LUBRICATING OIL PROPERTY INSIGHTS THROUGH SIMPLIFIED MEASUREMENT

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This small report aims to provide an overview of key measurable physical and chemical properties of lubricating oils, along with simplified measurement methods using more accessible tools. The focus is on practical parameters that can be conveniently tested to assess oil quality and performance. All information in the work is collected in accordance with the National Standards of China. These parameters can be used in intelligent systems to control and predict the condition of lubricating oil during work processes.

Keywords: intelligent system, wear prediction, lubricating oil properties, simplified measurement methods.

АНАЛИЗ СВОЙСТВ СМАЗОЧНЫХ МАСЕЛ С ПОМОЩЬЮ УПРОЩЕННЫХ МЕТОДОВ ИЗМЕРЕНИЯ

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Целью данного небольшого исследования является обзор ключевых измеряемых физико-химических свойств смазочных масел, а также упрощенных методов измерения с использованием более доступных инструментов. Основное внимание уделяется практическим параметрам, которые можно легко измерить для оценки качества и эксплуатационных характеристик масла. Вся информация в работе собрана в соответствии с Национальными стандартами Китая. Эти параметры могут применяться в интеллектуальных системах для контроля прогнозирования состояния смазочного масла во время протекания рабочих процессов.

Ключевые слова: интеллектуальная система, прогнозирование износа, свойства смазочного масла, упрощенные методы измерений.

Introduction. This report summarizes key measurable physical and chemical properties of lubricating oils and outlines simplified methods for their assessment using accessible tools. It focuses on practical parameters for convenient oil quality (physical, performance and chemical indicators). Compiled in accordance with China's National Standards [1], this data is suitable for integration into intelligent systems to monitor and predict lubricating oil condition during operation.

Physical Property Indicators (Directly Measurable)

Kinematic Viscosity (National Standard of China 265). **Measurement Tool**. Capillary viscometer.

Method of Measurement. Place the sample in the capillary viscometer and immerse it in a constant-temperature bath at 40 and 100 °C respectively. Measure the time taken for sample to flow through a specified capillary under gravity. Calculate kinematic viscosity (v) using formula:

$$\nu = Ct,$$

where C – the viscometer constant; t – the flow time.

Distinguishing Values. Different oils have distinct kinematic viscosity values at 40 °C and 100 °C. For example, common industrial lubricating oils may have kinematic

viscosities ranging from a few dozen to several hundred square millimeters per second (mm^2/s) at 40 °C.

Pour Point (National Standard of China 3535). **Measurement Tool.** Cooling apparatus (such as a refrigerator or a low-temperature bath), thermometer, and a container for the sample.

Method of Measurement. Place the sample in the container and cool it gradually in the cooling apparatus. At regular temperature intervals (usually 3°C), tilt the container to observe if the sample flows. The lowest temperature at which the sample still shows fluidity when tilted is the pour point.

Distinguishing Values. Pour points vary widely depending on the oil type. For example, some winter-grade diesel fuels may have pour points as low as –40 °C, while some heavy-duty lubricating oils may have pour points around –10 °C.

Density (National Standard of China 1884 – Pycnometer Method). Measurement Tool: Pycnometer, balance, and a thermometer.

Method of Measurement. Weigh the empty pycnometer, then fill it with the sample and weigh it again. Measure the temperature of the sample. Calculate the density using formula

$$\rho = (m^2 - m^1)/V,$$

where m^1 – the mass of the empty pycnometer; m^2 – the mass of the pycnometer filled with the sample; V – the volume of the pycnometer.

Distinguishing Values. Densities of oils are usually in the range of 0.7–0.95 g/cm^3. For example, diesel fuel may have a density around 0.83–0.86 g/cm^3.

Chemical Property Indicators (Laboratory Tests)

Acid Value (National Standard of China 264). **Measurement Tool.** Burette, conical flask, and a KOH (potassium hydroxide) solution of known concentration.

