

Why High Nitration is Not Good for Your Engine

By

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In recent weeks I have had several people ask me about High Nitration in oil samples and that some people have heard that it is normal. I addressed this issue in a warning ad to truckers and during a recent interview on a radio show. The interview was over 20 minutes but had to be edited down to less than 10 so the information on the Nitration was edited out but will be addressed in a future spot. Let me clarify something right up front, High Nitration is not normal in Over the Road Diesel Engines. I have talked with some of the top engineers at several major oil companies and they agree with me that High Nitration is only normal in Natural Gas Engines and should not be an issue in typical truck engines if they are maintaining their lube oil in a suitable condition. They also agree with me that if High Nitration is not normal in truck engines it may be that the user is not adding enough make-up oil to refresh the additives in the oil. Now, I for one can tell you that Gulf Coast Filters reads thousands of reports and our customers have normal Nitration Numbers and if High Nitration was normal I would be seeing it. That should put up a Red Flag right there, if thousands of not just our customers, but thousands of other truckers are not showing High Nitration in their oil it is not normal and if someone says it is they are **ABSOLUTELY INCORRECT!!!** What I find very interesting is how someone can try to explain to truckers that having High Nitration is not harmful to your engine. If that were the case why do just about all of the Major Oil Companies have additives in their oils to resist and combat Nitration? Why do the Laboratories bother checking the Nitration Level in the oil if it were not harmful to the engine? If you do an internet search on these key words, "S.A.E. New Oil Nitration" you can scroll through several pages and find good information on why the oil companies put additives in their oil and statements like "Exceptional oxidation and **nitration** resistance for long **oil life** " You will also see that High Nitration is only normal in Natural Gas Engines. Look below at one of the most common definitions of Nitration and I think you will agree with me that Nitration is not a good thing for your engine and causes oil degradation.

Nitration is caused by oil degradation in a reduced oxygen environment and results in nitrogenous by-products.

These compounds contain acidic precursors that may combine with water to form nitrous acids in the lubricant.

These acids attack the oil, reducing additive effectiveness and increasing the rate of oil degradation, which creates varnish, lacquer, sludge and engine deposits. Infrared analysis is used to directly measure nitration products in the engine lubricant. Nitration can be a problem for EGR engines due to NOx compounds forming deposits reacting with the lubricant.

You as an owner of a very expensive diesel engine that you depend on need to do your research if you hear things that go against what Experts have proven over many years in the industry. Look at the person or companies background, how long they have been in the oil analysis business and what qualifies them to be an expert on the subject. I find it pretty unbelievable how some folks that are not even qualified in the field are suddenly experts on oil analysis. I can tell you this; if someone tells you that running your diesel engine on oil with High Nitration is good it goes against everything Gulf Coast Filters has learned over a period of 30 Years. Something else to think about is that if someone has High Nitration in their oil, they must not be getting the moisture out of the engine because the NOx only becomes an issue when it mixes with Moisture and other contamination in the oil to form NOx compounds. See below some good technical information on oil contamination and how to "Safely" Extend Oil Drains.

The following is an outline of the steps that Gulf Coast Filters, Inc. would recommend in order to **SAFELY** Extend and/or Eliminate routine oil drain intervals on your engines. Within the following information I will cover what we have established (over a period of years starting in 1965) as obtainable goals in accomplishing this task.

Let us start by understanding the current situation that you are operating under. Your engines are presently equipped (with few exceptions) with only full-flow oil filters and you are following a routine oil drain interval. The factory full-flow filters on your engines are performing a protecting job, in that they are designed to remove the larger particles that would damage vital parts. The additive package of the oil is then utilized to hold the smaller microscopic contaminants that the full-flow has missed, in suspension, and to combat other problems such as acid formation, oxidation, nitration, moisture intrusion, and etc. The oil is allowed to remain in the engine until it becomes contaminated to the point that it is no longer suitable for use within the engine. **When Is This Point Reached?** According to American Petroleum Institute (API) Publication #1507, page 13, engine oil should be changed before additive depletion and oil contaminants can begin to affect engine performance and life. Gulf Coast Filters, Inc. fully endorses this recommendation!

