2.METHOD OF CALIBRATION & ANALYSIS OF TRACK DETECTORS.*)

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Determination of track detector's exposure to radon and its daughters has been based on the experimentally chosen calibration coefficient K_{RnDP} correlating the measured surface density of tracks with the exposure to radon progeny. K_{RnDP} coefficient is defined as follows:

$$K_{RnDP} = \frac{G - G_T}{E_{RnDP}} \qquad (1)$$

where: G is the measured surface track density of detector after exposure expressed as [track*mm^{-2}], G_T is the measured surface track density of detector's background expressed as [track*mm^{-2}] , E_{RnDP} is the exposure to radon progeny of detector expressed as [mJ*h*m^{-3}].

The surface track density G depends, for a given exposure E_{RnDP} , on the state of equilibrium F [1] between radon and its daughters during the time of exposure, and also on the depth of detector's chemical etching after the exposure. The depth of detector's etching can be determined on the basis of the measurement of its thickness before and afer chemical etching. The system of automatical microscope analysis of track detectors enables to correlate the depth of detector's etching with the light intensity passing through the detector during the read-out of tracks, assuming that the intensity of light falling on the detector and the thickness of detectors before etching are constant. The former assumption is conditioned by the equipment used for the analysis of detectors, while the latter is true for detectors cut out of the detecting material produced in the same production cycle, e.g.: the material sold in rolls. It is also important here that the detecting material should be coloured by the producer since it determines the application of this method with regard to visible light. The red-coloured dosimetric foil LT115 produced by Kodak fulfills these conditions. It can be thus written for LT115 detectors that:

$$K_{RnDP} = f(F,I) \qquad (2)$$

In order to find the apparent functional form of K_{RnDP} coefficient, LT115 detectors have been exposed to radon in the experimental chamber [2] at various states of equilibrium F. Five measurement series, 30 measurements each, have been made. Each series has been exposed at different equilibrium F, for 8 hours and at radon concentration of 150 kBq*m^{-3}. Examinations have been made for F value in the range F=0.04-0.8. After the exposure detectors have been divided into 10 classes etched for various periods from 120 to 210 minutes. Various depths of etching have been thus obtained, as well as various light intensities I during the read-out for particular detectors. NaOH solution at the concentration of 6N and temperature of 55°C has been used for the etching of the detector while the reading has been made by means of SYSTEM RADON described in the first part of the paper. The detector's background depends on the depth of etching, so G_T=f(I). For LT115 track detectors that dependence is as follows:

$$G_T = 0.0145*I - 0.884 \quad [\text{track*mm}^{-2}] \qquad (3)$$

This dependence was determined in the following procedure. The non-exposed detectors have been etched for various periods from 120 to 210 minutes and next the surface track density and light intensity was determined for these detectors. The linear regression has been applied for obtained data.

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K_{RnDP} value was calculated for each detector according to dependence (1). The regression curves made from obtained data are shown in Fig.1.

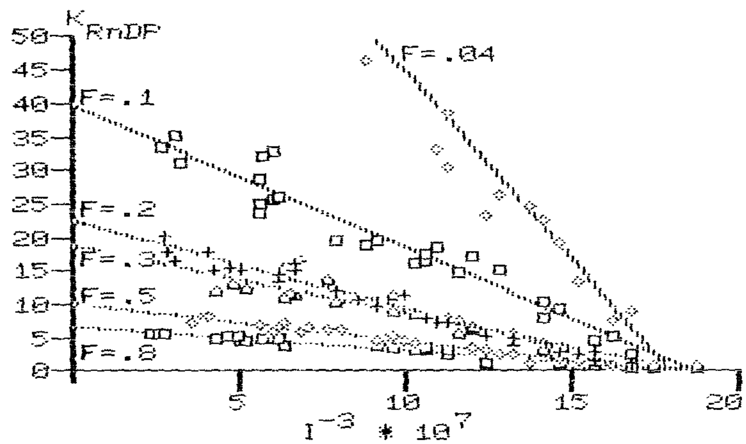

Fig.1. Diagram of the dependence of K_{RnDP} coefficient in the function of light intensity I for various states of equilibrium F.

On the basis of the computer analysis of experimental data the following dependence for K_{RnDP} has been obtained:

$$K_{RnDP} = (5.94 - 3.23*10^{6}*I^{-3}) * F^{-0.851} \qquad [\frac{track*mm^{-2}}{mJ*h*m^{-3}}] \qquad (4)$$

Exposure to radon daughter products, E_{RnDP} is calculated from correlation (5) resulting from equations (1),(2),(3). Thus:

$$E_{RnDP} = \frac{G - (0.0145*I - 0.884)}{(5.94 - 3.23*10^{6}*I^{-3})*F^{-0.851}} \qquad [mJ*h*m^{-3}] \qquad (5)$$

Exposure to radon E_{Rn} is correlated with exposure to radon daughters E_{RnDP} by equilibrium coefficient F :

$$F = \frac{178*E_{RnDP}}{E_{Rn}} \qquad (6)$$

where E_{RnDP} is measured in $mJ*h*m^{-3}$, while E_{Rn} in $kBq*h*m^{-3}$. Exposure to radon E_{Rn} can be calculated using correlation (6).

REFERENCES

1.ICRP, Radiation protection in uranium and other mines. Publication 24, 1976.
2.Domanski T., Chruscielewski W., Orzechowski W.: An experimental chamber simulating the equilibrium between radon and its daughters in mine air. Health Phys. Vol.41, No.1, pp 175-178, 1981.