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Analysis of Transformer Oil by Using MATLAB Software

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ABSTRACT:

Transformer is a device on which cost effective supply of electricity mostly depends. Hence, to manage the life of transformers, to reduce failures and to extend the life of transformer, some measures are being adopted. Power system reliability depends on the consistency of electrical equipment.DGA is most useful technique for fault detection in oil insulated transformer. When more than one fault exists in a transformer, other methods sometimes fail to diagnose. This paper carried the fuzzy three ratio method which overcomes the drawbacks of the conventional three-ratio method. This paper first carries the fuzzy membership functions for codes "zero"," one", "two", then it transfer the conventional logic "AND" and "OR" used in IEC three-ratio method into fuzzy logic . Accuracy of the carried method is much higher than the Conventional IEC Method. It is a sensitive and reliable technique for detection of incipient fault for oil immersed transformer. The fault type of transformer can be obtained efficiently as well as easily. Multiple faults can be diagnosed by using fuzzy method, while, it may not be possible for any conventional method. Cost of maintenance can be reduced and the life of transformer can be increase by applying fuzzy logic method the life. Fuzzy logic is the largest investment in the utility's system. Detection of incipient fault in power transformer is a crucial. DGA is a successful technique to detect these potential faults and it provide wealth of diagnostic information. This method is the most effective condition monitoring tool of power transformer and hence identifying a suitable condition –base asset management decision.

Keywords: *Power Transformer, Fuzzy Logic method, Dissolved Gas-In-Oil Analysis (DGA), Conventional Three-Ratio Method*

I.INTRODUCTION

The power transformer is a major apparatus in a power system, and its correct functioning is vital to system operations These devices, such as, Buchholz relays or differential relays, respond only to a severe power failure requiring immediate removal of the transformer from service, in which case, outages are inevitable. Thus, preventive techniques for early detection faults to avoid outages would be valuable. In this way, analysis of the mixture of the faulty gases dissolved in insulation oil of power transformer has received worldwide recognition as an effective method for the detection of incipient faults. The insulating organic compounds (cellulose paper and oil) produce gas when subjected to thermal and electric stress. Most gases originate in insulating oil and their composition is influenced by temperature.The significant source in this knowledge base is the gas ratio method. Some limitations of this approach are overcome by incorporating the diagnostic procedure and the synthetic expertise method. Proper functioning of power transformers is critical to secure operation of the power system. Methods to identify fault conditions before they deteriorate to a severe state have attracted great research interest.The following table indicates specification of Power transformer;

Table 1.1: Power transformer specification

KVA	10000	
Voltage at no load	HV	33000(Volts)
	LV	11000 (Volts)

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Current	HV	175(Amperes)
	LV	525 (Amperes)
Temperature Rise	45/50 Degree-Celsius	
Frequency	50Hz	
Impedance Voltage	8.35%	
Volume of Oil	6050 Litres	
No load loss	8.5KW	
Load loss	57KW	
Weight of Oil	5200Kgs	
Total weight	22700Kgs	

II. LITERATURE REVIEW

Fault gases in transformers are produced by degradation of transformer oil or other insulating materials, e.g. cellulose and paper. When discharge or overheating occurs, the oil around the fault will decompose into specific gases, which dissolve in the oil. Different fault types are therefore reflected by the different compositions of the gases-in-oil. Fault gases in transformers are produced by degradation of transformer oil or other insulating materials, e.g. cellulose and paper .

Hongzhong Ma, compare the fuzzy three ratio method and conventional IEC three ratio method. Programming is carried out by using MATLAB. Self-learning and adaptive fuzzy diagnosis systems, were developed to overcome the shortcomings of the IEC conventional system to learn automatically from the many practical and valuable diagnosis results as well as accuracy is high of fuzzy method as compared to IEC conventional method. Ali A Albakrey presents modified fault diagnosis method for power transformers using fuzzy logic technique.

The fuzzy analysis proves highly applicable to the problem, because it combines the values of gas concentrations with their evolution during the time period.[Fuzzy logic method does not need to spend a lot of time for "learning", it's programming is easy. Simulation results from practical generation and distribution transformer data show the program work well and the accuracy of the carried method is much higher than the conventional IEC method.

The fuzzy expert system combines the expertise and experience of the diagnosis experts with the diagnosis system using fuzzy if-then rules. The gas attribute thresholds to classify fault types were fuzzified to manipulate the imprecision and incompleteness of the DGA. The approach was designed according to existing classification criteria (e.g., IEC/IEEE standards). Such diagnosis was promising; however, many limitations exist. For example, the fuzzy expert system cannot learn from previous diagnosis results because the membership functions and the diagnostic rules were determined by practical experience or trial-and-error tests. Moreover, the diagnosis accuracy depends on the completeness and representation of accumulated human knowledge.