In order to eliminate the process of routine oil drains, thereby drastically reducing the amount of waste oil being generated, we must install additional filtration and establish the proper service intervals for these filters to deal with contamination missed by the full-flow filters and other types of contamination.

There are three basic types of contamination that must be dealt with: **“Solid”, “Moisture”** and **“Condition Caused”** Contamination. The following pages will fully explain these types of contamination and how adding additional By-Pass filtration will effectively control these areas.

1. **Solid Contamination:** It is generally recognized, backed by numerous tests and studies over the last 40 years, that contamination generated in an engine that is responsible for the majority of "normal" wear, is within the 1 - 20 micron range. Also this small solid contamination contributes to accelerating *Condition Caused Contaminants* such as Oxidation, Nitration, Acid Formation and more. Consequently, it is imperative that this contamination be removed from the system as fast as possible. The typical factory full-flow filter cannot control 1 - 20 micron particles due to its porous design to supply the engine with a high flow rate of oil. One must use filtration that is capable of controlling solids in the 1 - 20 micron range and smaller.
2. **Moisture Contamination:** Moisture contamination within the lube oil will cause viscosity increase, VI polymer decrease, TBN decrease, acid formation, accelerated oxidation and nitration. If left unchecked, it will cause accelerated wear, filter plugging, sludge formation, and corrosion of parts. To safely eliminate routine oil drains, one must use additional filtration that utilizes an adsorbent filter media, which can remove suspended moisture from the lube oil.
3. **Condition Caused Contamination:** There are three MAJOR types of contamination that are formed within the lube oil during normal use: *Oxidation, Nitration, and Acid*. These contaminants are formed when solid and moisture contamination are present, and certain operating conditions exist within the engine. These Condition Caused Contaminants can be controlled by the use of additional filtration and with the proper filter service interval.
 - a. **Oxidation:** Oxidation occurs when the hydrocarbon constituents (and other products) of lube oil combine chemically with oxygen. Lube oil in engines will combine with available oxygen under certain conditions to form a wide variety of oxidation products. Many of these direct or primary oxidation products combine with other materials such as wear metals, solid contamination, and moisture, to form second and third derivative products. As with most chemical reactions, oil oxidation is accelerated by heat and pressure. Heat in particular will speed up the oxidation process. Various studies have shown that lube oxidation (with many variables such as the type lubricant and additive package in the lubricant) that the oxidation rate can be doubled for every 15 to 20 degrees increase over 180 degrees F. Also, engine load, which will dictate the levels of oxygen and pressure within the engine, will accelerate the oxidation process. Effects of oxidation within the engine can be seen in the form of *accelerated acid formation, corrosion, oil thickening, deposit formation, and accelerated wear*.

Most of all the top quality lube oils have an additive package that contains oxidation inhibitors to slow the oxidation process and alkaline detergents that will neutralize acids formed by oxidation. Normally these additives will only last a certain length of time before they are used up and the oil must be drained. GCF, Inc. has established the correct means by which to control oxidation within engines. As we have seen, oxidation is greatly stimulated by the solid and moisture contamination. Solids tend to hold heat, thereby increasing the lube oil temperature around the solid contamination. This condition acts to accelerate oxidation. Combine this effect with the presence of moisture (H₂O) from normal condensation, and the oxidation process accelerates even faster. When moisture is present in the lubrication system, the level of oxygen available to mix with hydrocarbons in the lube oil is raised dramatically. The presence of normal solid and moisture contamination, combined with maximum operating load of the equipment, will produce high oil oxidation rates, even with normal oil temperatures. In order to control the oxidation process, the GCF PM Program offers filtration products that can control the levels of moisture, wear metals and other solid contamination. By removing this contamination, the oil will offer a better seal between the rings and liners and therefore reduce the amount of blow-by during the combustion process. Blow-by contributes to the amount of oxygen and moisture within the engine.

