TRANSFORMER MONITORING
OF
OIL TEMPERATURE & WATER IN OIL (ppm)

BOWDENS

Traditionally, the manner of determining the risk to any transformer of an excess of water has been to analyse oil samples to determine moisture content of the oil. By use of the industry standard Phipher chart, the water content of the paper insulation can be determined allowing a prediction regarding the life of the transformer to be made. However, recent development work has shown that it is not simply the total quantity of water in the transformer that is the determining factor; but it is the active water, or the rate of change of water migration between the paper and oil as temperature changes, that is a key factor in the degrading of the cellulose material.

Bowdens have introduced monitoring active water alongside temperature over a period of time. The data is presented graphically showing both temperature (°C) and water content in oil (ppm) to demonstrate the sometime dramatic changes in water in oil ppm values that can occur during the load cycle of the transformer. These variations reinforce the futility of taking an oil sample without reference to temperature. This long term graphical information however enables trends to be established and can show the rate of ageing, and also clearly highlight any differences between two transformers sharing the same load. Fig 1 below is an example showing the extent of rate of change in water activity over a two week period. The water content follows the temperature but lags by some hours.

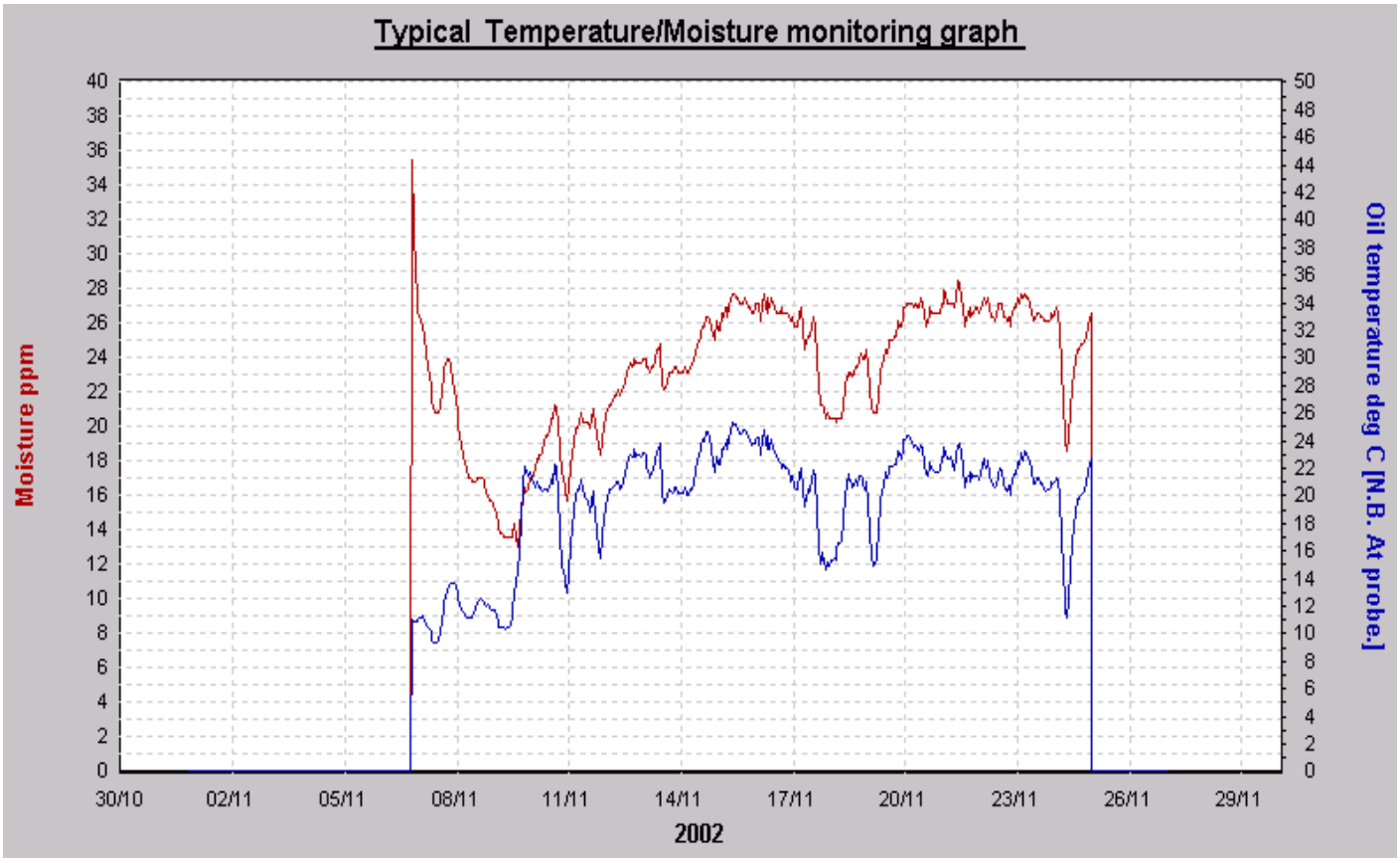

FIG 1

BOWDEN BROS LTD. North Holmwood, Dorking, Surrey, RH5 4HR Tel: 01306 743355

MONITORING WITH THE VAISALA HMP228 & HANWELL 'V' BUG LOGGER

The method employed by Bowdens to achieve this graph is with a portable monitoring kit comprising the Vaisala HMP228 monitor, and Hanwell 'V'Bug logger. Using a suitable flange adaptor with integral ¼ turn ball valve, the monitor probe can be fitted to any suitable existing valve, on the transformer. The HMP228 monitor requires a 240V 50Hz supply.

The logger is programmed to sample analogue data readings from the monitor at chosen intervals, but typically every 15 minutes.

