URANIUM EXTRACTION BY APRICOT SHELL-16501

Mirsaidov I.U.

Nuclear and Radiation Safety Agency, 17a Hamza Hakimzoda, 734003, Dushanbe, Tajikistan

ABSTRACT

In this paper, use of highly contaminated mine and drainage waters by local residents which lead to increase of doses is described. Uranium concentration in this water is studied. Possibilities of uranium extraction by cheap and local sorbent (almonds, peach and apricot shells) were investigated. It is revealed that apricot shell has very good sorption properties for uranium extraction. Detailed sorption parameters of apricot shell are described.

INTRODUCTION

Developments of uranium-mining industry result in accumulation of big amount of wastes and stockpiles. These wastes of mining industry formed a number of uranium tailings around mines, hydrometallurgy plants of Northern Tajikistan.

The serious problem is specification of many industry fields, and as a result, individual approaches are required for solution of environmental tasks. The uranium industry wastes contain radionuclides with high concentrations (basically uranium-thorium raw) and other harmful substances. The total amount of wastes in uranium tailings is approximately 55 million tons and influence on live and lifeless nature. In global scale, the water turnover and gas balance are changing in atmosphere.

Despite of long standing and multiple researches in the field of ecologically pure production, the problem of utilization and reprocessing of industrial wastes is still topical. That's why, economical, technological and ecologically justified need aroused in development and introduction of still new progressive and safe methods of problem solutions of biosphere deliverance from danger being contaminated by industry wastes and consumption. Preliminary account and wastes evaluation is necessary in order to select more rational way of problem solution.

EXISTING PROBLEMS AND PROGRESS MADE IN WATER DECONTAMINATION

Protective surface on stockpiles and tailings in our region is well penetrable for any atmospheric precipitation and these storages can be washed down by mud streams. Such situations can become the reason of sewage, drainage waters and ground surface around tailings contamination and much longer outside of their territories.

High uranium concentration on other hazardous substances was observed in mine and drainage waters, which are used by local residents for daily living needs, including drinking, cattle pond and land irrigation on farmland (Table 1).

Table 1

Uranium content (Bq/l) in water resources of Taboshar city.

Water sites	$^{238}U+^{234}U$	^{236}Ra
Drainage waters under tailings 1-2	1110 - 1450	-
Old open-pit	47 – 60	0,054
Drainage waters of old mines	37 – 40	0,160
Sari – Sakhli – Sai	26,7	0,020
r.Utaken – Su (source)	0,65	0,030
r. Utken – Su (Khujand)	0,73	0,034
Old Taboshar river	1,86	0,017

It is necessary to take into account that the use of mine and drainage waters for drinking with high contaminated levels by local residents can result in increase of doses for population more than 1mSv/year which is foreseen by radiation safety norms. The samples were taken from these lands for investigation of uranium concentration. Almonds, peach and apricot shells were among taken samples. Chemical analysis showed that there are no observations of uranium tracks in almonds and peach shells. However, analysis of apricot shell revealed uranium content. Uranium concentration in apricot shells taken from Taboshar city, 4-5 times exceeds its content in apricot fruitages and kernel of a shell. Thus, the apricots become the object of laboratory investigations.

We took samples of apricot shell from different regions of Northern Tajikistan – Kayrakum, Isfara, Chkalovsk, Ayni, Gafurov, J.Rasulov and other cities. The average gamma-background on ground surface, where fruitages were taken, in samples is 15-30 microroentgen/hour but in fruitage there is no uranium concentration. Here we can use apricot as indicator for uranium detection. There is no uranium in apricot fruitages since the trees are growing up on non-contaminated by radionuclides soils.

For identification of optimal sorption regime, a number of tests were carried out. The sorption characteristics of apricot shell depending on seed size of crushed shell, on temperature, on pH medium and from duration of soaking. Coefficient of shells' swelling capacity is equal to 1,17 (table 2.).

Table 2

Apricot's shell sorption in dynamic regime

(at =100 ml/day, U = 0,023 g/l, $m_{sorbent}$ = 20g and $d_{sorbent}$ =1mm, t = 35^{o}C)

Soaking, days	Exit		U,abs.g	Sorbent Saturation, abs.g, U	Sorption percentage ,U	Extraction U, %
	pH	U,g/l				
Entrance pH = 8,0						
1	5,0	0,0032	0,00032	0,00198	86,1	8,6
2	5,6	0,0011	0,00011	0,00219	95,22	18,1
3	5,7	0,00157	0,000157	0,00214	93,04	27,4
4	6,6	0,00157	0,000157	0,00214	93,04	36,7
5	6,95	0,00157	0,000157	0,00214	93,04	46,0
6	7,35	0,0021	0,00021	0,00209	90,86	55,1
7	7,35	0,00315	0,000315	0,00198	86,30	63,7

8	7,35	0,00315	0,000315	0,00198	86,30	72,3
9	7,1	0,0042	0,00042	0,00185	80,43	80,4
10	7,25	0,00947	0,000947	0,00135	41,17	86,3
11	7,65	0,0215	0,00215	0,00015	6,52	86,9
12	7,4	0,023	0,0023	0,000	0,00	-
Entrance pH = 3,7						
1	4,25	0,0075	0,00075	0,00209	90,86	9
2	4,26	0,0065	0,00065	0,00209	95,21	18,6
3	4,26	0,0085	0,00085	0,00209	90,86	27,7
4	4,24	0,0108	0,00108	0,00199	86,52	36,3
5	4,24	0,0115	0,00115	0,00178	77,39	44,1
6	4,07	0,0145	0,00145	0,00178	77,39	51,8
7	3,97	0,017	0,0017	0,00167	72,61	59,1
8	3,87	0,0175	0,00175	0,00146	63,47	65,4
9	3,87	0,0188	0,00188	0,00141	61,30	71,6
10	3,86	0,0195	0,00195	0,00104	45,21	76,1
11	3,85	0,0190	0,00190	0,00073	31,74	79,3
12	3,4	0,0214	0,00214	0,00052	22,6	81,5
Entrance pH = 1,8						
1	1,86	0,024	0,0024	0,00080	25,00	3,5
2	1,82	0,0295	0,00295	0,00025	7,81	4,6
3	2,0	0,0305	0,00305	0,00015	4,68	5,2
4	1,75	0,032	0,0032	0,00	0,00	-
5	1,75	0,032	0,0032	0,00	0,00	-

CONCLUSIONS

The sorption properties of apricot shell at constant regime showed that while increasing solution temperature and decreasing the apricot's shell size, the uranium extraction is increasing. However, the influence of pH on sorption percentage has extreme character. Exremum point is equal to 3,65 pH. It is considered that the optimal parameter of crushed shell's size is 1 mm and pH is 3,65. In these conditions, uranium concentration in sorbent reached 1,721 kg/tons, which is in absolute grams is = 0,0344g.

Further, change dynamics of uranium sorption process from mine and drainage waters is studied in different pH mediums. The high percentage of uranium sorption is foreseen at pH 8 and 3,65. In case if pH is 1,8 the sorption process goes slowly. If manifold of pH (solution in its exit way from sorption apparatus) 7…..8, one can consider that sorption process in apparatus is completed, since in this case sorbent saturation by uranium is completed.

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