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PRESERVATION OF GREASE QUALITY

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A recent investigation into lubrication at one of Belvac's clients has revealed problems relating to grease compatibility and contamination. The following technical bulletin is aimed at providing appropriate maintenance and lubrication practices to control or minimize such problems.

1.0 Background

Lubrication practices play an extremely important role when it comes to a machine's "trouble-free" operation. Maintenance personnel should possess the knowledge, skills and tools to properly perform lubrication tasks to achieve such reliability. This Technical Bulletin attempts to address essential DO's and DON'Ts with respect to grease storage, handling and dispensing practices.

1.1 Typical Grease Components

The typical makeup of a grease lubricant includes the following components:

1. 70 - 95% Base Oil: This can be either mineral oil (petroleum) or synthetic fluid. Base oil is the component that is actually tasked with lubricating the equipment by producing a film thickness (separation of surfaces in relative motion) to control friction, heat and wear.
2. 3 - 30% Thickener: The thickener in a grease serves as thickening agent, similar to a sponge, to contain the base oil and additives. It gives grease a thick consistency. The thickener can be of various types, including simple metal soaps (lithium, calcium, aluminum, sodium, etc.), complex metal soaps (lithium complex, calcium complex, aluminum complex, etc.), and non-soap thickeners (such as organo-clay and polyurea). These different thickeners have unique properties that direct their use towards specific applications.
3. 0 - 10% Additives: Additives are critical to the formulation of all types of lubricants. They are selected to suppress undesirable base oil properties, to enhance desirable base oil properties and to add all new properties to the base oil. The correct selection and concentration of additives can enable a grease to perform well in a challenging environment of heat, moisture, contamination and other harmful ingression/exposures. Grease additives include rust and oxidation inhibitors (R&O), extreme pressure (EP), antiwear (AW), viscosity index improvers, *etc*.

The chemistry of both the thickeners and the additives is very complex and it usually takes expert formulation knowledge and rigorous testing to establish an optimum blend of all of the above components in a finished grease product. For this reason the mixing of grease products (accidental or intentional) by users is strongly discouraged. Mixing different types of grease products creates a new untested blend with altered performance and chemistry which can sharply impair the reliability of machinery. The section below addresses the subject of grease mixing and incompatibility in more detail.

1.2 Compatibility of Greases

"Never mix greases that are incompatible." That is often the first and foremost warning that one will see regarding the handling and application of grease products. Without proper (and often costly) laboratory tests to confirm grease compatibility, grease mixtures usually produce different consistencies (which usually can lead to lubrication starvation), grease hardening/softening, premature degradation (*e.g.*, oxidation), harmful incompatible by-products from chemical reactions, and ultimately, machine failure.

The table below presents the basic compatibility properties of lubricating greases of different thickener types:

	Aluminum Complex	Barium	Calcium	Calcium 12-Hydroxy	Calcium Complex	Clay	Lithium	Lithium 12-Hydroxy	Lithium Complex	Polyurea
Aluminum Complex		I	I	C	I	I	I	I	C	I
Barium	I		I	C	I	I	I	I	I	I
Calcium	I	I		C	I	C	C	B	C	I
Calcium 12-Hydroxy	C	C	C		B	C	C	C	C	I
Calcium Complex	I	I	I	B		I	I	I	C	C
Clay (Bentone)	I	I	C	C	I		I	I	I	I
Lithium	I	I	C	C	I	I		C	C	I
Lithium 12-Hydroxy	I	I	B	C	I	I	C		C	I
Lithium Complex	C	I	C	C	C	I	C	C		I
Polyurea*	I	I	I	I	C	I	I	I	I	

B = Borderline C = Compatible I = Incompatible

**Not all polyurea greases are mutually compatible*

Source - Noria's "Machinery Lubrication" training material

The above compatibility table should be considered as a general guideline and relates to grease thickeners only. There are also many exceptions relating to specific commercial products that are not reflected in this table. Furthermore, compatibility of grease base oils and additives are not addressed. When considering the compatibility of all components of greases including base oils and additives, it is strongly recommended that testing be performed to assess important performance criteria, such as oxidation resistance, consistency, load carrying capacity, thermal stability, *etc*. Compatibility should be evaluated at various mixture concentrations between greases in questions such as 75:25, 25:75 and 50:50. These tests should be performed by a qualified ASTM grease lab.

