

CONDITION MONITORING OF POWER TRANSFORMERS: A CASE STUDY OF VARIOUS SUBSTATIONS IN THE STATE OF PUNJAB

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Mode of Study : F. Time

ABSTRACT

Power transformers have limited life. They are essential components of substations. Transformers do not have any moving parts except cooling fans or tap changers. Whatever outages are there, they are not because of wear out. Reason behind them is deterioration of insulation caused due to electrical, thermal, mechanical stresses. These stresses and presence of oxygen, moisture deteriorates insulation over a period of time. If these failures can be minimized, huge revenues can be saved. For that purpose, various factors responsible for ageing have been studied. Ageing is a chemical reaction due to thermal, electrical and mechanical stresses. These chemical reactions lead to products which help in determining the health of transformer. For example cellulose deterioration reduces degree of polymerization which is related to thermal ageing. There are certain other products like carbon dioxide, water, 2furfuraldehyde, 2acetylfuran, furfuryl alcohol, 5hydroxymethyl2furfuraldehyde. Hence, extent of insulation damage can be predicted from these products. These degradation products affect physical properties of oil and paper.

Over the years a number of techniques have been developed to find the remnant life of transformer. Laboratories have been using DGA and furan to find out condition and age of transformer. In the present study, all physical properties which are likely to be affected by degradation like breakdown voltage, tensile strength, viscosity, tensile strength, flash point, pour point, tan delta, degree of polymerization have been studied of the transformer oil samples of different substations in Punjab. Different gases like CO₂, CO, Ethane, Ethylene, etc are formed and furan derivatives dissolved in oil. Their analysis by comparing them with past data has been very informative for calculating the age.

DGA has been carried out on aged samples to find the incipient faults. DGA has turned out as life saving techniques for condition monitoring of transformers. Furan analysis has been very useful in projecting the age of transformer. Cellulosic paper degrades and form furan compounds. Cellulose consists of long chain of molecules. Due to paper degradation, they become susceptible to damages. Scientists have given different formulas for finding out age. In this work, CHENDONG'S formula have been used as it has been find out to be most accurate.

Chapter 1 describes the introductory part about transformers. It describes electrical scenario in India, transformer construction and various properties and tests studied for condition monitoring.

Chapter 2 presents the literature followed for this thesis work.

Chapter 3 describes the route map for thesis. It formulates the problem.

Chapter 4 describes present work. It explains various techniques like furan, DGA. Data from various transformers is presented and their oil reports.

Chapter 5 describes the inferences from the various tests conducted at the PSTCL lab. Inferences have been derived from the software reports. Graphs have been plotted using MATLAB. Obtained reports have been compared with past history of transformers. Remnant age has been calculated.

At last conclusions have been given and future scope in this field is proposed.