape of the wood during these stress periods. It is well to avoid wherever possible the accumulation of thick paint coatings upon a surface. In repainting work the old paint should be sanded down if it is very thick, before the repainting coats are applied.

d. For a long time it was thought that deep penetration was necessary for good adhesion, and that the addition of turpentine and other thinners would accomplish this. It would appear, however, that there is still some question as to the degree of penetration that may be obtained upon wood surfaces with oil paints, and that the type of thinner used is of relatively less importance than heretofore thought. Adhesion of the film to the surface rather than penetration into the surface is more important.

e. As a general rule on the same board paint will peel from summer growth wood, but will adhere satisfactorily to spring growth wood. One of the most pronounced differences between these two woods is the density; summer wood being three times as dense as spring wood. It would appear that the species that hold paint best are the light woods that contain but little summer wood.

f. Paint lasts longer on edge grain boards than upon flat grain boards. The bands of summer wood are very much wider on the flat grain. Therefore, the coating has greater difficulty in obtaining a mechanical grip on the wood and is more likely to flake off in large patches.

g. On flat grain boards the annual rings may be convex or concave. The convex, being nearer the bark of the tree, is called the sap side, while the concave is called the heart side. When boards on a house show loose grain and fail rapidly, they are usually found to be flat grain boards exposed heart side out. The sap side of flat grain boards presents better painting surfaces than the heart side of the same boards.

In conclusion, it should be stated that the scaling and crumbling which are sometimes exhibited by paint films are often due to moisture conditions, with subsequent shrinkage changes in the outer surface of the film. If a paint loses its elasticity, it does not function properly in a protective manner. For instance when moisture enters, causing major volume changes in the wood, these changes are likely to be violent, especially in refractive species such as yellow pine. Inelastic, non-protective films cannot accommodate themselves to such changes, and they break at the junction of the spring and summer wood bands, where the induced strains are maximum. More moisture enters, volume changes recur, and the adhesive properties of the paint film are lost.

MOISTURE: Several major changes in construction have occurred in recent years that contribute to paint failures due to excessive moisture. One is the building of tighter homes, with the more common use of weather-stripping, storm sash and insulation. This, coupled with the trend toward many families living in smaller quarters and a larger than average family living in a smaller space--all using hot water for showers, laundry units, baby bottle sterilizers, etc., accounts for much moisture inside the home and the great increase of paint failures due to condensation. It is found that trouble from condensation is prevalent in very few larger houses except in isolated areas of the home. About 2/3 of the homes built today are built without a basement. If constructed without a proper vapor barrier, basementless homes can be a serious threat to paint on the outside of the home. Often a paint job will be observed that is in good condition except for peeling or blistering under the cornice. In recent years there has been a trend toward placing the gutter almost directly above the wall. The overhang has been eliminated. It is evident that in the older construction only the paint on the underside of the cornice failed. Today there is often sufficient water in the form of melting ice and snow pushed up from the roof to cause a paint failure extending from the gutter to the foundation. It is believed that the moisture that enters the house because of ice and snow pile-ups, is the most common cause of paint failures in the colder areas. Generally speaking, 2/3 of the United States has enough snow cover to cause this type of damage. In localities where there is danger of damage due to ice dams, the following procedure may be used on new construction. Use two courses of 30 lb. roll roofing at the eaves. On these two courses a heavy coating of mastic such as roofing cement should be applied, allowed to dry and then shingles or slate applied. In existing construction, especially where roof and valley design requires a short gutter to carry away melted snow from a large roof area, it might be necessary to install a "de-ice cable". The cable should be dropped down the downspout and lie in the gutter. Where design forces a very short gutter to drain a large expanse of roof it is advisable to extend the de-ice cable up the valley. The heated cable creates a channel which allows water to drain into the downspout. Care should be taken to see that leaves are not allowed to remain in the gutters over the winter. The remedy in this case is the removal of the gutter or the installation of de-ice cables in the gutter and valleys.

Another cause of moisture entering behind the paint film is improper flashing at the juncture of two different types of siding material. For instance, the use of plywood above siding. The same type of failure often occurs when a belt board is not properly installed. The improper flashing of the chimney is another common source of trouble. The flashing should always fold under the brick and not be exposed to the top edge.