The following section addresses maintenance practice with respect to application, handling and storing of lubricating grease:

2.0 Grease Maintenance: Do's and Don'ts

2.1 Method of greasing

The most important factors when applying grease to a lubricated component include:

1. **Correct quantity is used**

The amount of grease used should be sufficient to provide lubrication to all the parts in frictional motion, to keep the external contaminants out of the free space, and to extend the lubrication interval to a cost effective level.

It should be low enough to prevent excessive heat generation from churning. The recommended pack and relubrication volume should be carefully determined.

2. Correct grease application method

Various lubrication methods, both automatic and manual, can be used to dispense grease to the correct location with relatively good volume precision and without introducing foreign contamination to the system. The correct application method should be selected with a thorough understanding and knowledge of the grease type and characteristics, purposes of lubrication, overall designs of both the lubricated components and the delivery systems that control the flow of the lubricant. Despite what method is used, the following basic Do's and Don'ts should be exercised:

- Select application methods based on factors relating to grease type, required relube frequency, required relube volume, accessibility, and contamination control. Common options for grease application include: manual grease gun, portable grease dispensing system, single-point automatic lubricator, and multi-point automatic lubricator.
- Where automatic grease distribution systems are used, DO NOT let hardened grease or grease that has been exposed to low temperatures to be pumped through a system before it has been warmed up and is of sufficiently low consistency.
- Where single-point lubrication devices are used, select lubricators that deliver positive-displacement volume supply and those that avoid contamination, over-lubrication, and excessively high delivery pressures.
- Where centralized multipoint lubrication systems are used insure proper settings for dispensing volume, cycle frequency, and alarming (for failed injectors and line blockage).
- If grease guns are preferred use guns only that can be loaded via cartridge or bulk pressurized method. Avoid suction or spatula loading of grease guns. Grease guns should be frequently calibrated for volume control. Grease guns with gauges for back-pressure measurement and/or volume meters are preferred.
- Grease fittings should be kept clean and tagged properly for lubricant type.
- Grease guns, grease supply reservoirs (automatic systems) and intermediate transfer containers should be maintained clean and properly marked for the designated grease type.

3. Correct type and quality of grease is applied

It is important that the required quality and cleanliness of the grease that is being introduced into the lubricated component or compartment be uniform and consistent. To achieve this, the following practices are recommended:

- Confirm the correct designation of the grease before introducing it to a machine, grease gun or pumping station reservoir.
- Periodically and/or when in question, test for the grease cleanliness level (and other crucial performance parameters such as consistency, elemental composition, etc.) before use to ensure that it has met the specified requirement; either from an internal specification or from the OEM. Testing the grease prior to application can also alert users that wrong grease is being used or excessive contamination is present.
- Ensure the component is clean of old hardened or contaminated grease or preservative material (new machines). NEVER add a different type of grease to an operating component without first removing all the pre-existing grease. Different grease types and brands should ALWAYS be considered INCOMPATIBLE unless laboratory analysis for compatibility (following a standardized method such as ASTM 6185) shows otherwise.
- Mounting, assembly or repair work should be done in a clean and dust-free area.
- Before manual re-greasing, check all the surrounding machinery parts (such as shafts, collars, area around grease fittings and drain port) and clean them thoroughly.

- For the components that are pre-greased (packed) and sealed for life, sample test to ensure cleanliness and correct grease volume. DO NOT remove the component from its package unless it is ready to be assembled.
- Use only lint-free cloth to clean the components and use non-powdered protective glove when applying grease. This practice will not only prevent impurities from entering the grease, but should also protect maintenance personnel from allergic reactions caused by petroleum products.

4. Correct lubrication interval is used.

Relubrication interval should be determined based upon the machine design and operating conditions (exposures, loads, speeds, temperature, shaft orientation, etc.). For example, it is necessary to lubricate more frequently in applications where there is a risk of heavy contamination, wet environment, bearings on vertical shaft, or in operating temperature in excess of 70º C.

