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INSIGHTS

OIL ANALYSIS

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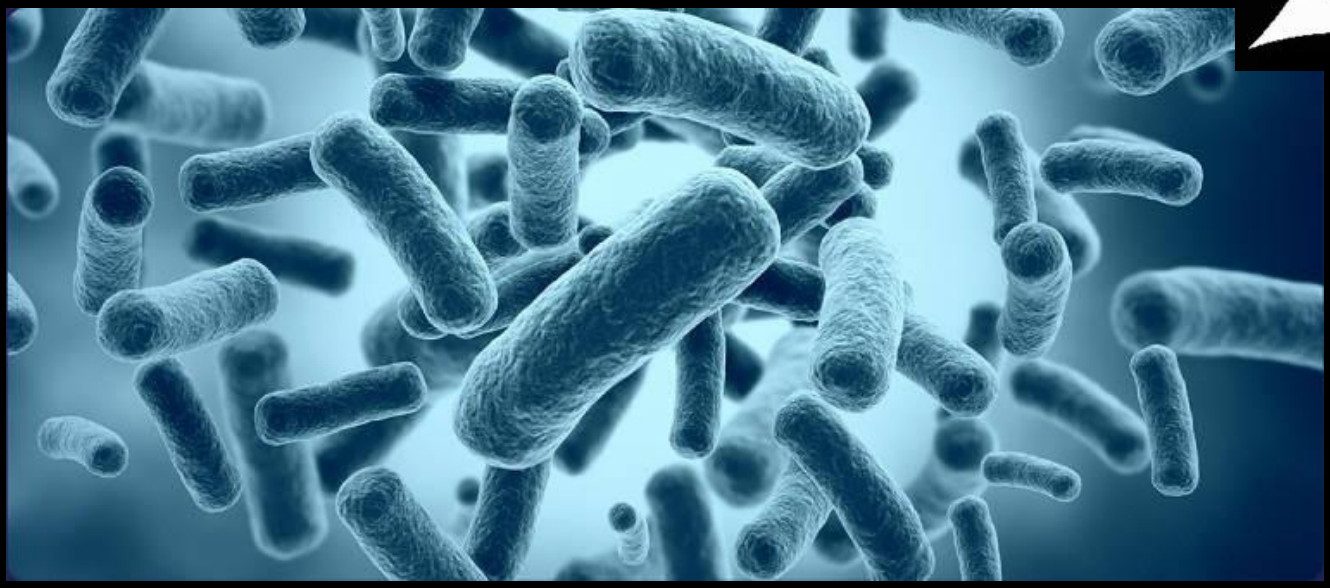
Introduction

Oil analysis actually began a little bit after World War, Two within the railroad industry, where they were using chemical type. Testing just basic wet testing of their oil to determine where metals that were taking that were generated within their engines, and this occurred about the time that it they went from the steam locomotives over to diesel-powered locomotives and then, after about two to three years. Around 1946, they were able to detect their first issue. Their first amount of you know. They had generated enough for medals that they could detect an actual failure getting ready to occur well after this had been in place for a while. Eventually, the US Navy got involved and they began doing some research, so they could start adopting this type of war medal analysis and then, from there around 1958, the first in-house laboratory was put into production and it was actually the Pacific Information Express. It was a trucking company that wanted to start looking at their wear medals within some of their own Road fleet and they so they put into place their own laboratory where they were doing tests internally. Around 1960, the first independent laboratory went into production, they're still open. Today so they kind of brought oil analysis to the masses, if you will so we're different industries to get involved and start utilizing oil analysis. But basically, you know over the last 70 years or so oil analysis has gone from just detecting, where metals in to looking at also lubricant health, as well as detecting contamination. So not only are we looking at any type of where males being generated to predict failure. We're looking at the lubricant health so that we can look at extending oil drinks and from there you know, also detecting those contaminants, so that we can, you know, extend the life of the component and extend the life of the lubricant. So again, there's initial focus on where metals and monitoring evolved to you know include.

