INVESTIGATION OF SOME SPECIFIC INDUSTRY OBJECTS EFFECT ON PLANTS

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ABSTRACT

Such industry objects as metallurgical works, chemical fertilizers manufacture, automobile industry and others are contribute to contaminate an environment. For example, it is known, that aluminum factories throw out in an environment fluorine hydride, solid fluorides, nitrogen dioxide, sulpher dioxide, hydrocarbons, ions of heavy metals and others. For comparison of harmful action of various industrial objects on plants we had investigate some leaves and seed of plants grown in areas of Tadjik aluminum factory, Chirchik works of heatproof and refractory metals, Asaka automobile works and Tashkent nuclear reactor action. Investigations were conduct by nuclear techniques and by physical and agrotechnical methods. The alternative methods have been used by Tashkent state agrarian university. High sensitive and reliable multielement instrumental neutron activation analysis (INAA) and X-ray radiometric techniques for determination of 27 elements in plant have been developed in the Institute of nuclear physics (INP).

1- INTRODUCTION

The use of plants in an environmental pollution studies is becoming more and more used in the last years. Lower plants such as mosses and lichens [1,2] have been used as biomonitors. For dry weather countries bark and leave of trees [3,4] have been used. Due to dry climatic conditions it is difficult to find moss or lichen in Uzbekistan. Leaves of fruit plants: vineyard, peach, apple, apricot, persimmon and mulberry trees as well as leaves of technical crops: cotton, corn, mint and clover, which grown near above specified objects and also some kind of seeds from areas near aluminum factory were sampled. The purpose of choice so much investigated kinds of plant widely popular over the country was to select plants which can be used as biomonitors in Uzbekistan.

2- EXPERIMENTAL

Samples from 4 sites near aluminum factory, 2 sites of automobile works, 1 site near works of refractory metals and 1 site in the institute of nuclear physics were collected. The site in Djarcurgan region on the distance of 150-200 km from aluminum factory is accepted as control region. On each site 5 subsample within 100x100 m area on the height of 2 to 3 m of the trees were taken, washed by distilled water and then were dried to constant weight at room temperature. The dried samples were crushed in agate roller and were analyzed with standard (IAEA 0393 algae) by using of INP water-water reactor (WWR-SM). Characteristics of developed techniques for determination of 27 elements in plants are given in table 1. The determination of this large number elements was achieved with using complex conditions of irradiation, including varying neutron energy and choosing optimum time parameters.

Table 1 Characteristics of developed techniques

Determined elements	Sample mass, g	Neutron Flux Density and spectrum, $n\cdot cm^{-2}\cdot s^{-1}$	Time of		
			irradiation	cooling	measuring
Na, K, Mn, Cu, Sr	0.1	7.5×10^{10}, thermal	16 h	2 - 3 h	5 m
Ti, AS, Se, Br, Rb, Cd, Sb, Ba, La, U	0.2-0.3	10^{14} fission spectrum	20 h	10 d	5 m
Sc, Cr, Fe, Co, Ni, Zn, Zr, Mo, Ce, Cs, Hg, Th				20 d	10 m

3. RESULTS AND DISSCUTION

INAA and X-ray radiometric technique experimental results of so much kinds of leaves and seeds have been obtain. For example X-ray spectrum of vineyard leaves measured with Si (Li) detector and ^{109}Cd source is shown in figure 1. Kα - lines of Ca, Fe, Cu, Sr and Zr will be seen. Ca concentration determined by X-ray method is $1.5\cdot10^{-1}$ %.