Transformers are usually designed for continuous operation in the system. These causes the windings to experience shear mechanical and electrical stresses. As these stresses cause the windings to heat, efficient cooling of the transformer is required. The rise in heat can deteriorate the insulation used in the windings and this heat rise can damage the transformer. To overcome this problem almost all the load bearing transformers are liquid filled. The liquid in all of these units is “transformer oil”, petroleum-based insulating oil refined specifically to meet the requirements of this application.

Fault detection can be classified based on either detection by signal model or model based on approach. In this work model based upon the parameter estimation is employed for fault detection. Signal model based fault detection methods are usually used for detecting machine vibration imbalance and bearing fault or knocking etc.

The two methods for fault diagnosis classification are: classification method (with structural knowledge) inference method (without structural knowledge). When the basic relationship between fault and symptoms is particularly or fully known in the form of

casual relation the inference method of fault diagnosis is employed. Fault tree is an inference method of fault diagnosis apart from neutral network and fuzzy based techniques. The symptoms and events are considered as binary variables and condition art of the rules are evaluated by Boolean equation. However fault tree is not popular method because of continuous nature of fault and symptoms. In this work inference method is based on AI technique is used for fault diagnosis.

Fault diagnosis is usually followed by fault detection wherein kind, size and location of fault is determined. In past decade the technique of neural network is rowing as data driven method which provides total new perspective for diagnosis.

III. PROPOSED SYSTEM:

We will describe a simple and efficient method of diagnosis of transformer incipient faults by fuzzy three gas ratio method. In the proposed system contains 10 MVA power transformer, due to increase in transformer oil temperature there are some internal faults are occurred. Here in this paper we have to discuss about IEC and Fuzzy three gas ratio method which is useful to identify transformer faults, which can be described as in the following.

A) FUZZY DIAGNOSIS SYSTEM:

The following block diagram indicates that data base of dissolved gas in oil goes towards fuzzification and membership function block; then output of both the block is given to rule base fuzzy inference system. Here we will get fuzzy output i.e.the knowledge-based fuzzy rule; by using defuzzification converts fuzzy output into crisp output.At last we are able to diagnose the fault in power transformer.

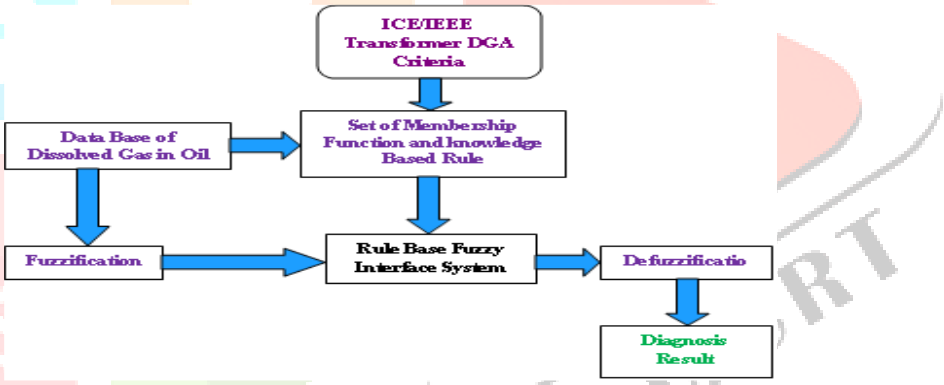

Figure1.1: Fuzzy diagnosis system

B) COST ESTIMATION TABLE:

Description	Quantity	Value (INR)	Per Unit (INR)
3p,33/11kv,10000 KVA OLTC Power Transformer Including Bushing, Radiator, Conservator, Transformer oil, Tools &Accessories	1	1,742,628	1,742,628
Mounting arrangements for Transformer	1	2,743	2,743
Labour and transport	1	618	618
Pipe Earthing	1	810	810
MATLAB	1	100000	100000
Total			**1,846,799**

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IV. RESULTS:

Sample of transformer oil check by using IEC conventional method and Fuzzy logic method; final output of MATLAB software are shown in following window

A)Required user inputs of fuzzy three gas ratio method**:**

Enter the value of concentration of Hydrogen gas in ppm H2 for the DGA sample:150
Enter the value of concentration of Methane gas in ppm CH4 for the DGA sample:110
Enter the value of concentration of Ethane gas in ppm C2H6 for the DGA sample:90
Enter the value of concentration of Ethylene gas in ppm C2H4 for the DGA sample:280
Enter the value of concentration of Acetylene gas in ppm C2H2 for the DGA sample:50

