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NEXT ISSUE

In August we will feature an article on the activities of the Paint, Varnish and Lacquer Section of the National Bureau of Standards. Such functions as research, preparation of specifications, technical advice, umpire testing in legal actions, pigment color standards, etc. will be covered.

FEATURES

DEPARTMENTS

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INDUSTRIAL HYGIENE IN THE PAINT FACTORY

BY ARTHUR C. STERN
Chief
Engineer Unit Division
Industrial Hygiene and Safety Standards,
New York State Dept. of Labor

INDUSTRIAL hygiene has been defined as "the science and art of preserving health through the recognition, evaluation and control of environmental causes and sources of illness in industry." It has been reported that about 2000 different raw materials are used by the paint industry, with as many as 600 of them being kept in stock by a single plant. Among such a large number of materials, there are bound to be some which will cause illness among employees handling them unless adequate safeguards are provided and used. Although the use of lead in paint has decreased markedly in the last decade, it nevertheless remains the most important health hazard in the paint factory and the material about which safeguards should center.

Arthur C. Stern

Ingestion of Toxic Material

TOXIC material enters the body in three ways: Ingestion, Inhalation and Skin absorption. By ingestion we mean allowing it to enter the gastro-intestinal tract by swallowing either some of the material itself, food contaminated by some of the material or mucous from the nose containing some of the material filtered out of the air breathed. Food contamination occurs not only by exposure of the food itself in a dusty workroom, but also by toxic dust carried on eating utensils, dishes, hands, hair and clothing, all of which may be transferred via the food to the mouth.

Ingestion of toxic material can be minimized if each paint factory using lead pigments or any other toxic powders adopt the following precautionary measures. (Note: Even if only non-toxic pigments are handled it is wise to enforce these regulations).

1. Storage or eating of food in the workroom should be prohibited.
2. A separate clean lunchroom should be provided. It should preferably be separate from the locker room.
3. A cap should be worn while working to prevent dust accumulation in the hair, and removed prior to eating to prevent dribbling dust from it onto the food.
4. Adequate and convenient washing facilities should be provided, and employees should be allowed a paid wash-up period before lunch.
5. Clean working uniforms should be provided, preferably daily but not less frequently than twice a week. Employees should be required to wear them at work but not be permitted to wear them home. Adequate locker space should be provided for storing both street clothes and uniforms, preferably separate lockers for each.
6. Adequate shower stalls should be provided and the employees encouraged to use them before changing into their street clothes.
7. Smoking and chewing tobacco or gum should be prohibited in the workroom.
8. The management should keep the workroom as dust-free as possible.

Inhalation—Inhalation of toxic material occurs whenever the worker breathes air containing toxic dust, gas or vapor. In the paint factory dust exposures occur primarily at the mixers, ball or pebble mills and varnish kettles, and in the handling of bags of pigments, extenders and resins for use in the mixers. A lesser exposure occurs in the handling and mixing of tinting pigments. (The dust problems of mixing and pack-

Toxic material enters the body in three ways—ingestion, inhalation and skin absorption, as illustrated above. Precautionary measures will eliminate or minimize these hazards and save not only health but man hours and tend to increase production. With 2000 different raw materials used by the paint industry, simple safeguards will help.

aging dry-mixed paints are beyond the scope of this discussion.)

The principal vapor exposures in paint manufacture occur at the reducing and tinting operations, in can filling, in cutting nitrocellulose and resins and in the cleaning of equipment with a solvent. Vapor exposures also result from leakage from pipe lines, meters, pumps, filters, etc. A small steady drip can allow a whole workroom's atmosphere to become charged with solvent vapor. *Skin Contact*—Skin contact with liquids and dusts can occur in all paint manufacturing operations up to the point the cans are sealed. Contact with solvents, resins, oils, dyes and similar materials can cause dermatitis and skin sensitization. Workers required to clean equipment with solvent should protect themselves with rubber gloves and, where necessary, impervious aprons. Workers required to handle resins or dyes to which they are sensitive should be similarly protected. Overly sensitive workers should not be required to handle chemicals to which they are sensitized.