Most of the paint failures on the exterior of homes are caused by moisture entering the back of the paint film either from the outside or from the inside of the building. Water reaches the back of the siding from the outside due to poor construction. Much of present construction permits water to be trapped with incorrect use of flashing and incorrect use of moldings. Water reaches the back of the siding from the inside of the building when moisture-laden air, seeking its low pressure area, the colder outside air, condenses at the dew point temperature. The lower the exterior temperatures, the greater the chances of condensation.

The simple examples of condensation are: Water condenses on the ice pitcher; on a cold day, you can see your breath when you step outside--you didn't see it when you were inside. The reason is that cold air can hold much less moisture in the form of vapor than warm air. Air at 70 degrees can contain 22 times the amount of moisture that air at zero degrees contains. It is obvious that warm air, if allowed to escape through outside walls, will condense when the interior humidity is high and the exterior temperature is sufficiently low.

To prevent condensation in sidewalls:

1. Eliminate overactive humidity devices such as an over-active humidifier. Use a de-humidifier. Vent appliances, such as a clothes drier, or unvented gas heaters. Eliminate excess vapor escaping from the earth in basementless homes. On crawl spaces, a good vapor barrier can be installed by laying 50 lb. roll roofing over the earth, lapped 6 inches, held down by stones or cemented.

slab floors must have a vapor barrier over the earth. The installation of a vapor barrier in new construction is simple. In existing slab floors, partial protection may be achieved by the use of a concrete hardener or the application of asphalt tile laid in asphalt cement.

2. Isolate excess humidity. Prevent the warm high humid air from reaching cold areas. Do this with the installation of an adequate vapor barrier.

Sidewall insulation contributes greatly to living comfort and is not necessarily a cause of exterior paint failure. When insulation is applied a vapor barrier must be continuous and unbroken to prevent passage of warm, moist air around the barrier. All joints must be lapped and securely fastened on studs, joists or bracing.

Membrane or attached vapor barriers, of course, are impossible in existing construction. For existing construction paint must be applied to interior of outside walls, and the top floor ceiling. Two coats of primer and sealer and one coat of polyvinyl sealer or wall paint, flat or gloss, or two coats of rubber base paint carefully applied make a good vapor barrier. Coated wall fabrics are also a good vapor barrier.

3. Ventilate the interior of the home to reduce excess humidity. Install a fan in kitchen and bath, either manually or automatically operated. When a fan is operating it is important that there be a slight opening to the exterior. This might be a slightly opened basement window or even a tiny opening in the fireplace damper. Remember the introduction of cold, drier exterior air is one factor that reduces the humidity.

If no fan is installed windows should be opened after taking showers and other home activities that produce vapor.

If you desire 70 per cent humidity in your home and the outside temperature is zero degrees, you will probably have a bad paint failure unless your dwelling has a perfect vapor barrier. Some day perfect homes may be constructed. Until then a combination of the methods outlined must be used, especially in small dwellings.

GAS DISCOLORATIONS: White and tinted paints containing lead compounds are darkened by hydrogen sulfide gas generated from sewage decomposition or industrial activities in some communities. They hydrogen sulfide acts upon the lead to produce gray or black lead sulfide, sometimes having a metallic lustre resembling graphite. Very little of such type of discoloration is noted, and where found it is generally upon freshly applied soft films that are quite permeable to gas. After paint has aged for a few months and become hard, hydrogen sulfide gas has relatively much less darkening action. Even where the paint has darkened, later on when there is less gas in the air oxidation may restore the normal color. Where it is necessary to remove the discoloration at once, hydrogen peroxide or a very dilute solution of acetic or muriatic acid sponged on the surface will rapidly remove the deposit. The surface should then be flushed with water to remove the chemicals.

METAL STAINS: The staining of paint to a yellowish or brownish color under copper screens and gutters and under iron hinges and lamps and the like is not uncommon.

Therefore, all copper and iron adjoining painted surfaces should be coated. If the owner desires to retain the characteristic color of new copper, varnish or clear lacquer should be used. Otherwise he may use paint or enamel of a color harmonizing with the rest of the building. On iron, a rust preventive primer should be used, and this should be followed with regular house paint.

MILDEW: Another type of discoloration of surfaces is due to mildew. This occurs most often in southern localities where both the temperature and the moisture content of the air are high, conditions favorable to the growth of mildew. Dark colored paints are more susceptible than light colored ones, because they are more likely to dry slowly and remain tacky longer.

