

Development of sensors for the on-site monitoring of dry-type electrical machines

Abstract

Electrical transformers can be grouped in two different categories, one that includes liquid insulated machines and another that comprises dry-type equipment. Each category has its own advantages which are strictly connected to the environment where the machines has to be installed and the strategy the owner decides to follow. For instance, the first category can have its insulating liquid sampled for diagnosis whereas the second is fire proof and requires a very small amount of maintenance activities. This last characteristic is also a limitation because it originates from the impossibility of sampling any parts of the apparatus for diagnostic purposes. Therefore the need for a tool able to monitor the health conditions of the dry-type transformer (and similar machines like electrical rotating machines) and capable of predicting imminent failures is sought.

In dry-type electrical machines the insulation is provided by polymeric material, and mainly by polyesters and epoxy resins. They can be both subjected to electrical and thermal stresses that can start and/or extend degradation phenomena, during which volatile and semi volatile molecules can be released. The detection of said molecules could be correlated to overheating or electrical problems. The purpose of this study was to investigate the thermal degradation of epoxy resin samples provided by a local producer of dry-type transformers, trying to isolate those organic compounds which can be descriptive of incipient or on-going polymer decay. The successive step was, first, to select and then to fabricate solid state sensors, based on metal oxides, able to interact with the compounds of interest and provide an exploitable response. Contemporarily, a portable and remotely controllable device was realized using commercial sensors and installed on in-service transformers to monitor their correct functioning. The main target was to link faulty behaviors to a possible concomitant release of semi volatile organic molecules.

Finally the aforementioned device was coupled with the sensors developed in the lab to check for the feasibility of an industrial in-field application.