

Transformer Oil Quality Analysis Using Image Processing

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ABSTRACT

Transformer plays an important role to meet the nation demand of reliable power system. The performance of transformer depends on the quality of the insulating oil. The transformer oil used in transformer provide insulation & cooling. Among the different insulating material used in transformers, mineral oil is the most widely used as insulating medium in oil filled transformers. Health of transformer mainly depends on its insulation. Transformer oil or insulating oil is an oil that is stable at high temperatures and has excellent electrical insulating properties. It is used in oil filled transformers. For better performance of transformer cooling and insulation between inner parts of transformer is essential. Transformer of help to keep transformer life healthy. By this analysis method we find the quality of transformer oil base of which working and health of transformer is depend.

Key Words: Image Pre-processing, Image Acquisition, Color Future, Quality Classification.

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I. INTRODUCTION

Transformer is a versatile device used at various points in transmission and distribution substation. The main purpose of power or distribution transformer is to transfer electric power from one voltage level to another. Mineral oil used in transformer possess specified characteristics and change in these characteristics is accomplished by ageing process. Transformer is an integral part of power system whose role is critical for a reliable power system. Periodically the health of transformer has to be checked which primarily depends on the type of insulation used. Out of different insulators used in transformer, mineral oil so as to say transformer oil is used as an insulation material in almost all transformers. Thus it is very important to perform oil analysis periodically to check transformer health. There are a number of traditional methods available. But these methods are very time consuming and expensive. This paper provides a quick simple method to analyze transformer oil and thus to check transformer health from the image of a transformer oil sample. The image processing technique involves pre-processing of the taken image of transformer oil in which first the noises are removed using median and weinner2 filter and histogram enhancement technique is used for better visibility. Now entropy which is the statistical measure of randomness is calculated which depends mainly on the deterioration of the taken oil sample.

In this project, we discussed about good properties of transformer oil and analysis of transformer oil with help of image processing. In image processing method, we have collected some transformer oil images and with help of these images, we analyses the actual condition of transformer oil. An image is that the arrangement of associate array, or a matrix, of sq. pixels organized specifically columns and rows. Image processing is the MATLAB tool, it works with help of programming. Means we create the program in MATLAB and then it execute with image processing tool.



Fig 1. Fresh Oil Image



Oil of, which is used for 3-4 months



Fig 2. Oil used for 8-9 months



Image of Burned Oil

We know that, the transformer oil is the most important part of transformer, due to this their maintenance keep regularly. According to analysis of transformer oil by using image processing, taking different types of images at different condition like a image of transformer oil which totally pure oil then second one is the oil (image) which is used for 3-4 months then third one is the oil (image) which is used for 8-9 month and last one is the oil (image) which used for long time due to this that oil is burned. According to above images we observed that there are some changes in color of transformer oil means there is deformation of transformer oil.

II. RELATED WORK

The fault free operation of power transformers is a factor of major economic importance and safety in power supply utilities and industrial consumers of electricity. The dielectric strength of an insulating oil is a measure of the oils ability to withstand electrical stress without failure. Useful Transformer Oil Property Determination – Acidity is the most important property of oil. It indicates whether the quality of oil has deteriorated or not. Acidity of oil is express in mg of KOH required to neutralize the acid present in a gram of oil. This is also known as neutralization number. The Dissipation test measures the leakage current through an oil, which is the measure of the contamination or deterioration. Dielectric dissipation factor is also known as loss factor or $\tan \delta$ of transformer oil. As oil gets aged, acidity increases therefore NN also increases. If oil NN is high, that indicates oil is more contaminated with materials, such as varnish foreign matter or oxidization. Usually there is no acid content in new oil, oxidation of insulation forms the sludge's and impulse out of transformer metal in side tank forms the soaps from acid assault and also increase the insulation degradation. NN is definite relation with Interfacial Tension (IFT). Interfacial Tension indicates the tension at interface between two non-mixing liquids. Solid insulation material produces the dissoluble polar contaminants and oil decompose product. Lower IFT indicates that oxidation products present on oil. To determine the acidity of oil, potentiometric titration with potassium hydroxide is used and for $\tan \delta$ measurement Schering Bridge is utilized. These conventional diagnostic methods are devouring much time to estimate the oil properties. To overcome the disadvantages of traditional method, an image processing technique of Entropy method is proposed in this work.

III. PROPOSED SYSTEM

The image processing technique involves pre-processing of the taken image of transformer oil in which first the noises are removed using median and gaussian filter and histogram enhancement technique is used for better visibility. Now entropy which is the statistical measure of randomness is calculated which depends mainly on the deterioration of the taken oil sample. Thus using regression method from the knowledge of entropy and learned data the state properties of oil can be predicted.

Noise is the presence of any unwanted signal which degrades the image signal and are removed through filters.

In the microscopic images the majority of pixels possess a luminescence less than average which results into poor visual effect. Histogram modification is a tool which pixels will be rescaled to values where there is a well distinguish between their pixel values and thus better to analyze it.

The first step is of image processing. The microscopic image obtained from oil sample contains noises which can interrupt in image processing detection and may leads to erroneous results. Noise is nothing presence of any unwanted signal which degrades the image signal. Noises can be generated from apparatus or from environment.