Personal cleanliness is the best safeguard against dermatitis. Therefore, the means recommended to prevent ingestion of toxic substances through the maintenance of clean hands, hair and body and the wearing of clean clothes are also the primary means of preventing occupational skin disorders. Although allergic reactions more serious than dermatitis, and even absorption into the blood stream, can occur as the result of skin contact with certain chemicals, these hazards are not of major significance in paint manufacture.

Dust Exposure

YEARS ago in paint plants, the major emphasis of industrial hygienists was on the prevention of ingestion of lead. Nowadays, major emphasis is on the prevention of inhalation of dusts containing lead or any other toxic element. The reason for this shift in emphasis is that although prevention of ingestion of contaminated food during the meal hour is important; prevention of inhalation of toxic dust during the more numerous working hours is considerably more important. Dusts may be toxic because they are absorbed by the blood in the lungs or because they cause the growth of fibrotic tissue in the lungs thereby impairing the lungs' vital capacity. Lead pigments and mercury salts are in the first category; silica and certain commercial varieties of talc are in the latter class. Certain alkaline and acid dusts have the ability to irritate the respiratory tract, but, fortunately, are not commonly found in paint plants. Whether or not dust is present in excessive quantity depends on its chemical composition, its size characteristics and the duration of worker exposure. Since a high concentration of any dust is a nuisance and makes for bad housekeeping, a good working rule is to control all dust sources regardless of the health hazard created.

Dust Sources—Materials Handling—This discussion is limited to the type of plant which receives its raw materials in bags and drums, predominantly the former, and which therefore does neither bulk material handling nor dry crushing and dry grinding. In any plant, visual evidence of dust on the floor, rafters, ledges, machinery, or in air shows where dust control is needed. Although points of dust dissemination vary from plant to plant, an overall pattern of most probable sources exists.

One damaged bag allowed to spill powder each time it is handled will leave a trail of dust throughout the warehouse and plant, ready to be stirred into the air by each footstep or truck wheel passing by. Personnel should therefore be instructed to place only undamaged containers into storage and to give special handling to damaged ones. A specific procedure should be developed for spill-free transport and quick utilization of damaged containers.

In general, plants which store and transport bags of raw material on pallets by means of lift trucks, disseminate less dust by material handling than those which pile bags on the floor. Piling on pallets keeps the floor open for both inspection and cleaning. Plants with good concrete floors are generally freer of dust than those with floors hard to truck over and to clean. Accessibility

and illumination of the storage area are both factors in their cleanliness. Dark, hard-to-get-at mezzanines are likely to be dustier than well lit, high ceilinged floor areas. Good floors permit the use of an industrial vacuum cleaner, the preferable method of floor maintenance in warehouse areas. Dry sweeping is the least desirable means of floor cleaning because, if toxic dust is on the floor, sweeping disseminates it into the air breathed by the porter.

Mixers and Ball Mills—The operations at a mixer or ball or pebble mill that cause dust dissemination are dumping bags, discarding empty bags and adding less than bag full quantities by means of a scoop. Once a mixer or mill has been loaded, it ceases to be a source of dust, since the latter is closed and, in the former, blade or can rotation before the pigments are wetted is too slow to disseminate dust.