2.2 Handling and storage of grease

The grease original quality and cleanliness should be kept in as high a level as it can be reasonably achieved. Therefore, process of handling and storing grease is of great importance when it comes to the correct performance of the lubricated parts. The following are basic guidelines that one should follow in exercising grease handling and storage:

1. Storage

- Do not use grease products that have been stored for long periods of time unless their condition and cleanliness have been verified by laboratory analysis. Establish appropriate shelf-life limits.
- When in doubt and if accidental mixing is suspected, consult references, lube suppliers or conduct compatibility tests.
- Use posters, signs and wall charts to educate and warn maintenance personnel about the risk of contamination and cross mixing of incompatible lubricants.
- Storage room should be separated from areas of contamination sources (such as metal debris, dust, chemical fumes, etc). The room should be heated and power-ventilated, as well as containing clean accessories such as rags, swabs, paddles, cleaning supplies, sample bottles and other necessities. Storeroom personnel are to be properly trained in storage techniques, inventory control and other knowledge regarding preventing contamination.
- Grease containers should always be labeled clearly with the type and brand of the grease, date of receiving at facility, etc. These markings should be kept in a position where they can be read easily. (Frequently, someone will see only a part of a label and will guess at the rest of it. As a result, the wrong lubricant is applied).
- Grease should be kept in their original containers until used. Drums, pales and kegs should be kept off the floor and supported by a rack, platform or blocks at least several inches high.
- NEVER leave the grease container uncovered, or improperly covered, or open. Instead they should be sealed tightly between uses. When temporary outside storing is necessary, heavy canvas tarpaulin or sheet plastic should be used as covers to keep off water and dust; in addition, the drums should be raised off the ground and stored on their sides, NEVER in the upright position. (When they are stored vertically, they trap water and dirt on the tops; additionally, dust can be drawn through even very small opening because of the vacuum created internally by temperature changes inside the drum).
- Wipe the edges of containers before opening it to avoid intrusion of contamination.
- Any tool used to handle or dispense grease should be washed and carefully wiped dry before use. Note, contaminants that are too small to see with the naked eye are still capable of causing wear and motion-impediment of moving parts.

- NEVER use wooden paddles or spatulas to remove or transfer grease from containers to grease guns or pumping systems. This practice poses high contamination risk to the new grease.
- Keep a separate inventory and utilization record of each product. Following this practice (filling out a record sheet stating how much grease is used and on which machine) even for small amounts, helps keep an accurate inventory of lubricants. Use the oldest container first (FIFO method).

2. Handling

- Fork trucks and wheeled hoists can be used for drum and keg handling. Drums manually handled should be rolled rather than dragged to avoid damage.
- A coding and tagging system should be in place to identify the contents of different lubricant containers, transfer/pumping systems, tools and pipes carrying grease throughout a plant. It is also important to make sure that all transfer valves, hose, and pipelines are kept clean; seal and gaskets should be maintained in proper condition.
- All transfer containers should be filled under CLEAN conditions.
- Grease drums should be emptied completely before discarding.

3. Safety

- Dispensing equipment should not be left unattended.
- Spilled or leaking lubricants should be promptly removed by proper method from floors to prevent slipping. Keep absorbent cleaning materials in a dry location.
- Drum slings should be used instead of rope slings for lifting.
- Lubricant and solvent containers should not be left in direct sunlight or in any very hot areas where there are possible sparks. This can cause spontaneous combustion.
- Ensure storage area is equipped with certified CO2 fire distinguisher or a sprinkler that produces a fine water spray.
- Smoking in storage area should be prohibited.
- Where necessary, machine should be shut down before lubricating.

3.0 Conclusion

In summary, the maximum usable life, performance and quality of grease is dependent on the care taken in selection, storage, handling, application and utilization. It is the responsibility of the equipment lubricator to pay careful attention to all aspects of the proper maintenance of grease to ensure that its maximum usable life is achieved.

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