



# Bakery Release Agents

**D. C. DARWIN**  
Avatar Corporation  
University Park, IL

Bakery release agents are an integral component of the baking process. Release agents with diverse physical properties are used for different stages of the baking process. For baked goods, release agents typically are applied in very small amounts as thin layers on equipment or product. Although the amount of release agent used for each baked good is small, the proper selection and performance of a release agent is critical to generating saleable baked goods. Proper application is important to provide a consistent, thin, oily film. Make a mistake in selecting a release agent and sticking will lead to product defects that reduce the product's value in the marketplace and increase waste due to disposal of defective product. Raw materials selection for modern bakery release agents is driven not only by technical performance criteria, but also by regulatory, allergen, and health-safety concerns.

## Application of Release Agents

The subject of mechanical application processes for release agents is an article in itself. Details regarding the application of release agent have been reviewed by Blumm (1) and Scott (7). Release agents are necessary to ensure maximum release effectiveness. A thin, uniform, full-coverage spread of release agent provides a slick release surface that enables the product to slide off without sticking. Overapplication of release agents is not the solution to the inability to generate uniform coverage. Overapplication wastes the release agent, can lead to puddles

of release agent that can chemically break down and cause gumming of pans, and may result in oil spray onto equipment surfaces, requiring cleaning and sanitary measures.

Equipment manufacturers often offer advice on the proper equipment and equipment settings for release agent applications. Some of the most common adjustments used to attain uniform coverage include

- Nozzle adjustment for efficient coverage. The release agent is applied only to necessary surfaces, with no clogging.
- Air pressure adjustment for effective atomization with minimum airborne spray.
- Temperature adjustment to maintain the release agent at the correct viscosity and provide enhanced coverage due to volume expansion with increasing temperature.

The proper amount of release agent to use depends on the product being released and the type of release agent selected. In practice, trial-and-error based on a recommended initial setting is generally used. To minimize costs, it is clearly desirable to use the minimum amount of release agent that results in efficient, undamaged release of the product.

## Composition of Bakery Release Agents

**Fluid Release Agents: Mineral Oil Versus Vegetable Oil.** Most release agents are low-viscosity fluids designed to create a thin layer of lubrication over the vessel or tool requiring release. Oil-based materials are an obvious choice. Two types of oil are common bases for release agents: mineral and vegetable.

Mineral oils are highly refined and purified oils resulting from the petroleum refinement process. During refinement of the mineral oil streams, the oils are divided into various fractions based on viscosities. These fractions can be used as-is, or they can be blended to gain finer control of the viscosity.

To qualify as a direct-contact release agent for bakery products, mineral oils must meet the specification described in 21 CFR 172.878 (2). In essence, 21 CFR 172.878

references U.S. Pharmacopoeia (USP) and other analytical tests that define white mineral oils of sufficient purity for direct food contact and human ingestion. The regulation limits the addition of release agent mineral oil taken up by bakery products to be no more than 0.15% by weight. Given the weight of baked products, the thin layers of release agent applied, the limited contact surface, and the less than 100% transfer of release agent onto the baked good, it is generally easy to remain under this limit.

Vegetable oils often are added to baked goods as ingredients. Oils such as soybean, sunflower, safflower, cottonseed, corn, canola, and coconut can be found in various release agent formulations. The properties of vegetable oils appropriate for ingredients in release agents are defined in the *Food Chemicals Codex* (5).

The choice between mineral and vegetable oils as components of release agents is a balancing act. Mineral oils are colorless, odorless, and tasteless saturated hydrocarbons. This gives them stability against polymerization and staining of the baked product. However, mineral oils have smoke points that can result in undesirable smoke formation in hot ovens. Vegetable oils have higher smoke points and, thus, are more resistant to oven smoking. However, many vegetable oils, especially soybean, contain unsaturated double bonds in their triglyceride structures. This leads to polymerization during heating, which results in undesirable gumming on bread pans. Vegetable oils also have a tendency to become rancid over time.

As a result, many of today's release agents are based on blends of mineral and vegetable oils. Appropriate stabilizers, such as antioxidants, are also added for extra protection.

**Solid Release Agents and Votation.** In applications where stiffness is desirable in a release agent, for example a grease, oils that are solid at room temperature are often used. These can be either naturally saturated fats or hydrogenated vegetable oils.

Naturally saturated fats occur in oils, including palm and coconut, as well as solid fractions that can be isolated from various oils. Because fully saturated "tropical" oils have negative health associations (8), in the United States it is not currently

common to find release agents based largely on fully saturated natural triglycerides.

Hydrogenation or partial hydrogenation removes double bonds from unsaturated triglyceride oils. As a result, hydrogenated oil has a rheological structure similar to a saturated oil. Such oils have higher melting temperatures and the solid nature of a fat.

