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EUROPEAN ATOMIC ENERGY COMMUNITY - EURATOM

DECONTAMINATION OF SYNTHETIC EFFLUENT BY FLOTATION

by

P. DEJONGHE (Belchim) and R. LOPES CARDOZO (Euratom)

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Joint Nuclear Research Centre
Ispra Establishment - Italy
Materials Department
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The authors' names are listed in alphabetical order.

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Decontamination of Synthetic Effluent by Flotation

INTERESTED by the communication of Sebba[1], some scanning tests were undertaken in order to ascertain whether the flotation of ions could be used for the decontamination of radioactive effluent. The results obtained may be considered as being indicative and of limited value only, owing to the fact that no special efforts have been made to achieve optimal conditions, to use foam stabilizers, etc.

The glass flotation cell used is illustrated in Fig. 1. Encouraging results have been obtained by use of a foam column of 60 cm and by introducing the surfactant, that is, sodium lauryl sulphate, 25 cm underneath the liquid inlet. The foam column proved to be very stable at $p\mathrm{H} = 2$ if distilled water was used for effluent make-up. When tap water, containing about 40 p.p.m. Ca^{2+}, was used, less-stable columns were obtained. In this case, a foam stabilizer should be used. Each run lasted at least 2 h; equilibrium was attained after 1 h.

Some results are given in Table 1. It appears that decontamination by straight ion flotation is high for Eu^{3+} and relatively low for Sr^{2+} and Cs^{+}. In order to improve the Cs^{+} decontamination, a copper ferrocyanide

Table 1

No.	Tracer	Carrier (p.p.m.)	Chemicals added		Decontamination factor*	
			Cu^{2+} (p.p.m.)	$Fe(CN)_6^{4-}$ (p.p.m.)	Flotation	Flocculation
1	^{134}Cs	—	—	—	$1{\cdot}4 \pm 0{\cdot}2$	—
2	^{134}Cs	1	—	—	$1{\cdot}1 \pm 0{\cdot}0$	—
3	^{134}Cs	—	15·1	11·5	375 ± 125	150 ± 50
4	^{134}Cs	1	15·1	11·5	90 ± 30	45 ± 20
5	^{137}Cs	—	15·1	11·5	25 ± 6	32 ± 6
6	^{89}Sr	—	—	—	$2{\cdot}5 \pm 0{\cdot}5$	—
7	^{89}Sr	—	—	—	$2{\cdot}4 \pm 0{\cdot}1$	—
8	^{89}Sr	—	15·1	11·5	$1{\cdot}7 \pm 0{\cdot}3$	$1{\cdot}3 \pm 0{\cdot}1$
9	^{89}Sr	1	15·1	11·5	$1{\cdot}3 \pm 0{\cdot}2$	$1{\cdot}1 \pm 0{\cdot}1$
10	^{152}Eu	—	—	—	330 ± 150	—
11	^{152}Eu	1	—	—	400 ± 90	—
12	^{152}Eu	—	15·1	11·5	200 ± 60	$1{\cdot}6 \pm 0{\cdot}2$
13	^{152}Eu	1	15·1	11·5	750 ± 250	$1{\cdot}1 \pm 0{\cdot}0$

Flotation runs, $p\mathrm{H} = 2$; 25 p.p.m. sodium lauryl sulphate; distilled water, except No. 5, where tap water was used; liquid flow-rate, 0·7 m/h; air flow-rate, 1 m/h, except No. 5, 1·55 m/h. Flocculation runs, in beakers under slow stirring during 0·5 h; distilled water; phase separation by centrifugation directly after stirring; $p\mathrm{H} = 2$.

All decontamination factors are average values from two or more runs; during each run three or more samples were taken after 1 h of operation when equilibrium was attained.

* Concentration column influent over effluent.

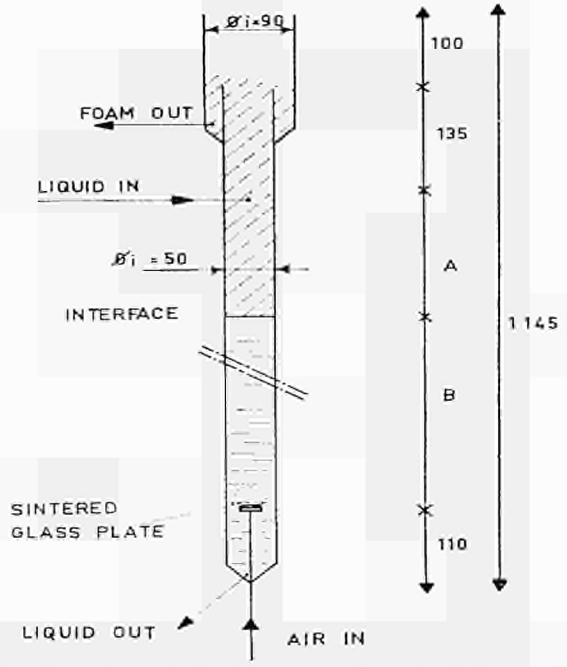

Fig. 1. Flotation cell (× 0·1). *A*, Distance from liquid inlet; *B*, distance from air inlet.

floccule was formed in the solution. It appeared that the ion flotation of Eu^{3+} is not affected but that the Cs^{+} decontamination improved markedly. Sr^{2+} decontamination remains almost unchanged, which becomes understandable after comparing the flotation results with the reference flocculation runs that were executed simultaneously under comparable conditions. In every case the effluent from the cell was completely clear and contained no floccules. On the whole, flotation gives equal or better results than does flocculation. It is noted that the flocculation, especially of Sr^{2+} and Eu^{3+} for which other chemical treatments give better results, was done under relatively unfavourable conditions, since at $pH = 2$ only copper ferrocyanide could be formed as precipitate, and this is a specific scavenger for Cs^{+} only. It is, however, very likely that if favourable conditions can be found, the same conclusion will be arrived at, although the influence of other contaminants present in waste effluent, such as organic materials, is unknown.

An interesting result of the flotation runs was that the separated foam volume represented a very small part of the volume of effluent treated. The average value obtained

for more than 30 runs was 0·01 vol. per cent. This is of great importance for the treatment of radioactive effluent since the concentrated radioactive phase, foam + flocculo, can possibly be stored insolubilized or contained without any further volume reduction.

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[1] Sebba, F., *Nature*, **184**, Supp. 14, 1062 (1959); *Ion Flotation* (Elsevier).

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