DryFilm RA Dispersions

Coating and Release Systems

Product Information

DryFilm dispersions are extremely stable lubricants, appropriate for anti-stick, dry film lubrication and mold release applications. Used extensively as release agents in processes involving the molding of rubber and plastic parts, DryFilm dispersions have a low coefficient of friction that also translates into superior effectiveness as a dry lubricant. In addition, DryFilm dispersions can be added to liquids (oils) and semisolid formulations to enhance lubricity, promote thickening, and retard fouling. DryFilm dispersion products are listed in Table 1.

Table 1. DryFilm Dispersion Products

Concentrate	Solvent
RA	HFC 43-10
RA/IPA	Isopropyl Alcohol (IPA)
RA/W	Water

Uses

DryFilm dispersion products are used in three major areas as dry lubricants, release agents, and additives to other compounds to improve lubricity and retard fouling.

Release Agent

DryFilm dispersions are used extensively as release agents in processes involving the molding of rubber and plastic parts. The extreme stability of DryFilm dispersion means that it is virtually unaffected either by the mold itself or by the material being molded.

In commercial applications, air-dried coatings of DryFilm dispersions typically provide multiple releases between applications, even with difficult-to-release materials such as epoxy resins. When DryFilm dispersions are fused onto the mold, they provide added durability and release properties. DryFilm dispersions are superior mold-release agents for a range of industrial applications and substances, offering substantially longer mold-release performance than either oils or silicones. Sample applications include:

- Molded rubber and plastics
- Chutes and slides
- Plastic laminates
- Conveyor belts
- Laminated wood
- Paper, pressure-sensitive labels
- Resin releasing
- Tanks and bins

Dry Lubricant

The low coefficient of friction that is characteristic of DryFilm polymer translates to superior effectiveness as a dry lubricant. DryFilm dispersions are the lubricant of choice for electric switches, window hardware, military equipment, and a range of other applications for which smooth, repeated movement is essential. DryFilm coatings improve abrasion resistance, extending the wear life of the product. They also provide dry lubrication as an inclusion in plastic and metallic bearing applications. DryFilm coatings can be infused into electro-less nickel-coated components to improve corrosion resistance while providing lubrication.

Specific Uses Include

- Lubrication of leather, plastics, and elastomers for use in drive belts, gaskets, packings, gears, bearings and sleeves, and chain drives.
- Coating and manufacture of metal, fabrics, thread, cord, twine, rope, and cable made from both natural and synthetic fibers.
- Manufacture of machine parts and fittings, including nuts and bolts, linkage and connectors, locks, power saw blades, machine mechanisms, electrical equipment, instruments, and office machines.
- Metalworking operations, including extrusion, rolling, drawing, and sizing.
- Use in precision audiovisual equipment, such as musical instruments, magnetic recording tapes, camera shutters, and film.
- Processes for the manufacture of glass and paper.
- Manufacture and finishing of furniture and hardware for construction and home sales, including door hinges, locks, and catches; window guides; slide channels on storm window sashes and screens; guides on furniture and cabinet drawers; zippers; and other household items.

Additives

DryFilm dispersions can be added to liquid and semisolid formulations to enhance lubricity, promote thickening, and retard fouling. Additional additives can be included with DryFilm dispersion formulations to enhance stability and adhesion. Products such as Capstone™ fluorosurfactants promote stability along with adhesion. As an additive, DryFilm dispersions are used in:

- Paints and finishes, paper and carbon paper coatings, and printing and writing inks.
- Elastomeric and resinous compounds, abrasive and grinding wheel compositions, and electrical (carbon) brushes.
- Waxes and polishes for metals, automobiles, appliances, furniture, shoes and leather, and skis, bicycles, rollerblades, and other sporting equipment.
- Bonded solid-film lubricants.

Application

DryFilm dispersions can be applied in any of several methods, including dipping, wiping, or brushing onto a prepared surface or by spraying (air sprays, air-less sprays, and aerosols). Containers of DryFilm lubricant formulations should be agitated prior to opening, because the active ingredient can settle during storage. Applications can be air-dried, and, if greater adhesion is desired, coated surfaces can be heat-fused.

Surface Preparation

Surface preparation is important for all application methods. All surfaces should be clean and dry before DryFilm dispersions are applied. Controlling surface roughness improves coverage, especially in air-dried applications; a smooth surface also improves results in mold-release applications. Properly applied, DryFilm dispersion coatings are not affected by water or other materials with which they come in contact.