The monitoring equipment can be left un-attended for the pre-determined monitoring period. When complete, the logger is connected to a laptop, and the stored data downloaded via a serial link. The data can then be presented in graphical form to analyse in detail. It is interesting to note from Fig 1 the high level of water ppm at switch on. This is due to the transformer being off-load. The monitor probe was measuring high water concentrations at the bottom of the tank until the transformer went on-load on the 10th November.

As standard practise Bowdens will take an oil sample at the end of the monitoring period, and using the proven Karl Fisher method, determine a ppm datum. This may be applied to the ppm data from the Vaisala, to re-base the graph which, because of the algorithm used to convert active water (aw) to moisture (ppm), may be affected by the condition of the oil. If the monitor reading is aligned with the Karl Fisher result from the same take off point, and at the same temperature, the rest of the data will be accurate.

Bowdens are developing an addition to the monitoring equipment, which will allow the sampled data to be sent direct to a PC via an SMS text message, rather than be stored in a logger. This will enable the graphical information to build on the PC as more data is sent. The data can be analysed in real time.

RESULTANT ACTIONS

Having analysed the graphical information, one can calculate the water content of the paper insulation, and decide whether any action should be taken to reduce the water content of the transformer.

Bowdens recommend fitting DryKeep on all new transformers, to keep the new asset in a dry condition; on de-commissioned transformers to stop a rapid accumulation of water in oil which will jeopardise the transformer when next put on-load; on key transformers, especially with heavy load cycles; and for older transformers with increasing ppm levels, to slow down the ageing process.
Fig 2. Shows the monitor used on a transformer that has just had a Drykeep fitted, with a noticeable decline in ppm against a steady temperature profile.

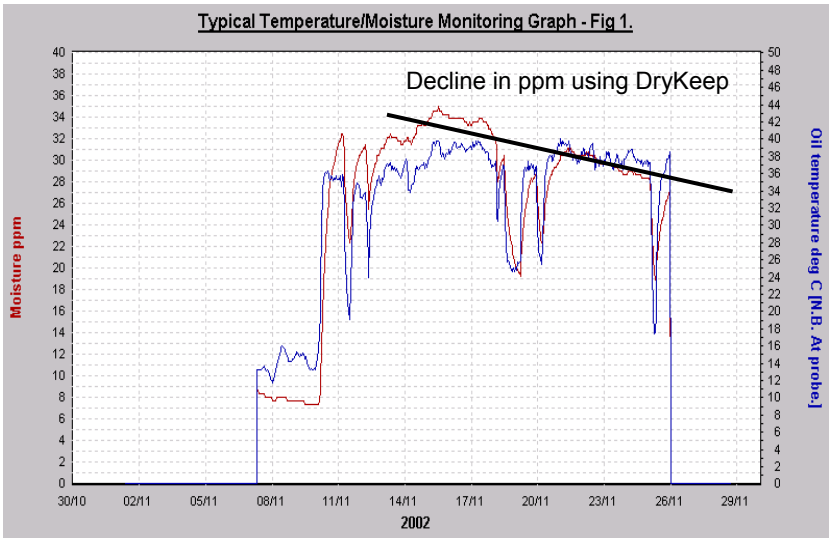

FIG 2

BOWDEN BROS LTD - Brickworks House, Spook Hill, North Holmwood, Dorking, Surrey. RH5 4HR. Tel: 01306 743355