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Effects of Air Contamination on Machinery and Lubricants

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Introduction

Air found in fluids has negative effects on lubrication, hydraulic systems, and reservoirs. The effect of air in lubricating oil depends on the quantity of air, its distribution, and its orientation. Air can exist in lubricants in dissolved, entrained, and foam forms. These three types of air contamination have significant impacts on both the physical and chemical properties of the lubricant and system. Air bubbles can decrease the fluid's pressure, which leads to poor component response and causes cavitation. Additionally, the temperature reduction and oxidation of the lubricant would result in oil degradation. The Koehler Air Release Value Apparatus is used to measure the time for air releases. This instrument consists of a test vessel and air flow control equipment for delivering heated air at the specified flow rate to a lubricating oil sample maintained at constant temperature.

Process of ASTM D3427 Method

In applications where agitation generates a dispersion of air bubbles in the oil, the capacity of a turbine, hydraulic, or lubricating oil to separate entrained air is a significant performance attribute.

A sample of oil is heated to a standard temperature (commonly 50℃)

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Compressed air is blown through the oil

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The oil sits while the entrained air rises to the surface and is released

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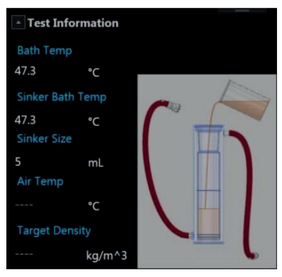
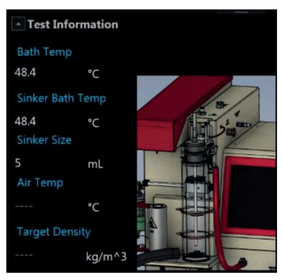
Measure the time for entrained air in the oil to reduce to a volume of 0.2%

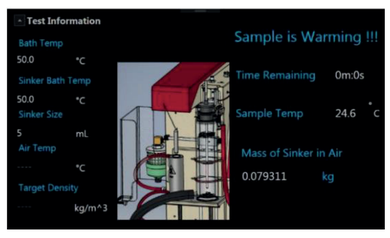
How the Instrument Works



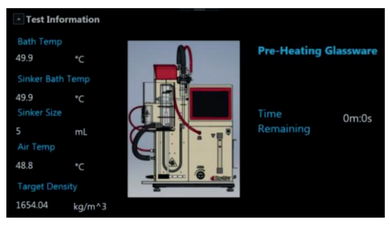
Heat the water bath and pour 180 mL of hot sample into test jar



Place jar on to stage and attach sample temperature probe

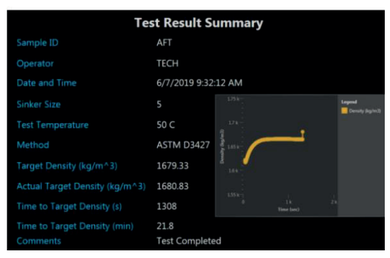


Change stage to density position, and adjust the level of the sinker



Replace the temperature probe with the top glassware, and pre-heat it at a specified time

Aeration begins. The remaining air intrusion time and air pressure are collected



The test stops after density reaches its target. The stage move to load position

Figure 1. Test procedure using K8853X Air Release Valve Instrument to illustrates the timer, status, target density, current density, and a graph of the density vs. time


K88530 Automated Air Release Value Analyzer

Adverse Effects of Air Contamination

Air in fluids can cause a variety of issues in a hydraulic and lubricating oil system, including intolerable noise, poor component response due to aerated fluids' spongy character, thermal degradation, cavitation damage, and severe fluid degradation. There are three different types of air in oil. Dissolved air is defined as microscopic air bubbles that are scattered in the oil at the molecular level but are not visible to the human eye. Although dissolved air is present in most new and in-service lubricants, large levels of dissolved air from pressured oil can hasten additive depletion and oxidation. The clouding of the oil is caused by entrained air. This is the most harmful sort of air contamination, since it can affect the oil's compressibility, heat transmission, film strength, oxidation, cavitation, and varnishing. Entrained air bubbles act as nuclei for dissolved air to emerge from the solution, generating a bigger air bubble that quickly collapses, causing severe damage to metal objects. Foam is the final stage of air contamination. Foam may not do much damage at the surface in some systems, but when it overflows the reservoir, it can create hydraulic compressibility concerns, corrosion, vapor lock, and the loss of system controls.

Conclusion

Air in lubricating oil can impact the quality of lubrication. The measurement of air quantities in oil and the determination of the ability of an oil to separate entrained air via ASTM D3427. This method determines the condition of different lubricants and hydraulic systems. The instrument includes an integrated touch screen control panel that guides users throughout the test operations and provides density calculations and time for measuring the air release value. The air release values indicate the rate of air bubbles rise and leave an oil sample.

Importance of Air Contamination Measurement

The air release test analyzes the speed of air bubbles rising and departing an oil sample, and the time for entrained air content to decline, which notifies manufacturers if reservoir residence periods are too short for air bubbles to reach the oil surface. The inability to maintain oil pressure, incomplete oil films in bearings and gears, and poor hydraulic system performance or failure can all come from a lack of time to filter out air contaminants in the oil. By measuring the air release properties, the negative effects of excess air can be minimized, which oil can separate surplus air quickly.