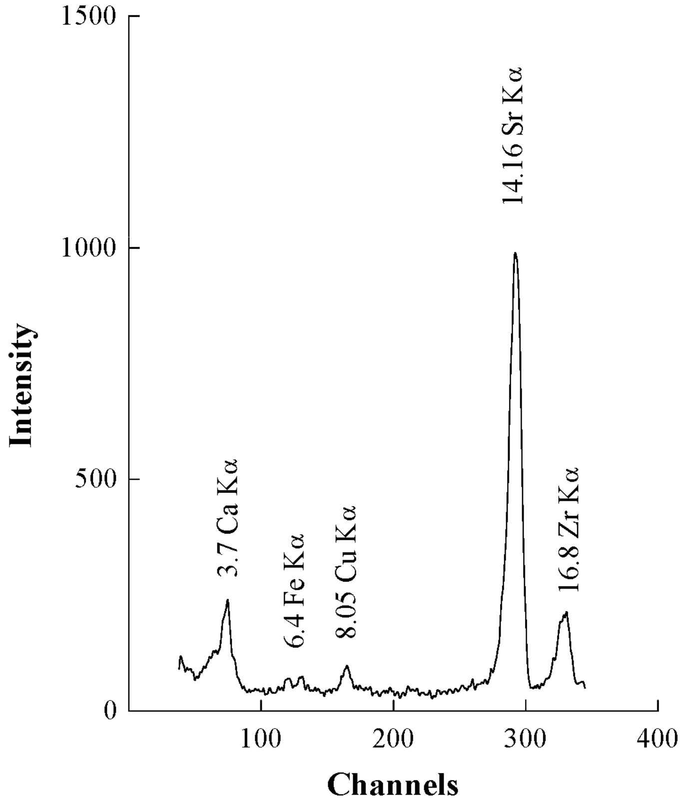

Fig. 1. X-ray spectrum of vineyard leaves with source ^{109}Cd

In the table 2 the INAA results of apricot, vineyard and peach leaves from different regions of Uzbekistan are given. In the table 3 the INAA results of mulberry leaves from investigated industrial objects in Uzbekistan are given.

Comparison results indicated that elemental content variation in seeds from 4 site of TadAF as well as in leaves from the same regions indicated that mild (Denau), average (Dashnabad) and highly (Sariassiya) polluted areas are observed near TadAF. This results are in agreement with the data of other organizations investigated fluoride contamination in this regions and with results of Tashkent State Agrarian University studies on the stability degree of specific plants to harmful ejection depending on their location from the object and dependencies of stability of the contents endogenous protective substances (routine and others) in plants depending on effect of harmful ejection of. the object.

Comparative assessment of fruit trees and technical culture investigated leaves indicated that the best collectors of air pollution may be considered mulberry and mint. In less degree quince, vineyard and tomato, clover accordingly. We think that mint (less tomato clover), mulberry (less quince, vineyard, pomegranate) can be use as biomonitors in Uzbekistan. Our studies are preliminary, not regular, carried out one and two-time only, so our conclusions can be not final. This work must be continued.

Table 2. INAA results of apricot, vineyard and peach leaves from different regions of Uzbekistan

