Chapter - 6

Transformer Oil

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CHAPTER - 6

TRANSFORMER OIL

INTRODUCTION

Transformer oil is like a blood in human body. Once power transformer is charged and commissioned, transformer oil becomes a key element to monitor the healthiness of unit and DGA is one of the important tools to predict probable fault developing in unit as well as analyse insipient trippings. In service, it is continuously performing the role of insulation under electric stress and cooling medium.

In India, the production technology, sourcing of petroleum crude and chemistry have undergone drastic changes in last 5 decades and today we have fairly good understanding of our requirement based on field experience.

Standardisation Committee thoroughly deliberated on various aspects and has come out with universally acceptable data-sheet of transformer oil specification, which could be easily produced and will perform in Indian weather conditions.

It is nevertheless, important to note that transformer oil alone can't perform unless designer takes care of following key points:

1. Design of cooling system to keep temperature rise under control.
2. Correct quantum of oil depending upon voltage and MVA rating of transformer.
3. To plug all probabilities of moisture ingress in transformer – Air-cell/ silica-gel breather/ Sealing System.
4. To confirm that oil does not react with any insulation material used in transformer.
5. Characteristics of oil for ageing must be studied in advance depending upon application of transformer in a system.
6. To take feedback from users on similar oil provided to other units in past for similar application.

The above key points must be covered in design review exercise.

Data Sheet

As per Annexure - 6.I and testing of oil as per specified standard is mandatory.

Pre-Commissioning Checks

1. Mode of transport and method of supply is important. Manufacturers and customers have to mutually agree on this. In case of bulk supply in tankers, due care is required to ensure that tanker is chemically neutral inside and sealed firmly for final inspection at its destination. In case, it is supplied in drums, it is to be ensured during usage that drum seal is intact.
2. Transformer oil received at site in tanker must be unloaded to another tank through filter machine only. Its BDV and PPM value for water content must be verified to ascertain that there was no infringement during transportation.
3. Transformer oil received in drums must be stored on an elevated platform. Drums are to be horizontally placed with its opening cap in middle.
4. Before filling oil in transformer through filter machine, it has to be filtered separately in oil tanks and ensure BDV and PPM value.
5. During filtration, temperature of oil must remain within 60°C.
6. Excessive filtration of oil must be avoided. In case BDV and PPM values are not achieved within 7 days, check the entire process thoroughly.

ANNEXURE 6.1

IEEMA STANDARD SPECIFICATION FOR TRANSFORMER OIL (for 132 KV & ABOVE CLASS UP TO 765 KV)

Sr. No.	Characteristics of Transformer Oil	Requirement	Method of Test
1	Appearance	The oil shall be clear transparent & free from suspended matter of sediments.	Visual. *(A representative sample of the oil shall be examined in a 100 mm thick layer, at ambient temperature.)*
2	Density, gm/cm^3 - at 29.5 ^{0}C maximum - at 20 ^{0}C	 0.89 0.895	IS: 1448 P16 ISO 3675 / ISO 12185
3	Kinematic Viscosity, in CST (sqmm/sec) - at 40 ^{0}C, maximum - at -20 ^{0}C, maximum	 12 1800	ISO 3104
4	Flash Point, ^{0}C minimum Penskey-Marten (Closed)	135	ISO 2719
5	Interfacial Tension at 27 ^{0}C Newton/M, minimum	0.04	ISO 6295
6	Pour point, maximum	- 30 ^{0}C	IS: 1448 P:10 / ISO 3016
7	Neutralization Value Total acidity mg KOH/gm, maximum	0.01	IEC:62021-1 or 2
8	Corrosive Sulphur (In terms of classification of copper strip+paper)	Not corrosive	IEC 62535 (1500C for 72 hrs)
9	Total Sulphur Content % w/w	< 0.15	BS 2000 Part 373 or ISO 14596
10	Electric Strength (Break down voltage) New Untreated Oil After treatment	 30 kV minimum (rms) 70 kV minimum (rms)	IEC 60156
11	Dielectric Dissipation Factor (Tan delta) at 90 ^{0}C	0.002 maximum	IEC:60247
12	Oxidation Stability[1] after 500 Hrs. @ 120 ^{0}C, Max Total Acidity in mg KOH/gm maximum Total sludge % by weight maximum DDF at 90 ^{0}C	 0.3 0.05 0.02	IEC 61125 (method C)
13	Presence of Anti Oxidation Inhibitor (Additive), Minimum Maximum	 0.25 % 0.4 %	IEC:60666
14	Water Content PPM (maximum) As delivered	< 30 (in bulk); < 40 (in drum)	IEC 60814

Sr. No.	Characteristics of Transformer Oil	Requirement	Method of Test
15	Poly Chlorinated Biphenyls (PCB) Content	Not detectable (< 2 PPM)	IEC 61619
16	Poly Cyclic (PCA) content, maximum	3%	BS 2000 part 346
17	2 FAL/ Furans, ppm	< 0.1	IEC 61198
18	Impulse Breakdown Voltage Test	> 145 kVp	ASTM method D 3300

Note:

1) In case utility decides to adopt uninhibited oil, only following change shall be applicable.

Sr. No.	*Characteristics of Transformer Oil*	*Requirement*	*Method of Test*
12	*Oxidation Stability after 164 Hrs. @ 120 ^{0}C, maximum* *a) Total Acidity in mg KOH/gm maximum* *b) Total sludge % by weight maximum* *c) DDF at 90 ^{0}C*	 *1.2* *0.8* *0.05*	*IEC 61125 (method C)*

2) In case of inhibited oil, content of additives shall be monitored by user at regular intervals and if depletion is observed below specified limit, corrective action shall be taken to prevent transformer risk in future.

3) P N A content shall be taken as finger print value by oil supplier and shown in acceptance test report.

4) When pour point (maximum) has been decided as (-30 ^{0}C), Lowest Cold Start Energizing Temperature shall be (-20 ^{0}C).