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K/EM-376

SANITIZED VERSION OF SOME COMMENTS ON TECHNETIUM AT THE OAK RIDGE GASEOUS DIFFUSION PLANT (JUNE 14, 1977)

(SANITIZED VERSION OF CRD DOCUMENT # K/GD-1705)

Compiled by
S. G. Thornton
Environmental Management Division
OAK RIDGE K-25 SITE
for the Health Studies Agreement

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Oak Ridge, Tennessee 37831-7314
managed by
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INTERNAL CORRESPONDENCE

NUCLEAR DIVISION

POST OFFICE BOX P, OAK RIDGE, TENNESSEE 37830

To (Name) J. H. Pashley
Division
Location K-1006, MS 271

Date June 14, 1977

Originating Dept. Materials and Systems Development

Answering letter date

Copy to E. J. Barber
A. de la Garza
R. L. Farrar
R. W. Levin
H. E. Trammell
Plant Records (RC)

Subject Some Comments on Technetium at the Oak Ridge Gaseous Diffusion Plant (U)

K/GD-1705

The volatile Technetium compounds (TcF_6, MW 213 and TcO_3F, MW 166), because their molecular weight is lower than UF_6, move upstream in the gaseous diffusion plants past the product withdrawal points and into the purge cascade. These compunds constitute a very low concentration of reactor-reprocessed feed material and also a low concentration of feed which has been through other diffusion plants. These materials cause little or no problem in diffusion plant operations until the concentration is very greatly enriched which does occur in the purge cascade. The compounds are strongly absorbed on barrier and other surfaces. They may introduce an adsorption type plug of the barrier but the magnitude of this plug is only 1 to 2% and is inconsequential in operation of the plants. There are indications that the plug can be recovered if the gas stream becomes free of Technetium, but this has not and will not occur in the near future. This characteristic of strong adsorption implies a long hold-up time and slow evolution over long periods of time. Typical concentration on barrier at ORGDP at the present time is shown in Table I. The numbers suggest a K-33 inventory of about 3.2 kg Tc^{99} (55 curies) but because of the sparse data and other factors which might influence it, the value is subject to rather large uncertainty.

The weak beta activity of Tc^{99} cannot be detected through walls of equipment during operation. The concentration of Tc compounds in the gas phase is too low to measure in the separating cascade but it can be detected in the purge where it generally follows the route of coolant-114 into the pigtail at K-310-3. Recent analyses at this location (Cell 6) are shown in Figure 1. An experimental MgF_2 trap has been installed at this location to determine its effectiveness for removing the Technetium compounds. In K-310-3 the UF_6 is separated by gaseous diffusion from coolant ($C_2Cl_2F_4$) and lights (N_2 and O_2) and the Tc compounds move generally with the coolant. The process stream which at this

location has been depleted in UF_6 is taken to NaF traps where further sorption of UF_6 takes place. Tc compounds are strongly sorbed on the NaF pellets and recent analyses of material from the NaF trap (Table II) have indicated concentrations of the order of 0.1 to 0.3% by weight.

Probably the Tc coverage is only 1 to a few monolayers, however, and the excess material then passes into the K-402-9 scrubber. In the scrubber the Tc compounds are hydrolyzed and dissolved in the KOH recirculating solution. There is little or no airborne passage through the KOH scrubber except perhaps the slight mist burden in the effluent stream. There are continual attempts to reduce the mist burden.

In the scrubber the Tc compounds remain in the solution but are, also, strongly adsorbed on the lime residue which is added periodically to precipitate fluorides, carbonates, etc., and thereby regenerate the basic scrubbing solution. The total quantity of Tc moving in the gas phase out of the cascade and into the scrubber is thought to be in the order of 0.1 to 0.3 curie Tc/year.* The filter sludge from regeneration does contain about 0.1 μg Tc^{99}/g. This sludge is collected in drums and buried in the contaminated salvage area. The recirculating solution must be blown-down periodically and this blow-down solution goes into the K-1407-C holding pond. This pond represents on-site retention since there are no liquid overflow routes and water is lost by evaporation.

Most difficulties with Technetium are encountered during maintenance operations and then in particular in the purge cascade. Because Tc^{99} is a very weak beta emitter the beta radiation is easily stopped by neoprene gloves, clothing, plastic face shield and respirators for airborne particulate material. The difficulties are primarily in the "nuisance" category.

Since all equipment which contains Tc also contains uranium, this equipment (converters, barrier, NaF, other trapping agents, etc.) is sent to K-1420 for recovery of the uranium values. The uranium is ultimately recovered by solvent extraction with the Tc following the raffinate or waste stream from this process. This waste stream may contain 3 to 8 curies Tc^{99}/year.* This solution is rich in nitrates and goes to Y-12 for biodegradation and ultimate return to ORGDP through the waters of Poplar Creek. Routine sampling for Tc in Poplar Creek above ORGDP has shown no detectable Tc with a detection limit of 60 pica curies/liter--an extremely low concentration.

R. L. Farrar

RLF:ea

Attachments

*These values were obtained from M. E. Mitchell. They are known to ERDA, but have not, at this time, been made public information.

