



ISSN: 2350-0328

**International Journal of Advanced Research in Science,
Engineering and Technology**

Vol. 8, Issue 3 , March 2021

Experimental Research of Utilized Oils of Traction Transformers

**Kutbidinov Odiljon Muhammadjon o`g`li, Yusupov Dilmurod Turdaliyevich,
Samadov Shakhboz Amirullo o`g`li, Abdullaev Eldor Sadulla o`g`li**

Master's student , Tashkent State Transport University, Tashkent ,Uzbekistan
Phd , Senior researcher, "Scientific and Technical Center" LLC of "Uzbekenergo" JSC, Tashkent ,Uzbekistan
Master's student, Tashkent State Transport University, Tashkent ,Uzbekistan
Assistant, Tashkent State Transport University, Tashkent ,Uzbekistan

ABSTRACT: In the article, four samples of T-1500 oils used in traction transformers were taken and tested. The results were compared with normative documents. As a result, three of the samples were found to be suitable for use in 27.5 kV traction transformers in accordance with the normative documents, and one was found to be unusable.

KEY WORDS: Traction transformers, sample, transformer oil, breakdown voltage, flash point, acid number, normative documents.

I. INTRODUCTION

The transformer oil, which has the advantages of well insulation performance and dielectric properties, is adopted as the main insulation dielectrics of transformer [16].

In process of long exploitation of power oil transformers are exposed influence number of factors which are bring to their destruction and failure. One of such main factors influencing for working of this electric equipment is a deterioration electro physical properties of transformer oil. Transformer oil, being used for isolation and cooling, also defines quality of working of oil transformers. As, 85% of breakages of oil transformers happen because of damage of isolation [6]. In this regard more actual task is timely purification and regeneration of oil of power transformers with their long exploitations.

In exploitation transformer oil contains the water which is contented in the process of aging of oil and cellulose isolation and also the water getting to oil from environment. The insignificant amount of water can have considerable influence to features of exploitation of the transformer. For example, if contents of water in transformer oil are exceeded by 50 ppm, then there can be a breakdown that leads to a transformer exit out of operation [7]. The carried-out analysis [8] shows that the content of water in transformer oil is the main reason for various type of damage of power transformers.

The reliable and long-term operation of oil transformers depends in many respects on the quality of the oil [1, 3, 9-13]. The quality of the oil also determines the trouble-free operation time of the traction transformers [1, 9, 13-21].

Transformer oil is used for insulation, providing about 80% electrical strength in the transformer, as well as for cooling by transferring heat from the active parts of the power transformer (coils, etc.) to the cooling system [1-7].

II. METHODS

The main operational characteristics of transformer oil are determined in accordance with the normative document [1-3, 19-21]. The most important indication of the insulation condition is the minimum breakdown voltage of the transformers and is determined in accordance with table 1 [10-11].

Table 1
Minimum breakdown voltage for transformer insulation [10]

Transformer operating voltage, kV	Breakdown voltage of the oil, kV
To 15	30
from 15 to 35	35
from 60 to 150	55
from 220 to 500	60

Why is transformer oil testing important?

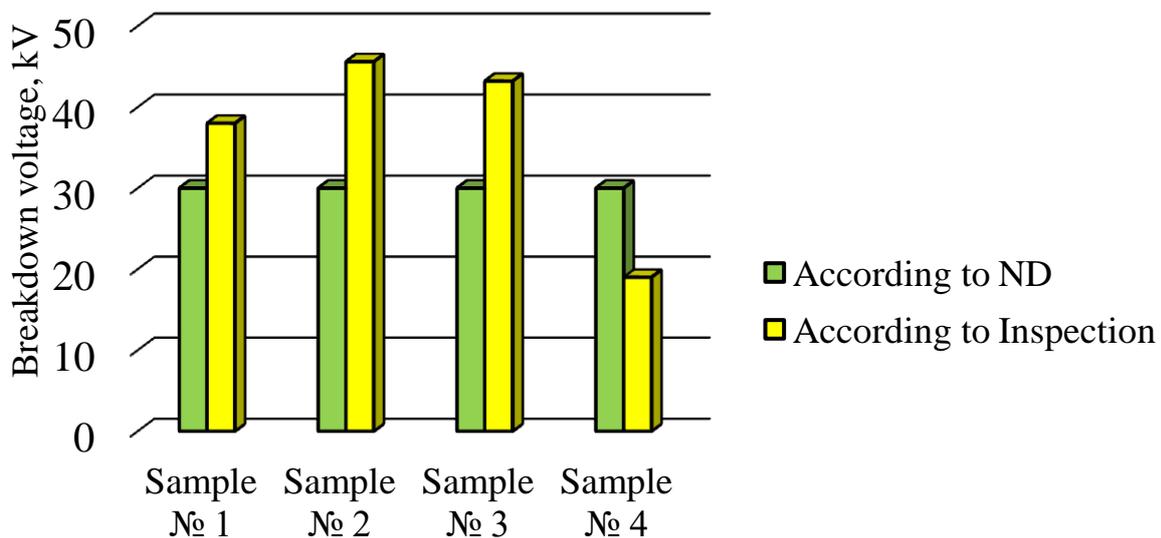
Transformer oil testing is important to:

