NYE® WILLIAM F. NYE, INC.
P.O. Box G-927, New Bedford, Mass.
AUTUMN 1990
LUBELETTER

VISCOSITY AS A FUNCTION OF SPEED

The "Apparent Viscosity" of Greases

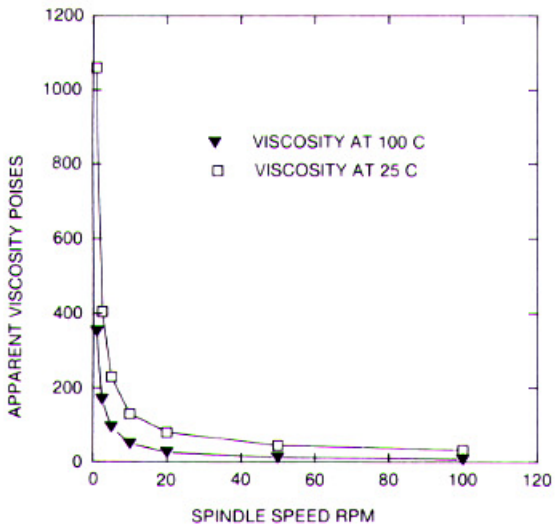
If we are asked for the viscosity of a grease, it's not easy to give a straight answer. Simple fluids, including most lubricating oils, follow Newton's Law, whereby the fluid's viscosity remains constant as a function of shear rate. Things get much more complicated when the oil is gelled and becomes a grease. Greases are non-Newtonian; their viscosity is highly dependent on the rate of shear, or the rate at which adjacent layers of grease move relative to one another. (The unit for shear rate is "reciprocal seconds".)

Recently, we acquired a computerized Brookfield viscometer which can display graphically the change in the shear resistance or "apparent viscosity" of a grease with the speed of rotation of a T-bar spindle as it descends through the grease. At extremely slow speeds, apparent viscosity is quite high; thereafter, as spindle speed or shear rate increases, there is a steep plunge to much lower apparent levels. This is "pseudoplastic" behavior, typical of most common greases.

A grease viscosity curve can show apparent viscosities only at a single temperature. A different temperature would involve a separate line on the graph, higher up if the temperature were colder and lower down if hotter.

We could also display the implications of the term "thixotropic", applied to greases which soften on agitation. Such a grease would lose viscosity over time at a constant shear rate. Also, as shear rate began to decrease, there would be a different viscosity curve for "slowing down". Thixotropic greases do tend to revert back to their original viscosities on standing over time. Grease viscosity thus becomes a very complicated shear rate/temperature/time continuum.

We are developing a data base for Nye greases which will eventually show the effects on apparent viscosities of different gellants in varying proportions and using different grease processing procedures. Stay tuned.



SPECIAL CONNECTIONS

Lubricants for Sensors

We once looked at the world of sensors as being hopelessly solid-state (hopeless from our perspective, that is , as a potential application area for oils or greases). Our customers have taught us otherwise. And the learning process has taken us into some fascinating new areas for functional fluids and compounds.

Sensors come in an endless variety - acceleration, flow, temperature, position, pressure, velocity, to name just a few. Many have no moving parts, but most of them have to communicate in some manner with the world around them, and the connections may need lubrication, protection or a boost of some specific kind.

Consider these special needs:

— wear or noise reduction in potentiometer contacts, either wire-wound or conductive track

Nye Fluorocarbon Gel 813 is a silicone-based grease with extreme wide temperature capability which has worked well on a broad spectrum of wiper/track combinations. Where resistance to hydrocarbon fuels is needed, the alternative is Nye Fluoroether Grease 833B.

— a sonic coupling fluid or compound

Nye Synthetic Oil 444 is a relatively low viscosity aromatic ether oil with excellent acoustic properties and superior thermal and oxidative stability. Its sound velocity is 1,585 meters per second at 25°C.

— an optical couplant of specific refractive index for a fiber optic assembly

Nye NyoGel OC-431A is a pliable, non-hardening, non-melting, crystal clear optical coupling gel formulated to possess the required refractive index (1.463) to minimize signal attenuation at fiber optic connections. Other refractive indices can be targeted with other formulations.

— protection and/or friction reduction for an electrical connector

Nye NyoGel 759G is a non-melting, water-resistant protective gel based on a stabilized, plastic-compatible high viscosity synthetic hydrocarbon fluid with good wide temperature properties. The gel is widely used in lubricating and protecting the electrical connectors in automotive underhood electrical harnesses.