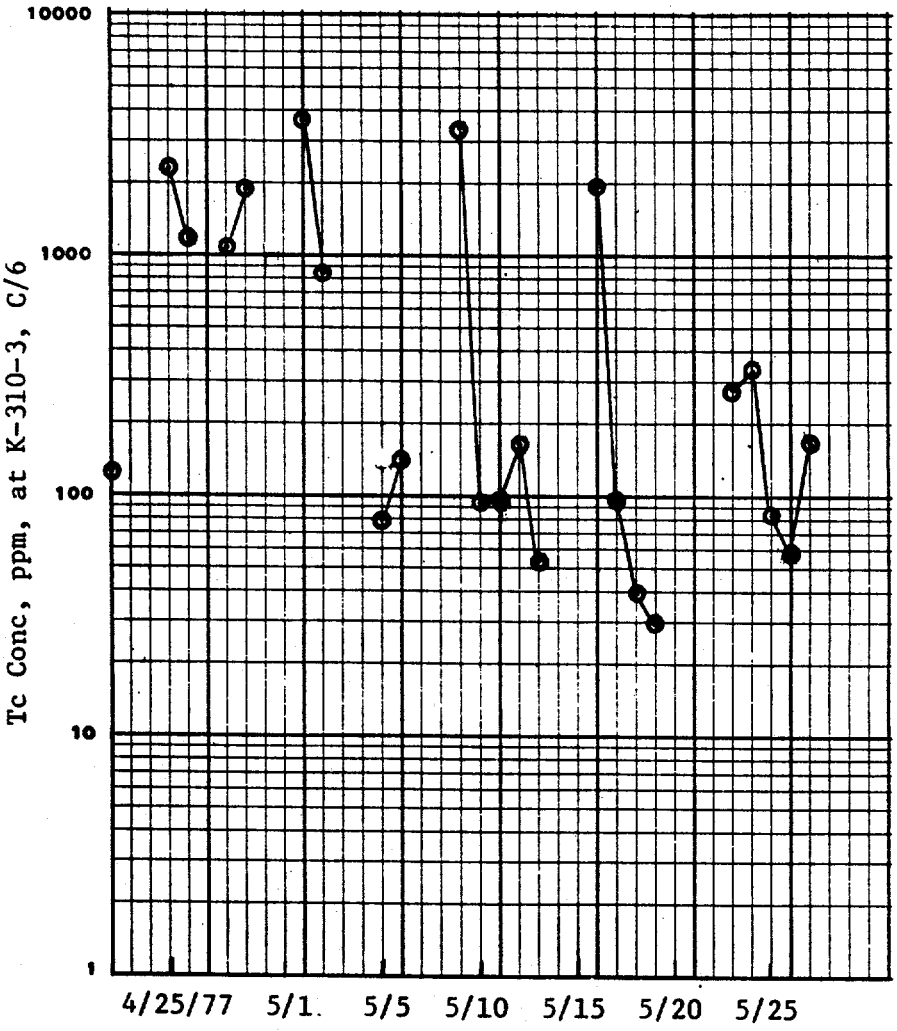

Figure 1. Tc CONCENTRATION AT K-310-3

[redacted]

Table I

SUMMARY OF BARRIER ANALYSES FOR TECHNETIUM

Cascade Location	K-902-1.5	K-902-1.4	K-902-5.1	K-902-8.9	K-902-8.2	K-402-9
Date sampled	6,7/76	10/76	6/75	2/77	1/76	7/76
On-stream date	2/57	10,11/56	10/61	8/54	8/54	3/76
Conv./cell sampled	3	2	4	1	3	1
Barrier type	SD	SD	T4	SD	SD	T4
ClF_3 treatment before removal	yes	no	yes	no	no	yes
Tc^{99} analyses/conv.	1	6	6	2	1	3
Tc^{99} inventory gm/stage	3.1	5.3	4.3	5.5	7.2	0.14
curie/stage	0.053	0.090	0.073	0.094	0.123	0.0023
Reference	(4)	(4)	(2)	(1)	(3)	(4)

K-33 average for five evaluations

g Tc^{99} stage 5.1

curie/stage 0.086

(1) Data not previously reported.
(2) *Monthly Report on Gaseous Diffusion Development for Period Ending August 31, 1975 (U)*, Union Carbide Corporation-Nuclear Division, Oak Ridge Gaseous Diffusion Plant, Sept. 9, 1975 (K-GD-1292, pt. 2) SECRET.
(3) *Monthly Report on Gaseous Diffusion Development for Period Ending June 30, 1976 (U)*, Union Carbide Corporation-Nuclear Division, Oak Ridge Gaseous Diffusion Plant, July 2, 1976 (K-GD-1292, pt. 12) SECRET.
(4) *Monthly Report on Gaseous Diffusion Development for Period Ending October, 31, 1976 (U)*, Union Carbide Corporation-Nuclear Division, Oak Ridge Gaseous Diffusion Plant, Nov. 8, 1976 (K/GD-1550, pt. 1) SECRET.

Table II

MATERIAL FROM K-311-1 NaF TRAP OBTAINED FROM L. D. BLAKENEY (12/76)

Sample Description	White Pellets	White Chunks	Yellow Pellets	Yellow Chunks	Purple Pellets	Brown Pellets
X-ray major	NaF		$3NaF \cdot UF_4$		$Na_2 \cdot UF_8$	$Na_2 \cdot UF_8$
minor	$3NaF \cdot UF_4$		NaF		NaF	NaF
very weak	$Na_7U_6F_{31}$				few extra lines	
Chem. Anal.						
%U	29.66	32.73	42.31	44.91	30.40	38.43
%F	39.35	37.76	37.32	39.40	42.80	40.57
Radiochem.						
$\%Tc^{99}$	0.09		0.22		0.31	
%U	24.9		41.3		39.1	
Spectrochem.						
%Ca	0.28	0.40	0.15	0.26	0.033	0.22

DISTRIBUTION

1. K-25 Site Records (RC)
2. ChemRisk/Shonka Research Associates
3. S. G. Thornton (K-25 EMD)
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