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

Form release agents

When you've chosen the form you've narrowed the choice of agent

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A form release agent must do several jobs:

- permit clean release of formwork from the hardened concrete during stripping
- protect the formwork for long life and extensive reuse
- help produce a hard, non-powdery, stain-free concrete surface with a minimum number of defects
- prevent corrosion of steel forms and consequent staining of the concrete surface

Form release agents fall into a number of categories (see Table) each of which has a distinctive influence on the concrete surface. These are described in detail in the next article in this series. The principles by which they are chosen and the kinds used in various applications will be described later in this article, but first their handling and application will be discussed.

Site storage

Release agents should have a reasonably long and stable storage life and should not be susceptible to damage from extreme temperature changes or from rough or repeated handling. Care should be taken to ensure that release agents are stored in accordance with the manufacturer's recommendations, particularly with regard to temperature extremes. Before use the release agents should be checked for sediment. To ensure uniformity it may be necessary to stir them adequately. Care must also be taken to ensure that they do not become contaminated. Release agents containing volatile solvents must be stored in airtight containers to prevent a change in concentration. Release agents should not be diluted at the jobsite unless specifically permitted by the manufacturer. Some oils have a critical emulsifier content and dilution makes the emulsion unstable and causes poor performance.

Application

The manufacturer's recommendations on the rate of spread and the method of application should be sought and followed. The optimum rate of spread will depend on both the type of release agent and the surface condition of the formwork.

Form surfaces should be thoroughly cleaned, preferably before erection; forms that are continually reused are generally treated with the form release agent just after stripping and cleaning. Also whenever possible, the application of the release agent should be so timed that it can dry or be absorbed into the formwork before the reinforcement is installed. This procedure prevents loose rust or dirt from the reinforcement from subsequently showing up as marks on the concrete surface.The release agent should be applied carefully to avoid contacting reinforcement or adjacent construction joints. A few release agents may have their chemical characteristics changed to some extent if directly exposed to strong sunlight for a few hours and their application may have to be timed accordingly.

Application methods

Any of various application methods can be used, depending on the type of agent. Spray or rolling methods are most commonly used be-

TYPES OF FORM RELEASE AGENTS *Detailed descriptions will be given in the next article in this series*	
STRAIGHT OIL	
Oil L EMULSIONS	Straight oil with surfactant Oil-phased (mold cream) emulsions Water emulsions
WAXES AND EMULSIFIED WAXES	
VOLATILE COATINGS	
CHEMICALLY ACTIVE RELEASE AGENTS	
MISCELLANEOUS	

Once the release agent has been applied the form face must be protected against weather and dust.

cause they are inexpensive and they produce uniform films. When spraying, a low-pressure, fine fog fanning out from the nozzle is most desirable.

Agents can also be applied by brushing, mopping, wiping or dipping, but the first three methods do not produce a sufficiently uniform film. Great care should be taken to see that the wide brushes or soft brooms used for applying the release agent are clean. It is best not to use cleaning solvent on any tools used for applying release agents but if a solvent is used care must be taken to ensure that it is completely removed before the tools are reused.

Usually the dip method of applying release agents is not practical for use on the jobsite. Therefore, when dipped coatings are required for lumber or plywood, pre-dipping at the mill is the most practical solution. Where a heavy application of an inexpensive coating is allowed, such as where appearance of the concrete surface is not critical, the roller, mop or broom methods are all applicable. The wiping method normally is used only when very light film applications are required on hard surface form materials or when excess release agents previously applied by other methods must be removed.

Precaution in applying

Whatever method of application is used, the release agent should be applied evenly in a very thin film without bubbles or streaks. There should be no excess release agent to stain the concrete or leave undesirable residue on the finished surface. If oils or greases are used, the excess should be wiped off to leave the surface of the forms just oily to the touch; some other types must be applied more carefully because wiping is not permitted. Once the release agent has been applied, the form face must be protected against the weather as well as against dust and other contamination.

An excess of oil on the form surfaces may cause dusting of the concrete surface. This excess oil accumulates a dirt film that prevents the concrete surface from setting properly. Then when the forms are stripped the exposed concrete surface is soft and chalky. The best method of preventing this dusting is to clean any excess oil and dirt from the form surfaces just prior to placing the concrete.

Prior to their first use, absorbent materials, such as lumber or sanded plywood, should be given two or three applications of release agents, at least a day apart, in order to overcome natural variations in absorbency. For each reuse only one coat is necessary.

Agents commonly used with various forms

The way a form release agent performs is markedly influenced by the form material. Therefore the release agent should not be chosen until the form material has been selected.

Wood and plywood forms. For wood forms most of the commercial oils are satisfactory: straight refined, pale, paraffin-base mineral oil and oil-phased emulsions have been successfully used. The oil should be capable of penetrating the wood to

some extent while leaving the surface only slightly greasy to the touch with no free oil on it. Generally speaking it has been found that the use of a release agent results in somewhat fewer adhesion problems if the wood has been saturated with water. With air-dry wood, the release agent has a much greater effect on the color of the concrete surface.

Form plywood is oiled at the mill, unless otherwise specified, generally with 100 or higher viscosity pale oil. Unless the mill oiling is still reasonably fresh when the panels are first used, the plywood may require another oiling; or it may need an application of other release agents of the wax or chemically active types. Linseed oil cut with kerosene also may be satisfactory.

A light coat of form oil or release agent must a/ways be applied before concrete of three-inch or lower slump is placed. It must also be applied if an unusually high degree of adhesion is anticipated, as might be expected if the mix is rich, the curing is rapid or there is to be a long period before the forms are stripped.