— effective transfer of thermal energy

Nye Thermal Coupling Compounds 925 and 926 are both metal oxide-based heat transfer media. Each has been formulated to provide wide temperature serviceability and ease of application. The 925 Compound is silicone-based; the 926 Compound contains no silicones.

Write or call for a literature package or state your specific need and a selected compound sample will be sent to you.

The Role of Additives in Specialty Greases

The many special lubricant applications which our customers bring to us require frequent sifting through what has become a complex formulary. When a grease or gel is called for, we need to select the most appropriate combination of base fluid, gellant and additives which directly meets all of the separate needs of the application.

The array of possible grease additives means that we have to ask a series of probing questions to identify just what combinations should be included in a candidate formulation. This article is intended as an advance warning so that you can be ready with a response when we pose these questions.

There may be some very special situations, probably involving machinery where incidental food contact is expected, where we want to keep the grease additive-free. Usually, though, we will try to cover the following bases.

Condition: Operating Temperature
Additive Decision: Antioxidant

Operating temperature range usually drives the selection of base oil and gellant. Several high temperature fluid types, such as fluorinated ethers do not solubilize anti-oxidants; however, with esters or synthetic hydrocarbons, a proper anti-oxidant for the high temperature operating pattern (steady soak vs. cycling) must be chosen.

Condition: Ferrous Metals, Moist Environment
Additive Decision: Rust Inhibitor

Rust inhibitors can be mild, as in turbine oils, or strong and water-displacing, as in preservative coatings. The choice is also affected by the type of gellant in the grease, clays and silicas being more difficult to inhibit without affecting grease stability.

Condition: Protection of Non-Ferrous Metals
Additive Decision: Corrosion Inhibitor

Copper and its alloys can be protected from corrosion caused by pollutants in the air by selection of an inhibitor from certain additive families.

Condition: Heavy Loads
Additive Decision: Anti-Wear or Extreme Pressure Additive

The combination of mating materials is the most important criterion for this decision. This large group of additives are primarily chemically active. Heavily-loaded steel-on-steel might call for a "liquid-moly" load-carrying additive or even fortification with molybdenum disulfide or some other solid lubricant. Chemical suitability for use with more reactive non-ferrous metals would lead to the selection of another chemical class of anti-wear additive. Rolling bearings with steel balls or needles in a steel raceway would again require another specific choice. If the application were plastic-on-plastic, where chemical activity could be destructive, possibly a fluorocarbon solid polymer would be useful. If certain strong rust inhibitors are required for the application and might compete for the metal surface, then again special compatible choices must be made.

Condition: "Flea-Power" Conditions
Additive Decision: Lubricity Additive

For extremely delicate mechanisms where absolute minimum friction can be tolerated, "lubricity additives" must be chosen. Whale oils, more specifically dolphin head oils, were the basis for our company's product line a century ago and were un-paralleled as lubricity additives and friction reducers for delicate instruments. Today, synthetic ester or vegetable oil combinations have proven effective.

Condition: Sling-off Prevention
Additive Decision: Tackifier or Adherence Modifier

Several families of high polymers can impart tenacity to a grease structure, although they can also increase drag since they must be sheared under relative motion of moving parts. This drag is a positive factor in our large family of damping greases, but in many situations, a judicious choice of type and quantity of adherence modifier must be made.

This represents only a partial list of the range of additive decisions when selecting a lubricant for your problem. Other needs might include viscosity-index improvers, dispersants, neutralizers or electrically or thermally conductive fillers. If you are quizzed unmercifully when you ask for help, there are good reasons for doing so, and we hope this listing explains some of them.

Perfluorinated Solvents for Oil Creep Barrier Films

The NyeBar fluoropolymer oil creep barrier films have been used for almost twenty years to retain within the bearing raceway the small volumes of oil required in precision bearing operation. They have also been used in many other situations both to prevent oil migration away from the point of application and to protect nearby components from oil contamination.

These films obtain their effectiveness from the presence of closely-packed fluorine atoms on the film molecule. Since it is so heavily fluorinated, some degree of fluorination is required in any effective carrier solvent for it. Trichlorotrifluoroethane has always worked very well; however, the ozone depletion controversy has targeted chlorofluorocarbons for elimination from commerce. Therefore, we are introducing a replacement set of NyeBar formulations, all using completely fluorinated solvents, which are "ozone-safe".

