IJIREEICE

ISSN (Online) 2321-2004
ISSN (Print) 2321-5526

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering

Vol. 7, Issue 8, August 2019

Futuristic Behaviour of Aging on Power Transformer Insulation Oil

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Abstract: The transformer oil insulation aging is deteriorating due to stresses. The life span of the transformer depends upon the various (parameters) factors i.e. Transformer oil Insulation, Paper insulation etc. The main objective is to analyse the transformers from various locations of the rating 12.5-20 MVA from different sub-stations located in Punjab .We have collected the data of 12.5-20 MVA power transformers from different sub-stations. We quest that the different parameters i.e. breakdown voltage, dielectric strength, resistivity, moisture, Tan-Delta and Flash Point are influences the age of the transformer. We showed it in pictorial way that how all the parameters influence aging of transformer in the graphical measures. From the different readings and testing reports we analyse the prediction of transformer oil. If we check the oil timely then the assessment of aging can be improved effectively up to 40-45 years.

Keywords: Breakdown Voltage, Dielectric Strength, Resistivity, Moisture, Tan-Delta, Flash Point

I. INTRODUCTION

Transformers square measure important parts of electrical power generation, transmission, allocation and wide control of transformers consists of liquid dielectrics like organic compound oil and solid insulation as paper. Power transformers of rating just about 12.5 MVA and 20 MVA area unit classically insulated with of 8500 litres approximately and 12500 litres approximately of mineral oil. Therefore the lifetime of an electrical device is eventually resolute by that of the solid insulation, even though different factors might origin it to fail early. [3]

The transformer oil insulation aging is deteriorating due to stresses. The life span of the transformer depends upon the various (parameters) factors i.e. Transformer oil Insulation, Paper insulation etc. A power transformer is a main and most important part of the electrical engineering. As discussed earlier the parameters of transformer insulation oil are deteriorating day by day as per aging of the transformer. Due to which the life span of transformers is 30- 35 years only. The power transformers have high manufacturing cost. We quest that the different parameters i.e. breakdown voltage, dielectric strength, resistivity, moisture etc. are influences the age of the transformer. We showed it in pictorial way that how all the parameters influence aging of transformer in the graphical measures. From the different readings and testing reports we analyse the prediction of transformer oil.

II. DATA COLLECTION

The transformer oil insulation aging is deteriorating due to stresses. The life span of the transformer depends upon the various parameters i.e. Transformer oil Insulation, Paper insulation etc. The main objective is to analyze the transformers from various locations of the rating 12.5-20 MVA of Punjab State Power Corporation Limited from different sub-stations located in Punjab .We have collected the data of 12.5-20 MVA power transformers from different sub-stations. We quest that the different parameters i.e. breakdown voltage, dielectric strength, resistivity, moisture etc. are influences the age of the transformer. We showed it in pictorial way that how all the parameters influence aging of transformer in the graphical measures. From the different readings and testing reports we analyze the prediction of transformer oil.

These transformers were of different construction company, serial number, date of installation, year of manufacturing, etc. but have same MVA rating, number of phases, voltage rating etc. The mineral oil was taken as per Indian Standard (IS): 335-1993(2005). On the basis of date of installation, the aging (in days) has been calculated and plotted on x-axis of the graph and on y-axis breakdown voltage (BDV), Moisture, Resistivity, tan-δ, Interfacial tension and flash point are showed. Transformers whose data is collected are shown in tables 3.1, 3.2, 3.3 respectively.

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Table 1 : Detail of Power Transformer (1, 2, 3 and 4)

Transformer No.	1	2	3	4
Constructed By	NUCON	NUCON	NUCON	GEC
Location	Rampura Dist. Bathinda	Bhucho Kalan Dist. Bathinda	Balianwali Dist. Bathinda	Gill Kalan Dist. Bathinda
Serial No.	6480	64505	64503	B-29420
MVA Rating	12 TO 20	12 TO 20	12 TO 20	12 TO 20
HV/LV in KV	66/11	66/11	66/11	66/11
Phases	3	3	3	3
Year of Manufacturing	2016	2015	2015	2014
Date of Installation	24-11-2016	08-12-2015	24-08-2015	26-05-2015
Aging (Days)	919	1270	1369	1470

Table 2 : Detail of Power Transformer (1, 2, 3 and 4)

Transformer No.	5	6	7	8
Constructed By	BBL	BBL	BBL	TAL
Location	Nathana Dist. Bathinda	Phul Dist. Bathinda	Kurali Dist. Ropar	Dhan Singh Khana Dist. Bathinda
Serial No.	5317/12	5425/17	5390/10	S00000258
MVA Rating	12 TO 20	12 TO 20	12 TO 20	12 TO 20
HV/LV in KV	66/11	66/11	66/11	66/11
Phases	3	3	3	3
Year of Manufacturing	2012	2014	2014	2014
Date of Installation	13-08-2015	21-11-2014	24-05-2014	26-03-2014
Aging (Days)	1474	1657	1820	1940

