



Technical Bulletin: Form Oil/Release Agents

Form Oil/ Release Agent Selection Criteria

Concrete form oils or release agents, are names typically used to identify materials that prevent concrete forms from sticking or adhering to hardened concrete. Even though there are no specifications available that define these materials from such authorities as the American Concrete Institute (ACT), APA the Engineered Wood Association (APA) or the American Society for Testing Materials (ASTM), common usage does suggest some differences between them. For example, "Form Oils" typically refer to petroleum compounds originally designed for other applications such as diesel fuel, heating oil and lubricating oils. On the other hand, "Release Agents" typically refer to materials that contain proprietary reactive ingredients, which are specifically formulated for use on concrete forms. Today, contractors can choose from hundreds of different options or product types available to them to fulfill their form oil/release agent requirements. So the question is, what should they use?

Unfortunately, there is no specific answer. However, having a basic understanding of the types of releasing materials available, how these releasing materials work, when form composition and condition play an important role, how the releasing materials relate to the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), and the Department of Transportation (DOT), how the concrete mix design can affect the releasing material performance and what the resulting concrete surface requirements are can all prove to be valuable information in the selection process.

Form Oil/Release Agents and How They Work

Concrete form oils/release agents can be broken up into three basic categories: barrier, reactive (or chemically active), or a combination of both.

Barrier types (non-reactive) work by creating a barrier between the form and the fresh concrete in the same way butter prevents cookies from sticking to the cookie sheet. Common examples include diesel fuel, heating oil, paraffin wax, used or recycled motor oil, lubricating oils and greases. These materials are commonly used because they are readily available and inexpensive to purchase. To create a barrier between the form and the fresh concrete, typically requires applying thick films of these products, usually in the range of 200 to 600 square feet per gallon or 5 to 15 square meters per liter. Unfortunately, rain showers, concrete abrasion during placement in the forms or the fluid concrete pressure against the form surface can move or remove the barrier, which could result in form sticking. Since these products are petroleum based, they do not readily mix with the water present in fresh concrete. Instead, they tend to separate or coagulate and form surface defects known as bug holes. These compounds frequently stain concrete and leave residual film at or near the concrete surface, which later may impair adhesion of paint, sealer, coatings, etc.

Reactive release agents contain proprietary ingredients that combine with the calcium of fresh cement paste to prevent the set of a minute surface film of concrete. This reaction prevents bonding between form and the concrete, and therefore, provides reliable releasing performance. The active ingredient in this type of release agent is generally a fatty compound dissolved in a carrier or vehicle that has historically consisted of a petroleum oil or solvent. However, recent technology has produced reactive types that utilize water as a vehicle instead of petroleum derivatives. The fatty compounds, which are commonly referred to as fatty acids, are derived from a variety of natural living sources such as fruits, vegetables, trees, and animals. The origin of the fatty acid utilized in the release agent can play an important role in release agent selection. For example, a release agent suitable for plywood or overlaid plywood forms, should ideally contain a fatty acid derived from trees which would chemically compatible with wood and paper overlays.

A by-product in the reaction of a fatty acid with fresh cement is a stable, non-water soluble soap which fills form surface pores, and thereby, improves releasing performance and protects the form from the highly alkaline concrete bleed water.

Properly formulated, reactive release agents produce fewer concrete surface defects or bug holes and little or no staining. Most importantly, they provide a better and more consistent release, which translates into less form cleaning longer form life and lower operation costs.

Combination barrier/reactive release agents are typically less reactive than straight reactive types. They can provide superior performance in some situations involving concrete that utilizes admixtures, early stripping schedules, and low temperature curing conditions. All of these situations have one thing in common, they can affect the reaction process that take place between the cement paste and the reactive ingredients of the release agent. Accordingly, supplemental high quality barrier type ingredients are added to ensure that a complete release is obtained while still minimizing concrete staining and surface voids as well as minimizing concrete buildup on the forms and related cleaning costs.

The most important criteria in the selection process of an oil/release agent is plain releasing performance i.e., clean separation from the concrete with no form damage and minimal form cleaning. The best and most reliable releasing materials are those that are either partially or completely reactive. While their unit cost may be higher than the barrier types, their application rate involves less material, and on an applied basis, they actual cost less.