The basic replacement product will be NyeBar-Type K, with two weight percent of the active non-wettable polymer and 98% of a perfluoroalkane solvent. Our in-house evaluations show no diminution of effectiveness for a NyeBar polymer film layer deposited from this solvent compared with that deposited from the traditional chlorofluorocarbon solvent.

The more popular NyeBar solutions are more dilute than 2 percent; and with Type K, lower concentrations will also be readily available, such as NyeBar-Type K, 0.2% concentration.

Many customers are already familiar with perfluorinated solvents, since they are currently used as blending solvents with trichlorotrifluoroethane to achieve lower volatility and slower drying time in many special NyeBar formulations. We plan to be sampling the new NyeBar-Type K formulations to all principal customers on our 1990 rolls. A new brochure will be written, also; and we invite your inquiries for a copy and an evaluation sample of this unusual product for controlling migration of oils and most other fluids.

UNEXPECTED VERSATILITY

The Two Faces of NyoGel 788

It has always been fascinating to watch a product prepared for one specific type of situation blossom over time to serve productive uses in other applications.

We see this happening with our NyoGel 788. This is a mildly thixotropic (see page 1), non-melting, water-resistant synthetic hydrocarbon-based grease originally intended specifically as a stay-in-place wormgear lubricant in situations where the worm-gear could not be enclosed so as to operate with an oil.

The base oil in 788 is of relatively high viscosity (over 400 cs. at 100°F) with good film strength. Equally important for wormgear use is a package of special load-carrying additives for lubrication of non-ferrous metals, such as brass or bronze, under load. Many load-carrying agents achieve their usefulness through chemical reaction with the metal surface, a sacrificial contribution. The chemical reactivity of the copper and other metals in non-ferrous alloys would mean that many such additives would be too chemically strong for the purpose, and corrosion would result. NyoGel 788, because of its specially-selected additives, can lubricate without this drawback.

NyoGel 788 is serving needs in equipment as varied as coin counters, textile looms and miniature aircraft. Its broadened use derives from its high base oil viscosity. This oil is not so viscous that noise damping capability would be usually expected, but in several situations, it has done precisely that, not only lubricating but quieting the gear-train. Applications have ranged from hospital beds to chain hoists and power tools.

We are now promoting NyoGel 788 as a noise damping grease for smaller to medium-sized gear-trains. It is a good selection for wide temperatures. Write for an evaluation sample.

FINE-TUNING FOR SPECIAL APPLICATIONS

Problem-Solving by In-House Lubricant Testing

One has need of a firm grip on reality when walking through our laboratories lately. On one side you could find a hospital bed going through multiple actuations and on the other several disembodied and dissected heads of dolls. A bearing from a chicken plucking machine is being checked for lubricant condition on one table while on another there is a regular whoosh of deep breathing from an automotive heating system blower being actuated by a bank of arcing switches.

Explaining all this gives us the opportunity to introduce a new staff member, Jim McGown, a mechanical engineer and a fifteen-year veteran of design and instrument development from Foxboro Co. With Jim's help, we have begun a selective program of in-house testing for unusual applications, where lubricant choice requires a step-wise approach to new lubricant formulations.

A good example of this would be in automotive heater hand controls where smooth operation is needed without compromising operability at low temperatures (to -40°C). Keeping one control with the customer's existing lubricant as a standard, Jim went through perhaps ten grades and variations in damping greases to fine-tune a formulation specific to the tolerances and moving forces of the particular design. This procedure, despite the time involved, is far more efficient in serving the customer's precise needs than simply sending three off-the-shelf greases and asking the customer to try them all.

We have to go slowly on this new program, but it has already shown outstanding results for several good customers.

By the way, the dolls' heads were disassembled to get at some electrical contacts inside the head which had potential corrosion problems.

Response Coupon

Cut along the above line and mail in your company envelope to:

WILLIAM F. NYE, INC.
P.O. Box G-927, New Bedford, MA 02742
Telephone (508) 996-6721

Special Requests or Comments:

Fill in your name company and mailing address on the reverse of this form.

