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Nye® Lubeletter

Synthetic Lubricant News from The SmartGrease *Company*™

SmartGel™ Enables Performance Improvements in Photonic Devices

SmartGels — viscoelastic, high-clarity optical materials — are catching on as performance boosters among OEMs who manufacture or specify high-brightness LEDs, flat panel displays, CCD arrays, and other light-based technology.

SmartGel is an enabling technology developed by Nye in the 1980s to eliminate signal loss within optical fiber connectors. 3M and Lucent designed these connectors to eliminate the labor and expensive equipment needed to fuse glass fibers throughout a communications network. Instead, fibers could be inserted into either end of an optical connector and secured. However, a small air gap between the two glass fibers within the connector caused reflection and signal loss. By filling the gap with SmartGel, light passed with minimal reflection from one fiber to the other and signal loss was virtually eliminated.

In theory, SmartGels can improve the efficiency of any photonic device in which light must pass through mated plastic or glass. Lumen output is a key measure of efficiency. The unavoidable micron-size air gaps between mated materials reduce lumen output because the refractive index of air is lower than the refractive index of the mated materials. Like an ocean wave hitting a sandbar on its way to shore, light reflects or scatters when it hits an air pocket, and lumen output is compromised. SmartGels minimize reflection because they are custom-designed to match the refractive index of the mated materials (±0.005); light passes with little or no reflection through the gap. SmartGels are also tailored to the optical clarity, pot life, cure rate, Shore hardness, and temperature requirements of the application. In short, they "know" how the product is supposed to perform.

In practice, SmartGels work. Applying them between the diode and the optical-grade plastic lens of an LED increases lumen output and extends operating life. In intensified CCD cameras, they maximize light transmission for very low-light imaging and eliminate the Newton's Ring effect. They're also being tested in other products, including PDAs, cell phones, avionics displays, photodiodes, and optical transceivers. SmartGels can overcome some disadvantages of optical epoxies, which can build up residual stress, fracture and delaminate; crack when cold; and soften when hot. Because they are viscoelastic, SmartGels absorb shock. Formulated with silicone and polyphenyl ether fluids, they withstand temperature excursions from –65°C to ≥ 200°C. Further, SmartGels are non-yellowing under typical conditions and generally unaffected by x-ray, ultraviolet, or exposure to sunlight. MORE On-line

NEWSClips

Dr. Susan Gardner joined Nye as Senior R&D Chemist in November 2003. Susan brings a strong technical background in organic chemistry, specializing in synthesis and characterization of polymers. Formerly, Susan was a principal scientist at Physical Sciences, Inc., where she designed polymers for military and commercial applications. She earned her Ph.D. in Organic Chemistry/Polymer Science at Michigan State University. During post-doctoral research, she synthesized a new blue light emitting polymer and fabricated LED devices.

Black & Decker's Materials Engineer Adrian R.B. Mulindwa visited Nye for lab training, focusing on the use of a Digital Scanning Colorimeter and Fourier Transform Infrared Spectrometer. The DSC evaluates oxidative stability. The FT-IR determines the chemical make-up of greases and oils. Each supports quality control and failure analysis.

Nye's QS-9000 continued certification was approved and ISO-9001:2000 certification was awarded in November 2003 by registrar BSI.

MORE On-line

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International Corner

Toyota Forklifts

Toyota Industrial Equipment launched its Forklift Maintenance Kit Program in Japan in 2003 and Nye's Fluorocarbon Gel 880 played a key role.

The "Brake Maintenance Kit," one of Toyota's genuine service parts, contains abrasive paper to remove build-up on disc brakes. Paper wipes are included to clean the surfaces. Fluorocarbon Gel 880 completes the kit to ensure a tight seal between parts during brake reassembly.

Fluorocarbon Gel 880 is a PTFE-thickened, heavy viscosity, dimethyl silicone grease designed for brake calipers, parking brake cables, and ball joints. It offers excellent resistance to water, thermal oxidation, and brake oil and remains stable over a wide temperature range (-40°C to 200°C). The grease has been assigned part numbers by DaimlerChrysler (MS-7751, Parking Brake Cable Systems), Ford (ESA-M1C200-A, Parking Brake Cables, Light Truck Calipers, Stabilizer Boots, Ball Joints), and GM (9985493, Parking Brake Cables).

Kits are being assembled in Nagoya by Tsuchiya Co., Ltd., Nye's representative in Japan. MORE *On-line*

Aerospace Applications Push Lube Envelope

Lubricants in space mechanisms need staying power. Missions depend on them. Afterall, you can't relube bearings on a probe heading toward Jupiter.

The U.S. Air Force Research Laboratory at Wright-Patterson Air Force Base often singles out three types of synthetic lubricants for critical applications. Perfluoropolyethers (PFPEs) and multiply alkylated cyclopentanes (MACs) are now used in many aerospace applications. Silahydrocarbons (SiHCs), not yet commercialized, are under investigation for advantages they seem to offer.

PFPEs come in five forms, each a slightly different, inert, fluorinated molecule. What all PFPEs have in common is excellent material compatibility; resistance to oxygen, chemicals, fuels, and gasses; low volatility; and broad temperature capability, which can range from –90°C to 250°C. However, most PFPEs don't fare well under high loads, especially in metal-on-metal applications.

MACs, manufactured by Shell as Pennzane,® were developed in the 1980s in a successful effort to match the low volatility of PFPE while improving performance under load. A synthetic hydrocarbon, MACs are superior to PFPEs for wear prevention. Additives, such as wear and load enhancers, are more soluble in MACs than in PFPEs. The operating temperature range for MACs, however, is only -40°C to 125°C.

Nye chemist Nicole St. Pierre synthesizes SiHCs for Wright-Patterson.

SiHCs offer excellent viscosity index, low volatility, receptivity to additives, and low-end temperature capability to -54°C. Their molecular weight can also be custom-designed by varying the number of silicon atoms added to the base hydrocarbon chain. As molecular weight increases, viscosity index, vapor pressure, and other lubricant characteristics improve.

Nye offers all five types of PFPEs in its UniFlor™ line of oils and greases. The exclusive North American distributor for Pennzane fluids, Nye offers formulated MAC oils and greases. Nye also synthesizes experimental SiHCs for Wright-Patterson. MORE *On-line*

Get smart about grease

The best synthetic grease for gears starts with the right oil. Synthetic hydrocarbon oils are the most widely used. They remain fluid at -60°C, are compatible with many plastics, and relatively inexpensive. Synthetic esters are ideal for cut-metal and powdered-metal gearing, especially iron and steel. With their ability to withstand temperatures as high as 180°C, esters have become the clear choice for severe-duty applications.

Polyglycols, frequently used in worm gear applications, have an affinity for brass and phosphate bronze. Silicones and PFPEs are compatible with nearly all gearing plastics. Suitable for broad temperature applications, both have shown exceptional, low-temperature torque characteristics. PFPEs are also resistant to chemicals and other aggressive environments. MORE *On-line*

Nye® *Synthetic Lubricants* *The* SmartGrease *Company*™

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