

New Definitive  
Tests for  
Corrosive Sulfur  
and  
Passivator  
Concentration in  
Insulating Oil



**The New Villain in our Industry is Corrosive Sulfur**

Weidmann-ACTI performs Corrosive Sulfur Analysis by ASTM methods 1275A, 1275B and the proposed CIGRE method. In addition, we can determine the level of Passivator in your transformer fluid.

There have always been traces of various sulfur containing compounds in mineral insulating oil. Some sulfur containing molecules can act as oxidation inhibitors and are thus beneficial. Other sulfur containing molecules have caused unfavorable reactions with transformer components, and these corrosive sulfur molecules can be detected in the laboratory with ASTM D-1275. In the past, if the transformer oil failed this test, it was rejected by the buyer. All was well and good for many years. Recently, however, oils that passed the ASTM tests have been found to be the cause of several transformer and reactor failures.

# We Know Transformers from the Inside --- Out!

## Possible Causes of Sulfur Related Failures

Several failures have been reported in locations where the ambient temperatures and/or the loading are high. Possibly high temperatures are breaking down sulfur compounds that would remain stable at lower temperatures. There may also have been changes in the crude oil sources or refining methods that could be responsible for the presence of these labile sulfur compounds. These are some of the most likely causes that are being examined.

## Nature of the Problem

When labile sulfur compounds are chemically altered due to thermal stress, the resulting sulfur compounds react with metals such as silver and copper. The cuprous and cupric sulfides that are formed are conductive and affect the dielectric breakdown potentials. Copper (1) and Copper (2) ions can also form. These ions can migrate into the paper insulation, interact with sulfide ion and form conductive materials. The presence of conductive compounds in the cellulose can lead to dielectric failure of the insulation.

## A Definitive Test for Corrosive Sulfur

We in the power industry are all aware of equipment failures traceable to corrosive sulfur in oil. Two important questions are how can we detect potentially corrosive sulfur compounds and how can we protect our equipment from attack by these destructive compounds.

ASTM D-1275A was developed to detect corrosive sulfur. This method provided satisfactory results, until recently. Equipment is now routinely subjected to additional thermal stress. These more severe operating conditions cause the conversion of previously stable sulfur-containing molecules to be converted to corrosive sulfur. The modified ASTM-1275B uses increased temperature (150°C vs. 140°C), and longer heating times (48 hrs vs. 19 hrs ). This more severe test does a better job in identifying problems but still does not directly address a known failure mode, deposition of  $\text{Cu}_2\text{S}$  in cellulose insulation, which can lead to dielectric failure. CIGRE has developed a new corrosive sulfur test that simulates what can occur in oil filled equipment containing both copper and cellulose insulation. This new analytical method, now available from Weidmann-ACTI, uses a copper strip wound with paper insulation. Both the copper strip and the paper are evaluated after immersion in heated oil. The oil is heated at 150°C for 72 hours. Another advantage of the method is that it requires only a 50 ml sample of oil compared to a 220—250 ml sample for the ASTM methods. This is currently the best test to identify a potentially dangerous corrosive sulfur problem.

## What Next?

Identifying the specific labile compounds in the oil that are breaking down to produce these corrosive sulfur compounds is a significant challenge. Once they have been identified, transformer oil suppliers should be urged to remove these compounds during the refining process. Addition of passivator will prevent deposition of corrosive sulfur products on the copper and the paper insulation. It will not reverse prior damage. Weidmann-ACTI has developed a laboratory method to detect passivator level. Passivator concentration diminishes over time so the oil should be tested for the current passivator concentration.

For more information about our Engineering and Diagnostic Services, Products and Systems, contact a Weidmann Representative by phone at 800-242-6748 or 802-748-3936, by fax at 802-748-8630, by e-mail to [service@weidmann-acti.com](mailto:service@weidmann-acti.com) or visit our website at [www.weidmann-acti.com](http://www.weidmann-acti.com)