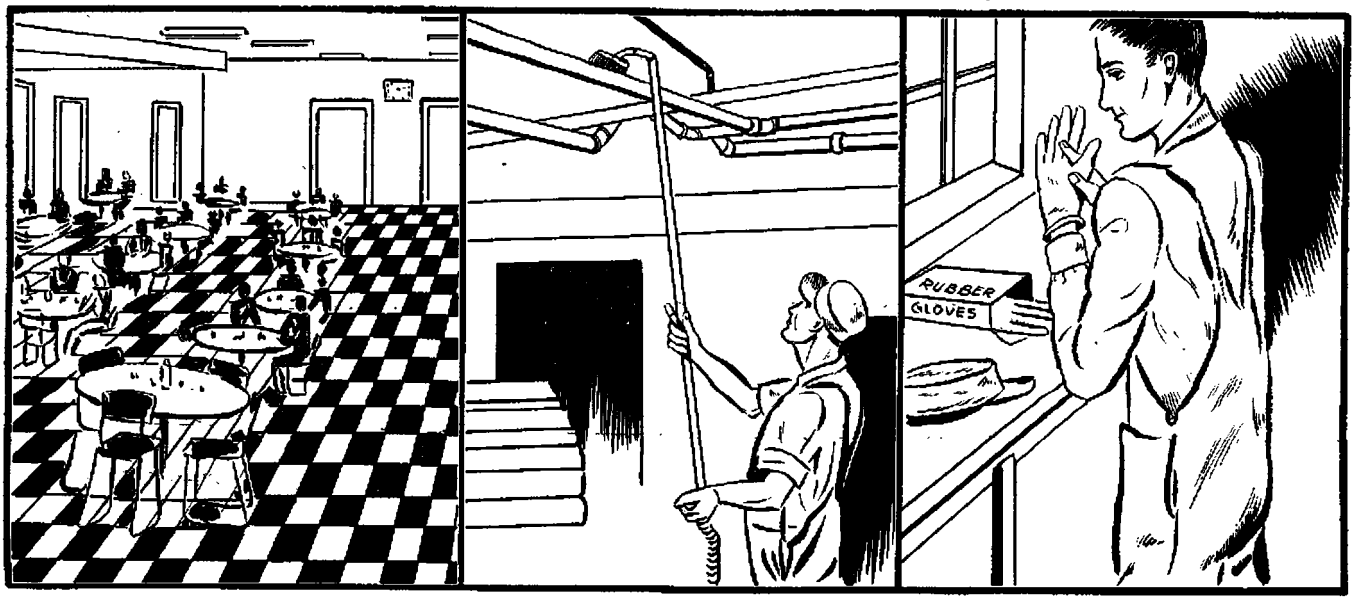
Slitting and emptying a bag into a mixer or mill disseminates dust for several reasons. First, there may be spillage onto the floor around the mixer or the mill feed spout, which spillage may be kicked into the air by men walking by. Secondly, there is the puff of dust which arises from the mixer or mill spout when a bag is dumped. There are two reasons for this puff: displacement from the mixer of a volume of air equal to the volume of solids added, and the escape of air entrained by both the downward fall of the powder and the upward flow of the displaced air. The very common habit of workmen of shaking bags or striking them against the side of the mixer or mill spout produces violent turbulent air motion and generally succeeds in disseminating into the air almost as much powder as is salvaged.

Handling and Weighing Powders—The use of an open bag or drum and a scoop to add less than bag-full quantities of powders to a mixer frequently disseminates dust out of all proportion to the quantity of material involved. Each scoop load must either have its excess material tapped back into the bag or drum, in which case a dust cloud arises from the container; or carried in the scoop, in which case it dribbles from it onto the floor as the scoop is carried to the mixer. Dumping the scoop load into the mixer again gives rise to a dust puff.

Scooping is more common in the mixing and weighing of tinting pigments and dyes than in the large batch mixing of white, green or yellow paints and therefore may involve relatively small quantities of quite toxic materials, such as certain dyes, anti-mildew and anti-fouling agents, germicides and insecticides used as additive agents to paints. Where there is any doubt as to the ability of the production personnel to handle such materials safely, they should be weighed, mixed and dispersed in a vehicle in the laboratory (under the laboratory hood if necessary) so that there will be no dust exposure to these materials in the factory. Where this is not practicable, the drums or cans of the more toxic materials and the scale should be all enclosed in an exhausted, lighted open front booth so that any dust formed is ventilated out of of the workroom and away from the employee handling the scales.