Dilution

The extendability of DryFilm dispersion products is a major asset, because it allows the user to customize the dispersion for ease of application and adequacy of coverage. Each DryFilm dispersion product can be extended with additional amounts of the base solvent.

DryFilm RA is furnished in a dispersion that is 15% solids by weight; DryFilm RA/W is 20% solids by weight.

DryFilm RA/IPA is 25% solids by weight. Table 2 is a dilution table showing the total parts of DryFilm dispersion and solvent required to achieve a range of final concentrations by weight.

Application Methods

Dipping

Dipping is useful for coating small parts, coils of wire, and items of varied shapes. The pieces are dipped in a dilute DryFilm dispersion; coating levels are determined by the concentration of solids, rate of withdrawal, and number of applications. A single dip is adequate for most uses.

Wiping or Brushing

This method is especially useful for coating continuous surfaces such as rods, tubing, or sheets. In addition, wiping and brushing are appropriate for coating small, selected areas of a larger part. One variation of this method is flood coating, followed by wiping.

Table 2. DryFilm Dispersion Products

DryFilm Dispersion Products	Dilution Table				
	Solvent	Solids wt%	Final Conc. wt%	Parts DryFilm Dispersions	Parts Solvent
RA	HFC 43-10	15	10.0	2	1
			5.0	1	2
			2.5	1	5
			1.0	1	15
RA/IPA	IPA	25	10.0	3	5
			5.0	1	4
			2.5	1	10
			1.0	1	25
RA/W	H_2O*	20	10.0	1	1
			5.0	1	3
			2.5	1	8
			1.0	1	20

*Use deionized water, warm to hot water preferred.

Air Spraying

Conventional spray equipment can be used to apply dilute dispersions. A solvent with low volatility is recommended, because more highly volatile solutions tend to evaporate quickly—producing dry deposits with poor adhesion.

Airless Spraying

Airless sprays can be applied with a hand-held spray gun or automatic spray heads operated either intermittently or continuously. The recommended technique is to apply a succession of thin coats, allowing the surface to dry between applications. Results from this technique are superior to the application of a single thick coating, which takes longer to dry and can cause "mud cracks," uneven coverage, and poor adhesion. As with all spraying, adequate ventilation should be maintained.

Aerosol Sprays

Aerosols allow convenient surface application and quick coverage. A range of formulations that contain DryFilm dispersions are available under different trade names from several suppliers. Many of these products contain other additives to impart special properties.

Drying

DryFilm dispersions, like any other applied coating, dry best in an area that is relatively free of dust. Adequate ventilation improves drying, as does allowing adequate spacing of covered pieces to avoid crowding. Drying times of DryFilm dispersion coatings are dependent on dispersion type and thickness of application, but increasing the temperature in the drying room can reduce all drying times.

Melt-Coating for Improved Adhesion

Adhesion of DryFilm dispersion coatings can be improved by melting the deposited solids. After the dilute dispersions are applied and the solvent is allowed to evaporate at room temperature, the surface can be heated to fuse the coating. The temperature for heat-curing the RA polymer is 305–310 °C (581–590 °F)*. Heat-curing to melt the coating is completed as follows:

- Measure the surface temperature directly with a thermocouple. You may observe a change in coating appearance, which may alter initially from an opaque white to a darker, translucent look and then clear and wet.
- Maintain the temperature of the coated surfaces (not the temperature of the ambient air) at the correct temperature for 5–10 min.
- If a white residue is left on the metal surface, buff with a soft cloth.
- When melt-coating DryFilm dispersions, provide adequate ventilation and observe all the precautions outlined in the section titled "Safe Handling and Storage."

* Note that this is the recommended temperature for the coated surface itself.

Removal of DryFilm

Coatings

Air-dried coatings of DryFilm dispersions can usually be loosened by applying solvent (wiping or dipping). Removal is then completed by wiping with a cloth or brush. Melt-coated DryFilm dispersion coatings, or those forced onto a surface by operations such as metal extrusion, are removed by oven heating, heated salt baths, pickling, or abrasion. Solvent washing is usually insufficient to remove melt-coated applications of DryFilm dispersions. Whenever DryFilm dispersions are being removed, it is important to follow all safety precautions for use of solvents or other removal processes.