Table 3 Detail of Power Transformers (9, 10, 11 and 12)

Transformer No.	9	10	11	12
Constructed By	IMP	T.A.	ECE	ECE
Location	Kurali	Rampura Dist. Bathinda	Rampura Dist. Bathinda	Nathana Dist. Bathinda
Serial No.	PT.7004	2000030	85950	84799
MVA Rating	12 TO 20	12 TO 20	12 TO 20	12 TO 20
HV/LV in KV	66/11	66/11	66/11	66/11
Phases	3	3	3	3
Year of Manufacturing	2012	2009	2006	2003
Date of Installation	27-10-2012	26-03-2010	24-07-2007	14-11-2003
Aging (Days)	2394	3354	4330	5764

Table 1,2 and 3 shows the transformers data which are located at various sub-stations in Punjab has different construction company, date of installation, manufacturing year, etc. have same KVA rating and same number of phases.

Fig.1 12.5 MVA Power Transformer

DOI 10.17148/IJIREEICE.2019.7808

IJIREEICE

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Electrical, Electronics, Instrumentation and Control Engineering

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Fig. 2 10 MVA Power Transformer

Transformers whose data is collected are shown in Figures 1, 2. These are 12.5 MVA and 20 MVA Power Transformers.

III. RESULTS AND DISCUSSIONS

The graphical representation of the data is shown below which is collected from different sub-stations of PSPCL located in Punjab. The data which is collected from different sub stations is differing for each transformer and aging of each transformer is also different.

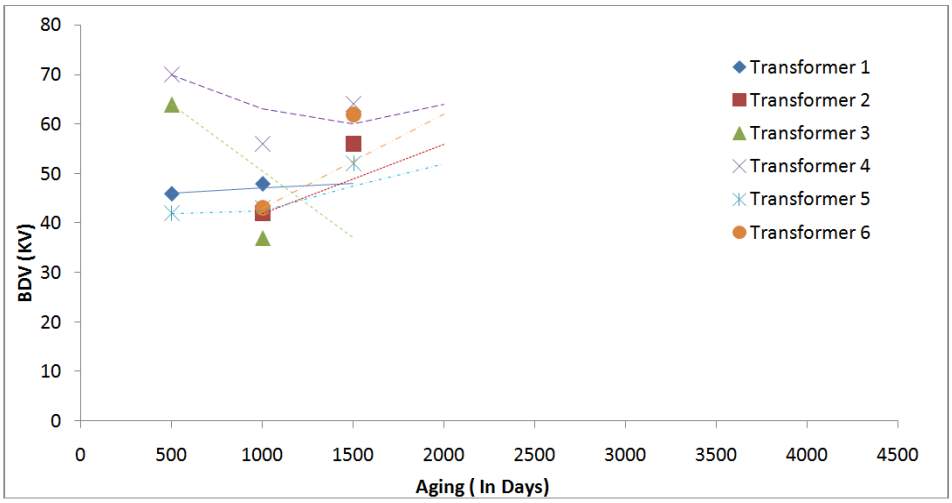

Fig. 3 Influence of aging on BDV of power transformers (Nos. 1, 2, 3, 4, 5, 6)

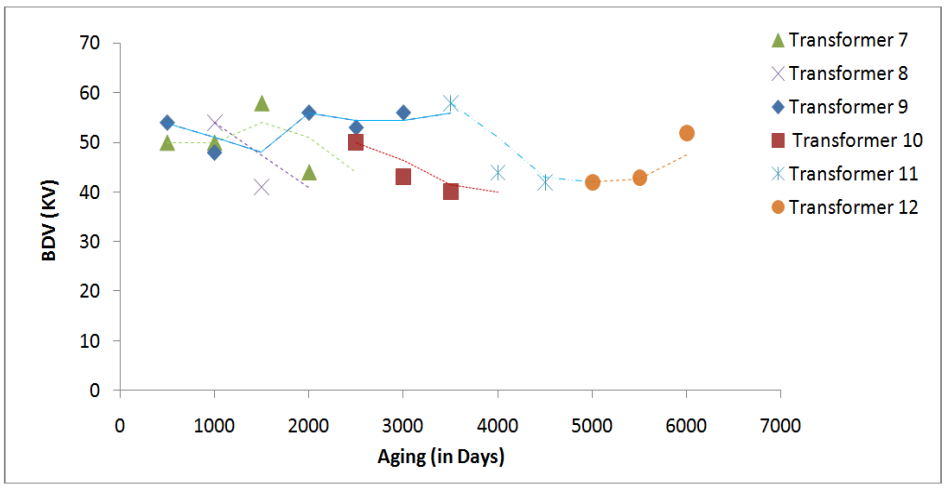

Fig. 4 Influence of aging on BDV of power transformers (Nos. 7, 8, 9, 10, 11, 12)

