Asian Journal of Information Technology 6 (1): 65-67, 2007

Ageing of the Varistors Containing Oxide of Zinc

Adjabi, N.R. Debbache and A. Omeiri
Department of Electrical and Electronic, Faculty of Sciences Engineering,
University of Badji Mokhtar-Annaba, Algeria

Abstract: The varistors are materials which belong to the class of ceramics and which in the beginning was primarily made up of Silicon carbide (Sic), but for a few years one has advantageously used the varistors Containing Zinc Oxides (ZnO); these last are used more and more for the protection of the electric components against overpressures.The varistors used as element of lightning protector on the lines of distribution of energy are subjected in a permanent way to the various types of constraints. We thus propose a study of the ageing of the varistors under the thermal stresses and electric. However, we examined, during the operation of ageing revolution according to the time of three sizes characterizing a varistor: the leakage current, the tension of threshold and the coefficient of linearity.

Keys words: Varistor, ZnO, ageing, temperature, leakage current, threshold voltage

NTRODUCTION

During, the operation of the varistors, like elements of lightning protector on the lines of distribution of energy, they are really subjected to several constraints of fields electric, heat, etc.... Consequently the degradation of their performances according to the time of application of these pressures is inevitable.

We present, first of all the evolutions relating to the parameters (Rousseau, 1992; Chi-Yen Shen, 1993; Laurent and Magaux, 1990) of the varistor according to two tensions of threshold, respectively for three levels different from the temperature. Finally we will analyze the lifespan of the tested sample.

Ageing: During the operation of ageing, we followed the evolution according to the time of three principal sizes characterizing a varistor (Rousseau, 1992): the leakage current, the tension of threshold and the coefficient of nonlinearity under the effect of tensions of constraint in effective values equalize to 0.55 and 0.75 times the tension of threshold.

The results of the tests presented relate to a sample defined by following dimensions: Thickness e = 8 mm; D = 5.4 cm diameter; surface S = 22.8 cm2; surface S2 = 11.34 m2 electrodes and the masses before and after cooking are respectively M1 = 100 g and M2 = 95 g.

Variation of the leakage current: Figure 1 shows evolution of the leakage current for an alternative tension

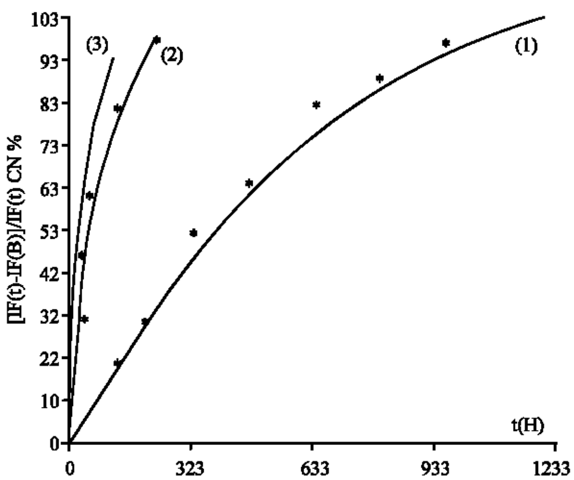

Fig. 1: Evolution of leakage current for U = 0.55* Ueff

of threshold of value 0.55 * Ueff.et of frequency 50 Hz at temperatures of 100, 120 and 150°C, respectively curved 1, 2 and 3.

Figure 2 shows the same type of Characteristics under the same constraints of temperatures, but this time, under a tension of threshold of 0.75* Ueff

ΔIf/Yew

For a voltage of threshold given the slope
Curves obtained are all the more large as the temperature is higher.

Corresponding Author: Mr. Adjabi, Department of Electrical and Electronic, Faculty of Sciences Engineering, University of Badji Mokhtar-Annaba, LP 12 Annaba 23000, Algeria

Table 1: The values of these slopes are calculated and consigned

	U
T°C	0.55 Ueff
100	0.16
120	0.144
150	0.06

Count 1.: Slope of the Yew = F (T)