Lubricity and Anti-Stick Properties

When applied to solid surfaces, DryFilm dispersions produce extremely low static coefficients of friction—the source of their effectiveness as lubricants. Unlike conventional lubricants, DryFilm dispersions minimize "slick-slip" problems. DryFilm dispersions are most effective in applications requiring low speeds and light loads. Under some conditions requiring high speeds and high loads, DryFilm dispersions may be abraded from the surface, making re-application necessary. Adhesion can be improved by adding a binder to the dispersion or by heat-curing.

Thermal Stability

PTFE, the active ingredient in DryFilm dispersions, has excellent high-temperature properties. It can be heated above its melting point before appreciable decomposition begins. PTFE contains a range of molecular weights. Prolonged heating can cause sublimation of the lower molecular weight fractions with accompanying weight loss. The actual sublimation rate is dependent on temperature, area, and air flow.

Thermal stability of DryFilm RA polymer is charted in Figure 1.

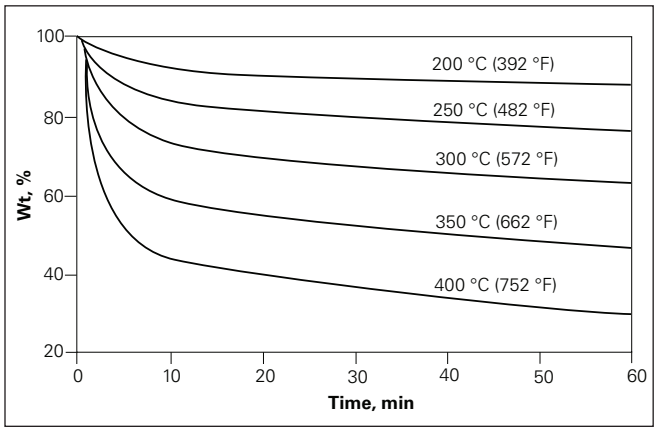
Chemical Stability

In laboratory tests, PTFE proved completely resistant to attack by concentrated nitric acid, concentrated hydrochloric acid, 30% aqueous sodium hydroxide, and 30% alcoholic potassium hydroxide at temperatures of 100 °C (212 °F) or slightly higher. Concentrated sulfuric acid attacks the fluorotelomer at 100 °C (212 °F), but it has no observable effect at room temperature.

Properties of Solvents

Table 3 shows the properties of the solvents that are used with the different DryFilm dispersion products. Additional details are contained in the Safety Data Sheet (SDS) for each product.

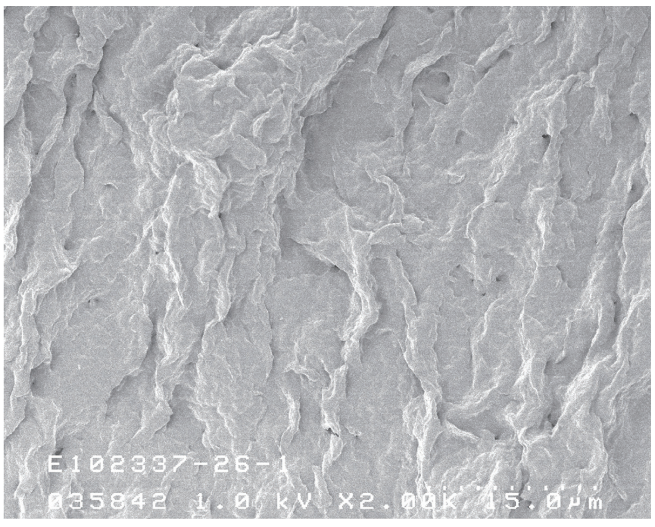
Figure 1. Thermal Stability of DryFilm RA



Product Description

DryFilm dispersions are fluorotelomers, highly fluorinated substances with a low molecular weight. The active ingredient is polytetrafluorethylene (PTFE), which has an extremely low coefficient of fiction and, thus, imparts high lubricity and excellent nonstick properties.

Because of the chemical stability of PTFE, DryFilm dispersions are resistant to attack by nitric acid, hydrochloric acid, sodium hydroxide, and alcoholic potassium hydroxide in most applications. It is also extremely stable thermally and can be heated above its melting point before appreciable decomposition begins. DryFilm dispersions are essentially insoluble in all non-fluorinated solvents. Typical properties of DryFilm dispersion products are shown in Table 4.



The ultralow molecular weight PTFE particles in DryFilm dispersion products impart an extremely low coefficient of friction, resulting in highly effective release agents.

