

# FEATURES OF ADSORBED CHEMICAL ELEMENTS AND THEIR ISOTOPES DISTRIBUTION IN IODINE AIR FILTERS AU-1500 OF NUCLEAR POWER PLANT

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The main aim of research is to investigate the physical features of spatial distribution of the adsorbed chemical elements and their isotopes in the granular filtering medium in the iodine air filters of the type of AU-1500 in the forced-exhaust ventilation at the nuclear power plant. The  $\gamma$ -activation analysis method is applied to accurately characterize the distribution of the adsorbed radioactive chemical elements and their isotopes in the granular filtering medium in the AU-1500 iodine air filter after its long term operation at the nuclear power plant. The typical spectrum of the detected chemical elements and their isotopes in the AU-1500 iodine air filter, which was exposed by the irradiation of bremsstrahlung  $\gamma$ -quantum producing by the accelerating electrons in the tantalum target, are obtained. The spatial distributions of the detected chemical element  $^{127}\text{I}$  and some other chemical elements and their isotopes in the layer of absorber, which was made of the cylindrical coal granules of the type of SKT-3, in the AU-1500 iodine air filter are also researched. The possible influences by the standing wave of air pressure in the iodine air filter on the spatial distribution of the chemical elements and their isotopes in the iodine air filter are discussed. The comprehensive analysis of obtained research results on the distribution of the adsorbed chemical elements and their isotopes in the absorber of iodine air filter is performed.

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## 1. INTRODUCTION

The latest concept of the development of energy in the world make use of as many new sources of clean energy and the further development of already existing technologies currently, the most important of them for their contribution to the economy of leading countries is the nuclear power. The new strategy of nuclear energy industry development in Ukraine, includes a wide range of research and development programs toward the 4-th generation nuclear reactors designs, including the sodium cooled fast reactor, lead cooled fast reactor, gas cooled fast reactor, very high temperature reactor, molten salt reactor, supercritical water-cooled reactor, which can be used in the various technological applications [1]. In this connection, the ecological aspects of the nuclear energy industry operation will require a significant attention, including the appearance of increasing necessity for the improved designs of the iodine air filters (IAF) in the air filtering applications at the nuclear power plants [1]. The air filtering with the application of the iodine air filter of the type of AU-1500 prevents a possible radioactive contamination of environment due to the introduction of the process of air filtering from the chemical elements and their isotopes, which are usually generated during the nuclear reactors operation at the nuclear power plants. In this research

article, we report the research results on the physical features of distribution of the adsorbed radioactive chemical elements and their isotopes in the granular filtering medium (GFM) in the iodine air filters (IAF) of the type of AU-1500 in the purge ventilation and systems at the nuclear power plant (NPP).

The research on the interaction of the aerosol streams, which transfer the radioactive chemical elements together with the small dispersive coal dust particles masses in the granular filtering medium, possessing the adsorption properties, represents a considerable interest for the branches of the physics, studying the properties of the granular substance [2], soft condensed matter [3, 4], transport and structuring of the small dispersive coal dust particles precipitations [5], and features of the chemical elements adsorption processes [6]. In the case of such complex systems as the air filters at the nuclear power stations, there is a big number of physical phenomena, connected with the aerodynamic and diffusion movement of the radioactive chemical elements and their isotopes together with the small dispersive coal dust particles masses. These effects frequently include both the self-interactions as well as the interactions with the adsorbing granular filtering medium. As it has been found in our previous research, the distribution of chemical elements, detected by the

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gamma activation method [7]. The allocation of dust masses, measured by the gamma activation method [7] and the gravimetric method [8-13], are characterized by the presence of the correlated maximums in the granular filtering medium in the adsorber in the IAF. It is difficult to explain this fact, going only from the diffusion representations about the physical mechanism of the chemical elements transportation and/or considering its similarity to the process, which occurs in the chromatographic columns, where the concentration maximums appearance in the distribution of the transported chemical compounds with the various molecular masses is observed. Considering other physical mechanisms, which can influence both the distribution of the small dispersive coal dust particles and the adsorption process of the radioactive chemical elements and their isotopes in the granular filtering medium with the cylindrical coal granules, we paid some attention to the fact that the air stream can generate the forced acoustic oscillations of the pressure  $P(r,t)$  and the air movement velocity [14]. The layer of granular adsorbent, in which there may be such oscillatory processes, plays a role of the acoustic resonator, whereas the propagating acoustic wave, which is multiple to its thickness, creates the standing wave oscillations. The pressure oscillations in the air can have a certain influence on the transportation of the small dispersive coal dust particles masses, causing their accumulation in the regions, corresponding to the anti-nodes of the standing acoustic waves [14]. On the other hand, the same oscillations of air density in the regions of the anti-nodes of the standing acoustic waves will lead to the increase or decrease of the external (in relation to the adsorbent granules) pressure of air, thereby making possible the forced ventilation of the internal air volumes between the cylindrical coal granules. This process should result in the excessive accumulation of the adsorbed radioactive chemical elements and their isotopes in these regions. The oscillatory processes can make an influence on the diffusion flows inside the cylindrical coal granules, resulting in an increase of the content of the adsorbed radioactive chemical compounds in the regions of the granular filtering medium in the IAF, where the acoustic oscillations reach their maximum amplitudes. The same action by the acoustic oscillations must have place in the adsorption processes, which originate in the small dispersive coal dust particles masses, concentrated in the described parts of an absorber in the IAF. Thus, the penetration of the radioactive chemical elements and their isotopes inside the small dispersive coal dust particles becomes relatively easy, because of their small sizes in comparison with the dust particles [14]. These acoustic mechanisms could significantly influence the processes of accumulation of the adsorbed radioactive chemical elements and their isotopes, leading to their re-distribution inside the IAF's absorber in the form of the concentration maximums, which correlate with the anti-nodes of the air pressure oscillations. In the previous research