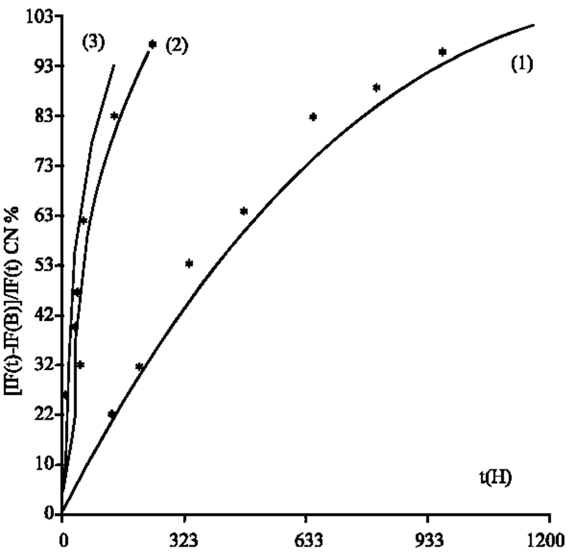

Fig .2: Evolution of leakage current for: U = 0.75 * Ueff

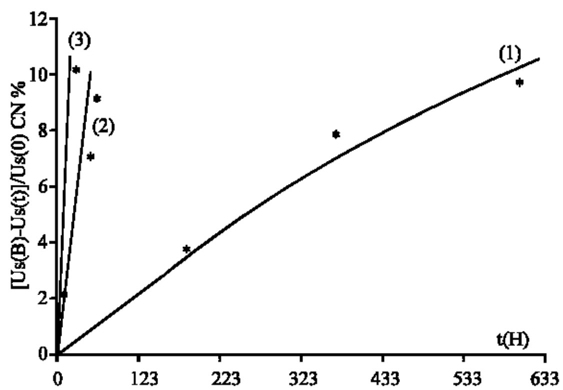

Fig. 3: Evolution of the voltage of threshold U = 0.65*Ueff

$$\Delta lf/Yew = [Yew(T) - Yew(0)]/Yew(t) \quad (1)$$

Where If (T) represents the leakage current has the moment of measurement (T) and Yew (0) the current at the beginning of ageing show in Table 1.

Variation of the voltage of threshold: Throughout ageing, the voltage of threshold tends to drop. In order to illustrate these variations, we have trace

$$\Delta us/Custom = [Custom (0)-Custom (T)]/Custom (0) \quad (2)$$

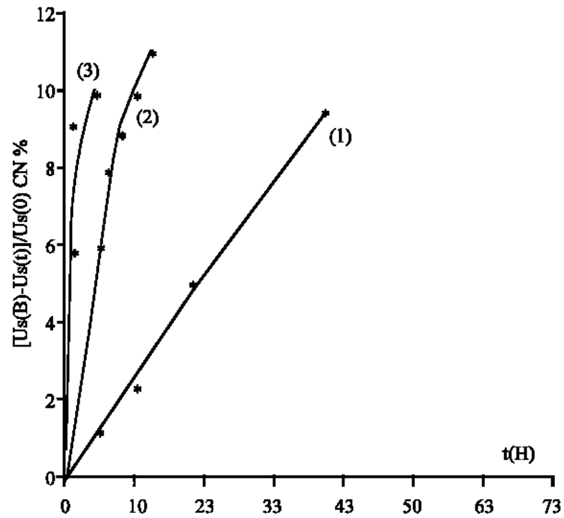

Fig. 4: Evolution of the voltage of threshold U = 0.75 * Ueff

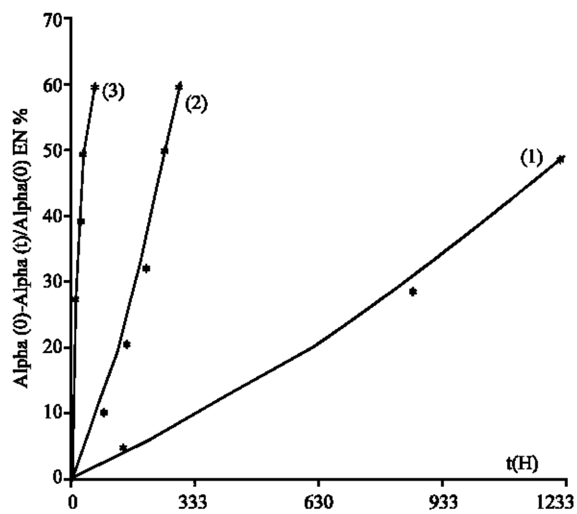

Fig. 5: Evolution of the coefficient of nonlinearity: U = 0.65 * Ueff

Or Custom (T) measurement has the moment (T) and Custom (0) at the initial moment Us (0) = 1800 volts.

One notices a reduction exaggerated in the tension of threshold a chopping of the tension of use and a thermal runaway.

Variation of the coefficient of nonlinearity: The results obtained are shown in (Fig. 3 and 4). The coefficient of nonlinearity defined by Δa (T)/α, decreases along ageing (Fig. 5 and 6). However, the reduction in A until approximately 70% of its initial value is not awkward in measurement or α (0) is rather important.