1. Determine essential electrical properties of transformer oil
2. Identify if a certain oil is suitable for future use
3. Detect whether regeneration or filtration is needed
4. Reduce oil costs and enhance component life
5. Prevent untimely failures and maximize safety [15].

III. RESULTS AND DISCUSSION.

If we look at the results of the inspection, we can see the following:

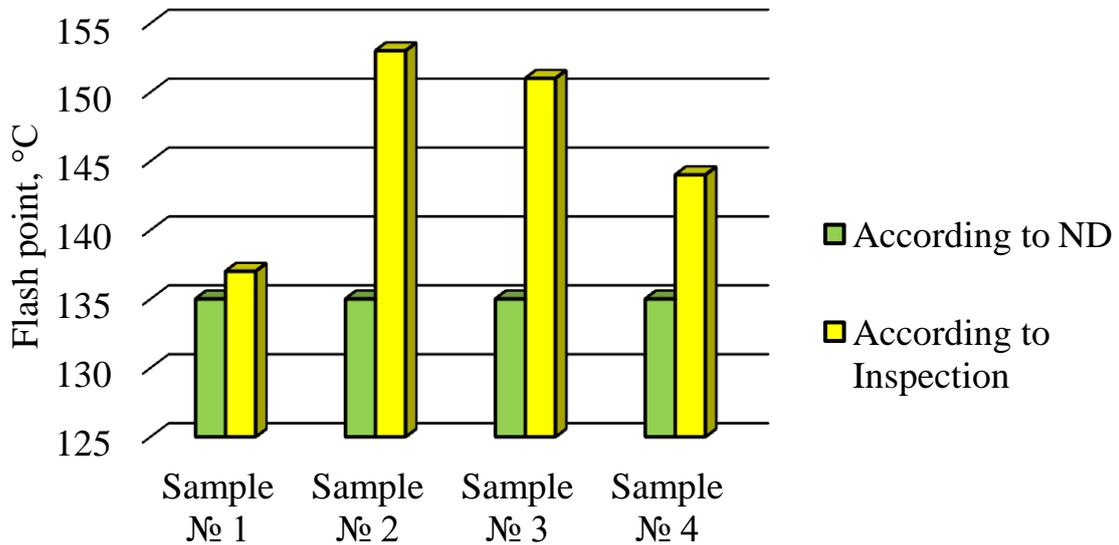
Breakdown voltage. The voltage at which oil breakdown occurs is called breakdown voltage (kV) [1-7]. A decrease in the breakdown voltage usually indicates contamination of the oil with various impurities [1, 16, 17-21]. Figure 1 shows the breakdown voltage of the transformer oils. According to the normative documents, this figure is higher than 30 kV. The results of the inspection showed that this indicator is above 30 kV in 3 samples and below 30 kV in 1 sample.