Dust Control at Mixers and Ball Mills—The dust control best suited for mixer and ball mill loading is exhaust ventilation by means of specially designed hoods over the top of each mixer and of each ball mill loading spout. Open top mixers should first be fitted with covers having hinged sections for access. A rectangular opening should then be cut out of the front portion of the cover slightly wider than a bag, if only bags are to be emptied into the mixer (or wide enough to take a drum or barrel if either is to be dumped into the mixer). The depth of the opining depends somewhat on the diameter of the mixer, being affected by the curvature of the front of the cover. For most cases, this depth need be no bigger than 18 inches for bag dumping nor than the diameter of a drum or barrel for barrel dumping. Vertical side and rear sheets of metal extending up at least a foot above this rectangular opening and terminating at the opening complete the hood. By keeping the top open handling bags is made easier. The fronts of the sides may also be rounded off on top for the same purpose. The front of the hood is permanently open. In the preferred method of control, a downward air velocity of about 200 ft. per

A separate, clean lunchroom should be provided, separate from locker room and free from dust and fumes. Regular cleaning of the "dust collector" nooks and crannies is imperative. A cap and rubber gloves are definite adjuncts for the prevention of accumulation of dust in the hair and the absorption of toxic material.



minute is maintained through this rectangular opening in the cover by taking an exhaust pipe connection from the rear cover. Thus for a 2½ ft. by 1½ ft. opening, 750 cfm of air would be required. To avoid the possibility of sucking out any raw materials from the mixer, a "bug-a-boo" in the minds of many executives considering exhaust systems, it is only necessary to keep the upward air velocity in the exhaust pipe connection to the rear cover so low that such loss of material cannot possibly occur. This is accomplished by using a long converging connection upward from the rear cover (at which level the upward velocity would be several hundred feet per minute) to the 6 inch exhaust branch pipe (where the velocity would be of the order of four thousand feet per minute).

As an alternate to the foregoing, a lateral draft hood may be built over the load opening of the mixer. This type hood must also be employed at floor level chutes to ball mills on the floor below. Exhaust of from 1000 to 1500 cfm per hood is needed for effective dust control. A fan, a dust collector and a discharge duct to the outer air complete the exhaust system.

Vapor Control

THERE is generally no vapor problem at the mixers and very little at the mills. The fact that milling raises the temperature of the paste being milled occasionally creates a vapor problem with formulations containing a vehicle component that will evaporate at milling temperature. An exhausted hood over the mill used for this job will control the vapor produced. The principal source of vapor in a paint plant is from open top reducing tanks and change-can mixers, where thinning and tinting are done in cans or tanks having a large evaporating surface area open to the workroom air. When paint cans are filled from these open-top vessels, the employee so engaged may find himself in an atmosphere having too high a vapor concentration, primarily caused by the can from which the filling is being done rather than the relatively small surface area of the cans being filled. However, if an open cloth filter is used between the large vessel and the cans being filled, a source of evaporation is brought close to the employee's nose. This is an unsafe practice and should be avoided. Closed filters should be used whenever filters are needed.

All rooms where can filling or reducing operations take place should be provided with room supply and exhaust ventilation. The ventilation rate depends on the types and intensity of operations in the workroom. Churn rooms are also ventilated to keep the solvent vapors from spreading throughout the factory. This generally involves exhausting the room to the atmosphere while taking the air supply from the adjacent workrooms in the factory. Air supply taken from outdoors must be heated in winter and so introduced to the workroom that no draft is created.

The above discussion refers particularly to paint manufature. In varnish making, the reducing of open kettles is best done under an exhausted hood.

