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Helvetica Technical paper on :
TOPIC: LIFE EXTENSION TECHNIQUE OF A POWER TRANSFORMER

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INTRODUCTION:- There are various methods of life extension Techniques of a power transformer. As Power distribution system transformers represent a substantial financial and work-time investment. Their availability and effective operating time can be increased by properly planned care and maintenance. Optimum expectations from any equipment is its' Faultless operation. The Life expectancy of oil impregnated paper and transformer board insulation is over twenty years, though subject to drying of insulation and quality filtering of insulation oil, transformer contains. The transformers are transported to site with empty insulation under pressurized nitrogen. Which requires De-gassing; followed by drying before filling with reconditioned oil. Alternatively, a transformer may have to be detanked to repair damages because of lightning or switching errors, or to determine the cause of excessive gas formation in Bucholz relay, or sharp increase in loss factor, etc. Here again the insulation requires drying, de-gassing etc.

With the help of MOBILE transformer oil purifiers, or centrifuging units [with its' accessories like Vacuum system, **Fuller's earth** system or **activated alumina** columns, instrumentation etc.] the all above said operations can be taken care of.

The transformer is also has to be treated for its longer life with all above said operations periodically, with the span of half yearly or quarter yearly maintenance.
The very purpose behind this is to improve the health of **OIP** insulation dielectric.

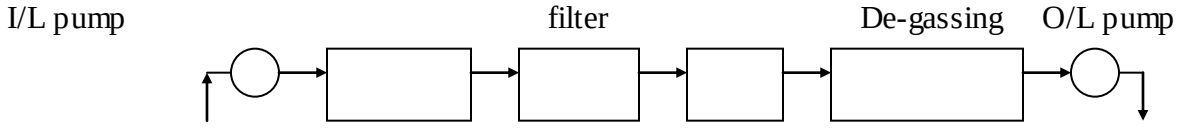
The following things are monitored during these activities: -

- Dissipation factor at 90 ^{0}c (tan δ) as per ----------IEC 250 /247
- Neutralization factor (Acidity of oil) ----------IEC 296
- Interfacial surface tension ----------IEC 296A
- Dielectric strength ---------- IEC 156
- Moisture / water content ---------- IEC760
- Sludge content ---------- IEC 422
- Dissolved gas analysis ---------- IEC567 / 599

Monitoring the above said parameters, needs use of **'Mobile transformer oil filter plant'** on periodic basis. That means the transformer oil in the transformer is required to be filtered with a PLANED maintenance, or planning for overhauls. Which involves the SHUTDOWN permissions from relevant authorities. This may not be possible on the **major grounds** of importance of the connected consumer needs, or political issues, or climate conditions, or socio-economical reasons.

OPERATION OF THE CONVENTIONAL TRANSFORMER OIL FILTERING PLANTS OR MACHINES: - The conventional mobile transformer oil filter plants or machines perform the following operations in a specific sequence, as described below.

Schematic Diagram of Mobile Filter Plant.



Oil in heater IRC Oil Out

1) **Suction pump**: - This pump is a **positive displacement** type pump (most commonly Gear pump) and this pump works as an **inlet pump** and takes the oil in the filter machine, from the transformer. It is then sent to **Heater Tank.** The need of this pump is for the penetration of the oil through the filter elements after heating.

2) **Heater Tank: -** This tank has cartridge HEATER elements, mounted in such a way that, they heat the in-coming transformer oil, to **reduce the viscosity** of the oil, so as to make it easier for filtration.

3) **Filter chamber: -** The relevant pore size filters (most commonly EDGE filters) are used with these Filter tanks or chambers. The heated oil enters in this chamber and, the output of oil from this chamber is given to the Ionic Reaction Chamber, to reduce the Acidity.

4) **IONIC REACTION COLUMN: -** This chamber consists of the **GRANULES** Of Activated Alumina, or Fuller's Earth. The HOT and FILTERED oil passes through this and the acidity of the oil gets reduced by ionic inter action of the oil with the granules. The oil is then passed to the De-gassing columns; where the Vacuum pumping system extracts out the dissolved gases and the moisture in the oil.

5) **OUT LET PUMP**: - This is a pump used to deliver the treated oil, back to the transformer.

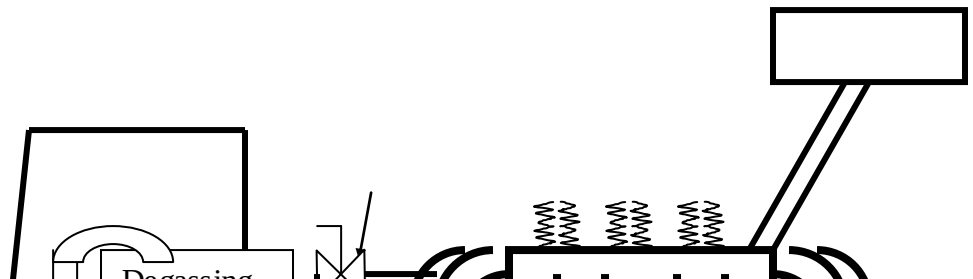
The use of the filter plant to treat the transformer oil in every transformer is very necessary as, ***Prolonging*** the **OIP** treatment may results in unwanted, unpredicted and unbelievable breakdowns of the transformer.

