CLEANING OF USED TRANSFORMER OIL

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Abstract

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. In this regard more actual task is timely purification and regeneration of oil of power transformers with their long exploitations.

Key words: the regeneration, transformer oil, electrophysical properties of oil, purity class, silica gel, zeolite, adsorbent.

Introduction.

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 [1-2]. The carried-out analysis [3-5] shows that the content of water in transformer oil is the main reason for various type of damage of power transformers.

Depending on content of moisture in transformer oil water can be in three states: free, emulsified and connected.

Free water has the large form, doesn't mix up with transformer oil and easily separates from his structure.

The emulsified water consists of small drops of liquid. Droplets of this water can be besieged or under the influence of electric field to be built in chains and to form the carrying-out bridges [4-8] and as a result of, this type of water, can influence to the puncture voltage of transformer oil. The puncture voltage of oil is the indicator characterizing ability of liquid dielectric to maintain the impressed voltage without breakdown. The carried-out researches [5] claim that increase the emulsified water in content of transformer oil suddenly goes down of puncture voltage as it is given in figure 1. Under the influence of electric field of a drop of the emulsified

water in oil are involved to places where voltage of electric field is higher and where begins emergence of breakdown [6-10].

The connected water has very small form, the chemical composition of this water is strong connected with a chemical composition of transformer oil and, it is almost impossible to be exempted from her. She also contains in fresh oil. On the other side, the connected water doesn't render an essential harmful influence on electro physical indicators of transformer oil [7-12].

In this regard, the purpose of this work is purification of transformer oil from the emulsified water for increase its puncture voltage.

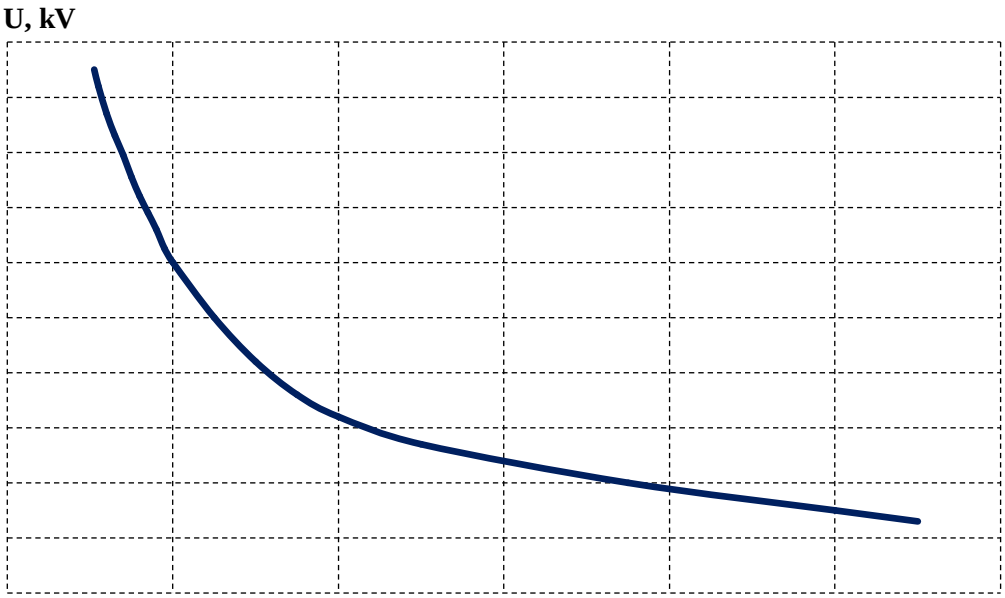

Figure 1. Influence of water to the puncture voltage of transformer oil

Experimental.

The sample of waste transformer oil with long exploitation is received by authors from the specialized enterprise to carrying out of research works.

Various methods are applied to carrying out regeneration of the waste transformer oil from water. On the basis of the carried-out analysis [13-15] authors offer table 1, where are given efficiency of the existing methods of regeneration of the waste oil from water.

Table 1. Efficiency of the existing methods of regeneration of the waste oil from water

Name of technology of regeneration	**Principle of operation**	**Efficiency of purification**		
		from free water	**from the emulsified water**	**from connected water**
Upholding	Is based on natural sedimentation of water, being in a suspension, at quiet standing of oil.	Deletes	Doesn`t delete	Doesn`t delete
Centrifugal separation	One of methods of removal of water of oil is carried out by means of centrifuges. The method is based on division of various fractions of non-uniform mixes under the influence of centrifugal force.	Deletes	Deletes	Doesn`t delete
Vacuum	It is based on vacuum processing of oil in a special sealed chamber for the purpose of decrease moisture in content.	Deletes	Deletes	Deletes
Adsorption purification	It is based on water absorption by various adsorbents on an external surface of granules and on an internal surface of the capillaries penetrating granules.	Deletes	Deletes	Deletes partially

The adsorptive way is applied for purification of transformer oil from the emulsified water. As adsorbents have used silica gel and zeolite.

Regeneration of transformer oil was carried out according to the closed scheme [11].

Optimum results have been received when total time of contact of adsorbents with oil made not less than 4 hours. The purified sample oils at a temperature 50-70 °C have been passed through porosity silica gel for deleting of products of aging of transformer oil.

The analysis of the regenerated transformer oil has shown its high dielectric properties, however availability of residual water hasn't allowed to reach the required level of electric durability of sample oil – 60 kV.

For the purpose of the residual, that is emulsified water and increase the puncture voltage of transformer oil has been subjected to regeneration by zeolite in combination with silica gel and ceramic membranes.

JournalNX- A Multidisciplinary Peer Reviewed Journal
ISSN: 2581-4230, Website: journalnx.com, June 18th & 19th, 2020

Results and Discussion.

Electro physical parameters of transformer oil before and after purification are shown in table 2.

Table 2. Electro physical properties of oil (before and after purification)

N	Electro physical properties of oil	Before purification	After purification (silica gel + zeolite)
1.	Electric durability (puncture voltage)	22,8 kV	60 kV (Norm 60 kV)
2.	Water content	Be present	Be absent
3.	Mechanical impurity	Be present	Be absent
4.	Content of the weighed coal	Be present	Be absent
5.	Colour	Brown	Yellow
6.	the content of organic acids (milligram hydroxide potassium in 1 gram oil)	0,030 (Norm 0,020)	0,018 (Norm 0,020)
7.	Outbreak temperature	147ºC (Norm 135ºC)	151º C (Norm 135ºC)
8.	Dielectric losses Tangent of angle δ at 20ºC	2,05%	0,05%
	Tangent of angle δ at 70ºC	6,86%	0,14%
	Tangent of angle δ at 90ºC	13,0% (Norm 1,7%)	0,20% (Norm 1,7%)

Laboratory researches on the adsorptive purification of oil with use ceramic membranes have shown high dielectric properties of the purified oil. Apparently from the table 2 oil quite conforms to requirements of normative document RH 34-301-633:2011.

Thus, the emulsified water is the most dangerous to life cycle of the power transformer as reduce of puncture voltage of transformer oil. Besides, the emulsified water also under the influence of electric field can be built in chains and form the carrying-out bridges.

Conclusions.

Using of the adsorptive method with a combination of ceramic membranes for purification of the waste transformer oil from the emulsified water is the most effective, from the economic point of view.

Carrying out timely regeneration of the waste transformer oil will allow to increase energy efficiency and reliability of working of the power oil transformer with long exploitation.

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