FUNCTIONAL PRODUCTS INC.

Innovative Chemistry for Lubricants

Additives for Grease

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Certified ISO 9001:2008 (With Design)

8282 Bavaria Road - Macedonia, Ohio - 44056 ***January 2012***

ADDITIVES FOR GREASE

FUNCTIONAL PRODUCTS INC.

Functional Products Inc. was founded in 1985. We received our ISO 9001:2008 certification in 2010, and we are REACH compliant.

Functional Products formulates and blends over 200 active products and also provides custom formulary capability for short and long-run needs.

Headquarters, general offices and manufacturing plant are located in Macedonia, Ohio. Sales offices and stocking points are located throughout the United States and Canada, as well as Latin America, Europe, Australia, India and Asia.

Mission Statement:

Functional Products Inc. is committed to providing our customers with quality products and services that meet or exceed their expectations through the use of continuous improvement.

Improve Your Greases With Our Polymer Additives

FUNCTIONAL PRODUCTS, INC. offers a variety of polymer additives that positively affect the performance of grease. The interaction of polymers in grease is more complex than the thickening polymers confer to base oils. Our specialty polymer additives form an interpenetrating, physical network with the grease soap to greatly improve the performance of the grease: better shear stability, enhanced water spray-off and thicken the grease.

How do Polymers Improve Grease?

The polymer forms an interpenetrating network with the grease soap matrix by chemical bonding, entanglement, or an amorphous crystalline reinforcement. The result is improved functional properties and a robust appearance.

- **Improved Shear Stability**

FUNCTIONAL V-4004A, **V-207**, **V-211**, and **V-176** greatly improve Cone Penetration (ASTM D217) and Roll Stability (ASTM D1831) performance test results for grease.

- **Enhanced Water Resistance**

FUNCTIONAL V-4004A, **V-207 V-211** and **V-176** reduce water spray-off grease loss by as much as 90% (ASTM D4049).

- **Increased Yield**

FUNCTIONAL V-4004A, V-207, **V-211** and **V-176** stiffen the grease and lower the NLGI rating grade. To bring the grease back in grade, approximately 10% more oil is added.

What Types of Grease Soap may be treated with polymers?

The specialty polymers are compatible with the following mineral and vegetable oil-based grease soaps: aluminum, lithium, lithium complex and calcium sulfonate systems.

Compatibility with Vegetable and Mineral Greases

Differences between vegetable and mineral oils require the use of compatible polymers when forming greases (see the illustration below). Although both oils are characterized by long hydrocarbon chains, vegetable oils have polar ester groups (A) and unsaturated double bonds (B).

Definitions:

Triglyceride — An ester derived from glycerol and fatty acids.

Health and Safety:

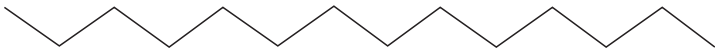
The product descriptions here, the Technical Data Sheets (TDS) and the product labels are not intended to take the place of a Material Safety Data Sheet (MSDS).

An MSDS is provided with each shipment of an order or a sample, or can be downloaded from our website:

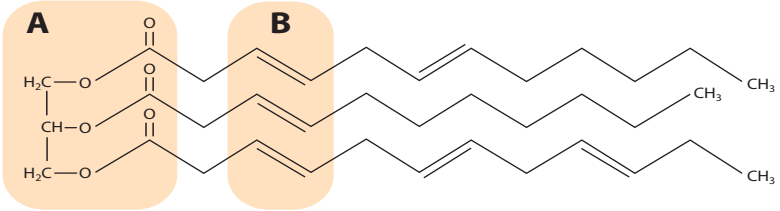
www.functionalproducts.com
Phone: 1-330-963-3060

Structural Differences Between Vegetable and Mineral Oils

Mineral oil (Linear Paraffinic)



Vegetable Oil (Triglyceride)



POLYMER ADDITIVES

For Water Spray-off and Shear Stability

APPLICATION

FUNCTIONAL V-207 and **FUNCTION V-211** are powdered polymers absent of diluent oil for formulating flexibility. Both provide exceptional visual tackiness to grease.

FUNCTIONAL V-4004A is a multifunctional polymer in liquid form designed to improve water resistance and mechanical stability. **FUNCTIONAL V-4004A** also increases the tackiness of the grease and reduces the soap content.

FUNCTIONAL V-4020 is a rapidly dissolving pellet polymer that interacts with the grease soap matrix and greatly boosts the soap's performance for water spray-off and shear stability.

FUNCTIONAL V-207, **FUNCTION V-211** and **FUNCTIONAL V-4020** are specifically designed for compatibility with the grease soap matrix. **FUNCTIONAL V-207** and **V-211** are added while cool, below 100°C.