Form Composition Dictates Form Oils/Release Agent Composition

Since there are a variety of form compositions being used today by contractors, there must also be a variety of releasing materials available that are each specifically designed for use on a specific form type.

Porous, or coarse wood forms like plywood or dimensional lumber require a more reactive type of release agent, and typically requires a heavier material application rate of 800 to 1,000 square feet per gallon or 20 to 25 square meters per liter.

High density overlaid plywood forms (HDO) require a less reactive type release agent, which is typically applied at a light material application rate of 3,000 square feet per gallon or 75 square meters per liter.

Medium density overlaid plywood forms

(MDO) require a reactive level and application rate in-between that of dimension lumber and HDO plywood, 1,500 to 2,000 square feet per gallon or 38 to 50 square meters per liter.

Any kind of form that has concrete buildup apparent on the form surface, actually becomes a form with a concrete face. The use of reactive release agents on such forms is very important for two reasons. First, they provide the most reliable releasing action in the face of potential concrete to concrete bonding. Second, there continued use will in time, gradually soften and remove buildup. Application rates on such forms depend upon the extent of buildup and its porosity, but will approximate 600 to 1,000 square feet per gallon or 15 to 25 square meters per liter.

Governmental Regulations of Form Oils/Release Agents

While current legislation may not indicate form oil/release agents as specific regulated items, the contents or components parts of the release agents are regulation irrespective of releasing material type. The objective of such regulation is to provide protection for the following:

- 1) *Health and well being of persons manufacturing, packaging, transporting, applying, and being exposed during and following release agent application.*
- 2) *The ground*
- 3) *Ground water and other water for human consumption*
- 4) *The air*

In general, the active fatty content of reactive release agents is usually not considered hazardous to either health or environment. These fatty materials are not strong body irritants, sensitizers, or carcinogens. They also, do not present any explosive or unusual fire hazards and are generally considered biodegradable if they are spilled or accidentally contact the ground or waterways.

The vehicle or carrier system in reactive release agents as well as many of the components of most barrier type form oils, may pose health and environmental problems. Most all reactive release agents contain some hydrocarbons as oils or solvents. These components are derived from crude petroleum and must be refined prior to use. Crude oil may contain harmful quantities of polycyclic aromatic hydrocarbons (PCA's), or poly nuclear aromatic hydrocarbons (PNA's). These substrates are confirmed animal carcinogens. The type of crude and the type and degree of refining, influence PCA and PNA content, and therefore, the degree of health hazard. Severe solvent refining, or sever hydrotreating, removes harmful concentrations of

These carcinogens from oil or solvents minimizing this health hazard. A second health hazard of petroleum based vehicles or solvents, relates to fire hazard potential. Many light oils and solvents have flash points below 141 degrees Fahrenheit (61 degrees Celsius), placing them in the flammable liquid category under maritime, air, and many foreign road transport regulations. Materials having flash points between 100 and 200 degrees Fahrenheit (38 and 90 degrees Celsius), are considered combustible liquids by the United States Department of Transportation (USDOT), and those having flash points below 100 degrees Fahrenheit (38 degrees Celsius), are considered flammable by the agency. When transported in containers with a volume greater than 119 gal. (450 liters), or in bulk tankers, materials with flash points below 200 degrees Fahrenheit (93 degrees Celsius), are considered flammable by the USDOT. It is very important to know the flash point of the release agent you considered. It will affect the requirements you must observe and comply with when you transport, store, and use the products.

Finally, the issues relating to potential environmental pollution must be addressed in the form oil/release agent selection process. The two most important issues are potential for air pollution, and potential for ground or ground water pollution. Air pollution regulations are being rigidly monitored at many state levels, as well as nationally. Most legislation dealing with air pollution addresses the volatile organic content (VOC) of the material. VOC, describes the amount of volatile hydrocarbons that can potentially evaporate, and therefore, pollute the atmosphere. Already, in some states the maximum allowable VOC for form oil/release agents is 250 grams per liter. Effective January 1, 1998, all fifty states must comply with federal regulation limiting form oil/release agents to maximum allowable VOC of 450 grams per liter. These levels exclude the use of many barrier type releasing materials as well as reactive types. It is the law, that all products used, must comply with the local and state and/or federal VOC regulations and the VOC must be indicated on all product literature, material safety data sheets (MSDS), and container labels.