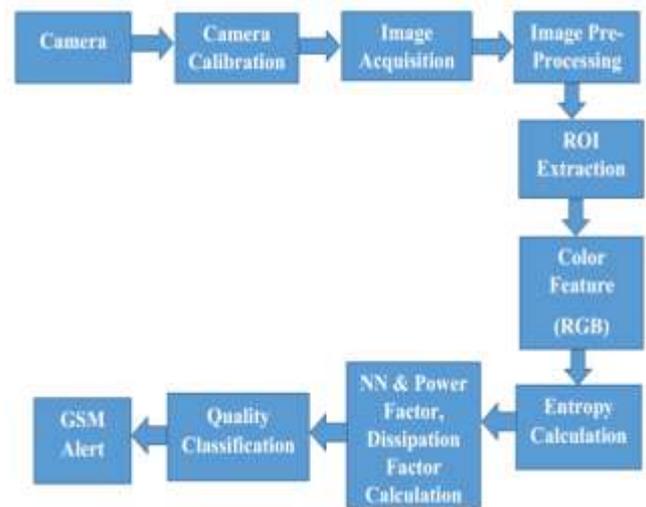


Fig 1. Image Processing Block Diagram

Image Enhancement is an important preprocessing tool which results in appreciate visual conception and helps in further processing of image. This is subjective i.e. the different methods to be applied is application dependent. The key functions are:

- Step 1: Deblurring of an image
- Step 2: Sharpening of an image
- Step 3: Improving brightness and contrast of an image
- Step 4: Proper edge highlighting etc.

Entropy Technique For Oil Property Determination:

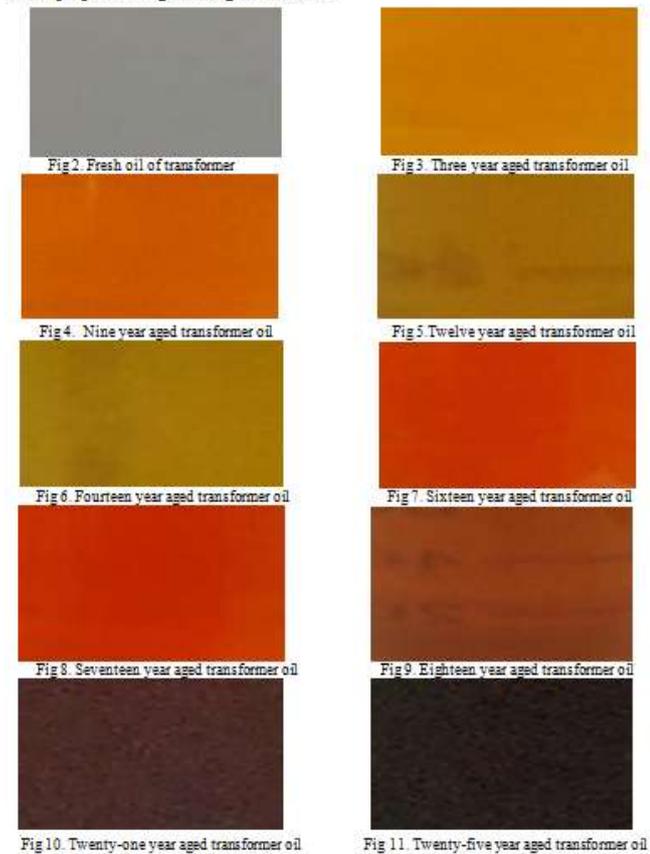
As oil gets aged color and texture of the oil changes, at the same time some of the properties related to oil also change. In this work Acidity and $\tan \delta$ of oil is calculated from image processing approach called Entropy.

ALGORITHM

1. Load the image
2. To remove noise use median and weinerner2 filters.
3. Enhance the image using histogram modification technique.
4. Find the Entropy (E).
5. Declare k1 and determine y
6. Check for $y \geq 14$
7. If y is less than 14 years, set $A_c = 0.013$ for NN and set $k_2 = 0.0021$ for $\tan \delta$ calculations
8. If $15 < y < 25$, set $A_c = 0.0159$ and $k_2 = 0.00716$ to compute $\tan \delta$ and acidity.
9. If $y > 25$, result will show error.

IV. RESULT ANALYSIS

After preprocessing of image collection:



IV. ADVANTAGES AND APPLICATION

ADVANTAGES

- 1) Less costly.
- 2) Time efficient.
- 3) Less maintenance required.
- 4) More reliable and more suitable than the other method.
- 5) More accuracy than other methods.
- 6) User friendly.

APPLICATION

- 1) Distribution transformers.
- 2) Can be used in oil processing industries.
- 3) Can be used in oil spill evaluation.
- 4) Can be used in transformer manufacturing industries.
- 5) Can be used in distribution substation.

VI. CONCLUSION

Image processing technique for transformer oil analysis is software based analytic technique which is fast, reliable and user friendly. Median and weininger2 filters were used to filter out the white Gaussian and salt and pepper noise (if any). Using histogram modification techniques the image quality was enhanced for better visibility and analysis. Entropy technique was used to find out different oil properties like NN, dissipation factor, power factor etc. to determine the performance of transformer. Using regression model was used to establish the relation between different entropy extracted from the image and NN, dissipation factor, power factor and to find the NN, power factor, dissipation

factor etc. of the sample. Thus this project provides an easy and fast method to check the transformer health from the image of transformer oil.

In this project we can interface the camera with MATLAB software for image processing purpose. In the sequence, it notices as quick and viable criteria as compared with conventional practices. Here, the proposed strategy works through statistical parameter such as entropy features of oil image. Subsequently, image processing complete procedure is employed to analysis of transformer oil quality.

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