Lacquer Making—In lacquer manufacture, the use of open-top mixers or cans and of open mills should be restricted to the incorporation of solids into an oil or varnish vehicle prior to mixture with the nitrocellulose solution. Since such operations are identical with the paint making operations already discussed, the same precautions and control means apply. All operations involving the cutting, reducing, pigmentation, tinting or storage of nitrocellulose and nitrocellulose solutions should be conducted in closed-top vessels and the workrooms should be well ventilated. Occasional operations involving open-top vessels should be locally hooded and exhausted as should filtering and can-filing operations. With properly designed hoods, a control velocity of 100 ft. per minute into the hood will usually suffice.

Varnish Making—Modern varnish and alkyd-resin kettles are connected to a fume exhausting and scrubbing system so that there is an inward flow of air into the kettle from the room. This air flow provides dust control when filling the kettle. Open kettles over open fires are inherently well ventilated by chimney action. At least one of the more toxic solids added to varnish kettles is available in pellet form to still further limit dust exposure. Note has already been made of the need for vapor control when thinning open kettles of varnish.

Respirators—Respirators are masks worn over the nose and mouth to allow a worker to inhale safely when he is working in a contaminated atmosphere. Respirators are primarily intended to protect workers in emergencies, while doing cleaning and maintaining of equipment, and in the performance of operations conducted only occasionally. They are not intended to be worn continuously throughout a workday nor to protect workers performing operations exposing them to contaminated air for a number of hours per day. Respirators are uncomfortable to wear and breathe through even when they are clean and fitted with new filters. They are even more uncomfortable when they get dirty and when a clogged filter or cartridge increases the energy that must be expended in breathing. This is particularly true on a hot day when the wearer is perspiring freely. Respirators should not be used as a substitute for dust control by exhaust ventilation, good housekeeping and similar means.

When respirators are used, the following precautions should be observed:

1. Only respirators, approved by the United States Bureau of Mines for the type of service intended, should be used in potentially dangerous atmospheres.

2. The respirator should be kept in a clean place between periods of use. Respirators hanging on hooks or lying on machines in the workroom will get contaminated by dust or vapor in the workroom atmosphere.

3. The management should assume responsibility for keeping respirators clean, sanitary and supplied with clean filters or cartridges.

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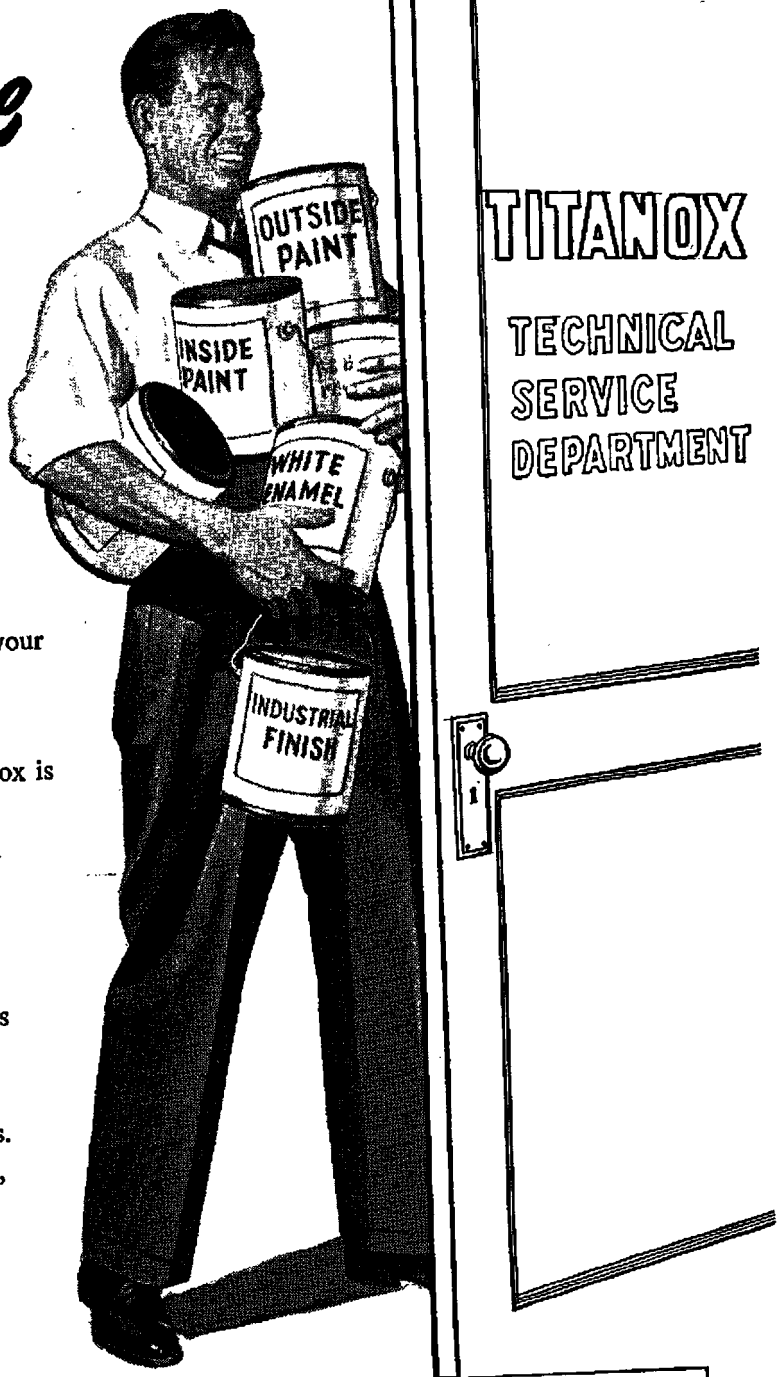

