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Anion WS5300 and Anion PG 1000 are Interchangeable Products

Introduction

The rotary kilns, calciners, dryers and coolers employed by the cement, paper, lime, and food processing, waste and chemical industries combine the large-diameter journal (or sleeve) bearings, anti-friction bearings, and several types of gearing. Equipment manufacturers have established that properly formulated petroleum oils satisfactorily meet their requirements for moderate temperatures. However, when bearing temperatures exceed 177°C (350°F), petroleum lubricants tend to develop carbonaceous residues and unacceptably low viscosities that may contribute to lubrication problems and certainly add to a continuing maintenance program. All ANION kiln Lubricants are formulated for high-temperature service.

Anion WS 5300 BearingLube is specially compounded PG derivatives that has a high viscosity index and is chemically and thermally stable. It is water-soluble and compatible with metals and many commonly used elastomers. Along with its superior high-temperature performance, it makes the kiln operation more economical by minimizing wear and reducing maintenance. Anion WS 5300 BearingLube performs well under most operating conditions and excels when roller shaft temperatures range from 150°C to 200° (300°F-390°F). At low rotational speeds, Anion WS 5300 BearingLube considerably reduces the wear of bronze, brass and steel sleeve bearings.

The following pages discuss the special features and benefits of Anion WS 5300 BearingLube. Provided also are procedures for converting from petroleum-based products to Anion WS 5300 BearingLube and for monitoring the condition of the new lubricant to maximize its performance.

Features and Benefits of Anion WS 5300 BearingLube

1. **Long Service Life and Lower Maintenance Costs**
2. **Easy Cleanup**
3. **Excellent Materials Compatibility**
4. **High Viscosity Indexes**
5. **Low Pour Points**

1. Long Service Life and Lower Maintenance Costs:

Anion WS 5300 BearingLube is chemically and thermally stable and is inhibited against oxidative degradation. Thus, the tendency to form sludge, varnish or carbonaceous residues is significantly less than with petroleum-based lubricants.

When roller shaft temperatures exceed 180°C, petroleum lubricants develop carbonaceous residues. These tend to reduce lubricant flow and starve the bearings of their lubricant. Because Anion WS 5300 BearingLube does not form sludge or residue, they operate very well at elevated temperatures for long periods of time. This means overall lower operating costs because of less downtime and greater production under demanding operating conditions.

2. Easy Cleanup:

Anion WS 5300 BearingLube is soluble in water, making equipment and shop cleanup easy. The lubricant is also soluble in methanol (whereas petroleum based lubricants are not).

3. Excellent Materials Compatibility:

Anion WS 5300 BearingLube is compatible with common metals such as iron, steel, brass, bronze and aluminum as well as most natural and synthetic rubber compounds or gasket materials. Therefore, the maximum operating temperature, rather than construction material becomes the main factor in selecting polymers for seals.

4. High Viscosity Indexes:

Viscosity of Anion WS 5300 BearingLube changes less with temperature than do unmodified petroleum oils. In addition, its viscosity is suitable for use in high shear applications. Measured by ASTM Method D-2270, the Viscosity Index value is 287.

Figure 1 on page 5 illustrates the relatively flat viscosity-temperature characteristics of Anion WS 5300 BearingLube. These curves demonstrate that Anion WS 5300 BearingLube provides useful viscosities at elevated temperatures, without an unduly high pour point that would reduce flow and pumpability at ambient temperatures. The viscosities of this lubricant in the 150°C to 200°C range also mean better hydrodynamic (load-carrying) fluid films in highly loaded bearings. Even under thin film and boundary

conditions, below the normally limiting value of ZN/P=1, Anion WS 5300 BearingLube has demonstrated excellent load-bearing performance.