IJIREEICE

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Electrical, Electronics, Instrumentation and Control Engineering

Vol. 7, Issue 8, August 2019

Graph shown in Figure 3 and 4 represents the Influence of aging on Breakdown Voltage of Transformer 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12 respectively. Breakdown Voltage measured in KV. Aging of transformer represents in days.

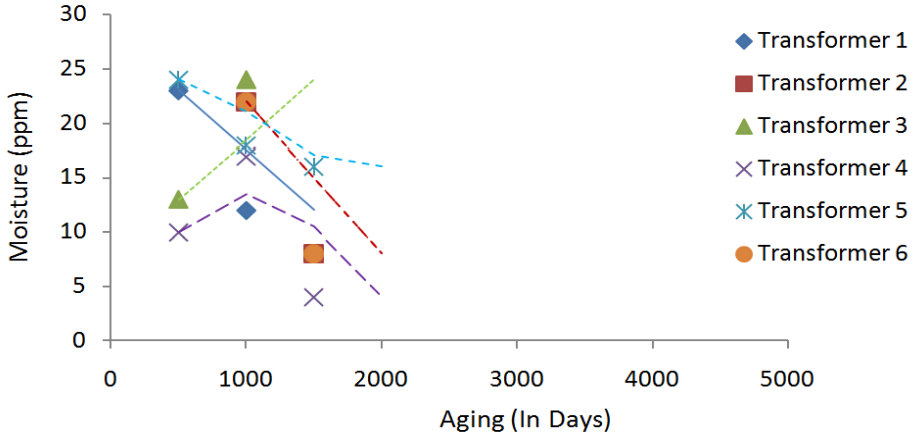

Fig. 5 Influence of aging on Moisture of power transformers (Nos. 1, 2, 3, 4, 5 ,6)

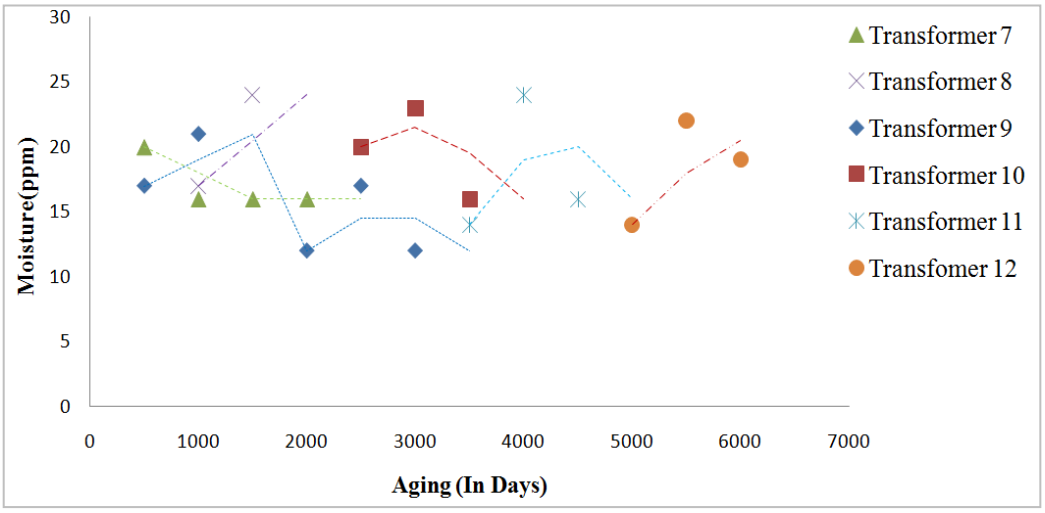

Fig.6 Influence of aging on Moisture of power transformers (Nos. 7, 8, 9, 10,11 ,12)

Graph shown in Figure 5 and 6 represents the Influence of aging on Moisture of Transformer 1, 2, 3 , 4, 5, 6, 7, 8, 9, 10, 11 and 12 respectively. Moisture measured in PPM. Aging of transformer represents in days.

