Part II of a series on form release agents and form coatings

Composition of form release agents

Their makeup is a clue to their performance

By Sidney Freedman, Director
Architectural Precast Division
Prestressed Concrete Institute
Chicago, Illinois

The first article in this series discussed methods of application of form release agents and which kinds of agents are appropriate for use on various kinds of forming materials. The composition of the various kinds of release agents will be described here to show how composition relates to performance under different sets of circumstances.

Straight (neat) oil

The earliest form coatings were unmodified oils of mineral, vegetable or fish origin. This kind of oil, still in use, contains no added surface-activating agents. Most are petroleum derivatives. These are light-bodied lubricating oils, the wax content of which varies with the crude source. The light-colored product, sometimes referred to as pale oil, is generally available through major oil companies. Other petroleum products sometimes used are light fuel oils and crankcase drainings; the latter should be avoided with architectural concrete.

Mutton tallow, lard oil or lard oil with stearic acid are satisfactory release agents when applied sparingly to avoid retardation. Castor oil and some other vegetable oils as well as compounds obtained from animals should be used only if they are free from a tendency to turn rancid.

When oils are used as form-release agents concrete surfaces are likely to have more bugholes than when other agents are used. But the surfaces also tend to be more uniform in color. If used in excessive amounts petroleum-based form release agents, with the exception of lacquer types, may enter the concrete surface and cause serious staining and low durability. This is evidenced by a powdery surface that results from a chemical reaction called saponification between the oil and the alkalies in cement. Petroleum-based agents also impair the bond to paint or other surface coatings.

Oil emulsions

Straight oil with surfactant. Straight oil or a mixture of oils to which up to two percent surfactant (emulsifier or wetting agent) has been added will produce concrete surfaces reasonably free from bugholes and color differences. Again, if the release agent is applied non-uniformly or in excessive amount the hardening of the surface will be retarded and color differences will occur.

Oil-phased (mold cream) emulsions. In water-in-oil emulsions, oil is the continuous phase in which water globules have been dispersed by means of an emulsifier. The kind of emulsifier and the amount used are critical because the emulsifier often causes color differences on the concrete surface. Non-uniform distribution of the emulsifier in the emulsion will also affect the color of the concrete surface. To avoid destroying the stability of the water-in-oil emulsion, it should be used undiluted. If the emulsifier is suitable for the job and the right amount is used, concrete will be uniform in color with few bugholes and virtually no oil discoloration. If too much oil is applied it may slightly retard the hardening of the concrete and cause color variations on its concrete surface. Oil phased emulsions were originally developed for use with wood forms; they should not be used on steel unless especially formulated to avoid corrosion.

Water-soluble emulsions. Oil-in-water emulsions in which the water is the continuous phase and the oil is held in the dispersed state by means of an emulsifier are not recommended. The oil globules can penetrate into the fresh concrete and cause severe retardation of hardening as well as pronounced color differences. These problems increase to the extent that the form material is high in the scale of absorption. Typical of these materials is a petroleum product supplied by oil companies, chiefly for use as soluble cutting oil. It usually contains a water-soluble soap in a light bodied mineral oil which forms a milky emulsion when mixed with water. Some oil companies also offer light-

colored fiber type greases and lubricating pastes, which also emulsify when mixed with water. They contain water-soluble soaps and light lubricating oil.

Waxes and emulsified waxes

Waxes (water-insoluble), usually carnauba wax, which are used as release agents have excellent release characteristics. However, application is limited to use at air and form temperatures above 50 degrees F. Regular wax is difficult to apply uniformly, a factor which may increase labor costs. However, emulsified waxes (water-soluble) that can be brushed, rolled or sprayed on the form have substantially reduced this difficulty.

Volatile or solvent coatings

Volatile coatings, another of the group of products based on petroleum, utilize a light paraffin or naphthenic crude base as the vehicle, which also contains various other ingredients. These other ingredients may be waxes, silicones, synthetic resins or even water-insoluble soaps. Typical of these materials are: paraffin or aluminum stearate dissolved in warm kerosene; petroleum jelly thinned with kerosene to a brushing consistency, and with up to 10 percent by weight of aluminum oleate added; a 50/50 mixture of stearic acid and benzene; or an emulsified stearate in a paraffinic or naphthenic crude base. Paraffin solvents are preferred over naphthenes; they are usually lighter in color although heavier in body. Because the vehicle evaporates there is no danger of its staining the surface or causing mechanical defects provided the agent is evenly and cleanly applied. These mold release agents tend to be expensive and may not produce as clean a release as some others.

Chemically active

Chemically active release agents contain compounds that reacts with the free lime present in fresh concrete to produce water-insoluble soaps and prevent the set of the film of concrete in contact with the form. When wet, these soaps are slippery and aid in reducing air voids at the form surface. When dry they act as release agents. They result in concrete surfaces very uniform in color and usually with a dull or flat finish. 1! not applied carefully without excess these chemical agents often produce heavy dusting and discoloration of concrete surfaces.

Composition varies widely from brand to brand. Some, formulated with oil, fuel oil or kerosene vehicles are limited in use to structural concrete applications. Others, made with such ingredients as polyvinyl alcohol, can be used for architectural concrete.

Miscellaneous t

There are also a number of release agents that do not fall into the above categories that produce satisfactory surfaces with uniform color.

Part I of this series appears on page 84 of the March issue. Part III, on form coatings, will appear in an upcoming issue.

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