Lubricants

You know the additive contaminant metals, the contamination, the lubricant properties and, basically, you know who can use oil analysis well, it fits a wide variety of applications in different industries. If you have something that has oil in it, that's lubricated, you can do some testing on it to find out what's going on internally within that component, so now touch a little bit on. You know, specifically what is oil analysis and what it can tell you. So, oil analysis basically is the use of a variety of different laboratory tests and we use it to monitor the lubricant health, the equipment, health and any type of contamination. That's going on. It's just basic testing to do prediction. Then, when we're talking about the lubricant health, we're looking at changes in the lubricant properties, you know such things as viscosity. Viscosity is going to be one of the more important properties of lubricant. In fact, when you're starting to use a lubricant when you're deciding what lubricant to use in a component, you look at the viscosity first before you look at anything else, because as long as that viscosity is properly selected, it is going to be able to irritate the Component correctly now, when we're doing testing we're checking to see if that viscosity is silicon spec if it starts to thicken up or if it starts to thin out, this can reduce the fluids capability of providing proper lubrication to that component. If we're talking about a component that has really small clearances and the viscosity gets too thick, it can start to starve the component, which can cause a failure. There are things that we look at and we're looking at additive metals. These are the elements within a lubricant that give it its some additional lubricating properties, and we look at such elements as magnesium and calcium variant, phosphorus zinc and even silicon and depending on the particular product it gives us an indicator, will see different types of elements being Used so we monitor these to ensure that those elements are where they should be is from a specification standpoint and also to ensure that we're not doing any type of Lube mixing some additives.



If you have like a hydraulic oil that has anti wear properties and you mix it with a turbine type of oil or an oil that has oxidation inhibiting properties, the answers can interact and ask the cause damage to the component because of how they're formulated to work. So we can actually detect lubrication, mixing, utilizing oil analysis and human that occurs, there's usually a recommendation to do an oil change just for any type of further damage. Other things that we look at as far as the lubricant health itself is going to be a the total asset number and the total base number now, depending on the specific component and the fluid being used, you will use one or the other, but typically not both When we're looking at the asset number or looking at the total number of acids that are being formed or reacted, the chemical reaction within that fluid and as the number of assets begin to build up, we will eventually start to see oxidation, which is when the viscosity Of the fluid will start to thicken up because the fluid is degradation, but the base number measures the ability of that lubricant to continue to neutralize assets.

So we're watching that number to make sure that the lubricant can still fight off the attacks that the acids are causing, and this is the number that you're going to want to look at specifically, if you're wanting to extend oil during intervals. We also want to look at the equipment, health, and this involves looking at different elements as well, and this and this point we're typically looking at where metals or the types of elements that compose the alloys. That components are made of we'll look at such things as iron, chromium, nickel, aluminum, aluminum, copper, lead, 10, cadmium and for certain medium. Now we don't necessarily look at one specific element when they see a combination of these elements, they're indicative of the specific alloy in the system, and as we see those trend upward, we can get a good idea of what specific component is wittering.

Of course, this can identify small problems before the serious amount of damage starts to occur, and it can also be utilized to predict failures in some more advanced cases. You can actually take this type of information and correlate it to past failure, information and start to predict. We know that in X number of hours this component is going to fail based on the current trending. So you know you can always do those repairs to that component before failure takes place. Now the things that we're looking at when we're talking about oil analysis and contamination is typically the particles that get in from outside the component and then they get inside the component. Eventually, if you get too many types of abrasives, those will start to cause the internal wear of the component, especially if they're very abrasive, but typically the some of the things that we're looking at as far as external types of contaminants. Well, we'll get that information through the elemental analysis and we'll look for things like silicon, sodium and potassium and even aluminum. Now, if we're having high particle counts, you know there might be a recommendation to change the filter or to do some type of a repair, depending on the specific types of elements that we see. We also do tests that will look for water in it, and oil is typically not a good thing, because it acts as a catalyst for oxidizing the fluid and that connected cause, a definite issues with the lubricant properties that we are also trying to Monitor will also test for fuel dilution, especially, we know we're talking about an engine fuel dilution.

You know, if you get too much fuel within an engine, it will start to thin out the lubricant and you won't get the same type of fluid film. That is required to adequately lubricate that system and it can increase. The amount of word is taking place. We'll also do testing for soot, so it is typically, you know only in in engines will we see that for the most part and there's a little hard carbon particles that tend to be very abrasive when it becomes too high of a concentration? Within that fluid? It will start to do a lot of abrasive damage as well, and so it tends to relate back to some type of the another maintenance task that needs to take place, some type of a repair to make sure that we're saving that component before it fails. Now, all this information together, we can use to determine the effectiveness of the current maintenance strategy. We can also use it to move towards a different type of maintenance strategy. You've run a current run to failure mode. We can see this information and say hey. Let's doing some work up ahead of you know up front to determine to you, know kind of eliminate having to put out the fires from unexpected failures that can be used to move more source of preventive type maintenance. Where we're preventing the failures from happening and again move towa perhaps a predictive type of maintenance strategy where making the repairs before occurs, we're making m opposed to majorre

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