# REVIEW ON MODERNITY IN USE OF TRANSFORMER OILS

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## Abstract – Transformer oil plays as cooling and insulating medium in transformers this insulating oil not only fills up the pores in the fibrous insulation such as paper, but also the gaps between the turns of the winding and the spacing between the winding and the tank . The function of oil used in large size transformers are cooling and insulation. Transformer oil must have certain properties like high dielectric strength, low viscosity, high flash point, very low moisture or water content, high specific resistance and so on. Transformers use various types of insulating oils. This paper highlights the development in oil market by discussing advantages and disadvantages of each of each oil.

**INTRODUCTION**

The transformers vital static component in power system. The demand of transformer is increasing due to enlargement of power system grid. It is known as high cost equipment and has a direct effect on power system operation. Any interruption in the transformer leads to reduce the fidelity of power system. Transformer oil is a special type of lubricant which used to insulate and cool electrical infrastructure. The main purpose of using oil in transformer is to provide electrical insulation between the various live parts and it also acts as a protective coating layer to prevent oxidation of the metal surfaces. Transformer oil is generally a highly refined mineral oil that is stable at high temperature and has excellent electrical insulating properties. It is used in oil-filled transformers, some types of high-voltage capacitors, fluorescent lamp ballasts, some types of high voltages switches and circuit breakers. Transformer cores and windings get heated up during operation due to various power losses. Transformers generate a lot of heat and the heat has to be removed or the copper will melt and leads to failure of transformer as a whole. Today, most transformers use insulating and cooling fluids derived from petroleum crude oil. The quality of the oil is very important for insulating and cooling. A high voltage, highly loaded transformers demands better quality oil than a low voltage, lightly loaded transformers. Transformer oil helps in:-It acts like an insulation between the windings for which cupper losses due to heating reduces.

-Providing an arc quenching medium.

-The oil helps in preparing a sludge which can be easily removed at the time of cleaning.

**MINERAL OIL**

In the transformer, mineral oil is used as an insulating cooling medium. It is a stable, non-conductive liquid that helps dissipate heat generated by the electrical components of the transformer. Mineral oil prevents electric arcing and provides insulation between lives parts and grounded structures. Mineral oil surrounding a transformer core-coil assembly enhances the dielectric strength of the winding and prevents oxidation of the core. Oil also picks up heat while it is in contact with the conductors and carriers the heat out to the tank surface. Mineral oil has been the traditional choice, there are alternatives, such as synthetic oil and biodegradable fluids, that are being explored for improved environmental safety. Mineral oils have proven reliable as an insulating medium but they have disadvantages:

-Combustibility– the explosion and fire cause heavy Damage to adjacent equipment and building.

-Fire suppression, barrier walls and huge or large physical separation are now a standard practice to reduce this risk. - Environmentally unfriendly– spilled oil must be treated as toxic waste. Mineral oil that escapes into water is especially harmful.

-Mineral oil is non-biodegradable.

# AKSARELS

Askarel oil is a synthetic, non-combustible, electrically insulating liquid that was commonly used as a transformer oil. It is used electrical transformers and electrical appliances because it was: Stable, Corrosive name, Low flammability and An excellent thermal insulation agent. Beginning about 1932, a class of liquids called polychlorinated biphenyls was used as a substitute for mineral oil where flammability was major concern. They function as both a lubricant and an fictional substitute, especially in environmental where traditional fictional is scarce or contaminants.

# ESTERS

In the transformers franchise, “Ester” often refers to ester based oil, which are used as lubricants in mechanical systems. In the transformers, such oil could be implied to enhance the performance and efficiency of their mechanical components. Ester liquids have been used in transformers for insulation and cooling purposes for over 20 years. These liquids greatly reduce environmental impact and significantly mitigate spillage and fire risks. **Synthetic Ester** dielectric fluids have suitable dielectric properties and biodegrade much quicker than mineral oil and hydrocarbon fluids. Due to their high cost compared to other less flammable fluids, synthetic fluids are generally limited to use in traction and

mobile transformers and other specially application. Ester oil being biodegradable, non-toxic to living things and having better fire resistive properties are more appealing to end users who have been slowly shifting towards the adoption of ester oil based distribution transformer.

