ITP Filter Particulate Decontamination Measurement

by

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ITP FILTER PARTICULATE DECONTAMINATION MEASUREMENT (U)

SUMMARY

A new test method was developed which showed the installed In-Tank Precipitation Filter Unit #3 provided at least 40,000x decontamination of the precipitated potassium tetraphenyl borate (KTPB) during the cold chemical runs. This filter is expected to meet the needed 40,000x hot cesium decontamination requirements, assuming that the cesium precipitate, CsTPB, behaves the same as KTPB.

The new method permits cold chemicals field testing of installed filters to quantify particulate decontamination and verify filter integrity before going hot. The method involves a 1000x

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concentration of fine particulate KTPB in the filtrate to allow direct analysis by counting for naturally radioactive isotope K-40 using the underground SRTC gamma spectroscopy facility. The particulate concentration was accomplished by ultra filtration at Rhone-Poulenc, NJ, using a small cross-flow bench facility, followed by collection of all suspended solids on a small filter disc for K analysis.

INTRODUCTION

The main function for In Tank Precipitation (ITP) filters is the removal of fine precipitated cesium tetraphenyl borate. Earlier demonstration in Tank 48 has shown that the filtered salt solution can be decontaminated from cesium by a factor of 40,000 (Ref. 1). This permits local salt disposal as a Class A saltcrete. The decontamination factor (DF) is a function of CsTPB solubility and removal of precipitated CsTPB. The solubility of cesium salt in ITP sodium salt solutions has been established (Ref. 2), as shown

$$\text{CsTPB} = 0.000032 \exp (-0.67[\text{Na}]) \text{ mol/liter at } 20^{\circ}\text{C}$$

and confirmed in Tank 48 precipitation demonstration.

To achieve the cesium DF goal we must also assure that the installed ITP filters have no cracks or leaks and provide a particulate DF at least 40,000, assuming negligible soluble cesium. A special Cross-flow Test Facility was built at TNX (Ref. 3) to test the mechanical integrity and particulate decontamination of new filters as they are received at SRS. However cold chemical ITP filtration tests started before the Test Facility was complete. This necessitated an alternate approach to demonstrate particulate DF as part of the plant tests. This can be done by measuring the concentrations of particulate potassium tetraphenyl borate (KTPB) used during the cold chemicals test runs since KTPB behaves similarly to cesium forming a fine 0.5 micron precipitate. The ratio of solid KTPB in the feed slurry over particulate KTPB in the filtrate defines particulate DF.

DISCUSSION

Cold Chemical Testing of ITP Filters

The cold chemical tests were conducted using an "average" hydroxide/nitrate salt composition (Ref 4). The initial concentration was approximately 5M sodium and the slurry contained 1.5 wt% precipitated KTPB. During the testing additional NaTPB and potassium salts were added to increase the insoluble solids to 4 wt% and then to 10 wt%. Based on actual analyses (Ref 5) the final concentration was 8.38 wt% solids consisting of 67.7% KTPB and 32.3% NaTPB. The observed filter flux rate is shown in

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*has similar
solubility product
constant values*

Figure 1, showing a logarithmic decrease with concentration.

Cesium was not included in these tests due to slow precipitation equilibrium (Ref 6). Since potassium behaves similarly to cesium and forms a similar TPB precipitate, it can be used for assessing filter particulate DF. Potassium is normally present in waste solutions at a concentration 100x cesium.

Particulate DF measurements were made on the 8.38 wt% slurry and ITP filtrate from that slurry. This allows highest sensitivity for detecting solids in the filtrate.

DF Measurement Requirements

To estimate particulate decontamination we must know the insoluble KTPB concentration in the slurry and the insoluble (particulate) KTPB concentration in the filtrate. High solids concentration, greater than 1 wt% can be obtained by difference between total KTPB and filtrate KTPB (Ref 7). For the test slurry the potassium concentration was calculated at 5.67 wt% KTPB or 63.5 g/l (Appendix E). The goal for 40,000 particulate DF is $63500/40,000 = 1.6$ mg insoluble KTPB per liter of filtrate (0.17 mg K/l).