Once we have removed the contamination, which acts as a catalyst to accelerate the oxidation process and have offered a cleaner oil to seal the engine, then we are left with **MINIMAL OXIDATION** for the additive package of the oil to contend with. The engine will use a certain amount of oil each operating day. Combine this amount of new oil with the amount added at the time the GCF Filter is serviced, and the engine will maintain a sufficient amount of active additives to keep oxidation in check indefinitely.

b. Nitration: The combustion chambers of engines provide one of the few environments where there is sufficient heat and pressure to break the atmospheric nitrogen molecule down to two atoms that can react with oxygen to form nitrous oxides (NO_x). This becomes a major problem for some engines, especially EGR engines. When nitrogen oxide products enter the lube oil through EGR and normal blow-by, they react with moisture present in the lube and become very acidic and rapidly accelerate the oxidation rate of the oil.

The GCF Filter controls the effects of nitration in the same ways it controls oxidation. By delivering cleaner oil to offer as a seal between the ring and liner, blow-by of NO_x is kept to a minimum. Also, the GCF Filter keeps the oil chemically dry and prevents the mixing of NO_x and moisture, which controls NO_x acid formation and accelerated oxidation of the oil.

c. Acid Formation: Acids are formed within the lube by several sources. We have already covered two of them in the form of acids formed from oxidation and nitration. In most all forms of fuel for internal combustion engines, trace amounts of sulfur are present. In some cases, where sour gas or high sulfur diesel fuel is used to fuel the engines, massive amounts of sulfur are present in the fuel. Sulfuric acid is formed within the lube oil when sulfur molecules react with oxygen in the combustion chamber to form sulfur oxides. These sulfur oxides are then blown past the rings and enter the oil. Here the sulfur oxides mix with moisture to form the highly corrosive sulfuric acid. It is next to impossible to remove trace amounts of sulfur from fuels. However, it takes two components to make the sulfuric acid, sulfur oxides and water. The GCF Filter removes the moisture from the lube and keeps it chemically dry, thus controlling the formation of sulfuric acid. Therefore, by using the GCF Filter, TBN levels can be maintained at an acceptable level.

After taking a look at all of the types of contamination and the effects they can have on an engine if left unchecked, I think that you can now see why the GCF PM Program is so important. You see, simply applying our filters to control the different types of contamination is not what I consider the complete picture. In order to successfully and safely eliminate routine oil drains, we must also apply certain tools and preventive maintenance measures to insure that these levels of contamination are held in check. The reason that Gulf Coast Filters, Inc. has been so successful in past years and has so many satisfied customers is the fact that we are not just a company that manufacturer filters, we have developed a specialized predictive preventive maintenance program that is tailored to the concerns of operating on greatly extended oil drain intervals.

So, How Do You Establish Proper Filter Service Intervals and/or Proper Oil Drain Intervals?

Listed on the following page is a brief outline of the type of program that we would recommend for your engines. This is the same type program that has been working for Shell Oil, Scott Paper Co., the U.S. Air Force, North Carolina Department of Transportation, and many other major users of Gulf Coast Filters for many years now.

GCF Recommended P/M Program

Install GCF By-Pass Lube Oil Filters on equipment to keep the lube oil clean

Join the GCF Oil Analysis Program allowing Gulf Coast Filters to monitor your oil analysis and track your engines wear rates and the physical properties of the oil

Use the GCF recommended service interval for your engine and application. Gulf Coast Filters has spent over 20 years establishing the proper filter change intervals for many different engines and will be able to let you know what is the right one for you. On typical Class 8 Tractors, we have determined that 10,000 miles is a good GCF change interval.

Extended and/or Total Elimination of "Routine" Oil Drains Can And Should Be Accomplished On Your Engines.

A dramatic savings in new oil purchases, labor costs, overhaul costs, and disposal costs of the waste oil, can easily be obtainable with a time-proven "System that Works"!