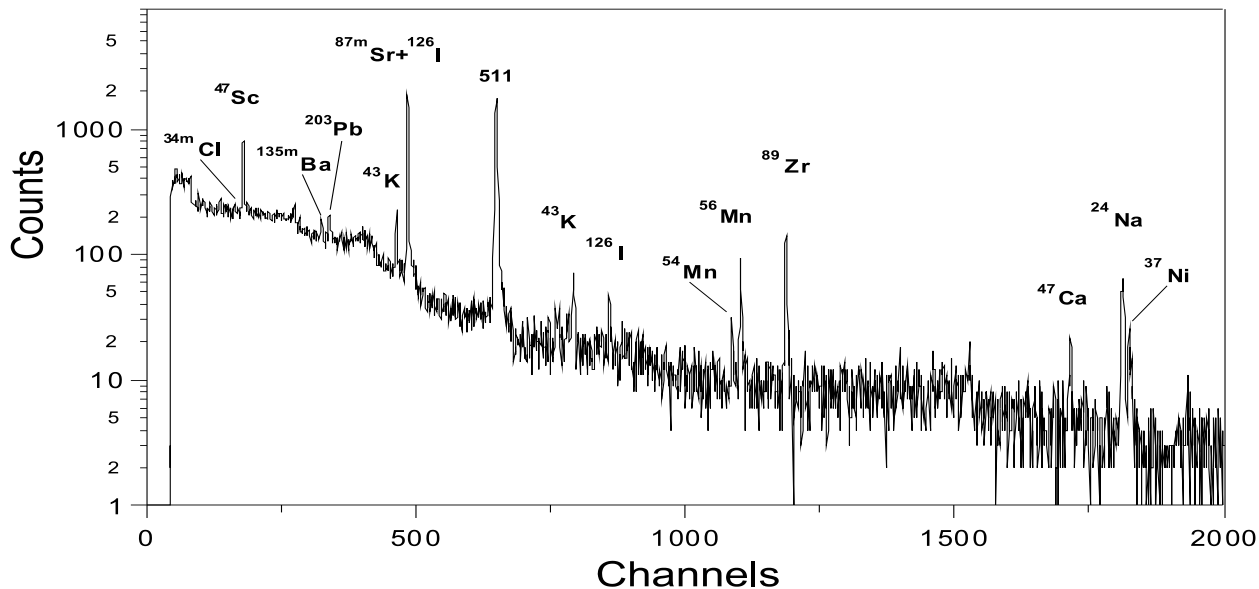
[7] with the gamma activation method application, it was found that there are the concentration maximums in the distribution of the adsorbed chemical elements and their isotopes in the IAF. In the present research, the more detailed improved research data on the distribution of the adsorbed chemical elements and their isotopes in the IAF at the NPP during its long term operation are presented. The possible physical mechanisms, resulting in a non-uniform distribution of the adsorbed chemical elements in the IAF at the NPP, are also discussed. The presented highly innovative researches are important, because they can improve our understanding on the nature of the physical-chemical processes in the granular filtering mediums at the air-dust aerosol streams action, and they help us to improve the advanced IAF's design for the air filtering applications at the NPP.

## 2. MATERIALS AND METHODS

The gamma activation method was applied to research the distribution of the adsorbed chemical elements and their isotopes in the granular filtering medium of an absorber in the AU-1500 IAF after many years of the IAF's operation at the Zaporozhskaya nuclear power plant (NPP) in Ukraine. The researched IAF has the following technical characteristics: the diameter of the IAF is about 1 m; the thickness of layer with the cylindrical coal granules is equal to 0.3 m. The IAF's absorber is made of the cylindrical coal granules of the type of SKT-3 with the granule's diameter of 2 mm and the granule's length of 3.2 mm. During the experimental research, the absorbers were opened with the special automatic experimental setup, then the probes were taken in the three places (at the center place and at the two places on the periphery) in the researched IAF's. The obtained probes were extracted at the various depths in the absorber and divided on the samples with the weights of 5, 6, 7 g with the purpose to perform the chemical composition analysis. It is necessary to point out that the macro- and micro- element composition analysis of the adsorbent of the type of SKT-3 together with its small dispersive coal dust particles fraction was performed by the means of the gamma activation analysis at the electron accelerator of scientific research complex "Accelerator" at the NSC KIPT in Kharkov, Ukraine. The samples were exposed to the irradiation by the bremsstrahlung gamma quantum from the Tantalum converter with the thickness of 2 mm. The energy of electrons was 22 MeV. The current of electron beam was 700  $\mu$ A. The time of exposition to the irradiation was 10 hours. The activity of the irradiated samples was measured by the Germanium-Lithium detector with the volume of 50 cm<sup>3</sup> and the energy resolution of 2,8 keV at the line of 1333 keV. The absolute content of the adsorbed chemical elements and their isotopes were determined in relation to the standards, which were exposed to the irradiation at the same time. The researches on the determination of fractional composition and the separation of the small

dispersive coal dust particles from the cylindrical coal granules were also conducted. It was found that the small dispersive coal dust particles mass share near the input surface of the absorber in the IAF reached 12%. In the process of measurements, it was established that the accumulated quantity of the small dispersive coal dust particles at the distances far away from the absorber's input surface decreased sharply.