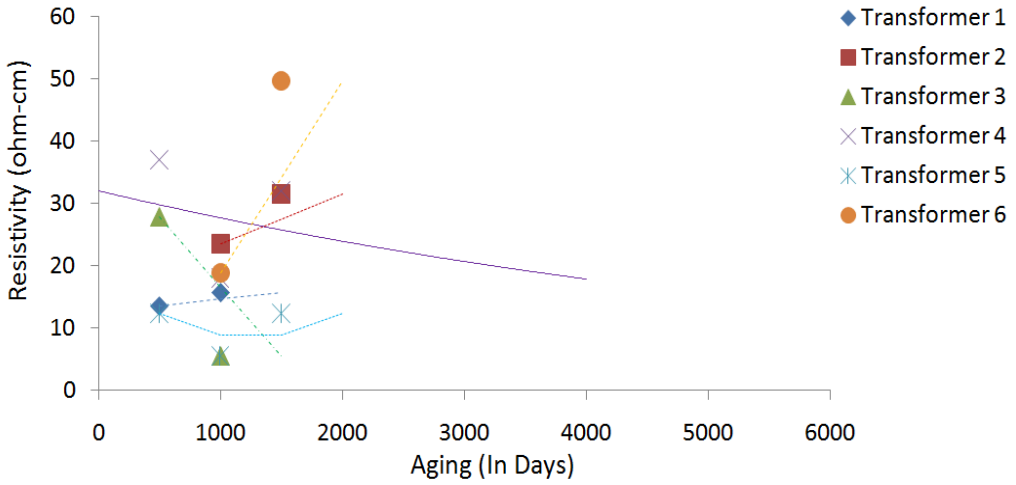

Fig.7 Influence of aging on Resistivity of power transformers (Nos. 1, 2, 3,4, 5, 6)

IJIREEICE

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Electrical, Electronics, Instrumentation and Control Engineering

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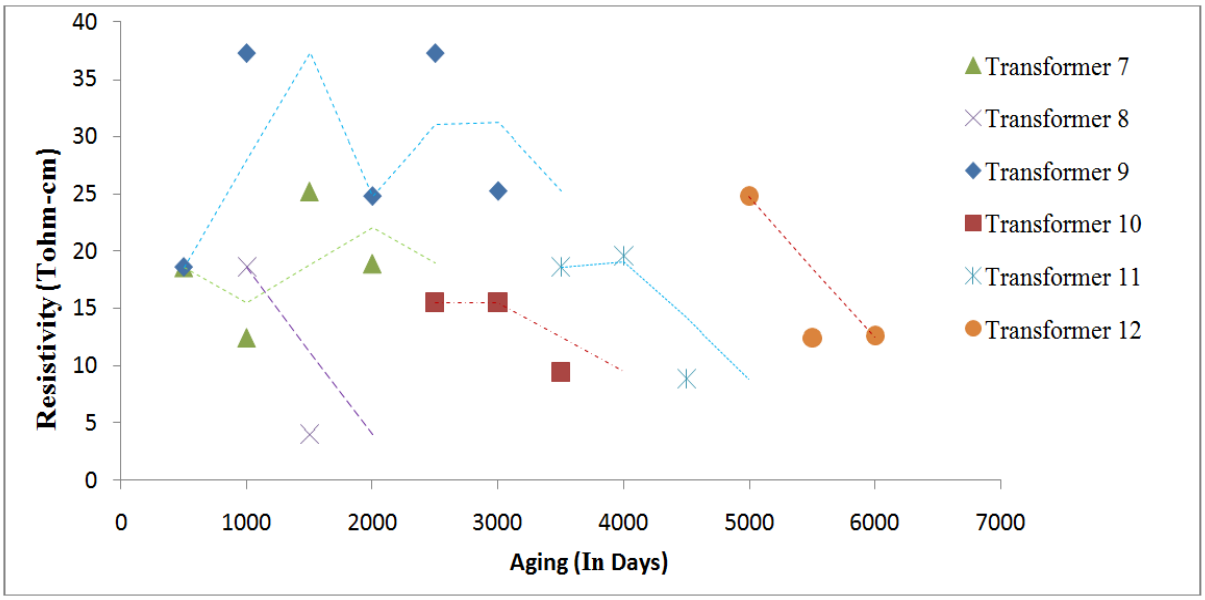

Fig. 8 Influence of aging on Resistivity of power transformers (Nos. 7, 8, 9, 10, 11,12)

Graph shown in Figure 7 and 8 represents the Influence of aging on Resistivity of Transformer 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 respectively. Resistivity measured in Ohm cm. Aging of transformer represents in days .

