OIL REPLACEMENT BY WATER IN OBSOLETE OIL-FILLED POWER CABLES

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ABSTRACT

A simple method based on successive purges was developed to remove the bulk of the oil content of obsolete cables. Tests performed on 3-phase 60kV sample demonstrate the feasibility of the process and the replacement of more than the 80% of its original oil content by water. Subsequent drying of the cable prevents leak in case of sheath damage. The cable can then be safely left in the ground without potential danger to the environment.

KEYWORDS

Oil-filled cables, water, pollution, environment.

INTRODUCTION

High Voltage Oil-Filled cables have been used for many decades with great success. However, new technologies based on synthetic insulation are now replacing old oil-filled cable lines with many advantages, among which lower maintenance costs. It is however not always possible (or sometimes too costly) to remove oil-filled cables from the field. Environmental issues may then be of great concern in case of sheath damage or lead sheath recristallisation that could give rise to oil leaks. For such situations the elimination of the oil contained in the cable may be the best alternative.

A method based on successive purge of the cable is presented here. The replacement of more than 80% of the original oil content by water is demonstrated. Subsequent drying operation prevents possible leakage in case of cable sheath damage.

METHOD

The replacement of oil by water cannot be achieved in a direct way, as cable oil is not miscible with water. An alternative solution is to use a solvent compatible with both oil and water, and not dangerous for the environment. This is the case for example for isopropanol (isopropyl-alcohol).

Successive purges are performed according to the following procedure:

1. Oil channels are isolated to ensure homogeneous flow through the different phases.
2. A selected solvent is injected from one end of the cable; expulsed oil/solvent mixture is collected at the other end.
3. The analysis of the collected liquid allows for monitoring of purging evolution and oil volume removal.
4. Time is given to the system for good diffusion of the purging liquid through the insulation.
5. Steps 2 to 4 are repeated until the analysis shows satisfactory oil replacement.
6. Steps 2 to 5 are repeated with water injection instead of solvent.

Finally, dry air or nitrogen is injected directly through the cables in order to expulse liquid contained in channels and to “dry” the cable insulation (water and solvent are removed by evaporation).

As a result, most of the initial oil content is removed from the cable. The residual liquid remains absorbed in the paper insulation and hence cannot leak out of the cable in case of cable sheath damage.

TEST ON SAMPLE

A 40m long 3-phase 60kV oil-filled cable has been used for assessment of the efficiency of the proposed method.

The test has been repeated twice with similar results.

Cable design

The cable constitution is as follows:

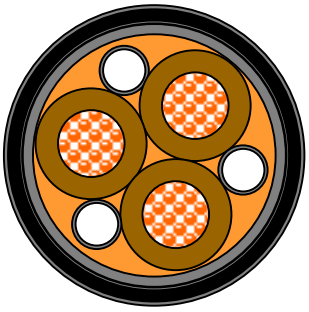

Figure 1: Cable design