The small dispersive coal dust particles mass shares were different at the centre and on the periphery in the absorber in the IAF. It makes sense to note that the quantity of the small dispersive coal dust particles was slightly smaller near to the absorber's walls, comparing to the quantity of the small dispersive coal dust particles at the centre of the absorber in the IAF.



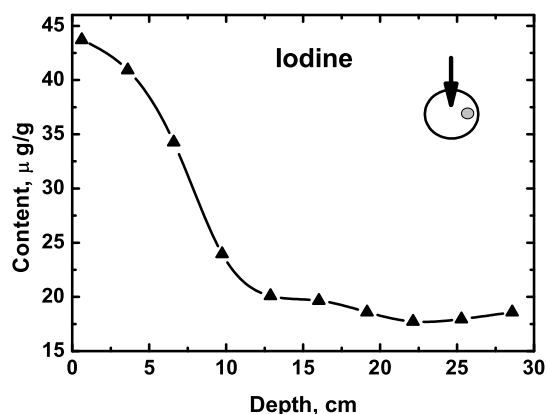
**Fig.1.** Typical spectrum of detected radioactive chemical elements and their isotopes in iodine air filter, obtained at gamma activation analysis

### 3. RESULTS

In the spectroscopy experiment, the induced activities of a number of the isotopes in the following reactions:  $^{55}\text{Mn}(\gamma, n)^{55}\text{Mn}$ ,  $^{127}\text{I}(\gamma, n)^{126}\text{I}$ ,  $^{35}\text{Cl}(\gamma, \gamma)^{35m}\text{Cl}$ ,  $^{90}\text{Zr}(\gamma, n)^{89}\text{Zr}$ ,  $^{88}\text{Sr}(\gamma, n)^{87m}\text{Sr}$ ,  $^{48}\text{Ca}(\gamma, n)^{47}\text{Ca}$ ,  $^{44}\text{Ca}(\gamma, p)^{43}\text{K}$ ,  $^{23}\text{Na}(n, \gamma)^{24}\text{Na}$ ,  $^{27}\text{Al}(n, \alpha)^{24}\text{Na}$ ,  $^{140}\text{Ce}(\gamma, n)^{139}\text{Ce}$ ,  $^{204}\text{Pb}(\gamma, n)^{203}\text{Pb}$ ,  $^{135}\text{Ba}(\gamma, \gamma)^{135m}\text{Ba}$  were measured. The typical spectrum of the induced activity for the probe, taken in the core of the IAF, is presented in Fig. 1. The researched IAFs are mainly intended for the chemical adsorption of the radioactive Iodine (I) at the NPP. Therefore, it was in the scope of our research interest to find out the quantitative content of the Iodine per a mass unit of the adsorbent; and its distribution, depending on the depth of the extracted probe. The measured distribution of  $^{127}\text{I}$  is shown in Fig. 2. The probes were extracted on the periphery of the IAF, and the direction of filtrated air flow as well as the exact position of probe extraction are shown in Fig. 2. The average specific content of small dispersive coal dust particles fraction at the depth of an adsorbent did not exceed 0,5%.

The fission of Uranium atoms in a nuclear reactor is accompanied by the accumulation of radioactive isotopes of the Iodine ( $^{131}\text{I}$ ,  $^{132}\text{I}$ ,  $^{133}\text{I}$ ,  $^{134}\text{I}$ ,  $^{135}\text{I}$ ). It is a well known fact that the half-decay period for the isotopes of Iodine is 8.1 days; in the case of  $^{131}\text{I}$ ; it is 20.9 hours in the case of  $^{133}\text{I}$ ;

it is 6.7 hours in the case of  $^{135}\text{I}$ . Getting to the IAF, the Iodine isotopes are captured in the IAF, where the physical process of their decay takes place.