The solubility of KTPB in salt solutions is a function of salt concentration and temperature and can vary between 3 and 12 mg/l within ITP testing profile, Table 1 (Ref 8). During the ITP tests as the solids concentration was increased the solution concentration decreased from 5 M sodium to about 3 M sodium due to dilution by added ingredients. A measure of total potassium in the filtrate or in solution would provide little guidance to insoluble KTPB.

The high solubility of KTPB makes it also impractical to wash any filtered precipitate. KTPB is significantly more soluble in pure water, about 60 mg/l, than in salt solutions. Saturated wash solution could be used but this would run the risk of introducing potassium to the precipitate, particularly since KTPB can recrystallize at lower temperature.

Scouting with Spiked Filtrate

Initially three samples were prepared by spiking a nominally clean ITP filtrate (Sample Ox) with 10x KTPB, equivalent to 4000DF, and 100x KTPB, equivalent to 400 DF (Ref 9). The spiked samples were used for evaluating different methods for KTPB analysis, Appendix A.

Scanning Electron Microscopy, showed a well defined crystalline KTPB structure with a narrow crystal size distribution, 0.2 to 1 micron, Figure 2. One drop of 100x sample

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was filtered and washed with two drops of water. At lower magnifications clusters of crystals were clearly visible, Fig 3A, and they were visible in the actual filtrate suspension using **optical microscopy**, Fig 3B. Optical viewing under a cover glass allow the only true observation of a filtrate without filtering, washing or drying. However, the 0.5 micron particle size is at the limit of optical resolution and we were not able to find any technique to accentuate the KTPB crystals, e.g. with back lighting or crossed polaroids. KTPB clusters were readily identifiable in the 10x samples, but none were found in the unspiked filtrate indicating visually at least 4000 DF.

An attempt to observe KTPB crystals by **Transmission Electron Microscopy** using liquid sample membrane was not successful probably because the membrane allows evaporation under vacuum resulting in salt crystallization at the surface.

Particle Size Analysis offers a potential tool but meaningful results could not be obtained with the SRTC laser analyzer. However excellent results were obtained using Lab-Tec analyzer at Lockheed Environmental, Fig 4, showing a uniform distribution of clusters up to 60 microns and a significant concentration of particles below 0.7 microns. Similar distribution was found in the 10x sample. The 0x filtrate also showed a distribution indicating possible KTPB in the filtrate. Subsequent SEM examination of the 0x filtrate refiltered on 0.2 μ filter medium showed a variety of "junk" such as Mg, Al, Si, Ca, Cr, Fe, Ni, possibly explaining the size distribution in the 0x sample. The Lab-Tech instrument was not able to provide a measure of particle concentration. This would have allowed to differentiate quantitatively between the spiked samples.

ICP Mass Spectrometry would have been applicable and useful for analysis of small concentrations in the presence of high levels of sodium, however, the instrument is set up with argon carrier gas, MW 40, and this is too close for effective separation of potassium, MW 39. Cesium at MW 45 can be analyzed readily even at much lower concentrations than potassium.

Neutron Activation was tried at ORNL but the sodium activity overshadowed the potassium. Particulate potassium on a filter paper may be analyzable but this was not tried.

Solid State Track Recording allows the observation of boron in KTPB and NaTPB. Crystalline boron will produce clustered tracks while the boron in solution produces random tracks, allowing the crystals to be counted (Appendix B). Initial results from S&T Center were promising but not definitive. This method could be developed if necessary to supplant direct K-40 counting.

Other techniques were considered and rejected. **Prompt Gamma** activation at S&T Center requires a large volume of solution and

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significant set up time. It was not clear that potassium could be identified in high concentration of sodium. **Ion Exchange** could be used to take up ionic potassium, but it was unlikely that the insoluble potassium would adsorb on the column.

