

SITRAM REG

Regeneration and removal of corrosive sulfur Preventive Maintenance

Introduction

Rising costs and performance pressures are forcing many operators to increase the utilization capacity of their transformers. Moderately aged transformers and network couplers are increasingly being operated at higher rates and in many cases using nominal power for the first time. At the same time, operating downtimes planned for maintenance have been reduced or completely eliminated.

The escalating load has led to more rapid ageing of insulating oil and the solid insulation. This can result in a drastic degradation of the dielectric properties of the insulating oil, which seriously endangers reliable transformer operation.

SITRAM REG, the online regeneration technology, is able to clean aged or corrosive transformer oil, restore its dielectric properties and increase the transformer availability. Regeneration processes requires special equipment, high competence and long time experience of staff. Siemens operators have experience in online regeneration of more than 300 transformers with different design, connections and at various ambient temperatures.

Features

SITRAM REG is a modified reclamation process based on the IEC 60422 standard. Oil is circulated continuously through regeneration columns in the plant.

Highly effective adsorption agents (activated fuller's earth) absorb the soluble and insoluble polar impurities,

degradations products as soon as corrosive sulfur compounds. The cleaned oil flows back into the transformer. This process cycle is carried in dependence of the size of the transformer and the condition of the insulating oil for several days up to weeks. SITRAM REG is carried out without interrupting transformer operation.

The term "fuller's earth" describes a group of naturally occurring minerals with different constituents and properties. SIEMENS SITRAM REG technology applies only natural fuller's earth mixture has high catalytic properties and is highly reactive with all kinds of corrosive sulfur compounds.

Benefits

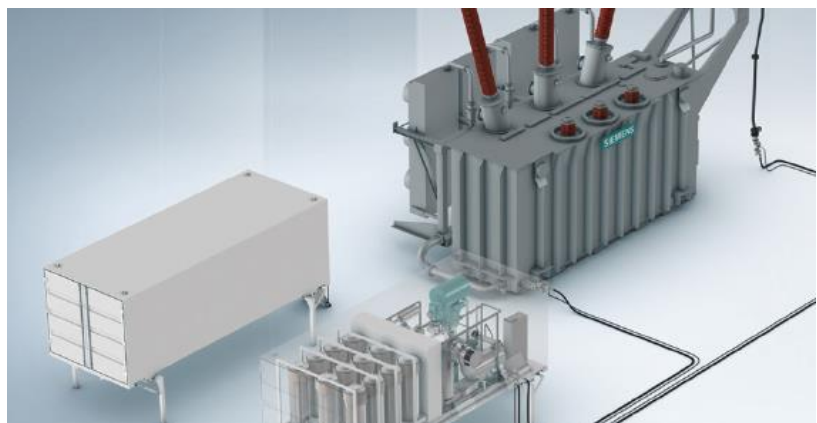
- Improvement of transformer oil to "actual new oil quality"
- Long-time improvement of transformer insulation condition through excellent and long-lasting

cleaning effect.

- More economical compared to oil change
- Complete and long-lasting removal of DBDS or another aggressive corrosive sulfur compounds
- Decrease of transformer failure possibility – reliability increase of old transformers
- Applied on energized transformers (no shutdown) – online regeneration process for units with oil amount
- Great and long-lasting cleaning effect

Scope of work / Deliverable

- SITRAM REG delivery to customer's site and Installation
- Connecting double-walled hoses and cable, venting of hoses and starting up the plant.
- Continuous reclamation of transformer oil
- Process accompanying oil tests in mobile laboratory
- Completing the process, topping up oil and adding inhibitor
- Draining and cutting hoses, hand over the transformer back to the customer
- Oil analysis in Siemens laboratory in Nuremberg with final test report.



SITRAM REG is a mobile solution. Mounted in a container, available at the transformer's installation site

