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Transformer Oil Sample Analysis

Increasingly in industry organisations are choosing to purchase power at high voltage to enjoy lower cost electricity and electing to purchase and maintain their own step-down and distribution transformers. This introduces a business continuity exposure, particularly where power supply is critical to continued operation or there are no alternative sources of power supply from emergency generators or secondary in-feed. Catastrophic failure of a transformer can result in protracted business interruption, particularly if the transformer is of an unusual capacity or size. Transformer manufacturers no longer hold transformers in stock even in standard sizes, most are now made to order and therefore lead times for replacement can be as much as twelve months. A fire or explosion within a transformer can also threaten other essential assets or equipment on site or spread to neighbouring property.

Like all items of essential plant and equipment, transformers need to be subject to routine and programmed maintenance and testing. As a minimum, transformers should be installed, operated and maintained in accordance with the manufacturer's recommendations.

The majority of conventional power and distribution transformers in service in Australia are of Oil Natural Air Natural (ONAN) cooling type. Considerable understanding of the condition and operating efficiency of the transformer can be gained through sampling the dielectric insulating fluid and testing it for impurities and dissolved gasses. Thermal and electrical faults in power transformers decompose insulating materials and generate gases which dissolve in the oil.

This testing should be performed by a competent, independent and accredited specialist laboratory to an acknowledged standard. The test results will provide you with and indication of an incipient fault long before serious damage occurs. When a fault occurs in a transformer, the cooling oil is broken down into a number of gaseous bi-products which readily dissolve into the cooling oil. The presence and quantities of these various gasses at abnormal levels can be interpreted as potential or existing problems with the transformer. The following should be considered as a guide only as different manufacturer's oil products will have different tolerances.

Gas	Syb.	Normal	Abnormal	Interpretation
Hydrogen	H_2	< 150 ppm	> 1000 ppm	Arching, Corona
Methane	CH_4	< 25 ppm	> 80 ppm	Sparking
Ethane	C_2H_6	< 10 ppm	> 35 ppm	Local overheating
Ethylene	C_2H_4	< 20 ppm	> 100 ppm	Severe Overheating
Acetylene	C_2H_2	< 15 ppm	> 70 ppm	Arcing

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Gas	Syb.	Normal	Abnormal	Interpretation
Carbon Monoxide	CO	< 500 ppm	> 1000 ppm	Severe Overloading, Overheating in paper insulation
Carbon Dioxide	CO_2	< 1000 ppm	> 15000 ppm	Severe Overloading

"Wearcheck Africa – Transformer General Information"

The cooling oil sample analysis can measure the dielectric strength of the oil. This will provide a measure of the oil's insulating properties and therefore the presence of contaminants such as water and acids.

Water in the oil will accumulate over a period of time and ultimately collect in the bottom of the transformer tank. The presence of dissolved water will adversely affect the performance of the oil to insulate. The presence of oil may also cause tank corrosion and failure. Water can also affect paper insulation and the remedy is often expensive and protracted.

Insulating oil will age with time, heat, water and oxygen resulting in the formation of a series of polar breakdown products such as organic acids, peroxides and ketones. The degradation of the oil from aging can be assessed by measuring the levels of acid in the oil. High levels of acid in oil will form sludge which can be partially conductive and be a heat insulator. This sludge can also block cooling reticulation thus generating more heat and accelerating the aging process.

The frequency of testing varies with the type, size age, and use of the transformer. The manufacturer's recommended frequency of testing should be sought and followed. As a rough guide, the following could be considered acceptable testing periods. Obviously, the more frequent, the greater the chance of diagnosing a fault before it turns into a business interrupting failure.

Transformers		Dissolved Gases
Rating	**Application**	**Frequency of Testing (Months)**
> 1 MVA	Furnace (high risk)	3
	Distribution (low Risk)	6
	Special	3 -6
< 1 MVA	Any Type	6 -12

Faults may develop over a period of time. It is very important the independent tester is providing you with consistent data which can be trended and analysed for stability or deterioration of observed conditions.

