APPLICATION OF LINAC FOR STUDY OF DIFFUSION MACRO- AND TRACE ELEMENTS IN MINERALS USED AT VACUUM DRYING

N.P. Dikiy, A.N. Dovbnya, V.A. Kutovoy, E.P. Medvedeva
NSC KIPT, Ukraine;
ndikiy@kipt.kharkov.ua

The gamma activation analysis at the powerful linear accelerator was used for study of element diffusion in minerals of heating elements before vacuum drying. It is shown, that after vacuum drying the transition of rare-earth elements from some sorts of ceramic coats in the dried commodity is possible. On spectral characteristics the optimum selection of used minerals for coats of heating elements is held.

PACS: 29.17.+w, 28.41Kw

INTRODUCTION

At present in many countries of the world one uses vacuum drying of vegetables for the purpose of their long-term storage and transportation. The vacuum drying has a number of advantages in comparison with traditional: convection, pneumatic etc.

The optimization of process of heating is achieved by the use of filters of infrared radiation in the range of 2,6-2,8 microns and 8-12 microns. Also the use of an infrared radiation is important for shaping a necessary thermal field in objects of vacuum drying. The ceramic coats of heating element can be used for effective transformation of thermal and solar radiation in a necessary spectrum of infrared radiation. Let us note that absorption of IR-radiation of various types of mineral coats is different in the range of absorption of infrared radiation of lignin. The converters of a spectrum of minerals on a basis of talc, montmorillonite, biotite can be optimal for this purpose [1]. Kaolin, quartz have the band of absorption in the range of lengths of waves from 10.5 to 13 microns and less suitable for use them as filters of infrared radiation.

The purpose of the given work was to use gamma-activation analysis to study the diffusion of macro- and microelements in ceramic coats of heating element used for vacuum drying vegetables.

METHODS

The investigation of content elements are carried out at the powerful electron accelerator with E=22 MeV, I=500 μA using brake radiation [2,3]. The spectrum of gamma radiation was registered by means of the Ge(Li)-detector of a volume 50 cm^3 and energy resolution 2.2 keV for gamma radiation with an energy 1333 keV. The absolute values of concentration macro and microelements in vegetables and ceramic coats of heating element are measured by a method of preparation of standard samples.

As an object of research we used beet before and after vacuum drying without and with the use of ceramic coats of a heating element. Samples of vegetables were cut with size 4×10×4 mm.

Vacuum drying of beet was performed under the following conditions: pressure 5 mm Hg, T=50°C. The halogen lamp (KG-220-1000) was a source of infrared radiation with the intensity of power supporting the temperature of a sample at a level T=50°C.

The samples of beet were packed in the aluminium foil. Then the packed samples were irradiated at the linear accelerator.

RESULTS

The results of the element contents in beet dried up with and without use of ceramic coats of the heating element are given in the table. It is seen, that such elements as potassium, chlorine, nickel, copper, zinc, bromine were products of sorption from ceramic coats of the heating element. Their concentration in the sample was increased. Some of rare-earth elements (lanthanum and yttrium) appeared in samples of beet. The transition of essential elements from ceramic coats of heating elements in samples after vacuum drying does not degrade their quality. However the transition of inappreciable amount of rare-earth elements (uranium and thorium) can result in impossibility of use them. These results testify the necessity of realization of the preliminary element analysis of used ceramic coats of the heating element. It is necessary to note, that at the given modes of drying the beet does not lose essential important elements and keeps the initial qualities.

Thus, the gamma-activation analysis can be successfully used for the study the element content in vegetables, and also for study the diffusion of macro- and microelements in ceramic coats of the heating element.

The work is carried out under support of STSU, project Gr 14j.

REFERENCES

1. U.L. Bregg, G.F. Klarinbull. *Structure of minerals*. M.:"Mir", 1967, p. 248-273 (In Russian).
2. N.P. Dikiy, V.I. Borovlev, Yu.V. Lyashko, E.P. Medvedeva et al. Nuclear-physical methods of analysis of noble metal and rare elements //*Problems of atomic science and technology. Series: "Nuclear Physics Investigations"*. 2001, № 1, p. 81-84.
3. N.P. Dikiy, A.N. Dovbnya, V.L. Uvarov et al. Use of accelerators in geology, medicine, isotopes production and atomic power energetic //*Problems*

of atomic science and technology. Series: "Nuclear Physics Investigation". 2001, № 1, p. 26-35.