To most effectively form solid release agents, a manufacturing process involving a refrigerated, scraped-surface heat exchanger is used. This process allows solid fats and liquid oils to be formed and set into a crystalline structure. The resulting release agent, referred to as votated grease, is tailored by formulation and processing to form the precise melting points and viscosities needed for the application. Details of the ranges of properties that can be generated in such materials have been discussed by Hegenbart (4).

Petrolatums, which are closely related to mineral oils and waxes, also can function as stiff release agents. Petrolatums have a regulatory allowance similar to mineral oils under 21 CFR 172.880 (3). They are allowed in baked goods at levels up to 0.15% by weight.

**Water-based Release Agents.** There has been some interest recently in water-based release agents. Oil-based lubrication is still required in these release agents, however. To provide oil lubrication in a water base, emulsifiers are used to emulsify oil droplets into the water phase. Because emulsions are thermodynamically unstable by nature, they can separate into phases. It is important to check emulsified products for phase separation before application in a baking process.

### Labeling Issues

**Lecithin and Soy Allergens.** Of all the fats and oils that can be considered for use as release agents, soybean oil is one of the most common due to its abundance and low cost. During the refinement of soybean oil, soy lecithin is produced as a by-product. Lecithin is a key component of many release agent formulations. It contributes to release agent adhesion, acts as a surfactant to promote reduced surface tension resulting in better release agent atomization and spreading, and has charged structures that aid in electrostatic spray guidance. As with vegetable oils, lecithin is also commonly added as an ingredient to many baked goods.

Recently, awareness of allergic reactions to soy in a small subset of the population has received heightened attention. In response, many companies have begun declaring on product labels that a product contains soy-based ingredients.

Using a release agent based on soybean oil definitely adds a soy-based ingredient into the product. However, in some ingredient declaration statements being requested by vegetable oil users, there is an explicit allergen exception for RBD (refined, bleached, and deodorized) soybean oils, because the refinement process removes the allergens

from the oil. RBD (or even more highly refined) soybean oil is the form commonly used in release agents. If soybean oil is considered problematic, other vegetable oils, such as sunflower, canola, etc., can be used in place of soybean oil in release agent formulations. Release agents based on non-soybean vegetable oils are less common, however, and are more expensive due to increased raw material costs.

Although the allergen can be removed from soybean oil, soy lecithin cannot undergo the same refinement. Thus, release agents containing soy lecithin should be declared as such to bakers, and bakers should make appropriate declarations on their labels. Soy lecithin can be replaced in release agents with other functionally equivalent components. Once again, costs for nonsoy lecithin release agents are higher due to the expense of the raw materials used.

**Trans Fatty Acids.** When developing stiff release agents based on vegetable oils, there is a need for rheologically structured materials. Materials based on hydrogenated vegetable oils contain trans fatty acids. Future labeling law will require the disclosure of trans fatty acids on the product label (8). Release agent manufacturers are able to provide this information based on the composition of the release agent and trans fatty acid measurements supplied by hydrogenated oil producers. Considering the small amounts of release agents incorporated into baked goods, it is likely that the levels of trans fatty acids transferred to baked goods from the release agent will be insignificant. However, given the negative health attributes of trans fatty acids, a market for release agents that do not contain trans fatty acids is likely to emerge (9).

**Non-GMO and Organic Release Agents.** The debate over genetically modified organisms (GMOs) in the food supply continues around the world. Due to the demand for non-GMO foods, ingredients that can be used to formulate non-GMO release agents are available. Most release agents can be custom made as non-GMO formulations. As would be expected, non-GMO products do carry extra costs.

Organic products is another specialized market segment. A U.S. law implemented in 2002 defines what can and cannot be used in organic food products and their production. Briefly, synthetic chemical and pesticide treatments cannot be used in the production of organic products, and GM products cannot be used as ingredients. The integrity of all ingredients must be tracked throughout the production chain by an approved external certification organization.

These regulations make organic bakery release agents much harder to formulate, but they can be produced. Many raw materials, such as mineral oils, currently used in release agent are not on the National Organic Program (NOP) list and, as such, are not allowed for use. Although organic vegetable oils are available, organic oil pro-

cessing makes it difficult, at best, to isolate organic lecithin, which removes a key release agent ingredient from the accepted list. Once an organic release agent formulation is arrived at that meets the regulations for raw materials, formal organic certification is needed to process organic raw materials. Given that the intent of organic certification is that if an organic version of a product is commercially available, it should be utilized, organic certifiers may drive forward the use of organic release agents.

### Types of Release Agents and Their Functions

To understand the different types of bakery release agents, it is conceptually easiest to follow the baking process from start to finish. Two classes of baked goods are relevant: standard goods with low fat contents and sweet goods with higher fat contents.