Dry plant pollen and mildew spores readily adhere to the tacky surfaces. When suitable conditions prevail, the mildew grows and produces a black (aspergillus niger) or green (penicillium glaucum) discolaration. Mildew growth on paint, however, is no more common than on many other surfaces.

To prevent mildew formation on paints follow these recommendations:

a. Make a careful examination of the surface. The soiled appearance may be due to dirt rather than mildew. Dirt washes off easily. Mildew is removed with considerable difficulty. Use a powerful pocket magnifying glass to determine whether mildew is actually present.

b. Most large paint manufacturers now manufacture mildewcide and fungicide paints to be used to prevent the growth of mildew. Generally speaking, preparation of the surface should be taken care of in the manner recommended by the paint manufacturer. However, where such preparatory information is not available the following may be used: The surface must be made clean by the removal of all dirt, grease, loose paint, etc., by standard methods. Grease should be removed with naphtha; the surface should then be washed with a soda or trisodium phosphate solution. Often it may be necessary to resort to an abrasive cleaner. Loose and peeling paint should be removed by scraping, wire brushing, etc. The surface should then be sterilized with a hypochlorite solution containing 1/2 to 1 per cent available chlorine and then washed with a mild alkali detergent and thoroughly rinsed. The surface should be thoroughly dry before repainting with an approved mildewcide paint. It is important to paint it immediately after it has become dry to prevent the possibility of the surface becoming reinfected.

c. Mildewcides can be made by the addition of mercury compounds to regular finishing coats of paint. This practice is not recommended as, on exterior work, such paints become harmful to human and animal life, and also since the majority of these paints that are used on interiors would be used in kitchens.

BROWN STAINING: The type of discoloration or staining that is often shown upon redwood and red cedar, two woods that are coming into wide use as siding for dwellings, is generally due to the presence of large percentages of coloring matter in these woods. In fact, leaching of these woods over long periods of time may make them practically white, thus indicating the high percentage of water soluble staining matter present. This staining matter is not of a resinous nature, and its effect upon paint should not be confounded with staining caused by resins.

The staining matter present in such woods, if painted when they are moisture saturated, may later be drawn to the surface by the sun and run down the siding to dry up in blotches that resemble tobacco juice. This effect is most often shown on new construction where the painting work is done before the plaster had thoroughly dried. Large quantities of moisture in fresh plaster pass through the siding and then through the paint to desposit the collected stain and cause the discoloration referred to.

In general, the cause of brown staining is the same as that of blistering, namely, the painting of wood wet by rain or by water forced through the walls from drying plaster, from leaky roofs, poorly mitered window frames or openings not protected by flashing.

It also may be well to point out that redwood and red cedar, which have in the past shown the greatest amounts of brown staining, are two of the woods upon which paint gives its best service. If moist conditions are avoided, painting jobs upon these two types of wood should prove extremely satisfactory.

On existing surfaces painted white or in light tints, that have shown discolorations such as those referred to above, removal of the spots may often be accomplished by sponging the surface with a 50 per cent water solution of alcohol. When the brown stain has become aged and oxidized so that the above treatment is no longer effective, a repainting job may be necessary. If by such time the plaster in the house is thoroughly dry, no fear of further discoloration should be felt.

Leaf Stains: Another source of brown stain may be occasionally observed. In rainy autumn weather, wet leaves may stick to the sides of the house until enough coloring matter has been extracted to stain the paint. This stain is not deep seated and disappears in a few months.

PART II

INTERIOR PAINT FAILURES

EFFLORESCENCE: This is a white discoloration which appears on the surface of a paint film, usually following application on new plaster. Most new plaster contains a certain percentage of salt bearing substances, which, if put into solution by moisture in the surface or in the air, will migrate in liquid form through microscopic pinholes in the paint film, and will spread out across the surface.

Efflorescence can be prevented by making certain that the plaster is thoroughly dry. During the drying process the area must be thoroughly ventilated to carry the moisture out of the structure. The drying of new plaster during the late fall, winter or early spring months is assisted by introducing heat into the new building, but heat alone is inadequate for proper drying. Unless the area is ventilated as mentioned, the water will condense on the freshly applied paint, accelerating the action of efflorescence.

Latex paint films are usually not affected by efflorescence and it may be merely washed off the surface with plain water or with mild detergents. It will not reoccur providing the moisture factor within the structure is properly controlled and held at a normal level.