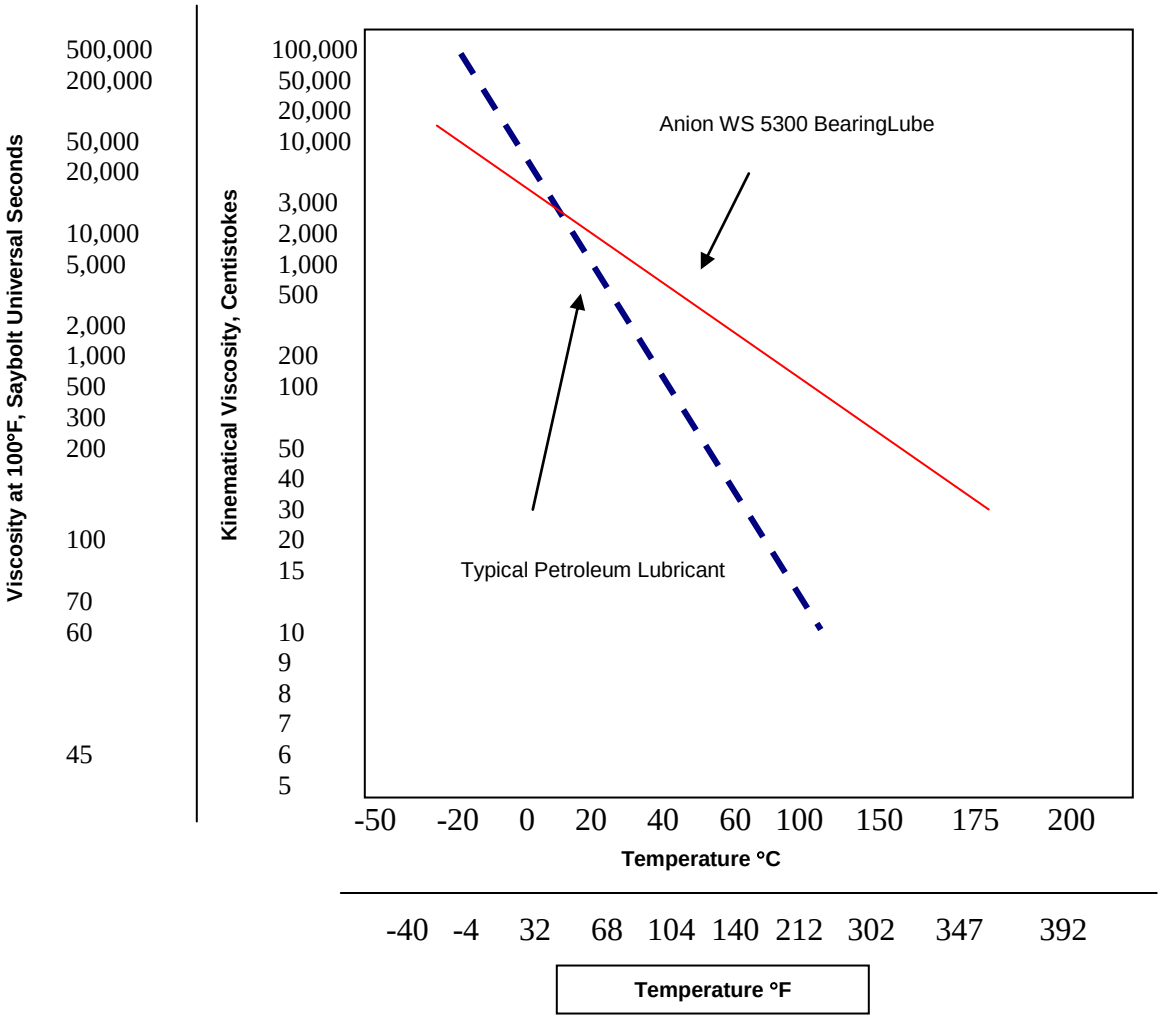
5. Low Pour Points:

Anion WS 5300 BearingLube contains no wax and requires no pour-point depressants to remain fluid at low temperatures.

Typical Properties

Viscosity, Centistokes[1]		ASTM D445
0°C (32°F)	14,000	
20°C (68°F)	2812	
40°C (104°F)	1050	
60°C (140°F)	473	
80°C (176°F)	263	
100°C (212°F)	160	
150°C (302°F)	68	
Density @ 15° (kg/L)	1·089	
TAN (Mg KOH g-1)	·02	
Viscosity Index, VI (ASTM D2270)	287	
Pour Point, °C (ASTM D97)	-29	(-20°F)
Specific Gravity at 20/20°C	1·059	
Vapor Pressure at 20°C, mm Hg	<0·01	
Water content, % by wt	<0·25	
Weight per Gallon, lb		
20°C (68°F)	8·82	
15·56°C (60°F)	8·85	
ΔPounds per Gallon, per °C	0·00657	
Coefficient of Expansion, per °C		
20°C (68°F)	0·00074	
55° (131°F)	0·00076	
Flash Point, °C (°F)		
Pensky-Martens Closed Cup	>192 (>377)	
(ASTM D 93)		
Cleveland Open Cup (ASTM D 92)	>296 (>564)	

Figure 1 • Viscosity vs. Temperature



How to Convert from Petroleum Oils to Anion WS 5300 BearingLube

General Considerations:

Manufacturers of rotary kilns usually provide detailed instructions for installing lubricant, for kiln start-up, and for maintenance procedures. Your equipment will perform best if you follow their written instructions.