Natural potassium contains 0.00118% radioactive K-40 which releases 11% of its gamma intensity at 1460 KeV. This can be counted directly by **Low-Level Gamma Spectrometry**. The ETS Underground Counting Facility can detect K-40 levels down to 1 pCi, or about 1 mg natural potassium. Scouting tests using 100 ml of 100x spiked liquid sample showed a measurable K-40 concentration, indicating that 10 liters of 1x (40,000 DF) liquid sample would have a measurable amount of potassium, provided that the volume could be reduced one hundred fold to 100 ml or less without destroying the particulate KTPB. The counting geometry was calibrated with known KTPB slurry and weighed KCl (Appendix C).

Particulate KTPB Concentration

Earlier contacts with Rhone Poulenc to find alternate filtration systems for late washing have identified a compact bench scale cross-flow filtration unit, Appendix D. The units are designed to circulate as little as 100 ml of solution. The filter medium is a thin layer of ZrO_2/TiO_2 on porous carbon and porosity is available from 0.45 micron down to 0.08 micron and lower for biological filtration.

For DF measurement four gallons of ITP filtrate sample (SIM-386) was decanted by siphoning off 15 liters for concentration at Rhone-Poulenc. The bottom 780 ml contained a light white precipitate and was kept separately for analysis. The 15 liter sample was then "concentrated" to about 100 ml at Rhone Poulenc by refiltering with 0.14 micron Carbosep® membranes. The filter was then rinsed with water for separate potassium analysis. Particulate solids from all three samples (sample bottoms, concentrate, and rinse water) were collected on separate 0.2 micron Millipore fluorocarbon filters and counted together for K-40. The total potassium was less than 2 mg, indicating a particulate DF >40,000.

Post Precipitation

Earlier observations have shown that a fine precipitate often appears in retained filtrate samples. This was analyzed earlier to be an aluminum silicate. A small amount of fine precipitate was present in most ITP retained samples including the 4 gal sample used for DF measurement. In this case any precipitated KTPB was less than 2 mg K. However as the sample temperature drops KTPB can be precipitated. About 40 ml was siphoned out from the bottom of 1 gallon SIM 379 retained filtrate. 20 ml was

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filtered and resulted in 25 mg unwashed solids. Another 20 ml was filtered and washed three times with 20 ml water each time. The residual dry solids was reduced to 3.5 mg and examined under SEM showing a mass of potassium crystals, Fig 7. Some of the KTPB crystals were exceptionally large, greater than 10 microns, indicating a slow crystallization during sample aging at reduced temperature. However aluminum and silicon were also observed confirming earlier analyses.

Alternative Membrane Integrity Testing

Commercial techniques are available for testing the integrity of filter elements, seals and connections, Ref 10. These methods require no precipitate and rely on "bubble point" formation or diffusion testing. These tests can be specified for acceptance of new filters.

CONCLUSIONS

Solids concentration offers a simple and useful technique for analysis of insoluble residues. Direct weighing of the collected solids can provide a guide to the concentration of insoluble solids. Conventional chemical analyses can then be used much more effectively since most of the soluble matrix solution has been removed. It may also be possible to develop quick cold rinsing to wash off the soluble salts and provide a more quantitative measure of retained solids.

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10. Millipore Direct Catalog, 1991-1992, pages 10 to 11.