Element	Concentration, %								
	Dashnabad, Tadjik aluminum factory			Djarkurgan, Tadjik aluminum factory			Chirchik metal works		Tashkent
	apricot	vineyard	peach	apricot	vineyard	peach	vineyard	peach	peach
Na	$3.5\cdot10^{-2}$	$2.0\cdot10^{-2}$	$1.8\cdot10^{-2}$	$1.3\cdot10^{-2}$	$2.9\cdot10^{-2}$	$2.0\cdot10^{-2}$	$2.8\cdot10^{-3}$	$1.6\cdot10^{-3}$	$5.4\cdot10^{-3}$
K	3.2	0.7	1.7	3.1	0.7	2.6	1.2	2.1	2.5
Sc	$9.2\cdot10^{-6}$	$1.7\cdot10^{-5}$	$6.1\cdot10^{-6}$	$8.2\cdot10^{-6}$	$7.8\cdot10^{-6}$	$9.0\cdot10^{-6}$	$1.2\cdot10^{-6}$	1.110^{-6}	3.110^{-6}
Ti	$1.8\cdot10^{-2}$	$2.1\cdot10^{-2}$	$2.0\cdot10^{-2}$	$2.4\cdot10^{-2}$	$2.0\cdot10^{-2}$	$3.0\cdot10^{-2}$	$2.0\cdot10^{-2}$	$1.3\cdot10^{-2}$	$1.6\cdot10^{-2}$
Cr	$1.9\cdot10^{-4}$	$2.5\cdot10^{-4}$	$1.7\cdot10^{-4}$	$3.6\cdot10^{-4}$	$1.3\cdot10^{-4}$	$3.0\cdot10^{-4}$	$9.7\cdot10^{-5}$	$1.5\cdot10^{-4}$	$1.7\cdot10^{-4}$
Mn	$3.3\cdot10^{-3}$	$4.9\cdot10^{-3}$	$9.4\cdot10^{-3}$	$3.7\cdot10^{-3}$	$5.2\cdot10^{-3}$	$4.1\cdot10^{-3}$	$1.6\cdot10^{-2}$	$3.9\cdot10^{-3}$	$6.8\cdot10^{-3}$
Fe	$4.8\cdot10^{-2}$	6.710^{-2}	$3.4\cdot10^{-2}$	$5.2\cdot10^{-2}$	$4.5\cdot10^{-2}$	$5.6\cdot10^{-2}$	$9.3\cdot10^{-3}$	$6.9\cdot10^{-3}$	$2.1\cdot10^{-2}$
Co	$3.3\cdot10^{-5}$	4.910^{-5}	3.110^{-5}	$3.8\cdot10^{-5}$	$3.9\cdot10^{-5}$	$4.0\cdot10^{-5}$	$1.8\cdot10^{-5}$	$1.2\cdot10^{-5}$	$2.7\cdot10^{-5-}$
Ni	$2.1\cdot10^{-3}$	1.710^{-3}	2.110^{-3}	$1.5\cdot10^{-3}$	$1.5\cdot10^{-3}$	$1.4\cdot10^{-3}$	$1.3\cdot10^{-3}$	$7.5\cdot10^{-4}$	$9.6\cdot10^{-4}$
Cu	$5.4\cdot10^{-4}$	$9.8\cdot10^{-4}$	$9.2\cdot10^{-4}$	6.110^{-3}	$9.9\cdot10^{-4}$	$3.6\cdot10^{-3}$	$5.7\cdot10^{-4}$	$3.5\cdot10^{-4}$	$4.5\cdot10^{-4}$
Zn	$2.4\cdot10^{-3}$	$2.6\cdot10^{-3}$	$2.8\cdot10^{-3}$	$2.7\cdot10^{-3}$	$4.8\cdot10^{-3}$	$3.0\cdot10^{-3}$	$1.5\cdot10^{-3}$	$2..0\cdot10^{-3}$	$2.9\cdot10^{-3}$
As	$2.7\cdot10^{-4}$	$1.5\cdot10^{-4}$	$2.2\cdot10^{-4}$	$1.9\cdot10^{-4}$	$2.5\cdot10^{-4}$	1.110^{-4}	$1.0\cdot10^{-4}$	$2.6\cdot10^{-4}$	$1.4\cdot10^{-4}$
Se	$5.6\cdot10^{-7}$	$5.6\cdot10^{-7}$	$5.3\cdot10^{-7}$	$4.8\cdot10^{-7}$	$5.9\cdot10^{-7}$	$4.2\cdot10^{-7}$	$2.6\cdot10^{-7}$	$4.3\cdot10^{-7}$	$3.4\cdot10^{-7}$
