Mobile Transformer Oil Purification Plant

July 2020 Brochure

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ABSTRACT

The necessity for regular purification of electrical insulating fluids in electrical apparatus has always been recognized. Moisture, solids and gaseous contaminants can affect the function of electrical insulating fluid as a coolant and insulator to a significant extent. This specification describes the equipment as supplied for the processing (degasification, dehydration, filtration and de-acidification) of transformer insulating oil. The purifiers are designed for processing transformer oil in workshops or in the field, in storage tanks, drums or directly in transformers. Purification of oil in transformers can be carried out off-load or on-load depending on the customer's preference. For purification of oil in the field, a mobile type purification plant, mounted on a roadworthy trailer and covered by a weatherproof canopy, is recommended and avaliable.

SCOPE OF SUPPLY

The scope of supply of this specification shall include the design, fabrication and factory testing of Vacuum Oil Purifier. Type E. Equipment will be mounted on a common base (open frame) or in a trailer and supplied in the form of a pre-piped and pre-wired package and shall provide a fully workable unit in accordance with this specification when received by the purchaser.

MANUFACTURING

The Purification Plant will be manufactured in **South Africa** to the highest standard. All components are 100% sourced from **local suppliers** as well as the best European manufactured components are used where possible. Also, all suppliers are located within a 50 kilometer radius from our site, meaning quick turnaround on services and repairs.

PERFORMANCE

The plant offers performance in a single pass through the purifier at full flow rate including:

Dielectric Strength: Improvement in dielectric strength up to 70kv with new oil.

Water Removal: From 50ppm down to less than 5ppm in a single pass and down to 3ppm after two passes as measured by the ASTM Method D-1533 Particulate removal: 98% of particles over 0.5 micrometer, or over 1 or 5 micrometer, as per your preference.

Gas Removal: From fully saturated with air (10 to 12% by volume) down to less than 0.1%% by volume as measured by the ASTM Method D-2945.

APPLICATIONS

- Various flow rates from 600l/h to 16000l/h
- Optional vacuum booster for improved performance
- Mobile or skid mounted units available
- On line water in oil sensor displaying water content in ppm
- PLC and SCADA controls options
- Dual vacuum system
- Power supply cable options
- Extension oil hoses options

FEATURES

- In house design capabilities
- On time delivery
- Customised units to meet your needs
- Highly specialised and experienced employees
- Professional after sales service

The oil purifier plant is equipped with various **access doors** enabling easy entry to internal components. The **control panel**, mimic and **vacuum chamber** front view are located at a comfortable level for operator convenience. The plants can be manufactured with **flow rates** from **600** liters an hour up to and including **16000** liters an hour, depending on the client's needs. Some examples: three most popular models, namely the TS-2000, TS-4500 and TS-6000, with flow rates of 2000 liters/hour, 4500 liters/ hour and 6000 liters/ hour respectively.

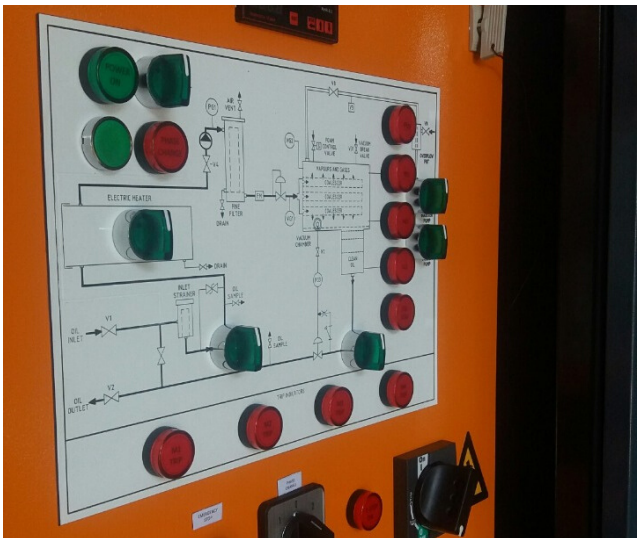
The plants are built on **open framed skids**, although **mobile options** are available. In this case the plant is built onto a single/ double axel trailer with access doors. Main power supply on all plants will be 400V/3PH/50Hz – control voltage 24 vac.

PROCESS DESCRIPTION

The process of treatment is based on the available technology:

Spreading of Oil: Which is vital for easy release of moisture and gaseous containment's is accomplished by porous media cartridge, called a coalesce. In this process, heated or unheated oil passes through the layer of bonded fiberglass, where millions of sharp edges shear oil and expose it to the effect of the vacuum. Spreading of oil by passing through porous media is so efficient that oil can be treated at temperatures as low as 20˚C.

Filtration: Of oil is by filtration cartridges constructed of non-migration type cellulose material featuring a large surface area and dirt holding capacity. Obvious advantage of cartridge type filters is the low cost of filtration, easy and fast change of filter cartridges and no loss of oil or time for back washing etc.



The flow diagram shows the main components of a typical unit for Oil Purification of electrical insulating oils. Insulating oil is drawn in by an Inlet Pump, and is heated up in the Heater and filtered by Fine Filter before it reaches the Processing Chamber where water and gasses contained in the oil are thoroughly exposed to vacuum by efficient by spreading and removed through a Vacuum Pump. Operation & Maintenance- the purifiers combine maximum simplicity with high safety standards. A number of sensing devices are built in, continually monitoring all vital parameters (see Alarms & Interlocks). If any of these parameters deviate from normal operation, the purifier will shut down, positively preventing inlet or outlet of oil, and a diagnostic light will remain on to inform the operator what corrective action is required.