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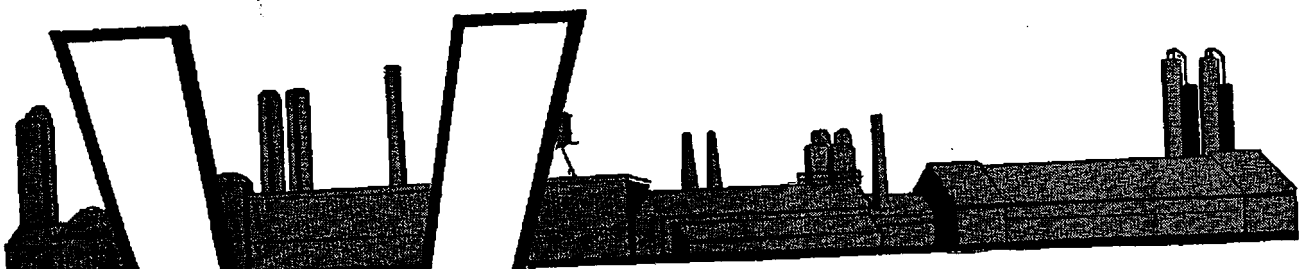

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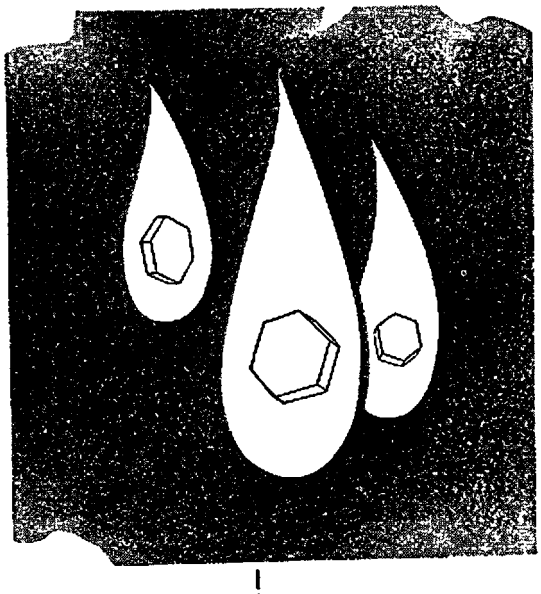