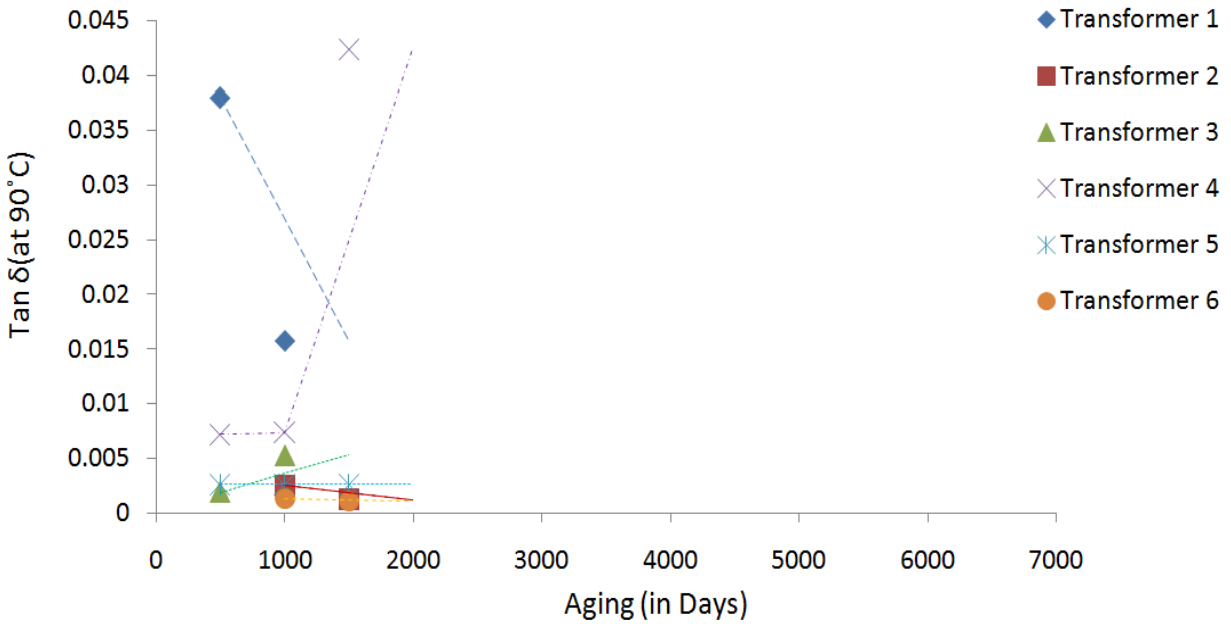

Fig. 9 Influence of aging on Tan-Delta of power transformers (Nos. 1, 2, 3, 4, 5, 6)

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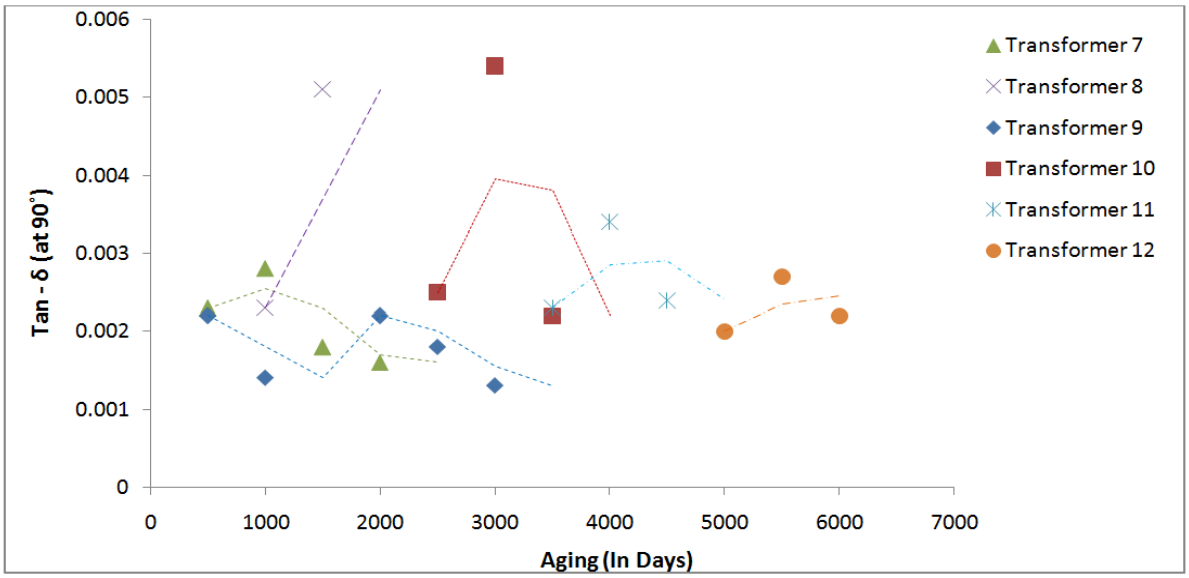

Fig. 10 Influence of aging on Tan-Delta of power transformers (Nos. 7, 8, 9, 10, 11, 12)

Graph shown in Figure 9 and 10 represents the Influence of aging on Tan-Delta of Transformer 1, 2, 3, 4, 5, 6, 7 , 8 , 9, 10, 11 and 12 respectively. Tan-Delta measured in 90˚C. Aging of transformer represents in days.