It is possible that efflorescence will permanently stain certain oil type flat finishes.

SAPONIFICATION: This is the result of a rather violent chemical reaction causing the newly applied paint film to actually convert to a "soap". The alkali in fresh plaster or masonry reacts with the oils ("fats") in oil type paints, converting the dry paint film to a brown liquid substance that is very soap-like in nature. This condition rarely occurs with modern paints due to the excellent chemical resistance of the alkyd resin which is now widely used.

Saponification is prevented by making certain that the plaster or masonry is absolutely dry, since alkalies in their dry form are relatively non-reactive. Further, it is prevented by the use of proper alkali resistant primers or finish coats as mentioned above. It is possible for saponification and efflourescence to occur at the same time.

BLISTERING: Blistering of interior paints may be caused by either the presence of moisture behind the paint film, or by chemical reaction with previously applied paints. Blistering due to moisture on interior surfaces usually occurs in basements, below grade, where leaks in the wall permit moisture under considerable pressure to distort the paint film.

Small pea-sized blistering may occur when latex paints are applied over old calcinated oil type finishes. Such finishes are also known as "limed-oil" types. The water present in the freshly applied latex material causes a gaseous reaction with certain ingredients in the limed-oil material, resulting in the blowing of small bubbles in the newly applied material. This condition is usually corrected by sealing such finishes with an oil type primer-sealer.

Blistering may also occur when solvents are "trapped" in a fast drying film of paint. In the painting of exposed exterior wood or masonry floors for example, blistering can occur readily wherever depressions exist in the surface. In such places direct sunlight causes fast "top dry", trapping solvents which "blow" blisters in the film when they evaporate.

PEELING: Interior paints may peel if; (1) applied over surfaces contaminated with oil, wax, grease, etc.; (2) if applied over powdery surfaces such as improperly mixed plaster, decomposed old paint finishes, or low grade compounds; (3) or if applied over extremely wet surfaces. Peeling can be avoided by thorough cleaning and rinsing of any surface, by removing or reconditioning unpaintable old finishes, by properly dusting and sealing problematical plaster surfaces, and by making certain that all surfaces are dry before painting.

ALLIGATORING: This is cracking and checking of a paint film in a very distinctive pattern, usually occurring where proper surface preparation is ignored in applying enamels over old varnishes. As the enamel ages and shrinks, it is able to "slip" on a smooth varnish finish. It can be avoided by ligh scuff sanding of the varnish, or dulling and softening it with a liquid surface conditioner prior to the application of the enamel.

BURNISHING: This can be described as the development of shiny spots in flat paints. It usually occurs when low sheen oil type paints with poor washing characteristics are spot washed. The rubbing action in washing actually polishes the coarse pigments, permitting higher light reflection and resulting in a "shiner" in that area. This problem can be solved by using non-burnishing, high quality latex paints.

SUCTION SPOTTING: Glossy paints will show flat spots when applied over improperly sealed and very porous areas in either new surfaces or previously painted surfaces. Flat paints applied over such areas will usually show dark spots. Suction spotting is prevented by spot priming such areas.

STAINING: This is a discoloration of paint coatings caused by either oil soluble or water soluble substances in the previously applied coating or in a surface. Discoloration will occur where leaking plumbing, leaking side walls etc. cause the migration of water soluble stains in certain building materials to migrate to the surface of the paint. Also, newly applied paint may be discolored if applied over old type stains on natural wood. If this occurs when applying water-thinned paints, it can usually be corrected by switching to oil type paints, or vice versa. If it is found that a stain is put into solution by either water-thinned paints or oil paints, then it is usually necessary to resort to a special neutral sealer such as a shellac to stop the bleeding.

BRUSH MARKING: This is a condition wherein the "tracks" made by the bristles of the brush remain permanently in the dried paint film. It can occur when paints are too thick, or when paints are "overbrushed" and the brushing action has been continued when the paint is actually drying. It is avoided by properly thinning a paint by using only a minimum of brush strokes, and by applying full, wet paint films at the proper spreading rate as shown on the label.

NON-DRYING: Paints or varnishes will not dry properly if: (1) applied over oil, grease wax, etc.; (2) if they are not thoroughly mixed; (3) if they are applied in damp areas, such as in basements; (4) if they are mixed with other paints with which they are not compatible.