

Powering Sustainability in the Transformer Industry

Over the five years we have been publishing Transformer Technology, one of the most downloaded, archived and read issues every year is our annual December Issue on Oils & Fluids. In 2023 we expanded the topic to “Insulation, Oils & Fluids” and this year, a more refined “Insulation Systems, Oils and Fluids”.

Given the broad use of mineral oils as the insulating oil of choice for decades, what strikes me most is how fast things are changing, even as it relates to this topic. Insulating papers are getting better, esters are rapidly growing as an alternative to mineral oil, and even that old standard is changing to meet the need for better oils and for decarbonization.

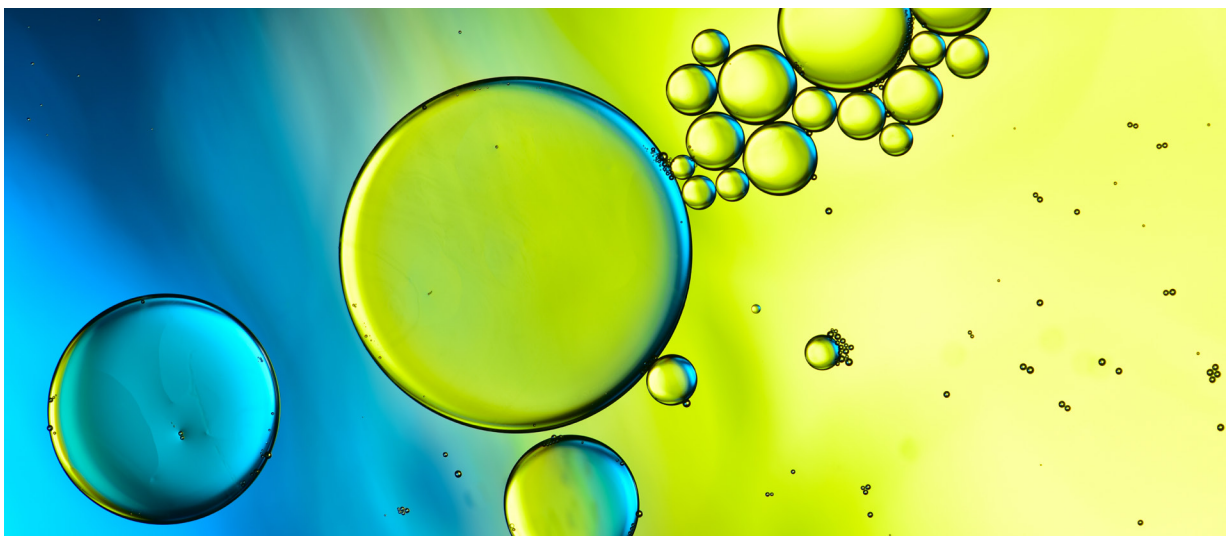
One of the often overlooked yet vital aspects of transformer operation and longevity is the use of oils and fluids. These substances are not merely passive elements; they actively contribute to the performance, safety, and durability of transformers. Let’s delve into the significance of transformer oils and fluids, their types, and the emerging trends in this field.

Transformer oils, also known as insulating oils, serve multiple functions. Primarily, they act as electrical insulators, preventing short circuits by providing a high dielectric strength medium. Additionally, they serve as coolants, dissipating the heat generated during transformer operation.

insulation and cooling. These oils are derived from refined crude oil and have been used for decades due to their excellent dielectric properties and thermal conductivity. However, mineral oils are not without their drawbacks. They are flammable, posing a fire risk, and their environmental impact is significant, given that they are not biodegradable and can cause soil and water contamination in the event of leaks or spills.

In recent years, there has been a growing interest in alternative insulating fluids that address the limitations of mineral oils. One such alternative is synthetic ester fluids. These fluids are engineered to offer superior fire resistance and biodegradability compared to mineral oils. Synthetic esters have a higher flash point, reducing the risk of fire, and they break down more readily in the environment, mitigating the ecological impact of potential leaks. However, they are more expensive than mineral oils, which can be a barrier to widespread adoption.

Another promising alternative is natural ester fluids, often derived from vegetable oils. These fluids are gaining traction due to their excellent environmental profile. They are biodegradable, non-toxic, and have a high fire point, making them a safer and more sustainable option. Natural esters also have good dielectric properties and thermal performance, although



This dual role is crucial for maintaining the transformer's efficiency and preventing overheating, which can lead to catastrophic failures.

Traditionally as mentioned above, mineral oils have been the go-to choice for transformer

they may require more frequent monitoring and maintenance due to their susceptibility to oxidation.

The choice of transformer oil or fluid is not merely a technical decision; it has broader implications for safety, environmental

sustainability, and operational costs. As the energy sector increasingly prioritizes sustainability, the shift towards more eco-friendly insulating fluids is likely to accelerate. Regulatory frameworks and industry standards are also evolving to support this transition, with organizations like the International Electrotechnical Commission (IEC) and Institute of Electrical and Electronics Engineers (IEEE) updating their guidelines to include alternative fluids.



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Oils and fluids used in transformers are far more than just ancillary components. They are integral to the transformer's performance, safety, and environmental impact. While mineral oils have been the industry standard for many years, the shift towards synthetic and natural ester fluids represents a positive step towards more sustainable and safer transformer operation. As technology advances and economies of scale come into play, the adoption of these alternative fluids is likely to become more widespread, benefiting not just the energy sector but society as a whole.



While mineral oils have been the industry standard for many years, the shift towards synthetic and natural ester fluids represents a positive step towards more sustainable and safer transformer operation.

But even as this trend accelerates, mineral oil suppliers are moving to lower carbon footprints and more specialized applications that esters find challenging to achieve, as ways to maintain their significance in the sector, something that adds to the sustainability argument.

The fact that this is the "theme" we have once again chosen for December 2024 is no surprise, given its importance to transformer reliability, resilience and life cycle management.

Enjoy!

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Alan has decades of experience in the power systems industry and is one of the greatest reliability experts out there.