Property	Limits values recommended for oil regeneration		Recommended limits for mineral insulating oils after filling in new electrical equipment prior to energization				
Acidity	Nominal system voltage > 170 kV	▶ > 0,15 mg KOH/g oil	Parameter	Unit	After filling, prior to energization IEC 60422		IEC 60296 for unused mineral insulating oils
	Nominal system voltage > 72,5 ≤ 170 kV	▶ > 0,20 mg KOH/g oil	Highest voltage for equipment				
	Nominal system voltage ≤ 72,5 kV	▶ > 0,30 mg KOH/g oil					
			Colour acc. ISO 2049		< 72,5 kV max. 2,0	72,5 bis 170 kV max. 2,0	> 170 kV max. 2,0
Dielectric dissipation Factor at 90 ° C and 40 Hz to 60 Hz	Nominal system voltage > 170 kV	▶ > 0,2	Acidity	mg KOH/g oil	≤ 0,03	≤ 0,03	≤ 0,03
	Nominal system voltage ≤ 170 kV	▶ > 0,5	Dielectric dissipation factor at 90 ° C and 40 Hz to 60 Hz		≤ 0,015	≤ 0,015	≤ 0,010
			Interfacial tension	mN/m	≥ 35	≥ 35	≥ 35
			Breakdown voltage	kV/2,5mm	> 55	> 60	> 60
Sludge	Where perceptible sludge is detected						after laboratory treatment 30-40 after delivery
Inhibitor	Inhibitor concentration < 40 % of original/initial value		Water content	mg/kg oil	< 20	<10	<10
			Corrosive sulphur		Non-corrosive		
			DBDS content	mg/kg oil	< 5		
Additional parameters	High colour value, low interfacial tension, Presence of sediments or sludge, or both Low passivator content		Experience values after implemented regenerations				
			Parameter	Unit	Typical values prior to regeneration	Siemens values after regeneration	After three years
			Colour acc. ISO 2049		4,5 – 6,0	≤ 1,0	1,0 – 1,5
			Acidity	mg KOH/g oil	0,15 – 0,30	< 0,01	≤ 0,01
Corrosive sulphur	Oil corrosiveness		Dielectric dissipation factor at 90 ° C and 40 Hz to 60 Hz		0,050 – 0,500	< 0,005	≤ 0,008 – 0,010
			Interfacial tension	mN/m	15 – 25	≥ 45	≥ 38 – 40
			Breakdown voltage	kV/2,5mm	40 – 60	≥ 70	≥ 60
			Water content	mg/kg oil	15 – 20	< 5	
In addition to above mentioned limits recommends IEC 60422 Standard regeneration, when rapid deterioration or acceleration in the rate of deterioration was observed.			Corrosive sulphur		Non-corrosive	Non-corrosive	Non-corrosive
			DBDS content	mg/kg oil	30 – 300	< 5	< 5

After successful oil regeneration under optimum process conditions, even insulating oil that has been used for years still fulfills the limit values with long-lasting effects comparable with applied limit values for new oils after filling in new transformer. In addition, the essential parameters for the dielectric properties of the oil remain stable even years after regeneration treatment. If implemented in a timely manner, SITRAM REG effectively and verifiably helps to extend the service life of transformers sustainably.

Technical Details

Regenerate instead of oil change

Reclaiming the oil filling offers several advantages over conventional oil change. It causes the equilibrium conditions to shift and produces the immediate onset of diffusion of all embedded degradation products from the solid insulation to the surrounding insulating oil. During the regeneration cycle they are bound by the adsorption agent and eliminated from the circuit.

In addition, treatment with SITRAM REG provides a clear improvement in ageing stability – in the case of an oil change, up to 15% of the old oil and almost all embedded and deposited ageing residue products remain in the transformer and cause the rapid onset of ageing of the new oil filling – a problem that doesn't even come up with SITRAM REG.

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The advantages over an oil change

- No service interruptions even for small transformers
- Saves resources
- Additional removal of moisture
- Great and stable long-term cleaning effect

Preventive Maintenance pays off

The degradation products embedded in the insulation system have a catalytic effect. Along with the high operating temperature, there can be a drastic decrease of remaining service life. Degradation of the solid insulation is irreversible and cannot be reversed by regeneration technology. As a result, regeneration should be carried out preventive as a rule. The timely, preventive use of SITRAM REG is a crucial weapon in the battle against the reduction of service life. However, oil regeneration is also recommended for high-aged transformers that must continue to operate. The condition of the solid insulation is preserved in this way, counteracting progressive ageing.

Advantages of the application on energized transformers

During oil regeneration process, not only the transformer oil should be cleaned. Also solved and impregnated oil in cellulose and cellulose itself have to be cleaned. Only in this case it is possible to keep the transformer oil purity at high level during the next years and achieve a long-lasting cleaning effect. Regeneration during transformer operation has advantages for the cleaning processes:

- A temperature difference between the windings and the surrounding oil increases the diffusion pressure.
- Higher temperature and mechanical vibrations contribute to redissolving processes.

Safety measures during SITRAM REG regeneration process

In order to guarantee highest transformer safety and prevent oil losses at all times during oil regeneration projects, an approved leak detector device using double walled hoses and solenoid valves is applied. Solenoid valves are installed at the four connection points of the flow and return flow. These valves are connected to the leak detector and central control system and immediately close by triggering of alarm.



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