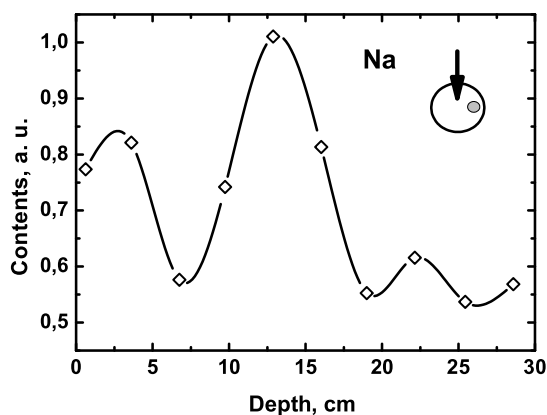


**Fig.2.** Distribution of specific content of Iodine ( $^{127}\text{I}$ ) in absorber of iodine air filter at NPP

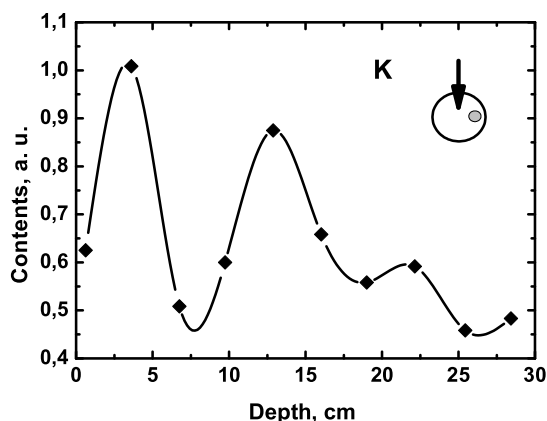
The stable isotope  $^{127}\text{I}$  is accumulated and preserved in the IAF at the moment of experimental measurements. As it can be seen in Fig. 2, the  $^{127}\text{I}$  is mainly accumulated in the frontal region of the IAF, i.e. there is the intensive adsorption of  $^{127}\text{I}$  as soon as it comes to the IAF. The specific content of Iodine in close proximity to the input surface of absorber in the

IAF is  $43 \mu\text{g/g}$ . Let us note that, according to our measurements results, the initial specific content of Iodine in the cylindrical coal granules in an absorber doesn't exceed  $5 \mu\text{g/g}$ . Some part of decay products of the Iodine isotopes could be detected in the reactions  $^{135}\text{Ba}(\gamma, \gamma)^{135m}\text{Ba}$  and  $^{133}\text{Cs}(\gamma, n)^{132}\text{Cs}$ . The Figs. 3 and 4 present a relative distribution of the light-weight alkaline chemical elements such as the Sodium and Potassium (the 1-st group of a periodic table of the chemical elements), which were obtained in our measurements.

It is visible that the chemical elements such as the Sodium and Potassium are non-homogeneously distributed in the absorber in the IAF and their dependences are well correlated along the length of the IAF.

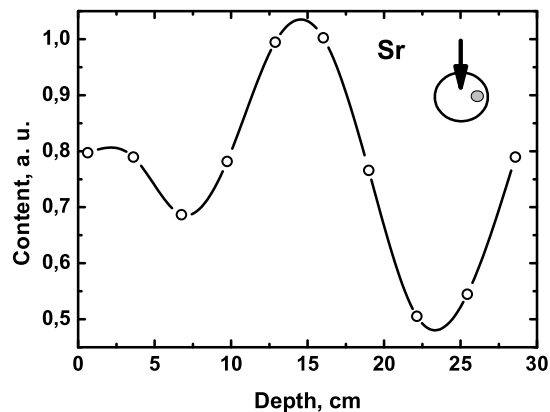


**Fig. 3.** Distribution of specific content of Sodium in absorber of iodine air filter at NPP

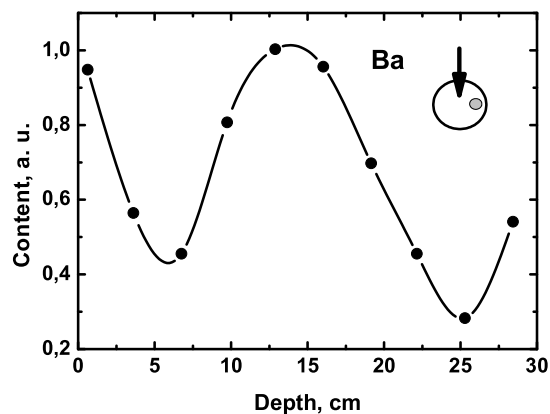


**Fig. 4.** Distribution of specific content of Potassium in absorber of iodine air filter at NPP

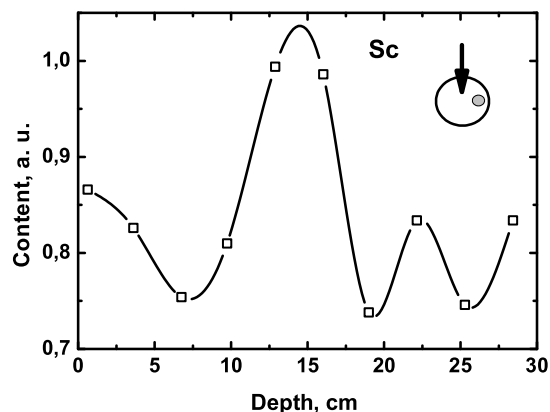
The distributions of radioactive chemical elements from the 2nd group from a periodic table of the chemical elements such as the light-weight Strontium and heavy-weight Barium are shown in Figs. 5 and 6. These distributions have a high degree of similarity. The easiest chemical element from the 3rd group such as the Scandium is distributed a little differently, but there is a main maximum in the center of absorber in the IAF as shown in Fig. 7.