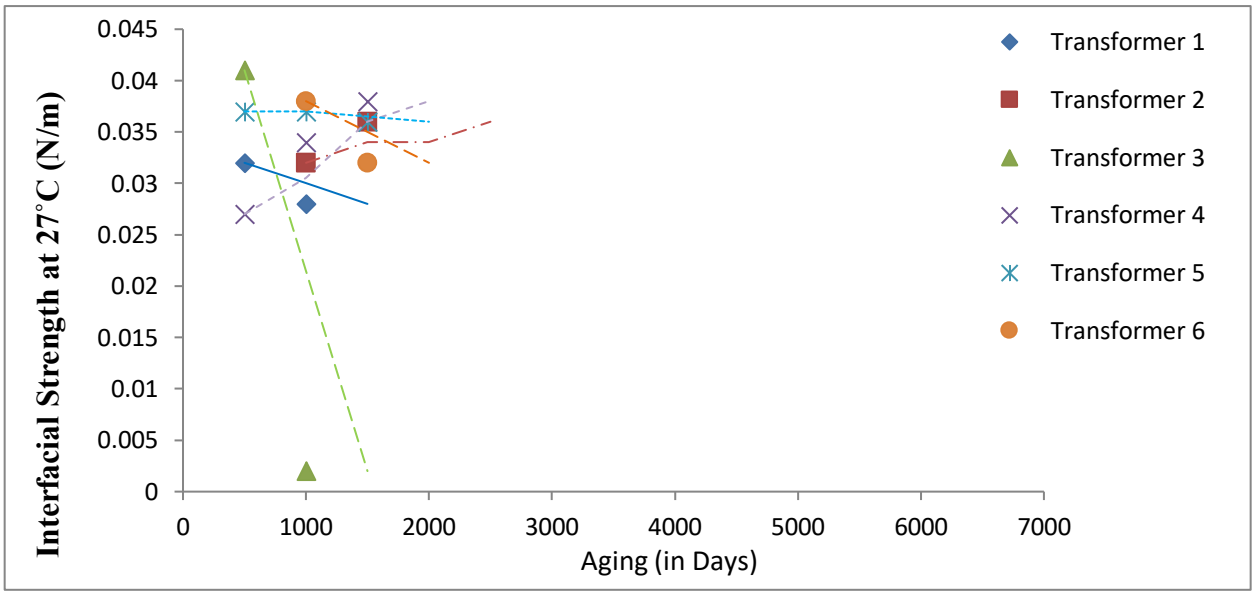

Fig. 11 Influence of aging on Interfacial Strength of power transformers (Nos. 1, 2, 3, 4, 5, 6)

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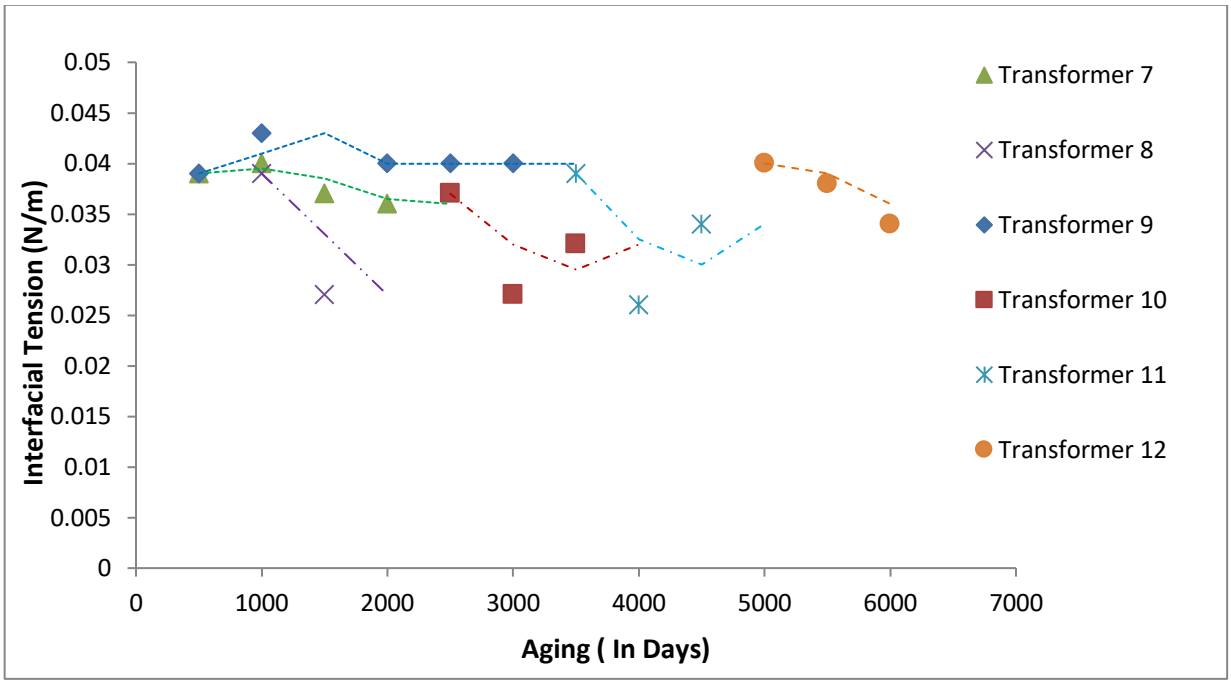