Table 3. Properties of Solvents

Solvent	HFC 43-10	Isopropyl Alcohol (IPA)	Water
Formula	$C_5H_2F_{10}$	$CH_3CH(OH)CH_3$	H_2O
CAS#	138495-42-8	67-63-0	7732-18-5
Boiling Point, °C (°F)	55 (130)	82 (179.6)	100 (212)
Freezing Point, °C (°F)	–80 (–112)	–89 (–128.2)	0 (32)
Density, g/cc (lb/gal)	1.58 (13.2)	0.79 (6.6)	1.0 (8.3)
Vapor Pressure	226 psia	33 mmHg	24 mmHg
Odor	Odorless	Alcohol	Odorless
Color	Colorless	Colorless	Colorless
Flash Point	None	11 °C (52 °F) TCC	None
Flammability—LEL	None	2.0%	None
Flammability—UEL	None	12.7%	None
Exposure Limits—AEL	200 ppm, 8- and 12-hr TWA	400 ppm, 8- and 12-hr TWA	
Exposure Limits—PEL	None Established	400 ppm, 8-hr TWA	
Exposure Limits—TLV	None Established	400 ppm, 8-hr TWA, 500 ppm STEL	
Exposure Limits—WEEL	400 ppm, 8-hr TWA	—	
TSCA Status	Listed	Listed	
DOT	Not Regulated	Flammable Liquid	

Table 4. Typical Properties of DryFilm Dispersion Products

	RA	RA/IPA	RA/W
Solids, wt%	15	25	20
Melting Point, °C (°F)	300 (581)	300 (581)	300 (581)
Telomer Solids			
Molecular Weight	3,000	3,000	3,000
Density, g/cc	2.2	2.2	2.2
Particle Size, µm			
Mean	3.7	3.7	3.7
Range	1–15	1–15	1–15
Dispersion			
Volatiles, %	85	75	80
Odor	Odorless	Alcohol	Slightly Sweet
Form	Fluid Dispersion	Fluid Dispersion	Fluid Dispersion
Color	Translucent, White	Translucent, White to Off-White	Translucent, White to Off-White
Specific Gravity	1.63	0.94	1.1
Density, lb/gal	13.6	7.8	9.2
Solvent	HFC 43-10	IPA	Water
Shelf Life	2 years	2 years	1 year

Safe Handling and Storage

General Practices

Please follow the guidelines as outlined by SPI (The Society of the Plastics Industry) or PlasticsEurope (Association of Plastics Manufacturers Europe). For detailed information on health and safety, refer to the Safety Data Sheet (SDS).

When using DryFilm dispersion products, a handler should observe the same precautions associated with many solvents and resinous materials in regular commercial use. A summary of these precautions is contained in this section. Adequate ventilation is important, and care should be taken to avoid inhaling spray mist or fumes containing DryFilm dispersions. Ventilation should always be adequate when DryFilm products are heated. Vapor from the solvent in DryFilm dispersion formulations may develop pressure inside storage containers. Caution should be exercised in opening containers; in normal practice, solvent containers should be opened away from the face; and any personal protection recommended in the SDS should be worn.Containers of DryFilm dispersion formulations should be closed promptly after use. This minimizes solvent loss by evaporation and prevents the resulting coagulation of the dispersed PTFE.

Open and use containers only in well-ventilated areas using local exhaust ventilation (LEV). Vapors and fumes liberated during hot processing, or from smoking tobacco or cigarettes contaminated with DryFilm, may cause flu-like symptoms (chills, fever, sore throat). Symptoms may not occur until several hours after exposure and pass within about 24 hours. Vapors and fumes liberated during hot processing should be exhausted completely from the work area; contamination of tobacco with polymers should be avoided.

Polymer Fume Fever

No lethal effect has been observed as a result of human exposure to heated DryFilm PTFE fluorotelomer. However, such exposure has caused a temporary flu-like condition similar to metal fume fever. These symptoms are also known as polymer fume fever; they are the only adverse effects observed in humans to date. The SDS has details on safe handling and storage of DryFilm dispersion products.

Medical Applications

For medical application and development, consult Chemours.

Food Contact Compliance

DryFilm RA dispersions are not approved for food contact applications.

For product information, industry applications, technical assistance, or global distributor contacts, visit krytox.com or within the U.S. and Canada, call 1-844-773-CHEM/2436 or outside of the U.S., call 1-302-773-1000.

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