Br	$1.7\cdot10^{-4}$	$1.9\cdot10^{-4}$	$2.8\cdot10^{-4}$	$3.4\cdot10^{-4}$	$3.2\cdot10^{-4}$	$1.6\cdot10^{-4}$	$1.3\cdot10^{-4}$	$2.0\cdot10^{-4}$	$1.6\cdot10^{-4}$
Rb	$5.1\cdot10^{-4}$	$3.3\cdot10^{-4}$	$5.8\cdot10^{-4}$	$3.5\cdot10^{-4}$	$1.9\cdot10^{-4}$	$4.5\cdot10^{-4}$	$3.0\cdot10^{-4}$	$1.5\cdot10^{-4}$	$3.8\cdot10^{-4}$
Sr				$4.4\cdot10^{-4}$		$9.9\cdot10^{-4}$	$5.3\cdot10^{-4.}$	$2.5\cdot10^{-4}$	$2.9\cdot10^{-4}$
Zr	$5.7\cdot10^{-3}$	$2.9\cdot10^{-3}$	$4.8\cdot10^{-3}$	$1.8\cdot10^{-3}$	$2.2\cdot10^{-3}$	$5.6\cdot10^{-3}$	$2.0\cdot10^{-3}$	$5.0\ 10^{-3}$	$4.4\cdot10^{-3}$
Mo	$5.4\cdot\cdot10^{-5}$	$7.5\cdot10^{-5}$	$6.8\cdot10^{-5}$	$4.7\cdot10^{-5}$	$6.0\cdot10^{-5}$	$6.0\cdot10^{-5}$	$9.9\cdot10^{-5}$	$3.5\cdot10^{-5}$	$6.0\cdot10^{-5}$
Cd	$6.5\cdot10^{-4}$	$1.7\cdot10^{-4}$	$2.0\cdot10^{-4}$	$3.6\cdot10^{-4}$	$1.0\cdot10^{-4}$	$1.8\cdot10^{-4}$	$2.2\cdot10^{-4}$	$2.0\cdot10^{-4}$	$7.0\cdot10^{-5}$
Sb	$2.5\cdot10^{-5}$	$2.5\cdot10^{-5}$	$2.5\cdot10^{-5}$	$5.4\cdot10^{-5}$	$1.6\cdot10^{-5}$	$3.5\cdot10^{-5}$	$8.4\cdot10^{-6}$	$1.0\cdot10^{-5}$	$1.3\cdot10^{-5}$
Cs	$6.2\cdot10^{-6}$	$2.6\cdot10^{-6}$	$6.9\cdot10^{-6}$	$2.4\cdot10^{-6}$	$4.8\cdot10^{-6}$	$6.2\cdot10^{-6}$	$<1.0\cdot10^{-6}$	$<1.0\cdot10^{-6}$	$<1.0\cdot10^{-6}$
Ba	$7.8\cdot10^{-4}$	$5.8\cdot10^{-4}$	$1.1\cdot10^{-3}$	$2.5\cdot10^{-4}$	$8.3\cdot10^{-4}$	$8.3\cdot10^{-4}$	$3.2\cdot10^{-6}$	$3.2\cdot10^{-6}$	$7.9\cdot10^{-4}$
La	$7.6\cdot10^{-6}$	$5.6\cdot10^{-6}$	$5.0\cdot10^{-6}$	$3.8\cdot10^{-6}$	$3.2\cdot10^{-6}$	$6.4\cdot10^{-6}$	$1.1\cdot10^{-6}$	$1.1\cdot10^{-6}$	$2.1\cdot10^{-6}$
Ce	$<2.5\cdot10^{-5}$	$<2.5\cdot10^{-5}$	$<2.5\cdot10^{-5}$	$<2.6\cdot10^{-5}$	$<2.7\cdot10^{-5}$	$<2.5\cdot10^{-5}$	$<2.5\cdot10^{-5}$	$<2.5\cdot10^{-5}$	$1.3\cdot10^{-4}$
Hg	$1.1\cdot10^{-4}$	$3.8\cdot10^{-4}$	$2.3\cdot10^{-5}$	$4.1\cdot10^{-4}$	$1.6\cdot10^{-4}$	$1.8\cdot10^{-4}$	$1.1\cdot10^{-4}$	$4.2\cdot10^{-5}$	$6.0\cdot10^{-5}$
Th	$3.2\cdot10^{-6}$	$7.1\cdot10^{-6}$	$1.9\cdot10^{-6}$	$2.1\cdot10^{-6}$	$3.0\cdot10^{-6}$	$6.0\cdot10^{-6}$	$2.4\cdot10^{-6}$	$2.0\cdot10^{-6}$	$2.6\cdot10^{-6}$
U	$7.4\cdot10^{-5}$	$1.2\cdot10^{-4}$	$4.1\cdot10^{-5}$	$1.2\cdot10^{-5}$	$3.9\cdot10^{-5}$	$3.9\cdot10^{-5}$	$2.3\cdot10^{-5}$	$1.1\cdot10^{-5}$	$3.1\cdot10^{-5}$