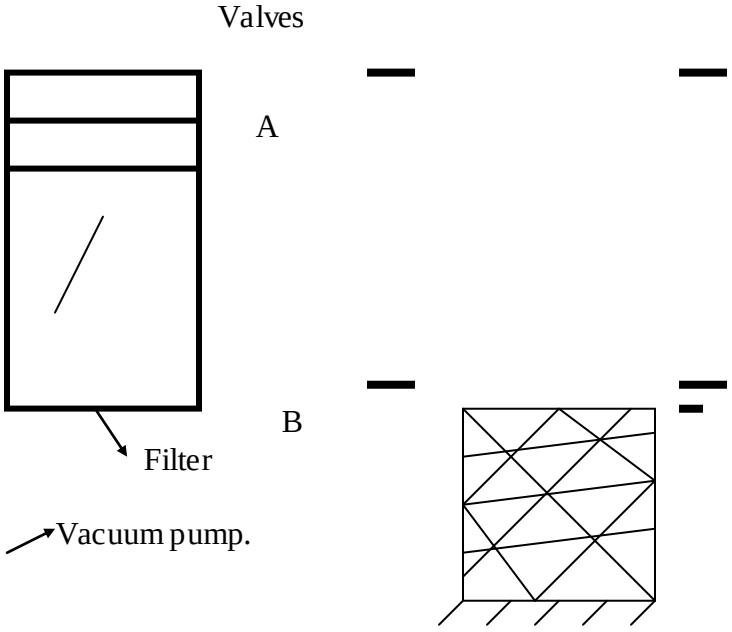
The use of all these pumps, heaters and all other said components of the Mobile filter plant consume very high power, approximately **1.5-watt/ ltr**, for minimum **1 hr**. For such a huge power consumption, a separate power connection
is needed.

But there is no alternative. To protect the transformer, the treatment is needed.

SOLUTION TO THE PROBLEM: -

We can solve this problem by using the technique called as **'THERMO-SIPHON' based transformer oil treatment plant**. Which can become an integral part of the Transformer. The schematic diagram of it is given below.





OPERATING PRINCIPLE: -
The transformer oil in the transformer has the cooling operation on the basis of **thermo-siphoning**. That means there is a development of oil currents, because the HOT oil being a lighter fluid floats over the comparatively cool oil columns of more viscosity. As the oil becomes hot because of operational heating of the windings. This Hot oil goes up and the cold oil (comparatively) comes down, there is an establishment of oil currents. These oil currents circulate the oil through the radiators.

The thermo siphoning effect is used to circulate the oil through the connected transformer oil purification system. The hot oil is fed to the filtration chamber; the other side of it is connected to the IONIC REACTION COLUMN, which reduces the ACIDITY of the oil. Further it is connected to the Degassing Chamber, which is Evacuated by High capacity Vacuum pump. The creation of vacuum in that chamber develops negative pressure of Approximate $1kg/cm^2$.
That means a suction pressure of $1kg/cm^2$. This suction pressure is sufficient for the oil particles to penetrate the filter pores.
This filtered oil, which is free from, suspended particles, is passed through the Ionic Reaction Columns. This oil having no suspended particles and reduced Acidity is subjected to High vacuum for de-gassing. This de-gassing process removes the dissolved gases and the moisture vapors from the oil. We need not heat the oil, neither we need to use the pressure-developing pump before filter. And we get the purified transformer oil at the outlet. This out coming oil becomes slightly cool due to de-gassing, hens again fed back at the bottom of the transformer.

Hence we are arranging the continuously working filter and de-gassing plant, in conjugation with working transformer, we are avoiding the accumulation of the acidity and the moisture in the transformer oil. Which reduces the chemical action-taking place on the paper insulation of OIP insulation, resulting in reduction of development of sludge and in turn **INCREASES THE LIFE** of the OIP insulation.

Increasing the life of insulation is nothing but the **INCREASING THE LIFE OF THE EQUIPMENT** that is the **Transformer.**

Comparison between the conventional Mobile plant and the Thermo Siphon plant. : -

The **only electrical power consumption cost of the Mobile filter plant**, in rupees is around **Rs.80/- per hour, for a 6kl plant (which is generally used for power transformers).** The processing cost can be calculated for a particular transformer. Normally the time consumption for processing of one transformer is in days (may be 8 to 20 days).

It means the processing cost (only electrical) for a transformer varies from Rs.15,500/- to Rs.40, 000/-. Then the other costs like **Labor cost, Lubricants cost, and machinery handling cost,** and oil filtration losses etc. make this **OIP** treatment very very **expensive**.

The **electrical power consumption cost of the Thermo-siphoning plant**, in rupees is around **Rs.1.04/- per hour. When we are using this system, we need to provide the supply externally for vacuum pump only.** The processing cost can be calculated for a particular transformer. As the time consumption for processing of one transformer is in significant, as we are processing it round the clock,
We do not need **separate Labors** etc for it.

Even we can develop these **Thermo-siphoning plants** for the capacities, suitable to the **Distribution transformers** as large as **240MVA 400 kV** power transformers.

SOURSES: -

There are few companys, who have developed and supplied such equipments at few places in INDIA.

Now, M/S Vacuum Plants And Instruments Manufacturing Co.Ltd. Pune. M/s VCPI Aurangabad, M/s Chaitanya Engineers and Associates Aurangabad, M/s Crompton Greaves Ltd and few other manufacturers developed their own designs and technologies in this area.

This is an **un-seen** or **un-attended** technology. There is a need of further researches in this area of need.

The recent know-how and other details about this technology can be made available with the author and the companies listed above.

The more detailed information about this technology requires more booking pages. Which covers the discussions about various insulation co-ordinations and the VA ratings, Voltage, current and temperature ranges, as well as the locations of the transformers.

Present attempt is to make the readers, aware of this technology. Various suggestions and more details will be welcome and appreciated.

Regards!