Product	Composition	Appearance	Water Spray-off*	Roll Stability*	Treat Rate**
V-207	Copolymer based on ethylene and propylene	White rubber powder	14.0%	4.4%	1.0%
V-211	Styrene/ethylene/butylene copolymer	White-yellow rubber powder	15.0%	4.8%	1.0%
V-4004A	Hydrocarbon polymer in naphthenic oil	Yellow-orange liquid	33.0%	3.0%	2.0%
V-4020	Copolymer based on ethylene and propylene	White rubber pellets	21.0%	4.6%	0.25%

* Reference for comparison is a lithium complex grease with ASTM D-4049 of 63% and ASTM D-1831 of 11.0%.
** Treat Rates may be optimized for a specific grease, usually within ± 0.5% by weight

FUNCTIONAL V-4004A, **V-207** and **V-211** are added while cool, below 100°C. **FUNCTIONAL V-4020** is added during initial reaction, with temperatures above 200°C.

TACKIFIERS

APPLICATION

FUNCTIONAL V-176 is a yellow-orange (<3 ASTM) tackifier that confers tack or stringiness to a lubricant, and may be used to provide adherence.

FUNCTIONAL V-191M is a white liquid best used in greases made with water or where water is a by-product of soap formation. The high active polymer level results in a modest viscosity compared to solutions of tackifier polymers in oil.

FUNCTIONAL V-570 and **V-572** are yellow-orange (<4 ASTM) tackifiers for fatty oil-based greases. **FUNCTIONAL V-570** is biodegradable and **FUNCTIONAL V-572** is approximately 90% readily biodegradable.

FUNCTIONAL V-584 is NSF registered as X1 category (No. 120913), where incidental food contact may occur.

Product	Composition	Kinematic Viscosity	Specific Gravity	Lbs. / Gallon	Flash Point	Treatment Level
V-176	Polyisobutylene	2,500 – 3000 cSt @ 100°C	0.86	7.10	175°C	0.5 – 1.5%
V-191M	High m.w. hydrocarbon	–	0.95	7.9	–	0.5 – 2.0%
V-570	Polymer	7,000 – 9,000 cSt @ 100°C	0.93	7.75	150°C	3 – 7%
V-572	Polymer	6,000 – 9,000 cSt @ 100°C	0.93	7.75	150°C	0.2 – 10%
V-584	Polymer	2,000 – 3,000 cSt @ 40°C	0.93	7.75	150°C	5%

EXTREME PRESSURE ADDITIVES

CERAMAX and RD-535 Extreme Pressure Grease Additives

FUNCTIONAL CERAMAX uses optimized bimodal particles to provide an efficient and economic additive for use in heavy industrial and food processing grease. **CERAMAX** provides lubrication and metal to metal protection under extreme loads and temperatures, making it an ideal replacement for graphite, MoS2 or PTFE. **CERAMAX** is available in white paste or white powder form with comparable performance, allowing maximum flexibility when formulating your grease.

FUNCTIONAL RD-535 is a liquid additive for vegetable based grease. At a 5.0% treat rate, **RD-535** has a Timken Weld Load of greater than 71 pounds (32kg).

Four Ball Extreme Pressure Test Results

	Wear Scar 40kg (mm)	Extreme Pressure Weld (kg)
Lithium Complex Base Grease	1.060	126
Lithium Complex / 1% PTFE	0.890	200
Lithium Complex / 1% MoS2	0.805	250
Lithium Complex / 5% RD-535	**0.820**	**250**
Lithium Complex / 1% Ceramax	**0.760**	**250**

MOBILITY and DROPPING POINT IMPROVERS

FUNCTIONAL PD-555 is a wax-crystal modifier primarily used in improving cold-flow properties of vegetable oil-based greases at temperatures below their mobility flow rate. It is effective under both rapid-cooling and extended cold storage conditions. **FUNCTIONAL PD-555** is effective in greases made from canola oil, sunflower oil or other triglycerides. **FUNCTIONAL PD-555** is approximately 95% readily biodegradable. Mobility flow rate reduces by 5° to 15°C.

FUNCTIONAL PD-610 is a wax-crystal modifier primarily used in improving the cold-flow properties of mineral oil-based greases at temperatures below their mobility flow rate.

FUNCTIONAL DP-200 is a high-performance additive designed for simple Lithium 12 hydroxystearate soap greases. By increasing the three-dimensional association of soap fibers, the grease becomes more resistant to flow at elevated temperatures. **FUNCTIONAL DP-200** is slightly dispersible in water. The dropping point is increased by 40°C.

Typical Properties and Treatment Levels

	Mobility Improvers		Dropping Point Improver
Property	**PD-555**	**PD-610**	**DP-200**
Compatibility	Vegetable Oil-based Greases	Mineral Oil-based Greases	Lithium 12 hydroxystearate greases
Appearance	Light-colored liquid	Pale yellow to amber liquid	Clear, colorless to light yellow liquid
Odor	Mild fatty	Mild	Mild
Lbs. per Gallon	7.75	7.6	8.5
Flash Point	160°C (320°F), min.	150°C (°F), min.	182°C (360°F)
Specific Gravity	0.93	0.90 Typical	–
Kinematic Viscosity	110 cSt @ 100°C	<800 cSt @ 100°C	–
Acid Value	–	–	330 – 390 mg KOH / g
Phosphorous Content	–	–	11.2 – 12.0%
Treatment Level	1%	0.10 – 0.50%	0.3 – 0.5%