MAIN COMPONENTS

Inlet Strainer: Solid particles over 90 microns are retained in the inlet strainer, preventing damage to the inlet pump and other components.

Inlet Pump: One positive displacement gear type pump complete with mechanical seal direct driven by TEFC motor.

Electric Heater: A low watt density heater (max. 1,7 watts/em") is used to prevent heat degradation of oil. Heater elements are encapsulated in steel tubes thus completely insulated from oil to prevent fire hazard and to provide uniform heating of oil. Heaters are controlled by heavy-duty contractors and a failsafe electronic type temperature controller

Fine Filter: Solid contaminants are retained by a cartridge type filter, featuring easy and fast replacement of cartridges.

Processing Chamber: Shell and all internal parts are made of carbon steel construction. Vacuum chamber features heavy-duty design, suitable for mobile installation.

Vacuum Pump: Mechanical vacuum pump rotary vane type is air-cooled, direct driven by electric motor and is sized to maintain vacuum of less than 1 mbar in vacuum chamber during last pass.

Oil Discharge Pump: A centrifugal pump featuring high suction capability removes oil from processing chamber and discharges it through a flow meter back into the transformer. Pump is direct driven by TEFC motor mounted on a common base.

INSTRUMENTATION

Instrumentation and electrical controls are located in a **dust proof** enclosure. A mimic panel is provided for the convenience of the operator showing the functions of the main components of the plant by way of **pilot lights**. Although the Purifier features fully automatic operation, a manual override of various functions is provided as standard. Even with manual override vital plant protection such as oil overflow are still in force.

The **standard** Instrumentation is compromised of:

Temperature Controller (1): An electronic type, highly sensitive featuring fail safe operation. Therefore a separate high temperature cut out is not required.

Vacuum Indicator (1): Absolute (capsule type) has a measuring range of 0-25 mbar.

Pressure Gauges (2): Installed before and after oil filters with measuring range of 0-400 KPa.

Vacuum Gauges (2): Before and after coalesces with measuring range of -100 to 0 KPa.

Flow Meter (1): With totaliser up to 999 990 Liters

Level Control (1): Continuously maintains level in vacuum chamber within 10 mm of normal

Flow Control (1): Manually adjustable from 10% to 100% of normal flow or intermittently down to 0%.

Foam Control (1): Occasional frothing or foaming oil can develop, especially if oil contains high amount of moisture or during initial heat up stage. If high foam is detected, vacuum will be reduced automatically and foaming reduced to acceptable level. Plant operation is not affected, unless severe foaming conditions persist for more than 3 seconds. After that the plant will shut down (see par. Alarms & Interlocks)

ALARMS & INTERLOCKS

The following **alarms** and interlocks ensure simple and safe operation of purifier:

Heater: Heater switches on only when flow of oil is positively ensured.

Foam / Overflow: Foam or oil overflow to vacuum pump positively prevented by photoelectric sensor.

Vacuum Break: Automatic break in vacuum chamber to pressurise and to protect vacuum pumps.

Low Level Alarms: Indicates absence of oil and will shut down plant.

Overloads: All motors are protected by overloads

Sound Alarm: In the form of a panel-mounted siren is provided.

Shut Down: Automatic and tight plant shut down in the case of any alarm situation

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In addition to direct alarms a number of **interlocks** are incorporated for safe operation:

Low Level / High Level Alarm:
If the level control system fails, either the High or Low Level Alarm will be activated and will **shut down** the plant.

OR

In the case of the inlet or discharge valve being closed during start-up or operation, no over pressure condition can occur, since High Level Alarm will **shut down** the plant

OPTIONAL EQUIPMENT & ACCESSORIES

Activated Fuller's Earth Filter: Fuller's Earth filters are used to remove a multiple of contaminants from transformer oils.

NOTE: Activated Fuller's Earth filter option is not designed to be used for regeneration/reclamation of transformer oil but for oil polishing. Activated Fuller's Earth cartridges are of the disposable type and are easy to change. They are only used for small quantities of oil. If the application is for large quantities of oil for regeneration/recycling, a regeneration plant is recommended.

Mobile Installation: Mounted on a roadworthy trailer. Single axle (up to 7000 liter/hour capacity) or a double axel trailer for higher capacities, is of steel weatherproof construction. The trailer is equipped with a 2" ball or pin tow hitch and an override brake as standard. Access to the machinery is through two double doors at the rear end of the trailer and side doors are fitted where required. Internal illumination is provided for lighting up the working area.

Portable Installation: Similar to mobile installation, two swivel and two fixed castors are used to move the purifier around the factory floor.

Vacuum Booster: For transformer evacuation and dry out, Vacuum Booster (Roots Rotary Blower) is recommended. Vacuum booster and pump combination is less sensitive in pumping large amounts of water vapor which is the case in transformer dry outs. Oil over flow device is incorporated to prevent oil from transformers entering into the booster.

NOTE: If this option is taken the backing vacuum pump size is then reduced. Please refer to the Flow

Schematic PLC Controls: The purifier can also be equipped with a simple PLC (programmable Logic Controller) to control the operation of the plant. The operator will simply push the "Start" button and the PLC will sequentially start the plant. If the operator pushes the "Stop" button, the plant will sequentially shut down after a 5 minute period to cool the heaters. Further facility exists that the plant can still be controlled manually by operator selecting "Manual Control". Even in manual control the PLC will look after all alarm functions in the plant. PLC type used is OMRON

Power Cable: Plant will be supplied with a 20m four-core flexible trailing cable.

Water Sensor: The plant can be equipped with an in line water in oil monitor. The monitor will display water content in the transformer oil in ppm (parts per million)