**Fig. 5.** Distribution of specific content of Strontium in absorber of iodine air filter at NPP



**Fig. 6.** Distribution of specific content of Barium in absorber of iodine air filter at NPP

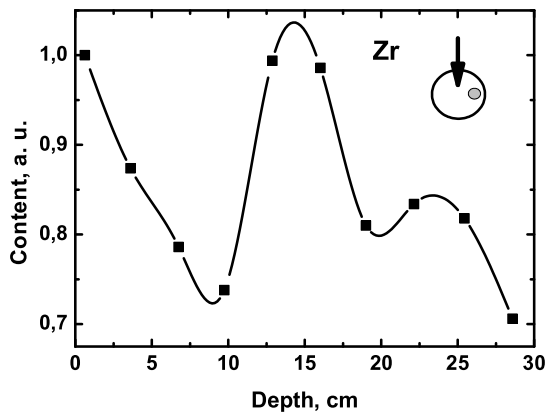


**Fig. 7.** Distribution of specific content of Scandium in absorber of iodine air filter at NPP

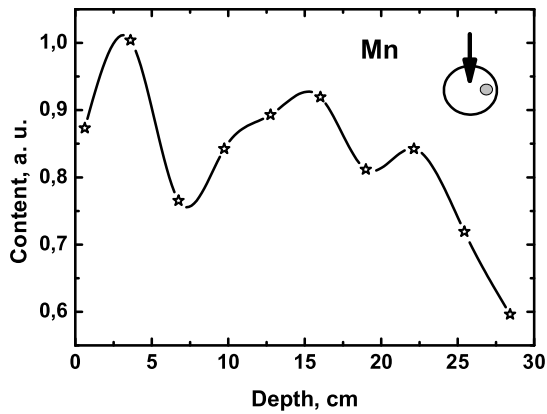
The distributions of radioactive chemical elements from the 4-th group of a periodic table of the chemical elements such as the Zirconium is given in Fig. 8.

The most light-weighted radioactive chemical element from the 7-th group of a periodic table of

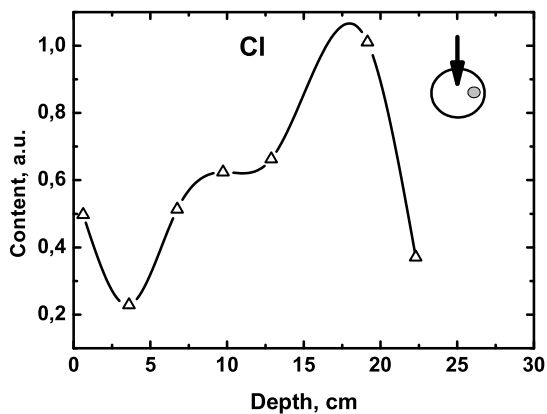
the chemical elements such as the Manganese has the distribution with the three maximums in Fig. 9.



*Fig. 8. Distribution of specific content of Zirconium in absorber of iodine air filter at NPP*



*Fig. 9. Distribution of specific content of radioactive Manganese in absorber of iodine air filter at NPP*



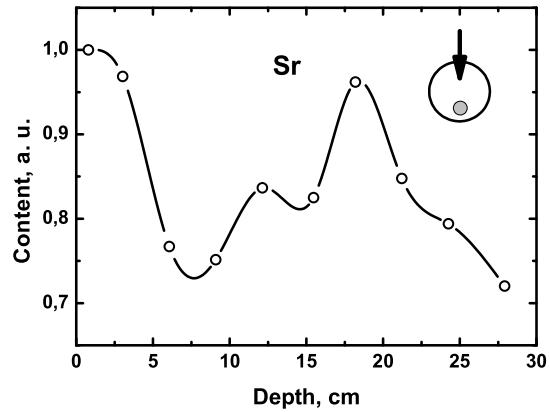
*Fig. 10. Distribution of specific content of Chlorine in absorber of iodine air filter at NPP*

In Fig. 10, the distribution of the Chlorine with the smaller mass, comparing to the Iodine mass, from the 17-th group of a periodic table of the chemical

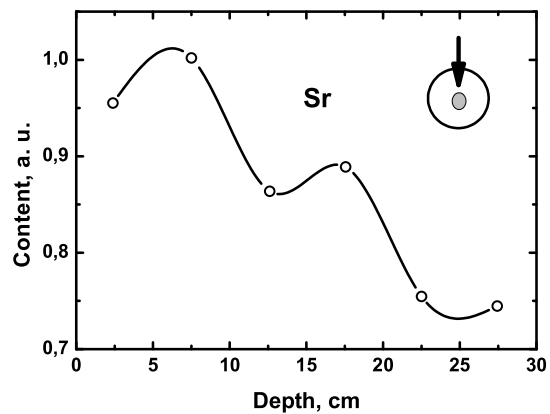
elements is depicted. It is necessary to comment that the distribution of the Chlorine in Fig. 10 is absolutely different from the distribution of the Iodine in Fig. 2.

We would like to show the distribution of the relative content of the Strontium at other places in the absorber in the IAF. In fig. 11, the distribution of the Strontium in the probe, extracted at the periphery region of absorber in the IAF is shown.

In Fig. 12, the distribution of the Strontium in the probe, extracted at the center of absorber in the IAF is shown.