Fig. 12 Influence of aging on Interfacial Strength of power transformers (Nos. 7, 8, 9, 10, 11, 12)

Graph shown in Figure 11 and 12 represents the Influence of aging on Interfacial Strength of Transformer 7, 8, 9, 10, 11, 12 respectively. Interfacial Strength measured in 27˚C N/m. Aging of transformer represents in days.

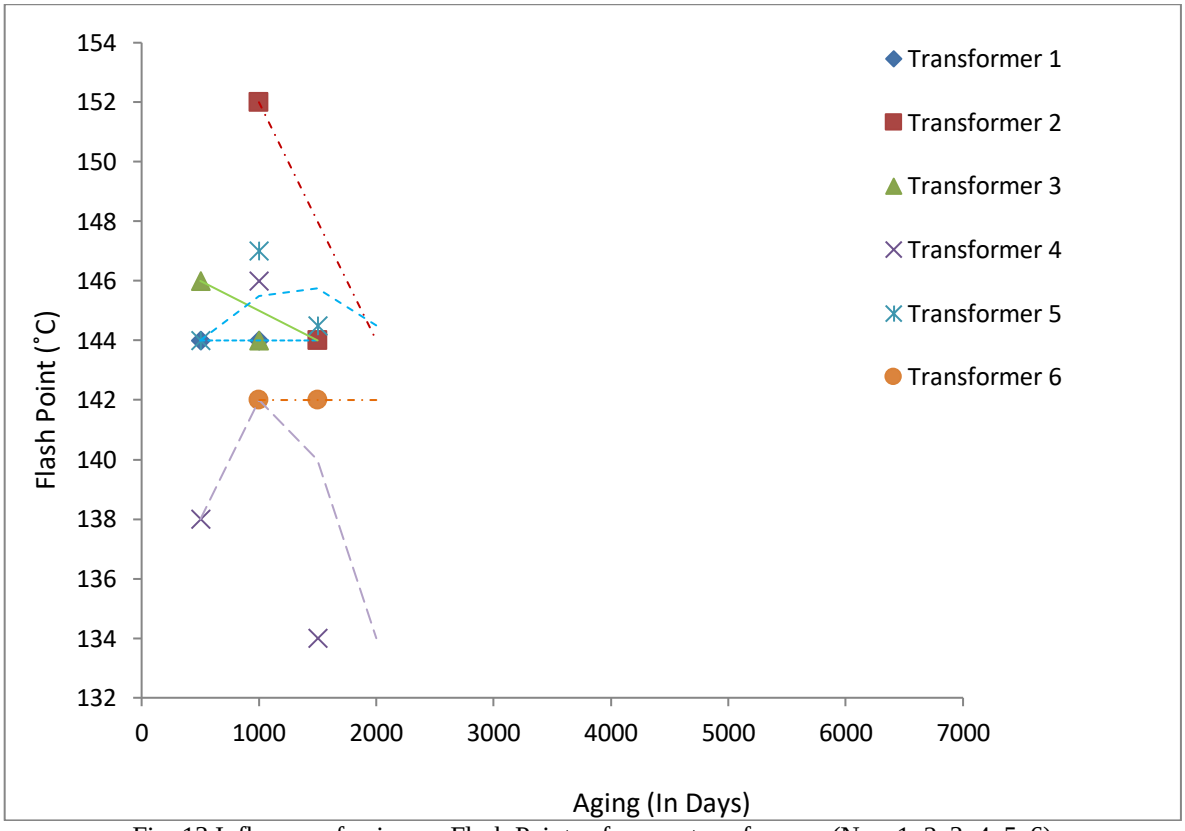

Fig. 13 Influence of aging on Flash Points of power transformers (Nos. 1, 2, 3, 4, 5, 6)