Transformer oil, 1

Figure 1. Breakdown voltage of transformer oils according to normative documents and inspection results

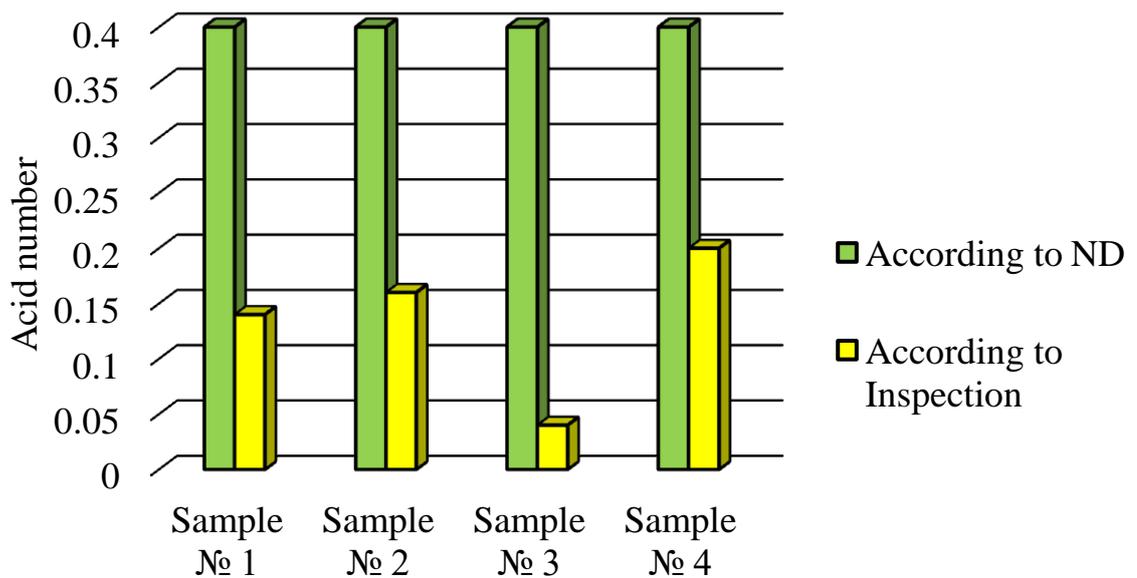
Flash point. The temperature at which vapors of an oil heated under standard conditions form a mixture with ambient air, which flares up with a slight explosion when a flame is brought to it, is called the flash point. The flash occurs so quickly that the oil does not have time to warm up and catch fire. For transformer oils, this temperature should not be lower than 135 ° C [1-5, 13]. The flash temperature test found that all of the sampled oils were in compliance with normative documents.



Transformer oil, 1

Figure 2. Flash point of transformer oils according to normative documents and inspection results

Acid number. The acid number is the number of milligrams of caustic potassium (KOH), which is necessary to neutralize all free acidic compounds that make up one gram of oil [1-5, 15]. According to the normative documents, this figure is the lowest at 0.4%. For all oils sampled, this figure is in accordance with the normative document.



Transformer oil, 1

Figure 3. Acid number of transformer oils according to normative documents and inspection results

Table 2

Values of oils in traction transformers according to normative documents [18]

Parameter name	Unit	According to ND
Breakdown voltage, no more	kV	30
Kinematic viscosity at 50 ° C	mm ² /sek	8
Content of mechanical impurities	%	0.007
Acid number mg KOH per 1 g of oil	% no more	0.4
Flashpoint , no more	°C	135
Density at 20 ° C	kg/m ³ , no more	885

III.CONCLUSION

According to the results of the inspection, 3 of the oil samples were found to be usable and onewas unfit for use.The breakdown voltage of the used transformer oils was found to be higher than the remaining values indicating whether the transformer oil was suitable or not.