*Fig. 11. Distribution of specific content of Strontium at periphery of absorber in IAF at NPP*

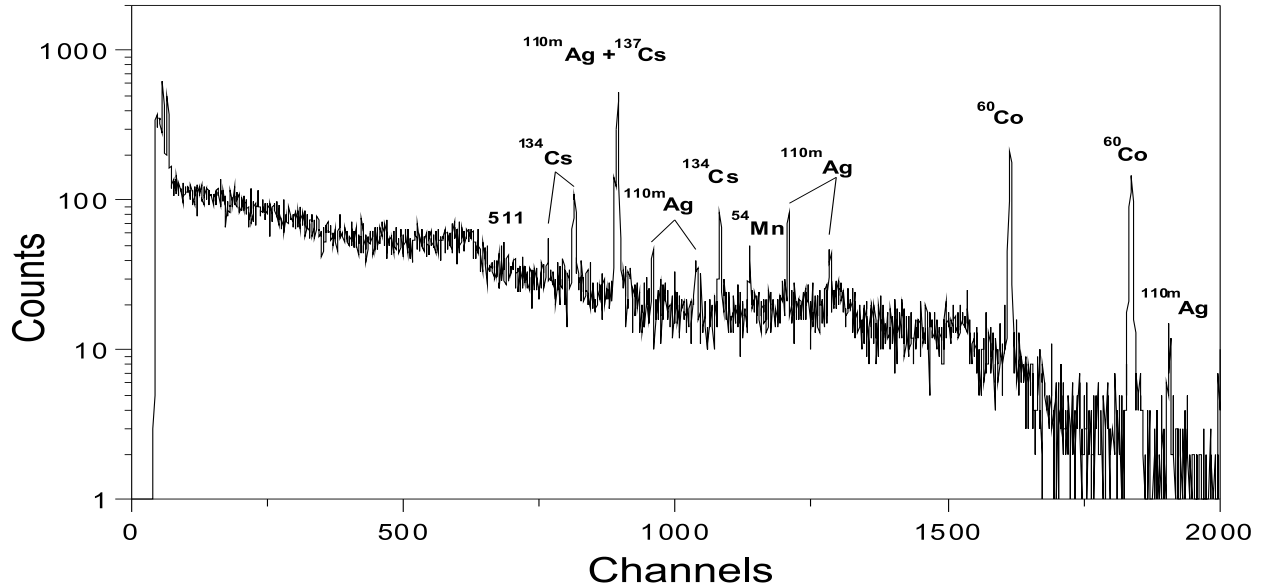


*Fig. 12. Distribution of specific content of Strontium at center of absorber in IAF at NPP*

On the upper net of the IAF, the thick and dense layer of the small dispersive coal dust particles layer, which was not captured by the aerosol filters, was registered. It was found that the direct inflow of aerosols into the IAF from the space, which is in close proximity to the nuclear reactor, worsens the IAF's aerodynamic performances. As it was shown during the research with the application of a model of the IAF, the presence of the small dispersive dust particles layer on the upper grid increases the absorber's aerodynamic resistance at the rate of 20

% . The typical spectrum of the detected radioactive chemical elements and their isotopes, which were precipitated at the grid of the AU-1500 iodine air filter, is presented in Fig. 13. As it can be seen, the presence of  $^{137}\text{Cs}$ ,  $^{60}\text{Co}$ ,  $^{110\text{m}}\text{Ag}$ ,  $^{54}\text{Mn}$  isotopes corresponds to a typical composition of the isotopes, which can be normally detected in the radioactive aerosols at the operating nuclear reactor. The small dispersive dust particles layer on the upper grid of the IAF rep-

resents the densely packed atmospheric dust, which is mixed with the operating nuclear reactor dust at the NPP. The dust layer was indissoluble, because of presence of the oils and moisture. The moisture mass fraction was 5 %. The particles with the size of about  $1\ \mu\text{m}$  represented a biggest share of particles in the small dispersive dust particles layer, according to the completed microscopy analysis.



*Fig.13. Typical spectrum of detected radioactive chemical elements and their isotopes in the IAF on the grid of iodine air filter*

#### 4. DISCUSSION

As we explained in the introduction, the distribution and accumulation processes of the adsorbed radioactive chemical elements and their isotopes in the granular filtering medium of absorber in the AU-1500 IAF strongly depends on both the physical features of the transportation processes of the small dispersive coal dust particles of the micro- and sub micro-sizes [8-14], as well as the action by the acoustic oscillatory processes, connected with the acoustic oscillations generation and propagation in the air in the granular filtering medium of absorber in the AU-1500 IAF [14]. The generating standing wave oscillations of the sound frequencies of the first harmonics, which represent the half-wave standing wave oscillations, described by the dependence between the wavelength and the thickness of granular filtering medium layer:  $\lambda_1 = 2L$  and by the next harmonic's dependence:  $\lambda_2 = 2L/3$ , have the biggest amplitudes. These standing wave oscillations are important for the process of excessive accumulation of the small dispersive coal dust particles, penetrating deeply into the adsorber, which takes place in the anti-nodes positions along the length of the IAF [14-16]. The pressure maximums in the standing wave oscillations are positioned: 1) in the case of the first harmonic, it is positioned on the distance of 15 cm, and 2) in the case of the second odd harmonic, they are located

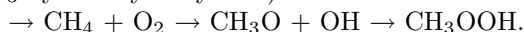
on the distances of 5, 15, 25 cm from the input surface of absorber in the IAF. The presence of maximums in the distribution of the small dispersive coal dust particles masses has been detected in the experiments with the vertical model of the IAF in [8] and the horizontal model of the IAF in [12]. According to the research in [9], the maximums of accumulation of the adsorbed radioactive chemical elements and their isotopes in the granular filtering medium of absorber in the AU-1500 IAF must be observed in these positions. On the one side, the alternating-sign pressure appearing in the positions of the anti-nodes of standing wave oscillations, results in an origination of the processes of accelerating penetration of the radioactive chemical elements and their isotopes together with the air into the cylindrical coal granules. From other side, it is a well known fact that such oscillations can intensify the diffusion processes, occurring in the cylindrical coal granules [14].

