DETERMINATION OF ^{40}K CONTENT IN DRUGS BY MEASURING THE RADIOACTIVITY

The element which is the mixture of some isotopes and contain at least one radioisotope in constant abundance can be determined by measuring its radioactivity. Chemical analysis usually determine total content of the element in the sample. For determination of total content of the element, it is necessary to know the isotopic composition of this element.

Natural potassium has a constant isotopic composition: It is a mixture of 3 isotopes: ^{39}K(93,08%) and ^{41}K(6,91) are stable, isotope ^{40}K (0,0118%) is radioactive.

Method for determination of potassium in solid samples (e.g. drugs) is based on measurement of natural radioactivity of ^{40}K. Isotopic composition of potassium does not change – the ration between the amount of radioactive isotope and total content of element is constant for all samples. The content of potassium in the sample is determined by comparing the measurements of the natural radioactivity of the sample (^{40}K) with the natural radioactivity of the standards, which contain defined amount of potassium. For determination of potassium content, method of calibration curve is used.

Standards and samples

Standards containing a mixture of potassium and natrium salts are placed in plastic pots covered by folia (mass of standard - 100 g)

Samples of potassium salts are placed in plastic pots covered by folia (mass of standard - 100 g)

Instrumentation

Three-channel spectrometric unit NV 3201 with Geiger-Muller detector, lead shielding

Task 1: Preparation of standards from KCl and NaCl

In plastic pots there are weighed and prepared standards containing 4 %, 11 %, 17%, 23 %, 27 %, and 35 % of potassium. These standards were prepared by mixing potassium and natrium salts. Calculate the mass of potassium and natrium salts which are necessary to prepare 100 g of standard. Write the content of ^{40}K in these standards in %.

KCl + NaCl

$K_2CO_3 + Na_2CO_3$

$CH_3COOK + CH_3COONa$

$K_2CrO_4 + Na_2CrO_4$

Composition of standards:

35% K	?% ^{40}K	?g K... + ?g Na...
27% K	?% ^{40}K	?g K... + ?g Na...
23% K	?% ^{40}K	?g K... + ?g Na...
17% K	?% ^{40}K	?g K... + ?g Na...
11% K	?% ^{40}K	?g K... + ?g Na...
4% K	?% ^{40}K	?g K... + ?g Na...

Task 2: Preparation of samples

In plastic pots there are weighed and prepared samples of potassium salts. Calculate the content in % of potassium in these samples: KCl, K_2CO_3, K_2CrO_4, $K_2Cr_2O_7$, CH_3COOK assuming that they are of p.a. purity.

	Mr	Total content of K	Content of ^{40}K
KCl	74,551		
K_2CO_3	138,205		
K_2CrO_4	194,190		
$K_2Cr_2O_7$	294,184		
CH_3COOK	98,15		

Task 3 Measurement of standards counts

Put the standard with the highest content of K into lead cover under GM-tube. Platic pot has to be placed closely under the window of GM-tube. Geometrical arrangements has to remain constant during all measurements. Measure the counts of this standard 5 times. Time of

measurement is 100 s. Write values of counts (number of impulses/100 s) into table and count the average. Use same procedure for the measuring of all standards.

Task 4 Construction of calibration curve

Using measured values construct the calibration curve – the dependence of the counts on content of K in sample (in mass percentage).

Task 5 Measurement of sample counts

By the same procedure, measure the counts of the sample 3 times and calculate the content of K in the sample using the calibration curve. In case of linear calibration curve calculate the content of potassium from the equation of the line or from the counts of one standard whose counts is the most similar to the counts of the sample.

Task 6 Calculation of potassium content in the sample

Potassium content in standard (%) Number of standard	Counts (imp./100 s)			
	Measurement n^{o}			
	1	2	3	average
35 (No.1)				
27 (No.2)				
23 (No.3)				
17 (No.4)				
11 (No.5)				
4 (No.6)				
sample				