Regardless of the lubricant used, equipment manufacturers agree that regular changes are essential. Discard the break-in lubricant because it may contain contaminants introduced during installation or the initial phase of operation. Then, schedule regular lubricant changes to ensure that the equipment operates at peak levels and to avoid costly maintenance and repairs. Typically, lubricant is changed annually, but the time between changes may vary, depending upon operating conditions.

As the time between lubricants changes increases, proper inspection and analysis become increasingly important. If you decide not to make regularly scheduled changes and rely instead on inspection and analysis, we recommend that you carefully review the section on Lubricant Test Methods.

Anion WS 5300 BearingLube, which is specially compounded (PG) derivatives, is incompatible with petroleum-based lubricants. That is why it is important to remove residual petroleum oil and related sludge whenever practical before converting to Anion WS 5300 BearingLube. Always empty bearing housings as completely as possible prior to converting to Anion WS 5300 BearingLube. This product is heavier than petroleum based lubricants. If the bearing is overfilled with Anion WS 5300 BearingLube, the remaining petroleum lubricant will flow out the shaft seal on most common kiln sleeve bearings. Minor contamination of Anion WS 5300 BearingLube by petroleum lubricants will have only very limited discernable affect on its performance.

The following sections offer general advice on draining and flushing. But remember, no one knows better than you, your specific operating conditions, equipment, and environment. Carefully review them to ensure that any chemical product is properly and safely used.

Conversion Steps

1. Drain

Elevate the temperature of the old lubricant as necessary to reduce its viscosity and improve drainage. Drain the petroleum lubricant from the reservoir. Flush with a compatible fluid or solvent if possible. Anion WS 5300 BearingLube is compatible with petroleum lubricants as a flush fluid.

2. Flush

If solvent such as high-flash naphtha is used, carefully consider the hazards before handling. Take all necessary precautions to protect your personnel, property, and the environment. Always read and follow a chemical's MSDS (Material Safety Data Sheet) before using it. Use a solvent only as a flush without operating the equipment, since it provides little lubrication.

If using an Anion WS 5300 BearingLube as a flush fluid, circulate in the system sufficiently long enough to remove all petroleum oil and to dissolve all sludge. If fluid is circulated at 70°C to 80°C this typically takes one hour. Use enough Anion WS 5300 BearingLube to insure all petroleum-based lubricant is displaced.

3. Drain

Drain the flushing fluid. Wipe the reservoir clean.

4. Painted Surfaces

Anion WS 5300 BearingLube softens and lifts many industrial coatings that petroleum lubricants do not. If the present coating seems intact, it probably was designed for petroleum service. If this is not the case, simply remove the coating.

5. Seals and Packing's

Anion WS 5300 BearingLube works well with the same seals and packing's used with petroleum oil at the same operating temperatures. At higher temperatures, you may want to reevaluate the type of seals and packing's you use. In either case, examine seals for wear and/or deterioration. Replace worn seals with new ones to prevent leaks and resulting damage or injury. Select an elastomer that is both compatible with Anion WS 5300 BearingLube and one that can withstand anticipated operating temperatures.

6. Operation of Reservoir Heaters

Kiln bearings are occasionally equipped with heating coils or immersion-type electric heaters. These heating units conveniently and rapidly lower the viscosity of the cold

lubricant. This makes it easier for the lubricant to circulate during start-up after an extended shutdown at low ambient temperatures.
Adequate lubricant flow and satisfactory heat flux should exist at the heater surfaces.
Limit steam pressure to 15 psig. Maintain the watt density of electrical heaters below 20 watts per square inch. Install a suitable intercept to activate the lubricant-circulating pump before the heater can be turned on. Initially, circulate the lubricant through a by-pass return line to assure and adequate flow in reservoir.