**Natural Ester** organizations have recognized the increasing stringency of environmental regulations and liability risks involving mineral oil and synthetic oil based transformer fluids. Natural ester oils extracted from seed were considered as potential transformer fluids as early as the 1890s. These early ester oils offered no performance or economic benefits over mineral oil. Based on research and development beginning in the early 1990s,natural esters have matured into suitable dielectrics with excellent fire safety properties while being non-toxic and biodegradable.

## COCONUT OIL

More recently, the environmentally friendly Coconut oil has been used as a transformer oil in Sri Lanka where it is freely available at all places there. **Properties of Coconut Oil :** Coconut oil is colorless pale brownish-yellow liquid. In temperate climate, it appears as greasy, somewhat crystalline, white too yellowish solid fat. In order to avoid problems with impurities present in coconut oil in the ordinary market in barrel-form, only commercially available purified coconut oil to be used in transformers. There are certain doubts regarding solidification of coconut oil and the same has been verified by M/s Lankan Transformers. M/s ABB also conducting experiments to use these oil in transformers.

## PALM OIL

* Indonesia is one of the largest palm oil producers in the world and there is an abundant supply of palm oil in the market. In general, palm oil is used to cooking oil, household use, and cosmetic products. The non-acidic and biodegradable properties of palm oil make it suitable for use as basic insulating oil in electric power transformers. Studies showed that Palm kernel oil have good properties to act as insulating and cooling liquid in a transformer. Palm oil has potential to be used as a substitute for mineral oil in transformers because it is biodegradable, renewable, and environmentally friendly. It has dielectric strengths of 25 KV in its crude state compared with transformer oil which has a maximum dielectric strength of 50 KV and has a very high flash point 242℃.

**Benefits of palm oil:–** Fire safety, it has higher flash and fire point. Moisture tolerance, palm oil can tolerate moisture well, which can improve its performance and longevity. Lifespan, it can extend the life of insulating paper in transformers, which can reduce maintenance costs. Sustainability, palm oil is a renewable resources. Palm oil has high permittivity as compared to mineral oil with an increase in temperature. High permittivity reduce the electric field in the oil when applied to a plated dielectric with a pressboard inside a power transformer.

**TABLE: VARIOUS 0ILS PROPERTIES**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Property** | **Mineral Oil** | **Silicone Oil** | **Synthetic Ester** | **Soya Bean Oil** | **Coconut Oil** | **Palm Oil** |
| BDV (KV) | 50 | 40 | 43 | 39 | 60 | 25 |
| Moisture content (%) | 0.15 | 0.1 | 0.1 | 0.2 | 0.1 | 0.19 |
| Pour Point (℃) | -40 | -55 | -50 | -1 | 23 | 15 |
| Flash Point (℃) | 140 | 290 | 270 | 243 | 225 | 242 |
| Density (g/cc) | 0.89 | 0.87 | 0.97 | 0.92 | 0.92 | 1.5 |

# CONCLUSION

Transformer oil is used in electrical transformers and other high voltage equipment to insulate, cool, and prevent arcing and corona discharges. Transformer oil can be regularly tested in a laboratory to monitor the health of equipment. The vegetable oils are good alternatives for transformer oil. The limitation thereof are; inferior oxidative property, poorer low temperature properties, higher viscosity and higher cost to produce. They can be used in their raw form for low voltage transformer but have to be refined and purified to improve on their properties for high voltage transformers. In terms of economic costs and environmental considerations, Soya bean oil, Coconut oil and palm kernel oil appear to be viable alternatives to transformer oils and they are readily available in India, Malaysia, Sri Lanka etc.

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