*-The confidence intervals are given for probability 0.975 and 5 multiple determinations.

Table 3. Results of INAA of mulberry leaves from different regions of Uzbekistan

Ele-ment	Concentration, $\overline{x} \pm \frac{t_{p,f} \cdot S^{*}}{\sqrt{f}}$, %				
	Dashnabad	Djarkurgan	Asaka region	Asaka works	Tashkent INP
Na	$(2.3\pm0.3)\cdot10^{-2}$	$(6.7\pm0.8)\cdot10^{-3}$	$(7.4\pm0.8)\cdot10^{-3}$	$(7.7\pm0.8)\cdot10^{-3}$	$(3.6\pm0.4)\cdot10^{-3}$
K	1.5 ± 0.1	1.6 ± 0.1	1.7 ± 0.1	1.8 ± 0.1	1.7 ± 0.1
Sc	$(1.5\pm0.2)\cdot10^{-5}$	$(1.6\pm0.2)\cdot10^{-6}$	$(2.7\pm0.3)\cdot10^{-6}$	$(3.3\pm0.4)\cdot10^{-6}$	$(1.5\pm0.2)\cdot10^{-6}$
Ti	$(2.1\pm0.2)\cdot10^{-2}$	$(2.3\pm0.2)\cdot10^{-2}$	$(1.9\pm0.2)\cdot10^{-2}$	$(2.0\pm0.2)\cdot10^{-2}$	$(1.5\pm0.2)\cdot10^{-2}$
Cr	$(2.3\pm0.2)\cdot10^{-4}$	$(7.1\pm0.8)\cdot10^{-5}$	$(9.8\pm1.0)\cdot10^{-5}$	$(1.2\pm0.2)\cdot10^{-4}$	$(6.3\pm0.7)\cdot10^{-5}$
Mn	$(4.6\pm0.5)\cdot10^{-3}$	$(7.3\pm0.8)\cdot10^{-3}$	$(3.5\pm0.4)\cdot10^{-3}$	$(4.1\pm0.4)\cdot10^{-3}$	$(5.7\pm0.6)\cdot10^{-3}$
Fe	$(7.6\pm0.8)\cdot10^{-2}$	$(1.3\pm0.2)\cdot10^{-2}$	$(2.0\pm0.2)\cdot10^{-2}$	$(3.0\pm0.3)\cdot10^{-2}$	$(1.5\pm0.2)\cdot10^{-2}$
Co	$(5.8\pm0.6)\cdot10^{-5}$	$(1.3\pm0.2)\cdot10^{-5}$	$(2.5\pm0.3)\cdot10^{-5}$	$(2.3\pm0.3)\cdot10^{-5}$	$(1.2\pm0.2)\cdot10^{-5}$
Ni	$(2.1\pm0.2)\cdot10^{-3}$	$(1.5\pm0.2)\cdot10^{-3}$	$(2.5\pm0.3)\cdot10^{-3}$	$(1.2\pm0.2)\cdot10^{-3}$	$(1.3\pm0.2)\cdot10^{-3}$
Cu	$(2.3\pm0.3)\cdot10^{-3}$	$(3.3\pm0.4)\cdot10^{-3}$	$(1.2\pm0.2)\cdot10^{-3}$	$(1.1\pm0.2)\cdot10^{-3}$	$(7.3\pm0.8)\cdot10^{-4}$
Zn	$(3.3\pm0.3)\cdot10^{-3}$	$(2.5\pm0.3)\cdot10^{-3}$	$(2.8\pm0.3)\cdot10^{-3}$	$(2.3\pm0.3)\cdot10^{-3}$	$(2.3\pm0.3)\cdot10^{-3}$
As	$(5.6\pm0.6)\cdot10^{-4}$	$(1.8\pm0.2)\cdot10^{-4}$	$(8.8\pm1.0)\cdot10^{-5}$	$(2.2\pm0.2)\cdot10^{-4}$	$(1.0\pm0.1)\cdot10^{-4}$
Se	$(4.3\pm0.6)\cdot10^{-7}$	$(8.9\pm1.0)\cdot10^{-7}$	$(4.6\pm0.6)\cdot10^{-7}$	$(6.9\pm0.8)\cdot10^{-7}$	$<1.8\cdot10^{-7}$
Br	$(1.2\pm0.2)\cdot10^{-3}$	$(2.8\pm0.3)\cdot10^{-4}$	$(5.5\pm0.7)\cdot10^{-4}$	$(6.9\pm0.8)\cdot10^{-4}$	$(2.0\pm0.3)\cdot10^{-4}$
Rb	$(1.2\pm0.2)\cdot10^{-4}$	$(2.5\pm0.3)\cdot10^{-4}$	$(3.0\pm0.3)\cdot10^{-4}$	$(2.4\pm0.3)\cdot10^{-4}$	$(4.0\pm0.4)\cdot10^{-4}$
Sr	$(6.3\pm0.7)\cdot10^{-4}$	$(6.6\pm0.7)\cdot10^{-4}$	$(4.8\pm0.5)\cdot10^{-4}$	$(4.3\pm0.5)\cdot10^{-4}$	$(2.5\pm0.3)\cdot10^{-4}$
Zr	$(6.2\pm0.8)\cdot10^{-3}$	$(4.0\pm0.6)\cdot10^{-3}$	$(4.0\pm0.5)\cdot10^{-3}$	$(2.8\pm0.3)\cdot10^{-3}$	$(2.5\pm0.3)\cdot10^{-3}$