The content of elements (relative units) in beet after vacuum drying with the use of infrared radiation without and with application of ceramic coatings of the heating element

	Symb.	Name	Counts, Native	error, native	Counts, Clay	Error, clay
14	Si	Silicon	17886	0.026	6341,5	0,057
15	P	Phosphorus	6440	0.019	5878,4	0,0216
16	S	Sulfur	2820	0.018	2687,4	0,0202
17	Cl	Chlorine	6708	0.007	7624,4	0,0068
19	K	Potassium	146340	0.003	207832,5	0,0026
20	Ca	Calcium	6494	0.016	6739	0,019
22	Ti	Titanium	85.9	0.091	67,2	0,1348
24	Cr	Chromium	10.3	0.484	8,1	0,657
25	Mn	Manganese	111.5	0.047	131	0,0477
26	Fe	Iron	59.8	0.031	53,5	0,0321
27	Co	Cobalt	3.3	0.409	3,2	0,4587
28	Ni	Nickel	8.6	0.07	15,6	0,0585
29	Cu	Copper	25.5	0.042	35,2	0,0392
30	Zn	Zinc	63.2	0.023	72,1	0,0233
31	Ga	Gallium	3.6	0.131	3,5	0,1575
34	Se	Selenium	0.7	0.313	0	1
35	Br	Bromine	58.8	0.013	84,4	0,0114
37	Rb	Rubidium	53.1	0.012	55,3	0,0129
38	Sr	Strontium	18.2	0.021	18	0,0225
39	Y	Yttrium	2	0.207	2,2	0,2003
48	Cd	Cadmium	4.4	0.181	5,2	0,1823
52	Te	Tellurium	1.1	1	0	1
57	La	Lanthanum	0	1	33,3	0,1581
58	Ce	Cerium	0	1	50	0,1359
72	Hf	Hafnium	2.3	0.858	1,5	1
73	Ta	Tantalum	1	1	4,7	0,6754
74	W	Tungsten	7.4	0.334	4,7	0,5429
81	Tl	Thallium	1.3	0.332	0,9	0,5405
82	Pb	Lead	2.5	0.295	3	0,2606
90	Th	Thorium	0.9	0.4	0	1

ИСПОЛЬЗОВАНИЕ ЛУЭ ДЛЯ ИЗУЧЕНИЯ ДИФФУЗИИ МАКРО- И МИКРОЭЛЕМЕНТОВ В МИНЕРАЛАХ, ИСПОЛЬЗУЕМЫХ ПРИ ВАКУУМНОЙ СУШКЕ

Н.П. Дикий, А.Н. Довбня, В.А. Кутовой, Е.П. Медведева

Гамма-активационный анализ использован для изучения диффузии элементов в керамических покрытиях нагревательных элементов до и после вакуумной сушки. Показано, что после вакуумной сушки возможен переход редкоземельных элементов из некоторых видов керамических покрытий в высушенную продукцию. По спектральным характеристикам проведен оптимальный подбор используемых минералов для покрытий нагревательных элементов.

ВИКОРИСТАННЯ ЛПЕ ДЛЯ ВИВЧЕННЯ ДИФУЗІЇ МАКРО- І МІКРОЕЛЕМЕНТІВ У МІНЕРАЛАХ, ВИКОРИСТОВУВАНИХ ПРИ ВАКУУМНОМУ СУШІННІ

М.П. Дикий, А.М. Довбня, В.А. Кутовий, Е.П. Медведєва

Гамма-активаційний аналіз використаний для вивчення дифузії елементів в керамічних покриттях нагрівальних елементів до і після вакуумного сушіння. Показано, що після вакуумного сушіння можливий перехід рідкісноземельних елементів з деяких видів керамічних покрить у висушену продукцію. По спектральних характеристиках проведений оптимальний підбір використовуваних мінералів для покрить нагрівальних елементів.