TABLE 1

KTPB Solubility in Salt Solutions

Temp °C	[Na] °K	0 mol/l	1	2	3	4	5	6
0	273.15	1.29E-04	7.00E-05	3.81E-05	2.07E-05	1.12E-05	6.10E-06	3.32E-06
5	278.15	1.30E-04	7.08E-05	3.85E-05	2.09E-05	1.14E-05	6.17E-06	3.35E-06
10	283.15	1.35E-04	7.36E-05	4.00E-05	2.17E-05	1.18E-05	6.42E-06	3.49E-06
15	288.15	1.44E-04	7.84E-05	4.26E-05	2.32E-05	1.26E-05	6.83E-06	3.71E-06
20	293.15	1.57E-04	8.54E-05	4.64E-05	2.52E-05	1.37E-05	7.44E-06	4.04E-06
25	298.15	1.75E-04	9.49E-05	5.16E-05	2.80E-05	1.52E-05	8.27E-06	4.49E-06
30	303.15	1.97E-04	1.07E-04	5.83E-05	3.17E-05	1.72E-05	9.35E-06	5.08E-06
35	308.15	2.27E-04	1.23E-04	6.70E-05	3.64E-05	1.98E-05	1.07E-05	5.84E-06
40	313.15	2.64E-04	1.44E-04	7.80E-05	4.24E-05	2.30E-05	1.25E-05	6.80E-06
45	318.15	3.12E-04	1.69E-04	9.20E-05	5.00E-05	2.72E-05	1.48E-05	8.02E-06
50	323.15	3.72E-04	2.02E-04	1.10E-04	5.97E-05	3.24E-05	1.76E-05	9.57E-06

Temp °C	[Na] °K	0 mg KTPB/l	1	2	3	4	5	6
0	273.15	46.2	25.1	13.6	7.41	4.03	2.19	1.19
5	278.15	46.7	25.4	13.8	7.49	4.07	2.21	1.20
10	283.15	48.5	26.4	14.3	7.79	4.23	2.30	1.25
15	288.15	51.7	28.1	15.3	8.30	4.51	2.45	1.33
20	293.15	56.3	30.6	16.6	9.03	4.91	2.67	1.45
25	298.15	62.6	34.0	18.5	10.04	5.45	2.96	1.61
30	303.15	70.7	38.4	20.9	11.35	6.17	3.35	1.82
35	308.15	81.3	44.2	24.0	13.04	7.08	3.85	2.09
40	313.15	94.7	51.4	28.0	15.19	8.25	4.48	2.44
45	318.15	111.7	60.7	33.0	17.92	9.74	5.29	2.87
50	323.15	133.3	72.4	39.3	21.38	11.62	6.31	3.43

Shading indicates solubility range under process conditions

FIGURE 1

ITP Filtrate Flux Unit #3

STRIP.WQ1 LOG_FIT

FIGURE 2

100x Spiked KTPB

Spiked KTPB

3A. SEM

3B. OPTICAL

Lockheed Environmental Services and Technology Company
Technology Demonstration and Remediation Division

Sample ID : F-40.0 ppm KTBP
CF Code :
Date : 12/02/92
Time : 10:11:35
Scanned Counts Mean : 16.4
Standard Deviation : 22.0
Skewness : 0.4
Kurtosis : 11.3
Coeff. of Variance(%) : 134.1
Counts : 22149

Cycles : 13
Scaling : 1.00

M.Cycle Time: 1.0 sec.
Averaged last 10 cycle(s)

Channel Size (microns)	%/Channel	Channel Size (microns)	%/Channel
<0.7	16.4984	25	3.1668
0.7	3.7394	31	3.9628
1.0	4.4471	37	5.7516
1.3	4.4266	44	4.3373
1.8	4.6282	53	2.9149
2.3	4.0465	63	1.9974
3.0	3.5122	75	0.9627
4.0	3.3613	88	0.2791
5.0	3.6861	105	0.1011
6.5	4.8579	125	0.2350
8	5.4044	149	0.3054
10	4.4694	177	0.0000
13	4.2380	210	0.0000
17	4.8632	250	0.0000
20	3.8072		

100x Particle Size Distribution

FIGURE 5

LAB-TEC PARTICLE ANALYSIS SUMMARY

Ver. 5.20.07

Lockheed Environmental Services and Technology Company
Technology Demonstration and Remediation Division

Sample ID : F-0.4 ppm KTBP
CF Code :
Date : 12/02/92
Time : 10:23:25
Scanned Counts Mean : 13.3
Standard Deviation : 20.7
Skewness : 0.4
Kurtosis : 11.3
Coeff. of Variance(%) : 155.6
Counts : 9036