As it is shown in the experimental data in Fig. 2, the Iodine is well adsorbed in the IAF at the initial moment of its penetration into the IAF. The main share of  $^{127}\text{I}$  is absorbed by the granular filtering layer with the thickness of 10 cm. The spatial distribution of Iodine has a decreasing diffusion-type dependence [8] on the distance from the source. However, nevertheless, the concentration maximum is clearly visible on the curve of characteristic dependence. This maximum is positioned in the point, where there are

the anti-nodes for the two harmonics of the pressure waves in the air in the IAF. Therefore, the additional absorption is connected with either: the excessive accumulation of the small dispersive coal dust particles or the influence by the acoustic waves on the adsorption of chemical elements and their isotopes in the granular filtering medium of absorber in the AU-1500 IAF. In Fig. 2, there is also a small next maximum in the position near to the absorber's output, which can be related to the action by the acoustic oscillations of second harmonic, which is slightly shifted by the air stream.

The Alkaline metals such as the Sodium and Potassium have the clearly expressed distributions with the maximums, which are located at the forward fronts of anti-nodes, i.e. they are promptly absorbed at the initial stage of filtering process at the moment of entrance to the region of anti-nodes, generated by the acoustic waves. Therefore, their maximums are shifted to the position of source, i.e. to the absorber's input region in the IAF.

Moreover, it is necessary to consider the two possibilities: 1) the cross replacement by the chemical elements and their isotopes in the course of the absorption or 2) the presence of co-operative absorption in the IAF. Thus, for example, the distributions of the radioactive Strontium and Barium from the 2-nd group of chemical elements, are characterized by the maximums of absorption (see Figs. 5 and 6), which are similar to the maximum of absorption of Iodine (see Fig. 2). Of course, we don't take to the consideration the giant absorption maximum of Iodine near to the absorber's input surface in the IAF in Fig. 2. Whereas, for example, the Potassium (see Fig. 4) was forced to move deeply into the absorber out of absorber's sub-surface region in the IAF. It is a well known fact that the Barium can easily create the oxides and nitrides. Also, the Barium can easily form the  $Ba(IO_3)_2$  and the  $BaI_2$  chemical compounds, which can have the influences on its distribution in the absorber in the IAF. The radiation activity results in the creation of the Acetic acid from the Methane, containing in the air (the oxidizing of  $CH_3$  by the Hydroxyl OH):



The acetic acid can intensively react with the chemical elements of the 2-nd group.

The Scandium, which is a chemical element from the 3-rd group, has a central maximum of distribution in the region of joint maximums of the both harmonics at the distance  $L = 15$  cm from the absorbers input surface in the IAF. The Sc is accumulated on the forward front of the first maximum of the second harmonic of the standing wave oscillations at the absorber's input surface; and it is also accumulated on the backward front near to an absorber's output surface in the IAF.

The Zirconium distribution accompanies the Iodine distribution; however in the places with the small concentration of  $^{127}I$  at the absorber's output surface, it is concentrated in the region of the third

maximum of the second harmonic of the standing wave oscillations at the distance  $L \approx 25$  cm from the absorbers input surface in the IAF.

The Manganese, which is a chemical element of the 7-th group, is inclined to occupy the forward fronts of maximums of acoustic oscillations, but, at the center, it occupies the position at the distance  $L = 15$  cm from the absorbers input surface in the IAF (see Fig. 9).

The Chlorine, which is a chemical element from the 17-th group, occupies the back front of the first maximum of the second harmonic of the acoustic oscillations and the back front of the second maximum of the second harmonic of the acoustic oscillations, i.e. there is its replacement in the region, where there are no the concentration maximums of other chemical elements (see Fig. 10).

In Figs. 11 and 12, the physical features of distribution of the Strontium at the different places of probes extraction are shown. It is visible that the air streams can flow non-uniformly, resulting in some non-significant changes of distributions of the adsorbed radioactive chemical elements in the core of the IAF. At center of the IAF, the Sr has a maximum of accumulation near to the absorber's input surface, whereas at the periphery it accumulates in the region at the distance  $L = (17...18)$  cm from the absorbers input surface in the IAF.

In the cases of other chemical elements with the distribution dependences, which are not shown in our research paper, it is necessary to point out that the Calcium has its accumulation maximum at the distance  $L = 15$  cm.

Let us stress that the Ba, Sr, Sc, Zr, Ca chemical elements can have a positive impact on the absorption capacity of the cylindrical coal granules of the type of SKT-3, forming the chemically stable compounds with the Iodine.