Method of Measurement. Dissolve a known amount of the sample in a suitable solvent (such as a mixture of ethanol and ether). Titrate the solution with the KOH solution until the endpoint (usually indicated by a color change of the indicator) is reached. Calculate the acid value using the formula:

$$Acid\ value = (Vc \cdot 56.1)/m,$$

where V – the volume of the KOH solution used (mL); c – the concentration of the KOH solution (mol/L); m – the mass of the sample (g).

Distinguishing Values. Acid values are expressed in mg KOH/g. Fresh lubricating oils typically have low acid values, often less than 0.5 mg KOH/g, while used or degraded oils may have higher acid values.

Water Content (National Standard of China 260). **Measurement Tool**. Distillation apparatus (including a distillation flask, condenser, and receiver), and a solvent (such as xylene).

Method of Measurement. Add a known amount of the solvent and the sample to the distillation flask. Heat the flask to distill the water along with the solvent vapor. The water condenses in the receiver. Measure the volume of the collected water. Calculate the water content as a percentage of the sample mass.

Distinguishing Values. Water content is expressed as a percentage. For most lubricating oils, the acceptable water content is usually less than 0,1 %.

Performance Indicators (Simulated Working Condition Tests)

Demulsibility (National Standard of China 7305). **Measurement Tool**. Beaker, stirrer and timer.

Method of Measurement. Mix a specified volume of the oil sample with a specified volume of water in the beaker. Stir the mixture at a constant speed for a specified time.

Then, stop stirring and measure the time required for the oil-water mixture to separate into distinct layers.

Conclusion. Simplified methods for measuring key oil properties (viscosity, pour point, etc.) provide practical lubricating oil quality assessment. These vital parameters enable easy monitoring and maintenance, ensuring optimal equipment performance. These parameters can be used in the newest artificial intelligence systems designed to predict the condition of lubricating oil and its impact on the wear process.

References

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ИНФОРМАЦИОННО-АНАЛИТИЧЕСКАЯ СИСТЕМА ДЛЯ ПОВЫШЕНИЯ ЭКОНОМИЧЕСКОЙ ЭФФЕКТИВНОСТИ РАБОТЫ АВТОТРАНСПОРТА РУП «ГОМЕЛЬЭНЕРГО»

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Изложены вопросы разработки и внедрения информационно-аналитической системы, направленной на повышение экономической эффективности эксплуатации автотранспорта РУП «Гомельэнерго». Описаны цели и задачи системы, архитектурные и технологические решения, обеспечивающие надежность, масштабируемость и интеграцию с корпоративной инфраструктурой предприятия. Рассмотрены ожидаемые результаты внедрения, выражающиеся в снижении эксплуатационных расходов, сокращении простоев техники, повышении прозрачности процессов учета и планирования, а также в общем росте эффективности работы автопарка.

Ключевые слова: информационно-аналитическая система, цифровизация, автотранспорт, *ASP.NET Core*, *Entity Framework*, управление автопарком, эффективность, автоматизация, *MS SQL Server*.

INFORMATION AND ANALYTICAL SYSTEM FOR IMPROVING THE ECONOMIC EFFICIENCY OF MOTOR TRANSPORT OF RUE GOMELENERGO

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The issues of developing and implementing an information and analytical system aimed at improving the economic efficiency of operating vehicles of RUE Gomelenergo are considered. The goals and objectives of the system, architectural and technological solutions that ensure reliability, scalability and integration with the enterprise's corporate infrastructure are described. The expected results of the implementation are considered, which are expressed in lower operating costs, reduced downtime, increased transparency of accounting and planning processes, as well as an overall increase in fleet efficiency.

Keywords: information and analytical system, digitalization, motor transport, ASP.NET Core, Entity Framework, Fleet Management, Efficiency, Automation, MS SQL Server.

Современные предприятия энергетического сектора находятся в условиях активной цифровой трансформации, когда эффективность производственных процессов напрямую зависит от уровня автоматизации и качества информационных систем.