Mo	$(9.0\pm1.0)\cdot10^{-5}$	$(5.3\pm0.7)\cdot10^{-5}$	$(4.6\pm0.6)\cdot10^{-5}$	$(3.1\pm0.4)\cdot10^{-5}$	$(4.2\pm0.6)\cdot10^{-5}$
Cd	$(1.1\pm0.1)\cdot10^{-4}$	$(4.7\pm0.5)\cdot10^{-4}$	$(1.3\pm0.2)\cdot10^{-4}$	$(4.1\pm0.5)\cdot10^{-4}$	$(8.3\pm0.9)\cdot10^{-5}$
Sb	$(2.9\pm0.3)\cdot10^{-5}$	$(2.4\pm0.3)\cdot10^{-5}$	$(2.8\pm0.3)\cdot10^{-5}$	$(1.8\pm0.3)\cdot10^{-5}$	$(9.6\pm1.0)\cdot10^{-6}$
Cs	$(4.2\pm0.5)\cdot10^{-6}$	$(1.5\pm0.2)\cdot10^{-6}$	$(1.4\pm0.2)\cdot10^{-6}$	$(3.3\pm0.4)\cdot10^{-6}$	$<2\cdot10^{-6}$
Ba	$(6.3\pm0.7)\cdot10^{-4}$	$(1.1\pm0.1)\cdot10^{-3}$	$(2.7\pm0.3)\cdot10^{-4}$	$(1.3\pm0.2)\cdot10^{-4}$	$(3.5\pm0.4)\cdot10^{-4}$
La	$(4.6\pm0.5)\cdot10^{-6}$	$(1.7\pm0.2)\cdot10^{-6}$	$(2.5\pm0.3)\cdot10^{-6}$	$(2.2\pm0.3)\cdot10^{-6}$	$(1.3\pm0.2)\ 10^{-6}$
Ce	$<2\cdot10^{-5}$	$<2\cdot10^{-5}$	$(1.4\pm0.2)\cdot10^{-4}$	$(1.1\pm0.2)\cdot10^{-4}$	$<2\cdot10^{-5}$
Hg	$(3.7\pm1.0)\cdot10^{-4}$	$(7.9\pm0.8)\cdot10^{-5}$	$(1.4\pm0.2)\cdot10^{-4}$	$(1.2\pm0.2)\cdot10^{-4}$	$(4.3\pm0.5)\cdot10^{-5}$
Th	$(4.2\pm0.5)\cdot10^{-6}$	$(2.8\pm0.3)\cdot10^{-6}$	$(8.6\pm1.0)\cdot10^{-7}$	$(6.2\pm0.7)\cdot10^{-7}$	$(5.4\pm0.6)\cdot10^{-7}$
U	$(5.6\pm0.6)\cdot10^{-5}$	$(2.2\pm0.3)\cdot10^{-5}$	$(1.7\pm0.2)\cdot10^{-5}$	$(2.3\pm0.3)\cdot10^{-5}$	$(3.1\pm0.3)\cdot10^{-5}$

- The confidence intervals are given for probability 0.975 and 5 multiple determinations.

Obtain data are compare with the generalized table of typical chemical elements spreading in soil, plants and human blood [5]. Preliminary comparative analysis of these data will show that contents of K, Cr, Zn, Cs, Ba, Th are on the same level as in the typical elemental contents of vegetation, the contents of Na, Mn, Se, Rb, Sr and La elements are less than in typical elemental contents of plants and the contents of Sc, Ti, Fe, Co, Ni, Cu, As, Br, Zr, Mo, Cd, Sb, Ce, Hg and U elements are higher than in typical plants.

In general we can make followed conclusions: 1). mulberry and mint leaves can be used as biomonitors in summer season; 2). such technical culture as clover can be used as a collector of harmful substances from soil and air in order to subsequent destruction this collector plant; 3). all investigated regions are polluted; 4). the Sariassiya region is polluted heavily; 5). the plant, which can be used as biomonitor for yearly monitoring, must be find.

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