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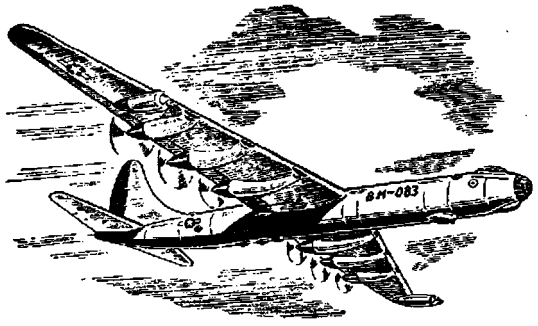
Type III, Baking, Class 1 gloss and Class 2 semi-gloss	AROPLAZ 1136-X-50



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Plasticizers for P V C

U. S. Patent 2,538,254. Robert J. Lee, La Marque, Tex., and Robert H. Reiff, New Cumberland, Pa., assignors to Pan American Refining Corporation, Texas City, Tex., a corporation of Delaware.

A resin of reduced corrosion tendencies selected from the group consisting of polyvinyl chloride resin and polyvinyl chloride-acetate copolymer resin containing between about 80 and about 95 percent of polyvinyl chloride and between about 20 and about 5 percent of polyvinyl acetate, said resin comprising between about 15 and about 100 percent by weight, based on said resin, of a phenyl naphthyl ketone selected from the group consisting of unsubstituted phenyl naphthyl ketones and unsubstituted phenyl methylnaphthyl ketones.

Coatings for Flexible Surfaces

U. S. Patent 2,537,017. Gerald R. Barrett, Winchester, Mass., assignor to Monsanto Chemical Company, St. Louis, Mo., a corporation of Delaware.

A coating composition for flexible surfaces comprising as essential film forming materials: (1) polyvinyl butyral; and (2) a copolymer consisting of the copolymerization product of a secondary alkyl half ester of an ethylene α,β-dicarboxylic acid selected from the group consisting of maleic and fumaric acids, wherein the alkyl radical contains from 6 to 10 carbon atoms, and styrene, said half ester and styrene being copolymerized in a molal ratio between 1:1 and 1:2; and a plasticizer for said film-forming materials.

Allyl Esters

U. S. Patent 2,536,568. Maxwell A. Pollack, Denville, N J., assignor to E. F. Drew & Co., Inc., New York, N. Y., a corporation of Delaware.

A method of making modified oils having valuable film forming and drying properties which comprises heating a drying oil to a temperature in the neighborhood of 300° C. for a sufficient length of time to cause partial polymerization of unsaturated acids to take place, alcoholizing said oil so polymerized with an unsaturated monohydric alcohol having 3 to 10 carbon atoms, and heating said unsaturated alcohol ester at about 300° C. for a sufficient length of time to increase the viscosity of said product.

Coating Composition

U. S. Patent 2,537,017. Gerald R. Barrett, Winchester, Mass., assignor to Monsanto Chemical Co., St. Louis, Mo., a corporation of Delaware.

A coating composition for flexible surfaces comprising as essential film forming materials: (1) polyvinyl butyral; and (2) a copolymer consisting of the copolymerization product of a secondary alkyl half ester of an ethylene α,β-dicarboxylic acid selected from the group consisting of maleic and fumaric acids, wherein the alkyl radical contains from 6 to 10 carbon atoms, and styrene, said half ester and styrene being copolymerized in a molal ratio between 1 : 1 and 1 : 2; and a plasticizer for said film-forming materials.

FORMULATION FOR SPEC FINISHES

Sixteen suggested formulations to meet U. S. Government paint specifications are offered to paint manufacturers and paint technologists in a 32-page booklet prepared by Rohm & Haas Company, Washington Sq., Philadelphia 5, Pa.