Lubricant Test Methods

Five tests are particularly useful in monitoring the condition of Anion WS 5300 BearingLube:

1. Appearance
2. Viscosity
3. Ester Content
4. Antioxidant Content
5. Petroleum Oil Contamination

1. Appearance:

Visual inspection of a sample of used lubricant can frequently provide useful information. In service, Anion WS 5300 BearingLube develops a characteristic deep-mahogany color to transmitted light. Nevertheless, samples should be clear. If they are turbid or contain sediment, they are either contaminated and/or the victim of inadequate filtration.

Closely inspect the sediment after washing away lubricant with methanol. This may help you determine the sediment's origin. A low-power magnifying glass frequently provides better resolution than higher-power microscopes.

Insoluble debris, for example, may represent residual contamination that was introduced into the system when the lubricant was installed. Metallic-wear particles could indicate that not enough lubricant is reaching a vital part of your equipment.

2. Viscosity:

When the kiln is in operation, viscosity changes in Anion WS 5300 BearingLube may reflect how much the lubricant has degraded and/or how much it is contaminated. If the lubricant's viscosity is significantly higher or lower than when it was put into the system, consider recharging the system with fresh lubricant. Periodic viscosity measurements will establish a base line from which significant changes will be apparent.

Determination of viscosity can be a routine measurement, and the same methods used for petroleum products can be used with Anion WS 5300 BearingLube. Kinematical values in centistokes (cSt), described in ASTM Method D 445, are internationally recognized.

The standard temperature used to evaluate lubricants is 40°C (104°F). However, Viscosity Index (VI) measurements are determined at 100°C (212°F). In fact, determining VI at even high temperatures may help predict how lubricants will perform in hydrodynamic conditions.

Anion WS 5300 BearingLube	**Typical Viscosity Range, cSt at 100°F**	1036-1620

3. Ester Content:

The ester content, expressed in mill equivalents per gram (meq/g) sample, indicates how much ester-type degradation products have dissolved in the lubricant. Anion WS 5300 BearingLube has an initial ester content of 0.16 to 0.18 meq/g. The recommended upper limit of ester content is typically 0.5 meq/g, depending in part upon other characteristics. The following outlines the procedures used to determine ester content.

Reagents Required:

(a) Potassium hydroxide in 80 percent methanol, approximately 0.2N. Dissolve 11.2g of potassium hydroxide in 200 mL of distilled water and dilute to 1 liter with methanol.

(b) Standard hydrochloric acid of exactly known concentration near 0.1N.

(c) A pH meter or a pH indicator such as a paranaphtholbenzein solution. Dissolve 1 gram of paranaphtholbenzein in 100 mL of isopropanol (99 percent grade).

Procedure:

Prepare the lubricant sample and a "blank" in separate 250 mL Erlenmeyer flask. Weigh, to the nearest 0.01 gram, 3 to 5 grams of well-mixed lubricant sample I none flask. Pipette exactly 20 mL of 0.2N alcoholic potassium hydroxide into the flask. Add a few clean glass beads and reflux the solution for 1.5 to 2 hours.

Prepare the "blank" by pipetting exactly 20 mL of 0.2N alcoholic potassium hydroxide into the other flask. Also add a few clean glass beads to this flask and reflux the solution for 1.5 to 2 hours.

Next, wash down the condensers of both the lubricant sample and the blank with at least 50 mL of distilled water. Titrate the contents of each flask with standard hydrochloric acid. After they have been used, Anion WS 5300 BearingLube usually has a dark color, which makes it impractical to use a colorimetric indicator. Use a pH meter instead (end point 8.5 pH units). Ten drops of the indicator should change the color from blue to orange.

Calculation:

$$\frac{(B-A) \times N}{\text{grams of sample}} = \text{mill equivalents of ester content per gram of lubricant sample}$$

where A = ml of hydrochloric acid required for sample
B = ml of hydrochloric acid required for blank
C = normality of the hydrochloric acid

4. Antioxidant Content:

All lubricants exposed to air at elevated temperatures oxidize and deteriorate. Anion WS 5300 BearingLube contains antioxidant additives to stabilize them. You can gauge the lubricant's condition by determining how much antioxidant remains in the lubricant. To continue in service, the lubricant should have at least 10 percent of its original antioxidant level (sometimes referred to as inhibitors).

Option 1: Colorimetric Method

Determination of Antioxidant Content:

To determine the amount of antioxidant in used Anion WS 5300 BearingLube, oxidize the antioxidant with ferric ammonium sulfate in an aqueous solution containing 50 percent sulfuric acid. If inhibitor is present, an intense blue color develops, indicating as little as 0.1 mg of antioxidant in the ferric sulfate reagent.