**Trough Grease.** Standard baked goods begin with the mixing of flour, water, flavorings, and processing agents (oils, emulsifiers, etc.). Yeast is frequently used in dough formulations. In commercial bakeries, dough is often allowed to rise in a vessel called a trough, which is a deep channel with sloped walls. Adherence of dough to trough surfaces results in inefficient transfer of dough to the dough divider, loss of dough, and the need to clean the trough. Therefore, before the dough leaves the mixer, the trough is prepared for release of the dough by applying a release agent called trough grease.

Due to the vertical walls of the dough trough, trough grease has to have a solid nature. At the same time, spraying a liquid is the most convenient application method. For this reason, trough grease typically is supplied as a low melting point, solid grease. Trough grease can be melted and sprayed on or applied in its grease form with a brush or cloth. In either case, complete coating of the bottom and sides is necessary for successful release.

Trough greases are available in forms based on mineral oil, vegetable oil, or both. Because the dough is not heated in the trough, smoking is not an issue. Controllable properties and lack of flavor make mineral oil-based products the preferred type.

**Divider Oil.** Dough is transferred from the trough to a device called a dough divider. This device contains a blade that segments the dough into the required portion size. The divider blade has a thin coating of divider oil applied to it to facilitate release of the dough from the blade.

The dough divider manufacturer typically specifies divider oil characteristics. In the United States, divider oils are almost always food-grade, white mineral oils. The two most common mineral oils are specified by their viscosities: 90 SUS (Saybolt universal seconds) or 210 SUS. Mineral oils with viscosities of 70 and 350 SUS also are used. In countries where white mineral oils are not allowed for direct food contact applications, vegetable oils are used as di-

vider oils. Because the vegetable oils are natural, there is not as much opportunity to select a viscosity appropriate for the machinery, and performance can suffer.

**Bread Pan Oil.** After the dough is divided, dough balls are placed in bread pans that have been pretreated with a uniformly applied release agent referred to as bread pan or depanning oil. This release agent facilitates the smooth release of the baked product from the bread pan.

Bread pan oils are subject to the heat of the baking oven and, as such, their properties when heated dictate the selection of materials. Formulations of bread pan oil are more highly developed through research and experience than the basic mineral oil used in a divider oil. A balance must be attained between mineral oil bases that can smoke and vegetable oil bases that can polymerize. By varying the ratio of mineral oil to vegetable oil in a bread pan oil, a proper balance of properties can be achieved. To increase stability, bread pan oils typically have an antioxidant package incorporated into them. To provide upgraded release properties and enhance electrostatic spray behavior, lecithin may also be added to bread pan oils.

**Specialty Release Agents.** Release agents are also available for special baking processes. One such process is band oven baking, in which dough is placed on a metal mesh band, traverses through an oven, and is released at the end of the oven fully or partially baked. In these types of processes, higher viscosity release agents are placed in a reservoir that dips the traversing band into the release agent or are sprayed onto the band. The raw materials used in these release agent formulations are similar to those used in bread pan oils. Specialty release agents are available for other types of processes as well, including extremely high-temperature baking.

**Pan Grease.** Many sweet goods contain enough oils and fats as ingredients that, due to oil bleeding out of the product, external release agents are not needed. Sweet goods without sufficient emerging oil to provide for release require a pan grease release agent. Pan greases are often votated, as described above, to provide a solid structure without relying solely on "hard fats" as ingredients.

These greases typically are applied to pans by spraying, sometimes at a slightly elevated temperature that melts the grease into a flowable state. Historically, some pan greases have contained grain flours, such as common wheat flour. A significant fraction of the industry has turned away from these flour-containing products, however, because they are harder to manufacture, harder to spray, and require extra equipment cleaning.

### Conclusions

Bakery release agents are integral processing aids for optimal production of many baked goods. As hard as pan glazers try to make everlasting pan glazes (permanent pan coatings) (6) and bakery machine manufacturers try to eliminate sticking points, the use of bakery release agents to facilitate efficient release remains prevalent. Many custom release agent formulations are available, and bakers should not hesitate to contact a release agent supplier to help solve problems with sticking.

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An advertisement appeared here in the printed version of the journal



**David C. Darwin**

David C. Darwin is vice president of marketing for Avatar Corporation, a manufacturer and developer of release agent solutions for food, pharmaceutical, and personal care product applications. During his career he has been involved in R&D, technical service, and marketing functions. Darwin is an inventor on 10 issued U.S. patents. He has a B.A. degree in integrated sciences from Northwestern University, an MBA degree from the Smith School of Business at the University of Maryland, College Park, and a Ph.D. degree in chemistry from the University of California at Berkeley.