Send at no charge or obligation a lubricant sample especially selected to meet the following needs:

Type of Mechanism _____

Components to be Lubed _____

Materials of Construction _____

Ball or Sleeve Bearing (if either)? _____ Sintered Metal? _____

Preference for Oil _____ Grease _____ Dry-Film _____

Is Oil Creep a Problem? _____

Will Lube Touch Plastics? _____ Type: _____

Elastomers? _____ Type: _____

Lowest Operating Temperature _____ °C/°F.

Highest Operating Temperature _____ °C/°F.

If an electric contact, is arcing expected? _____

Desired Life at High Temperature _____

Present Lube _____

If unsatisfactory, in what way? _____

ANGLING FOR AN INVITATION

Lube Seminars for Your Engineering Staff

Within the last twenty-four months our technical staff has given over a dozen "lube seminars" to the collected engineers at valued customers and prospects. Our audiences have ranged all the way from staff engineers at a major automobile manufacturer to the assembled membership at a regional Lubrication Engineers meeting.

These programs can help eliminate mystery about lubricants and lubrication by identifying the significance of lubricant physical properties and the ways in which they contribute to and affect the performance of a design component. They are "non-commercial"; we won't be pushing products, only principles and guidelines.

Each program is tailored to the design interest of the audience. At a switch manufacturer, for example, we would concentrate on the problems of electric contact lubrication, arcing, millivolt drop and the effects of low and high temperature on lube performance. At an appliance manufacturer, on the other hand, the presentation could broaden into such additional subjects as the compatibility of lubricants with plastics and elastomers and the factors affecting lube choice for geartrains, sintered bearings and rolling element bearings.

We have found these presentations to be productive for both sides, evidenced by follow-up reports from the engineers attending and equally by the new ideas we obtain on application needs and problems.

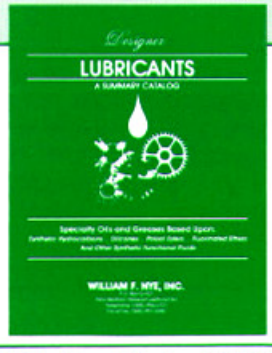
All we need is an invitation. There are six technical types in the company here, each of whom either has been or can be called on to participate. We usually need an overhead projector for transparencies and a screen. Some weeks advance notice on a scheduled date may be necessary so that we can co-ordinate our schedule with yours. A minimum of a half dozen engineers should be assembled to give a critical mass for these seminars.

We should note that there are some areas where our rather specialized background would make our presentation less useful, such as for plant engineers involved with maintenance lubrication of plant production equipment or for firms manufacturing heavy machinery. Our niche is in lubricants for highly-engineered components which are lubricated for life, which possibly see constraining low or high temperatures during operation, or otherwise have special lube needs because of tolerances, torques, special materials or hostile environments.

We invite your invitation.

LITERATURE SECTION

Write for our free Designer Lubricants Catalog, a comprehensive summary of the range of specialty synthetic oils and greases available from William F. Nye, Inc. Although not a complete catalog, it gives a reasonable overview of the problem-solving possibilities within the several realms of specialty lubrication which Nye serves. Check below for this catalog or for other special literature.



Cut along this line and mail sample or literature request to: **William F. Nye Inc., P.O. Box G-927, New Bedford, MA 02742**

Check below for special catalogs and other literature:

- ☐ Designer Lubricants, a Summary Catalog
- ☐ Lubricants for Electric Contacts and Connectors, a special catalog.
- ☐ The Lubeletter Digest, a compendium of over twenty articles from Nye Lubeletters for the years 1972 to 1987.
- ☐ Fluid-Central Catalog, a descriptive summary of the grades and physical properties of the principal synthetic functional fluids.
- ☐ Flexibility in Packaging, a pictorial guide to small oil and grease dispenser containers presently available.
- ☐ Precision Dispensing Equipment, a list of references to manufacturers of precision dispensing apparatus.
- ☐ Nye Lubricant Kit H, a two-page brochure on a special kit of oils and greases in dispenser containers for instrument servicemen.
- ☐ Precision Bearing Greases: Ultrafiltered Packaging, a small volume price list for super-cleaned commercial bearing greases.

Send Lubricant Sample (from reverse) or literature (as checked to the left) to:

Name: _____

Title/Position: _____

Company: _____

UPS ☐ or Mailing ☐ Address: _____

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WILLIAM F. NYE, INC.
P.O. Box G-927
New Bedford, MA 02742-0927
Tel: (508) 996-6721
Fax: (508) 997-5285