Metal forms. Form release agents that are satisfactory on wood are not always suitable for steel forms. Release agents for steel forms should contain a rust inhibitor and be free of water. Materials that have been used successfully include straight oil with controlled quantity of surfactant, paraffin grease, petroleum jelly, blended oils consisting of a petroleum base along with synthetic castor oil, and chemically active release agents.

If sticking occurs on rough surfaces of steel forms they may be conditioned by rubbing in a liquid solution of paraffin in kerosene. Another method is to clean the forms, oil them with a nondrying oil and then expose them to sunlight for a day or two. Lanolin and palm oil are effective in preventing concrete adhesion to aluminum. Oil emulsions

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Most rubber mattings do not require release agents if the surface is thoroughly cleaned and moistened just before concreting.

of the consistency of thick cream also are recommended for aluminum.

Fiberglass forms or plastic form liners. So-called "fiberglass" forms are really plastic forms reinforced with fiberglass. These forms and plastic form liners can be used a few times without a release agent because of their hard, smooth finish but after a few uses the surfaces become so rough as to necessitate the use of a release agent.

A difference in color is obtained when a release agent is used. To obtain uniformity of color it is desirable, when the forms or liners are to be reused extensively, to apply a suitable release agent throughout the job from the very first use. An oil-phased emulsion or a high quality household wax containing carnauba wax are the preferred release agents. A release agent similar to a diesel fuel oil but nonstaining also may be used. If curing requires high temperatures a silicone release coating should be used.

Various plasticizers that may be incorporated in the plastic to permit fabrication may not always remain inert in the presence of form coating chemicals. Their effect on forming materials or concrete may not be apparent until after several reuses but they can cause crazing of concrete or a powdering away of the form surface. Any such tendency should be carefully watched for. If there is any doubt, the manufacturer who processed the plastic should be consulted.

Rubber form liners. Most rubber mattings do not require application of release agents if the surface is thoroughly cleaned and moistened with water just before concrete is placed. Some users prefer to coat the rubber with a thin film of castor oil or other vegetable oil, lanolin or water emulsion wax. Mineral oils, oil solvent-based release agents or paraffin wax should not be used as these will soften and swell the rubber. The rubber supplier's instructions should be carefully followed since some of the newer synthetic rubbers have a closer resemblance to plastics than to the natural product. A specific release agent may be recommended, or none at all.

Plastic foams. Paraffin oil generally is lightly sprayed over plastic foam forms or form liners. Castor oil, or petroleum jelly thinned with kerosene, also are good release agents.

Concrete forms. Concrete forms, even if they are ground, smoothed and polished, require a release agent to prevent sticking and enable easy stripping. Light colored petroleum oils or oil emulsions of various types have been used successfully. Alternatively, the concrete surfaces can be coated with one or two coats of epoxy resin and then waxed. Saponifiable oils should not be used as release agents.

Corrugated cement-asbestos sheets when used as form liners should have an oil-phased emulsion applied as a release agent.

Oil-tempered hardboard or fiberboard. Watertight, oil-treated hardboards produce concrete surfaces of uniform color and require only small amounts of a release agent (either oil-phased emulsion or pure oil with surfactant) .

The safest approach to evaluation of release agents is to apply them to a test panel or a non-architectural portion of the concrete on the project.

Fiberboard should be coated with grease having a calcium stearate or aluminum stearate base. Alternatively they can be oiled with a paraffin base oil free of volatile constituents and having a viscosity of not less than 250 Saybolt seconds at 100 degrees F. Hard compressed fiberboard or other hardboard may cause brownish stains when used for white concrete, and for this reason the face should be treated with a clear lacquer or catalyzed resin.

Plaster molds. When plaster waste molds are thoroughly dry, two coats of white shellac should be applied to the mold surface to make it waterproof and nonabsorbent. Before concrete is placed in it, the mold should be lightly greased with a nonstaining soft yellow cup-grease, white petroleum jelly, or a cup-grease that is thinned by adding a mixture of crystallized stearic acid and kerosene to a point where it can be applied with a brush.

Choosing the form release agent

One valuable standard for evaluation and selection of a release agent is prior experience. However, the safest approach is to evaluate several different commercial release agents under actual use conditions, either on a test panel or on a non-architectural portion of the concrete on the project. In addition, information should be obtained from the manufacturer of the release agent about the kind of form surface for which the product is intended and the proper method of application.

In making the selection the following may have to be considered:

- Compatibility of the release agent with the form material or form sealer; that is, whether the release agent softens the plastic form face.
- Final surface requirements. If surfaces are to be plastered or paint-

ed, the form contact area should be treated with materials that don't leave oily or waxy residues that interfere later with adhesion of plaster or paint. Some contractors consider it sufficient to wet the forms with water if surfaces are to be plastered. If the stripped surface is slightly rough the plaster will adhere better.

- Durability of the final surface. The release agent should not cause the concrete surface to soften and dust. Moreover, it should not impede wetting of surfaces that are to be water cured nor should they otherwise hinder the proper functioning of curing compounds.
- Discoloration and staining. On forms for architectural concrete, regardless of the kind of concrete finish, a 1 00-percent nonstaining form release agent free from pigments should be used. It will prevent uneven coloring of the concrete. The type of release agent used is of less importance, however, for exposed aggregate concrete because the discoloration usually does not penetrate to any great depth.
- Time period before stripping.
- Environment of the cast concrete.
- Uniformity of performance of the release agent.

For architectural concrete surfaces the same release agent should be used throughout the entire job.

Part II of this series will appear in an upcoming issue of Concrete Construction.

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