Formulations cover: Federal Specification TT-E-485B, a rust-inhibiting olive drab enamel for drums and other metal products.

TT-E-489, a synthetic gloss enamel for exterior and interior surfaces, TT-E-506B, an interior gloss enamel, white or with tints, TT-E-508, a semi-gloss interior enamel, white or with tints, TT-P-636, a synthetic primer for ferrous metal and wood surfaces, TT-R-266, alkyd resin solutions.

Quartermaster Corps Tentative Specification O.Q.M.G. No. 167, protective interior lacquers for steel containers for fuels and lubricants.

JAN-P-72, a lacquer-resisting synthetic primer, JAN-E-480, a phenol or urea formaldehyde baking enamel, MIL-E-5557, a black heat-resisting glyceryl phthalate enamel, MIL-P-6889A, a zinc chromate primer for aircraft use, MIL-V-6894, a glyceryl phthalate spar varnish, MIL-S-10181 (Ord), a lacquer type sanding surfacer, MIL-E-15090, a light gray equipment enamel (Formula III), Amendment 1.

Bureau of Ordnance Specification 52-E-13 (Ord), a rapid drying semi-gloss enamel.

Bureau of Aeronautics Specification 52-L-26 (Aer.), a low water-sensitivity cellulose nitrate lacquer.

LACQUERS AND SEALERS

Furniture lacquers and sanding sealers are described in a new bulletin prepared by the Merrimac Div. of the Monsanto Chemical Co., Everett, Mass. Pointing out that the finest wood and best design are wasted under an inferior finish, the bulletin sets forth qualifications for clear and matte finish lacquers. Properties discussed include percent solids, application, gloss, flexibility, durability, and resistance to scratching, printing, alcohol, heat, cold and moisture.

CHEMIGUM

A new technical booklet on Chemigum, a nitrile synthetic rubber produced by The Goodyear Tire & Rubber Company, has been prepared and released.

In announcing its availability, H. R. Thies, manager of Goodyear's Chemical Division, said the booklet lists properties, compounding techniques and applications in a wide range of products.

Use of the material in general and pressure adhesives is also included.

ABRASION TESTING

Bulletin No. 5003 describes "Model 140" standard abrasion testing set manufactured by the Taber Instrument Corp., 111 Goundry St., North Tonawanda, N. Y.

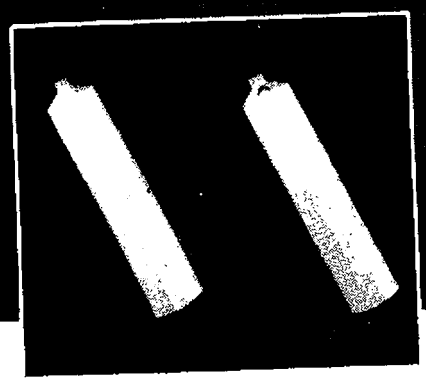
DECORATING STYRENE

Decorative treatments for Lustrex styrene plastic are described in a new, 28-page, illustrated booklet prepared by Monsanto Chemical Company's Plastics Division, Springfield, Mass.

Post-molding processes discussed in the booklet cover metalizing, lacquering, all types of stamping and printing, and destaticizing. Operating methods and processes are illustrated by charts and photographs.

Advantages of lacquering, as well as preparation of plastics surfaces, lacquering methods and operating methods are described fully. Metalizing methods include electroplating, spraying, vacuum metalizing and cathode sputtering.

Why the simple test won't crack EPON® RESIN finishes!



TWO ALUMINUM TUBES . . . *the one on the right coated with a standard white enamel . . . the left-hand tube coated with an Epon enamel.*

These enameled toothpaste tubes looked alike originally. But after a brutal "accordion" test the Epon resin finish on one remained smooth and unharmed . . . even on the sharp corners! The second tube, coated with a standard widely-used enamel, cracked and flaked off.

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