The almost constant concentrations of the Ni, Ce, Pb adsorbed chemical elements along the length of the IAF was observed. We would like to note that the  $PbI_2$  compound is one of the most stable Iodine's compounds.

Let us note that the simultaneous consideration of both the diffusion mechanism and the acoustic mechanism in our research on the processes of the accumulation and distribution of the adsorbed chemical elements and their isotopes in the granular filtering medium of an absorber allows us to explain the obtained complex dependences of the distribution of the adsorbed chemical elements and their isotopes in the granular filtering medium of an absorber in the AU-1500 IAF at the NPP.

## 5. CONCLUSIONS

The main purpose of our research was to investigate the physical features of distribution of the adsorbed radioactive chemical elements and their isotopes in the granular filtering medium in the iodine air filters of the type of AU-1500 in the heating purge ventilation systems at the nuclear power plant. In

our research, the  $\gamma$ -activation analysis method was applied to accurately characterize the distribution of the adsorbed radioactive chemical elements and their isotopes in the granular filtering medium in the AU-1500 iodine air filter after its long term operation at the nuclear power plant. We obtained the typical spectrum of the detected chemical elements and their isotopes in the AU-1500 iodine air filter. The spatial distributions of the detected chemical element  $^{127}\text{I}$  and some other chemical elements and their isotopes in the layer of absorber, which was made of the cylindrical coal granules of the type of SKT-3, in the AU-1500 iodine air filter were also comprehensively researched. The possible influences by the changing aerodynamic resistance of the iodine air filter on the spatial distribution of the chemical elements and their isotopes in the iodine air filter were discussed. In addition, the comprehensive analysis on the obtained research results on the distribution of the adsorbed chemical elements and their isotopes in the absorber of iodine air filter was performed, the criteria of iodine air filter effective operation were formulated and the possible iodine air filter design improvements were proposed.

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## ОСОБЕННОСТИ РАСПРЕДЕЛЕНИЯ РАДИОАКТИВНЫХ ХИМИЧЕСКИХ ЭЛЕМЕНТОВ И ИХ ИЗОТОПОВ В ЙОДНЫХ ВОЗДУШНЫХ ФИЛЬТРАХ АУ-1500 АТОМНОЙ ЭЛЕКТРОСТАНЦИИ

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Главной целью работы было исследование особенностей, распределения адсорбированных химических элементов и их изотопов в гранулированной фильтрующей среде в йодных воздушных фильтрах типа АУ-1500 в системах приточно-вытяжной вентиляции на атомной электростанции. Использован метод  $\gamma$ -активационного анализа для точного изучения распределения адсорбированных химических элементов и их изотопов в гранулированной адсорбирующей среде в йодных воздушных фильтрах АУ-1500 после их долгосрочной работы на атомной электростанции. Получены типичные спектры обнаруженных химических элементов и их изотопов в йодном воздушном фильтре АУ-1500, образцы из которого облучались тормозными  $\gamma$ -квантами, возникавшими при прохождении ускоренных электронов через танталовую мишень. Найдено пространственное распределение йода и ряда других химических элементов и их изотопов в слое адсорбента, который состоял из цилиндрических угольных гранул СКТ-3. Детально обсужден возможный механизм влияния стоячих колебаний давления воздуха в йодном воздушном фильтре на пространственное распределение поглощенных химических элементов и их изотопов. Выполнен всесторонний анализ полученных результатов исследования пространственного распределения адсорбированных радиоактивных химических элементов и их изотопов в адсорбенте йодного воздушного фильтра.

## ОСОБЛИВОСТІ РОЗПОДІЛЕННЯ РАДІОАКТИВНИХ ХІМІЧНИХ ЕЛЕМЕНТІВ ТА ЇХ ІЗОТОПІВ У ЙОДНИХ ПОВІТРЯНИХ ФІЛЬТРАХ АУ-1500 АТОМНОЇ ЕЛЕКТРОСТАНЦІЇ

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Головною метою було дослідження особливостей розподілення поглинутих хімічних елементів та їхніх ізоотопів у гранульованому середовищі у йодному повітряному фільтрі типу АУ-1500 у приток-втягових системах на атомній електростанції. Метод  $\gamma$ -активаційного аналізу застосовано щоб охарактеризувати розподілення поглинутих хімічних елементів та їхніх ізоотопів у гранульованому фільтровальному середовищі йодних повітряних фільтрів типу АУ-1500 після їх довгого терміну роботи на атомній електростанції. Отримані типові спектри виявлених хімічних елементів та їхніх ізоотопів у повітряному фільтрі АУ-1500, зразки з якого опромінювалися гальмовими  $\gamma$ -квантами, які виникали при проходженні прискорених електронів через танталову мишень. Просторове розподілення йоду та деяких інших хімічних елементів та їхніх ізоотопів у абсорбері, котрий був заповнений циліндричними гранулами вугілля типу СКТ-3, у повітряному фільтрі АУ-1500 було досліджено. Можливий вплив стоячих коливань повітряного тиску в йодному повітряному фільтрі на просторове розподілення радіоактивних хімічних елементів та їхніх ізоотопів у йодному повітряному фільтрі було обговорено авторами. Зроблено всебічний аналіз отриманих результатів дослідження просторового розподілення хімічних елементів та їхніх ізоотопів у повітряному фільтрі.