Reagents:

(a) 50 percent sulfuric acid. While stirring and cooling slowly add concentrated (95 percent) sulfuric acid to an equal volume of water.

(b) Ferric ammonium sulfate in 50 percent sulfuric acid. For each liter of reagent, dissolve 1.38 g of ferric ammonium sulfate ($12H_2O$) in 500 mL of water. To this, slowly add 500 mL of concentrated sulfuric acid. Stir and cool as the acid as added.

Procedure:

Weigh one gram of used lubricant sample (weighed to the nearest 0.01 g) into a 50 mL volumetric flask. Dilute to 50 mL with methanol. With pipette, transfer 2.0 mL of the methanol solution to a 100 mL volumetric flask and add 20 mL of the ferric ammonium sulfate reagent. Let stand at room temperature for about 1.5 hours, but no more than 4 hours. Dilute to 100 mL with 50 percent sulfuric acid and mix. Measure the optical density of this solution at 600 millimicrons, using distilled water for the zero setting. You may use a Bausch and Lomb Spectronic 20 Colorimeter or its equivalent.

Next, prepare a blank by using an equal aliquot of methanol solution. Dilute it to 100 mL with 50 percent sulfuric acid. Do **not** add ferric ammonium sulfate reagent because this blank represent the background color of the used fluid. Measure the optical density of this blank, using distilled water as the zero setting.

To determine the absorbance per gram of sample, subtract the blank's absorbance from the absorbance of the sample. Divide the remainder by the weight (in grams) of the sample.

You can determine the percent concentration of antioxidant remaining in the used fluid. Simply read it directly from the graph (Figure 2, page 13).

Calculation:

$$\frac{\text{Absorbance sample} - \text{Absorbance blank}}{\text{Grams of sample used}} = \text{Absorbance per gram sample}$$

Option 2: Ultraviolet Spectroscopic Analysis

Another way to determine the antioxidant level of used Anion WS 5300 BearingLube is to use ultraviolet (UV) spectroscopic analysis, conducted at a wavelength of 254 mm. As a rule, use a 2 percent sample of fluid diluted in methanol.

5. Petroleum Oil Contamination:

Because Anion WS 5300 BearingLube is not miscible with petroleum oils and has a higher density, petroleum oil contamination can frequently be determined by separating the two layers. Usually, separation will occur by letting the lubricant stand undisturbed for a period of time. However, if the amount of contamination is very small or if the sample is dark and emulsified, this simple procedure may not work.

If this happens and you still suspect that the lubricant is contaminated, you can separate the contaminant from the lubricant by taking advantage of the fact that Anion WS 5300 BearingLube is soluble in methanol, while petroleum oils are not. And by diluting the sample with methanol, you can also measure the amount of petroleum-derived sludge and residue that has been cleaned out of equipment (that had previously been operating on petroleum lubricants) because of the solvent action of Anion WS 5300 BearingLube.

Procedure:

Prepare a solvent mixture containing (by volume) 80 parts methanol and 20 parts distilled (or deionized) water. Mix thoroughly 20 mL of well-mixed used lubricant sample with 80 mL solvent mixture. If this is carried out in a 100 mL graduated cylinder, separation into two layers will then provide an immediate measure of the hydrocarbon contamination. The indicated volume in the cylinder should be multiplied by five to give the percentage of petroleum oil present in the used lubricant sample.

Product Safety

When considering the use of any ANION PERFORMANCE CHEMICALS products in a particular application, you should review our latest Material Safety Data Sheets and ensure that the use you intend can be accomplished safely. For Material Safety Data Sheets and other product safety information, contact ANION PERFORMANCE CHEMICALS. Before handling any other products mentioned in the text, you should obtain available product safety information and take necessary steps to ensure safety of use.

No chemical should be used as or in a food, drug, medical device, or cosmetic, or in a product or process in which it may contact a food, drug, medical device or cosmetic until the user has determined the suitability and legality of the use. Since government regulations and use conditions are subject to change, it is the user's responsibility to determine that this information is appropriate and suitable under current, applicable laws and regulations.

ANION PERFORMANCE CHEMICALS requests that the customer read, understand, and comply with the information contained in this publication and the current Material Safety Data Sheet(s). The customer should furnish the information in this publication to its employees, contractors, and customers, or any other users of the product(s), and request that they do the same.

Figure 2: Antioxidant Level as Measure of Absorbance