Most all petroleum oils are not considered biodegradable, and since they can contaminate the ground or ground water, they are considered a potential pollutant. Strict care must be taken when using release agents containing such oils or solvents to prevent them from contacting the ground or waterways. Containers should be stored to preclude vandalism or accidental leakage, and should be emptied in their entirety before disposal. Check with local environmental agencies for information on disposing of containers. Care should be taken to immediately contain all spilled liquid, to remove it and any contaminated soil promptly, and to dispose of

such in a manner consistent with local and federal regulations (this may well mean use of hazardous water transporters and disposal firms.)

Extreme caution and care should be exercised in selecting release agents to insure they are in compliance with applicable regulations, and that you are completely aware of the potential health and environmental hazards accompanying their transport, storage, use, and container or contents disposal. Penalties for violating such legislation, can reach astronomical proportions.

How can you obtain information about the health and environmental hazard potential? Review the material safety data sheets (MSDS) that by law must be supplied with the material. They will list any potential hazards if they have been properly prepared. Any hazardous composition, must be listed together with maximum safe exposure limits, and correct handling procedures to reduce or eliminate potential overexposure affects. The MSDS must list the potential as human or animal carcinogens. They must also list the flash point and related fire or explosive potential. Finally, the MSDS must indicate proper storage and disposal procedures.

Given the potential health and environmental hazards that may be involved in transporting, storing, using, and disposing of solvent or oil based release agents of any of the above referenced types, consideration should be given to the new generation of water based products now available. Many of these products significantly reduce the hazard potential and in some instances, have exhibited releasing performance superior to their solvent or oil based counterparts.

Concrete Mix Design

The concrete mix design can significantly affect the releasing material performance. Generally speaking, the use of pozzolans such as fly ash, blast furnace slag, and microsilica slow concrete curing time, and increase the time necessary for the concrete surface to achieve sufficient strength to allow form removal without adhesion. Cold weather worsens this situation. Accordingly, when early form stripping is an objective, less reactive release agents, particularly those of the combination chemically active/barrier type, applied at heavier material applications rates of 800 to 1,500 square feet per gallon or 20 to 38 square meters per liter, produce the best results with HDO plywood. Wood forms to include MDO plywood, need release agents that are more reactive, and which are applied at higher material application rates of 600 to 1,100 square feet per gallon to 15 to 28 square meters per liter, to protect the wood from the aggressive alkalinity of these pozzolan modified

concrete mixes.

Other factors to consider include the incorrect use of water reducing and air entraining admixtures, as well as the excessive use of water in the concrete mix, which can frequently result in unwanted surface defects or voids. Unfortunately, many contractors confuse these results with poor form oil/release agent performance.

Concrete Surface Requirements

Concrete surface objectives also influence selection of the releasing material. When the surface appearance is critical, the use of a barrier type release agent is not recommended, since they tend to stain concrete and increase the number of concrete surface defects i.e., spalls caused by adhesions or bug holes. Again, reactive or combination barrier/reactive types work best. Some recent generation, reactive water based types, have also been providing exceptional results.

Where concrete appearance is important, greater control over releasing material application rate and uniformity is **MANDATORY**. Most releasing material manufactures, specify product application rates and application equipment for specific form types, which should be used as starting points.

Summary

With the overwhelming number of releasing material types available, proper selection can be difficult. However, if you follow certain guidelines during the selection process, the task of finding the right product can be simplified. Starting on the premise that in most applications, reactive or combination barrier/reactive type release agents work the best, you can significantly reduce the number of options available. EPA, OSHA, and DOT regulations for the products you may be interested in, must always be considered. The best choice would be a product that poses the least exposure to harmful or potentially carcinogenic compounds, and can be safely transported across public roads. Knowledge of the concrete mix design, and how it can affect the release agent performance, is also an important consideration. All admixtures (to include pozzolans) have some affect. Since there are endless number of concrete mix designs to consider, all of which can be affected by varying weather conditions, and since individual concrete surface requirements vary, actual site testing becomes a necessity. Site testing under site conditions is the best insurance for fine tuning product selection for individual application requirements. Some release agents are produced by manufacturers that specialize in that field, and have the necessary product range and field use experience to accommodate most performance requirements on all types of compositions.



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