REFERENCES

- [1]. Yusupov D.T., Qutbidinov O.M. //Analysis of some influencing factors on the performance characteristics of traction transformer oil //Republican scientific and scientific-theoretical conference on the theme: "XXI century - the century of intellectual youth" Tashkent, April 24, 2020. –62-63 pages.
- [2]. Yusupov D.T., Qutbidinov O.M. //Influence of wetted impurities on the performance characteristics of transformer oil // Republican network scientific remote online conference on "The role of students in scientific and practical research in Uzbekistan". Tashkent .year 2020 May 20. part IV. pages 144-146.
- [3]. Salikhov T.P., Kan V.V.,Yusupov D.T. Purification of transformer oil with adsorbents combined with a ceramic membrane // Energy security and energy saving. 2016 year. №3 page.37-41.
- [4]. Serebryakov A. S., Semenov D. A., Stepanov S. E. Analysis of results of measurements of parameters insulations of power oil transformers // Bulletin NGIEI. 2020. № 4 (106). P. 24–35.
- [5]. Lijun Zhou, Dongyang Wang, Lei Guo, Lujia Wang, Junfei Jiang and Wei Liao. FDS analysis for multilayer insulation paper with different aging status in traction transformer of high-speed railway. IEEE Transactions on Dielectrics and Electrical Insulation Vol. 24, No. 5; October 2017
- [6]. Bogachkov I.M., Savinih YU.A. Regeneratsiyatransformatornogomaslavrashayushimmysamagnitnimpolem.Nauchno-tehnicheskijjurnal "Geologiya, geografiya i globalnayaenergiya", 2010 g., №3 (38), str. 79-80.
- [7]. M.A. Suslin, V.A. Tetushin, V.N. Chernihsev, D.A. Dmitriev // Mikrovolnovoytermovlagometricheskijmetodkontrolyaorganicheskixsoedineniy, Vestnik TGTU, 2004 g., Tom 10, №2. <http://cyberleninka.ru/article/n/mikrovolnovoy-termovlagometricheskij-metod-kontrolya-organicheskix-soedineniy>
- [8]. PankajShukla, Y.R. Sood, R.K. Jarial. Experimental Evaluation of Water Content In Transformer Oil // International Journal of Innovative Research in Science, Engineering and Technology, Vol. 2, Issue 1, January 2013. Pages 284-291.
- [9]. Laphorn A.P. "A 15 kVA high-temperature superconducting partial-core transformer—Part 1: Transformer modeling", IEEE Trans. On Power Delivery, Vol. 28, No.1. 2013.P. 245-252.
- [10]. Edstrom F.A. "Modeling impact of cold load pickup on transformer aging using Ornstein-Uhlenbeck process", IEEE trans. On Power Delivery, Vol. 27.No.2. 2012.P.590-596.
- [11]. GD 34.43.105-89. Guidelines for the operation of transformer oils. c. M.: «Tech energo », 1989 year. page 58.
- [12]. Hilber P.P. "Influence of ambient temperature on transformer overloading during cold load pickup", IEEE Trans. On Power Delivery, Vol.25.No.1. 2013.P.153-161.
- [13]. Guidance document RH 34-301-633:2011. Instruction. Operation of transformer oils. – T: Uzbekenergo, – 2011. – page 98 .
- [14]. Manevich L.O. Transformer oil processing. 2nd ed., Rev. and. add. –M .: Energoatomizdat, 1985. –p. 95-96.
- [15]. ZhanW.H. "Development of a low-cost self-diagnostic module for oil-immersed forced-air cooling transformers", IEEE Trans. On Power Delivery, Vol. 30, No.1. 2015. P.129-137.



ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 8, Issue 3 , March 2021

- [16]. Bo Qi, Member, IEEE, ChunjiaGao, Hao Han, Xiaolin Zhao, Qing Yuan, Shuqi Zhang, and Chengrong Li, Senior Member, IEEE//Electric field distribution characteristics and space charge motion process in transformer oil under impulse voltage//DOI: 10.1109/ACCESS.2019.2931492.
- [17]. Mohamed Seghir, TaharSeghier, BoubakeurZegnini, and AbdelhamidRabhi//Breakdown voltage measurement in insulating oil of transformer according to IEC standards//Proceedings of the 2nd International Conference on Electronic Engineering and Renewable Energy Systems (pp.543-551) //DOI: [10.1007/978-981-15-6259-4_57](https://doi.org/10.1007/978-981-15-6259-4_57).
- [18]. GOST 982-80. "Transformer oils specifications" Interstate standard.M.:Standartinform, 2011, page 11.
- [19]. Muhammad Ali Mehmood, Jian Li, Feipeng Wang, Zhengyong Huang, Jawad Ahmad, M. ShoaibBhutta// Analyzing the health condition and chemical degradation in field aged transformer insulation oil using spectroscopic techniques //2018 International Conference on Diagnostics in Electrical Engineering(Diagnostika).
- [20]. EL-Sayed M. M. EL-Refaie, Mohamed R. Salem, and Wael A. Ahmed// Prediction of the Characteristics of Transformer Oil under Different Operation Conditions// World Academy of Science, Engineering and Technology 29 2009.
- [21]. Tapan K. Saha, Senior Member, IEEE, and PrithwirajPurkait, Member, IEEE//Investigations of Temperature Effects on the Dielectric Response Measurements of Transformer Oil-Paper Insulation System//IEEE Transaction power delivery, vol. 23, No. 1, January 2008.