Selecting the Proper Filtration To Achieve Your Goal:

Now that I have explained what types of contamination that need to be controlled in order to extend or eliminate oil drains, I would like to comment on what type of filtration is needed to deal with this contamination. There are many different types and brands of after market filters and centrifugal equipment on the market today that boast claims of greatly extending or eliminating routine oil drains. Many of these claims are true, however, in many cases the truth has been stretched by methods of marketing, claims based on "in-house testing" and testimony from isolated customer bases. Also, many of these filters and centrifuges fall short of dealing with and controlling the amounts and types of contamination that need to be removed in order to achieve our goal of extending and/or eliminating routine oil drains. In order to select the "Right" filter for the job, your choice should meet the following criteria and offer the following benefits:

- 1. Choose filtration that has the ability to control 1 - 5 micron sized particles and control them within the quantity that the engine or equipment is generating.** Be sure to ask to see several lab reports taken on engines or equipment similar to yours showing ISO cleanness levels. These ISO levels show particle counts within the 5-50 micron range for engine oil and 2 - 50 micron range for hydraulic applications. Don't be taken by what is said in the brochure, statements like "Capable of removing down to 1 micron particles" or "Can remove particles as small as 1/10th micron in size". This type of marketing is common. In other words, for these companies to legally be able to advertise with such statements, all they have to do is to show that their filter or centrifuge has removed a few of this size particle. Sure these filters or centrifuges can remove "down to" and "as small as", but can they control them in quantity? Get the lab reports! There are several depth-type by-pass filters on the market that have the capability of controlling these 1 - 5 micron sized particles and the GCF Filter is one of them. There are at least two brands of inexpensive centrifuges on the market that claim to be able to remove extremely small solids, however, centrifuges do not have the ability to control moisture.
- 2. Choose filtration that has the ability to remove moisture** from the lube and keep the lubricant chemically dry at all times. This is most critical. If you will remember, in order to control oxidation, nitration, acid formation, viscosity increases, and the other problems linked to moisture contamination, one must choose a filter that has the capability of removing moisture. Most of all depth-type by-pass filters with an absorbent filter media such as cellulose (paper) or cotton fibers have this capability and the GCF Filter is one of these. However, the low cost centrifuges that I had mentioned above do not have this capability. Only more expensive (\$12,000.00 & up) centrifuges that are motor driven, equipped with water ejection ports and separator plates have this capability.

These types are mainly used on extremely large engines such as found on ships.

3. **Choose filtration that has been proven within your field and that can be confirmed by several legitimate users in field test results.** If at all possible, choose filtration that has been documented on your type of equipment and your type of operating conditions. Ask for field test results on equipment similar to your own. The Gulf Coast Filter is one of the most documented filters on the market today. We have numerous test results from the field on equipment ranging from over-the-road trucks to massive engines on oil field equipment. Also, the U.S. Air Force has successfully tested our filters and programs and this information is available to government entities. Any company can claim results on a Test stand, but we have real world test results on real world engines.
4. **Choose filtration that is backed by a company that can offer a proven P/M Program to coexist with their product and your existing P/M Program.** There are a lot of companies out there that specialize in selling filters, however, there are few filter companies that sell filters and specialize in Predictive Preventive Maintenance. Find the company that offers proven suggestions that will make their product work with your P/M Program and to help move your program up to a higher level of equipment monitoring. Gulf Coast Filters, Inc. personnel are specialists in the field of predictive preventive maintenance, within the areas of lubrication, filtration, and equipment monitoring. We work directly with the maintenance personnel to come up with a lube oil maintenance and equipment-monitoring program that will coexist with your present P/M Program.
5. **Choose filtration that is the most cost effective.** Last but not least and should be the most important, choose the filtration that is the most cost effective. There are filter manufacturers that guarantee to double your oil change or to greatly extend your oil change interval. Look for a filter that will offer to eliminate routine oil changes all together and run the maximum of miles between filter changes. Gulf Coast Filters utilizes a massive element for holding huge amounts of contamination allowing you longer filter change intervals.