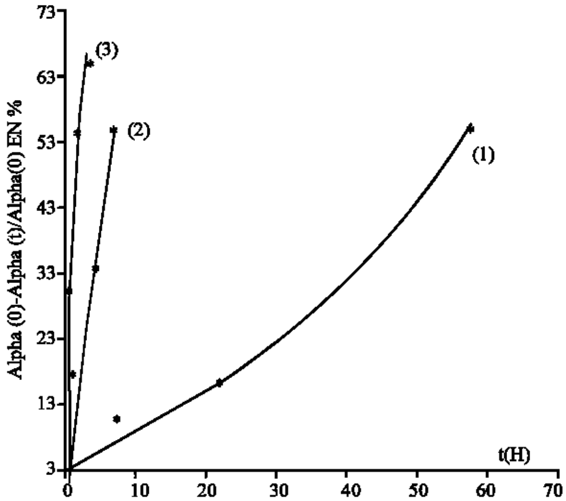

Fig. 6: Eevolution of the coefficient of nonlinearity: U = 0.75 * Ueff

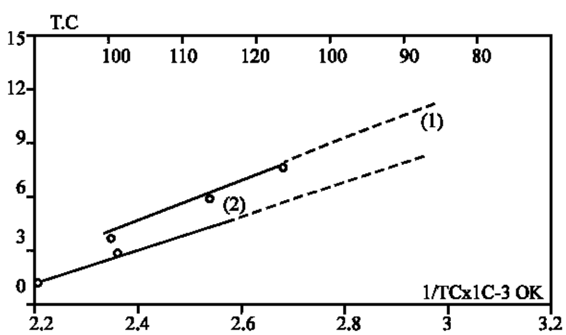

Fig. 7: Lifespan according to temperature

Lifespan: Lifespan of a varistor being time with the end of which the derivative of the tension of threshold defined previously exceeds 10% (Roussean, 1992; Chi-Yen Shen, 1993). For the layout of its evolution, we use the static model of Arrhenius Dakin (Laurent and Magaurc, 1990). In theory, the lifespan is given by the following relation:

$$FD = A.E^{C/T} \quad (3)$$

With

T : Temperature;

A : Constants;

C : Slope of log (FD) = F (1/T)

We present in Fig. 7 the relation Log (FD) according to the reverse of the temperature T [°K].

The both values of slopes 13200 and 9710, respectively for the tensions 0.55* Ueff And 0.75 * Ueff. Knowing that actually in practice industrial applications, the temperature of the varistor very seldom exceeds 40-45°C (Levinson and Herbert, 1986), then, if we suppose that the temperature is of 40°C and by using directly the lines of 7, we obtain the values of the lifespan.

Corresponding, are 67 years for a tension of 0.55* Ueff and 37 years for a tension of 0.75* Ueff these values are obtained by corresponding line prolongation. Up to the value T = (40+273°K).

We read then log (FD) from which we deduced FD.

CONCLUSION

The layout of the evolution of the leakage current, the voltage of threshold and the coefficient of nonlinearity throughout ageing, enabled us to determine the maximum constraint of relative use, the sample studies for the value 0.55* Ueff, the leakage current remains stable in the course of time. The dissipated power is too weak and insufficient to cause a thermal runaway. Moreover, the derivative of α and Ueff remaining weak, this type of varistor preserves consequently all its effectiveness for Over potential protection It Would be appropriate, however, to contribute For Varistors Having other Compositions.

REFERENCES

Chi-Yen Shen, 1993. The effect of Antimony Oxide on the Electrical Properties and stability of ZnO varistors. J.J.A.P., 32: 1147-1153.

Gupta, T.K. Application of Zinc OxydeVaristors. J.AM. Ceram. Soc., 73: 1817-1840.

Inada, M., 1978. Chrystal phases of Nonohmic Zinc Oxide Ceramics. JPH. J. Applied Phys., pp:1-10.

Levinson, L.M. and H.R. Herbert, 1986. Zinc Oxyde varistors a review. Bull., pp: 639-646.

Laurent, C. and C. Mayaux, 1990. Comportement à long terme des isolants solides, vers la prévision des seuils de dégradation. RGE., pp: 30-36.

Rousseau, A., 1992. Parafoudre à Oxyde de Zinc pour les réseaux HT, Fabrication/utilisation. RGE., pp: 81-87.

Simoni, L., 1981. A général approach to the endurance of electrical under temperature and voltage. IEE Trans. Elect. Insul., 16: 277-289.