Three Ratios

X = Acetylene C2H2 / Ethylene C2H4

X =0.1785

Y = Methane CH4 / Hydrogen H2

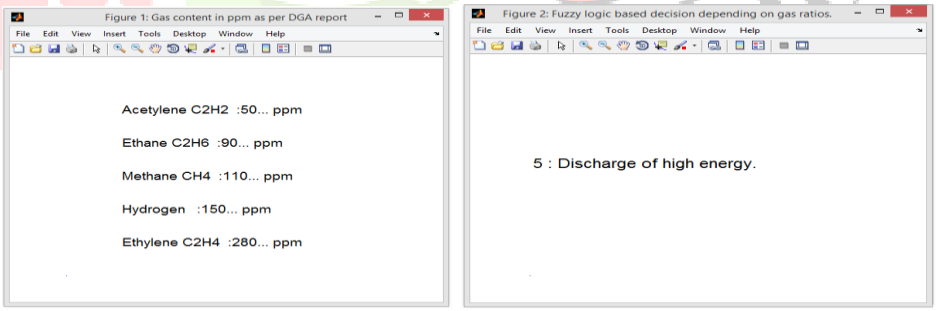
Y = 0.733

Z = Ethylene C2H4 / Ethane C2H6

Z =3.111

Fault is Discharge of High Energy.

Output of Fuzzy Three Gas Ratio Method:



B) Required user inputs of IEC based conventional three ratio method:

Amount of gas present in oil sample:
Enter the value of concentration of Hydrogen gas in ppm H2 for the DGA sample :150
Enter the value of concentration of Methane gas in ppm CH4 for the DGA sample :110
Enter the value of concentration of Ethane gas in ppm C2H6 for the DGA sample :90
Enter the value of concentration of Ethylene gas in ppm C2H4 for the DGA sample :280
Enter the value of concentration of Acetylene gas in ppm C2H2 for the DGA sample :50
Roger Ratio

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X = Acetylene C2H2 / Ethylene C2H4

X = 0.1785

Y = Methane CH4 / Hydrogen H2

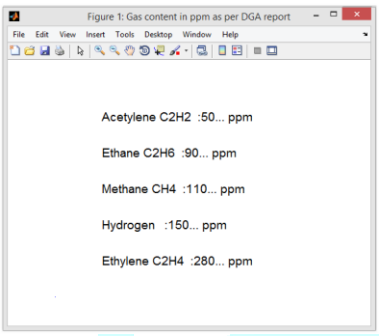
Y = 0.733

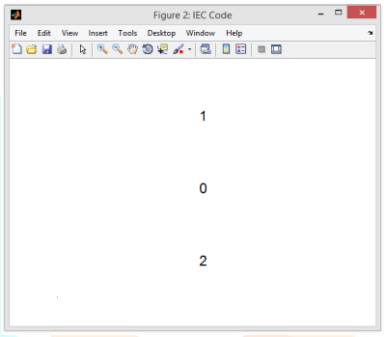
Z = Ethylene C2H4 / Ethane C2H6

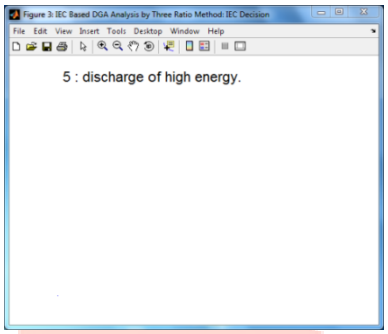
Z = 3.111

Fault is Discharge of High Energy

Output of IEC Based Conventional Three Gas Ratio Method:







Comparatively Study of Fuzzy and IEC conventional method:

Sr. No.	Fuzzy Three Gas Ratio Method	IEC Conventional Method
1	Accuracy 88.89%	Accuracy 66.67%
2	Programming short	Programming lengthy
3	Lot of time required for learning	Less time required for learning
4	After IEC code generation fault will detect.	In fuzzy method we can easily detect the fault.

V. CONCLUSION

A Power transformer fault diagnose method based on Fuzzy Three Ratio Method. This method can overcome the drawbacks of the Conventional IEC Three Ratio Method such as: no decision, can't diagnose multiple faults. Simultaneously this method does not need to spend a lot of time for learning, its programming is easy. Simulation results from practical generation and distribution transformer data show the program work well and the accuracy of the proposed method is much higher than the Conventional IEC Method. The 33kv/11kv Distribution Substations Power Transformer was taken for study of Identification of Transformer Incipient faults by using Fuzzy logic-IEC based 3 gas ratio method at Sonai, Ahmednagar.

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