IJIREEICE

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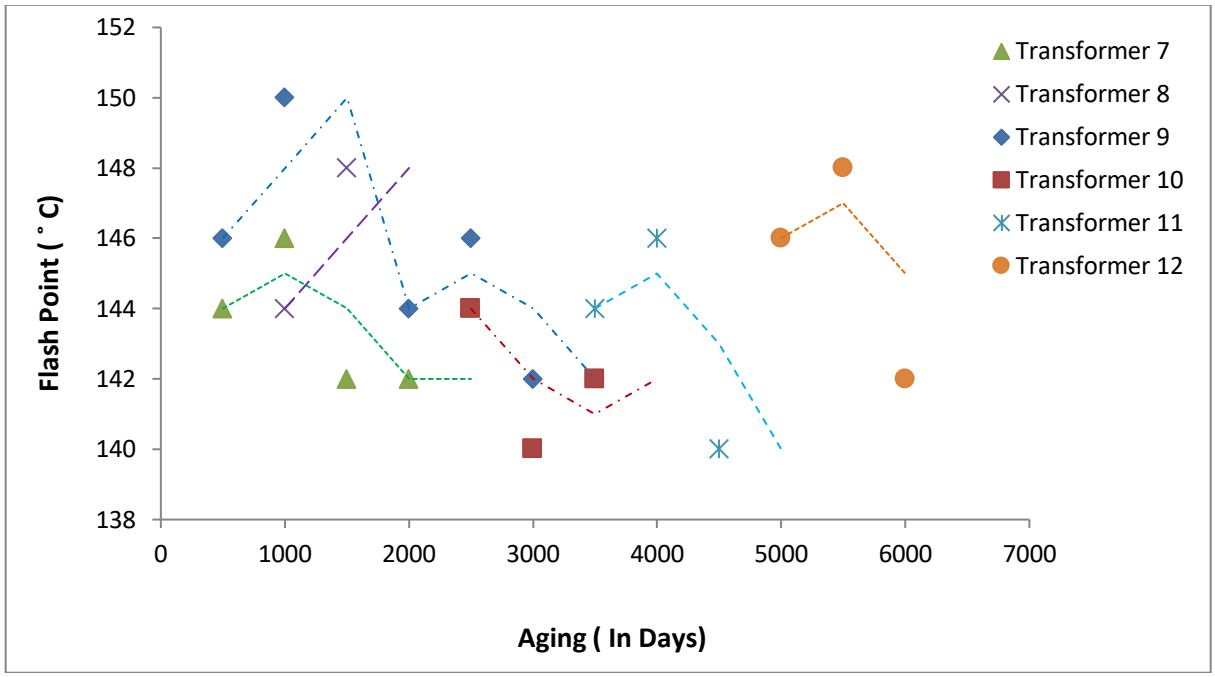

Fig. 14 Influence of aging on Flash Points of power transformers (Nos.7, 8, 9, 10, 11, 12)

Graph shown in Figure 13 and 14 represents the Influence of aging on Flash Points of Transformer 1, 2, 3, 4, 5, 6, 7 , 8, 9, 10, 11 and 12 respectively. Flash Points measured in ˚C . Aging of transformer represents in days.

IV. CONCLUSION

In a summary, in this work power transformers of rating 12.5 MVA to 20 MVA of different manufacturing company and date of installation and same rating starting from 2003 to 2016 have been reported. The properties of insulating oil such as breakdown voltage, moisture, tan-delta, resistivity, interfacial tension and flash points have been represented graphically with respect to aging of transformer. It is concluded that some of the properties are increasing and some decreasing with aging in some of the transformers. It has been observed that transformer 3 is worse than the others, the reason may be due to improper maintenance, improper cooling system design, due to presence of conducting impurities, moisture contents, oxidation of oil, may be due to increases in size and number density of free particles, etc. Conclusion of the work is that the aging of power transformers will increase up to 40-45 years if we regularly do the maintenance of transformer's oil.

ACKNOWLEDGMENT

I would like to express my greatest gratitude to the people who have helped & supported me throughout my journal paper. Special thanks my parents for their undivided support and interest who inspired me and encouraged me to go my own way, without whom I would be unable to complete my journal. At last but not the least I want to thank my friends who appreciated me for my work and motivated me and finally to God who made all the things possible.

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ISSN (Online) 2321-2004
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BIOGRAPHIES

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