# Fast Measurement of the potential alpha energy concentration (PAEC) by the modified Markov method

By the Markov method the Potential alpha energy concentration (PAEC) can be determined by one Air sample in few minutes. The filter loading by pump take five
minutes, after that ten minutes will be need to analyze it. During this time the measuring place can be changed already.

Required is a still not activated filter. In the device two appropriate cycles are defined:

1. MARKOV method with manual filter change (MARKOV Filter change)

The measurement will stop automatically after the analysis time, so that for every measurement one single value will be saved. The end of the measurement is acoustically signaled. Before every measurement a new filter has to be used.

2. MARKOV method without Filter change (MARKOV cont.)

This method serves most of time for calibration purposes. After the sampling and the analysis a further period will be attached, in which the collected Radon daughter products are completely disintegrated. A measurement series of a 3 hours interval will be recorded.

## Application limits and measurement accuracy

The method based on the determination of the filter activity inside one certain interval during the daughter product decay process. It consists one approximate proportionality between
in the interval counted decay and the PAEC. Due to the different daughter product atmospheres the methodical maximum deviations will be **+18% and -15%**.

## Important hints

Measurements with „MARKOV Filter change " without filter change will lead to wrong results. It is recommended to keep a quantity of available. After a decay phase of at least 3 hours the filter could be used again.

The measurement of the decays will be realized by the comparator CMP1, whose output is connected with the input of counter CNT1. The comparator threshold is set, that only alpha decays will be registered. This should not be changed. The counter CNT1 must be configured as total pulse counter.

At the definition of the measuring cycle the spectrometer has to be activated.
Through this the power supply of the detector will be switched on. The parallel recording of the spectra is also for the quality assurance important.

ATTENTION: The calculated measuring values for the spectrometer are not corresponding to the real values, because here is a continuous Air flow assumed.

The length of time of the single steps inside the cycles may not be changed.

# Calibration and physical units

A specific calibration is not necessary, as the device constant $C_{cal}$ already had be determined during the calibration for the continuous daughter product measurement. The PAEC will be calculated as follows:

$$PAEC = N * C_{cal} * K$$

PAEC    Potential alpha energy concentration

N       Quantity of the counted pulses during the measurement (counts)

$C_{cal}$    Calibration factor for aerosols (visible in the configuration of the spectrometer)

K       Proportionality factor for Markov Method: 30.5MeV/(counts*min).

In the configuration of Counter CNT1, $C_{cal}$ and K are summarized in one constant. The calculation of measured value bases on a linear curve, described by the coefficients A0 and A1. A0 is always Zero.

Example:

$C_{cal}$=2min / l(Value according to calibration of the spectrometer SPEC1 in configuration)
A0=0MeV / L
A1=2min/L*30,5MeV/(counts*min)=**61MeV/(L*counts)**

The values of the coefficients A0 and A1 will be registered into the correspond input fields of the configuration window from CNT1. The unit is then MeV/L

Should be shown the unit of the PAEC in nJ / m³or WL or the equilibrium equivalent Radon concentration (EEC), then the coefficient has to be multiplicated with a factor X.
In the following table the values are shown:

| Measurand | Target unit | X |
|---|---|---|
| PAEC | MeV/L | 1 |
| PAEC | MeV/cm³ | 0.001 |
| PAEC | nJ / m³ | 6.25 |
| PAEC | WL | $7.7*10^{-6}$ |
| EEC | Bq/m³ | 0.029 |

Example:

Output as EEC in Bq/m³:A1=61*0.029=**1.769Bq / (m³*counts)**

Source: Dr.Christian Feddersen,"Elaboration vpn setting parameters for a device working with modified Markov method ",Berlin1995