Cycles : 12
Scaling : 1.00

M.Cycle Time: 1.0 sec.
Averaged last 10 cycle(s)

Channel Size (microns)	%/Channel	Channel Size (microns)	%/Channel
<0.7	26.3041	25	2.1884
0.7	2.8503	31	2.4844
1.0	2.6985	37	3.1986
1.3	2.4262	44	1.8310
1.8	3.3884	53	0.7377
2.3	3.9856	63	0.6619
3.0	4.1114	75	1.5176
4.0	3.8503	88	1.4751
5.0	4.0846	105	0.5643
6.5	4.6155	125	0.1111
8	5.0328	149	0.0000
10	5.8542	177	0.0000
13	5.8506	210	0.0000
17	6.1902	250	0.0000
20	3.9871		

0x Filtrate Particle Distribution

SERIES II

WED 02-DEC-92 14:15

Cursor: 0.000keV = 0

SERIES II

WED 02-DEC-92 14:22

Cursor: 0.000keV = 0

Junk in Filtrate

Washed Post Precipitate

SCANNING ELECTRON MICROSCOPE SRL C-112

FRI 30-APR-93 16:05

Cursor: 0.000keV = 0

0.000

VFS = 512

10.240

20

LOO-FF2 35MG WASHED

Microprobe Analysis

Techniques for Potassium Measurement

Analytical Method	Capability	Comments
Direct K ⁴⁰ Activity Bill Winn, ET	Direct Potassium measurement 725-2057	Detect 100X sample Need 100X concentration
Neutron Activation of filter paper w/ppt Paul Cloessner/Marti Finney, ADS Larry Robinson, ORNL	K, Cs 725-2198/9656 (615) 574-4912	Direct K measurement in Na matrix not possible. Unwashed K particulates on filter paper: Na still too high.
Solid State Track Recording of paper Frank Ruddy, S&TC	Identify Boron Crystals (412) 256-1064	Direct B crystal count not effective. Need ppte on filter paper.
Scanning Electron Microscopy Dan Steedly, ADS	Observation of particulates onn filter paper 725-2324	K particles observed in 10X and 100X spiked samples. None in ITP filtrate.
Optical Microscopy Cliff Carlson, ET	Liquid sample observation and count. 725-5416	K agglomerates observed in 10X and 100X spiked samples.
ICP Mass Spectrometry Justin Halverson, ET	Argon carrier gas interferes with potassium measurement. 5-9625	No Cs in cold feed Needs development
Transmission Electron Microscopy Mike Tosten, MT	Liquid sample observation 725-6230	Potassium masked by sodium salt crystallization.
Fourier Mass Spectrometry Bob Weller, ET Michelle Buchanan, ORNL	Accurate Cs and K determination 725-9557 (615) 574-4868	SRTC instrument not available for at least six months
Analytical after IX on column Chuck Coleman, ADS	Selective adsorption and analysis	Not effective on particulate, needs development.
Prompt Gamma Neutron Activation Frank Ruddy, S&TC	Used for soil analysis. Need large volume eg. 2 m ³ soil	High setup and development
Particle size analysis John Domenech, Lockheed Env.	Size analysis without dilution (702) 361-0740	Works directly on 10X to 100X filtrate. Cannot distinguish from filtrate "trash".
Laser Particle Size Analysis Jane Bibler	Particle size distribution >1µm	Unable to interpret optical data.
TNX Leak Test Lester Kilpatrick	Particulate K in filtrate	Requires filter relocation to TNX, or equipment setup in ITP Area.

APPENDIX B

RESULTS OF KTBP ANALYSIS USING SOLID STATE TRACK RECORDERS

F. H. Ruddy
(W)STC (412) 256-1064

In December of 1992, initial measurements were conducted to develop a new method for analysis of potassium precipitated as KTBP. The method is based on assay of boron in KTBP using the following reaction:

The energetic ^4He nucleus (alpha particle) produced can be detected by means of a Solid State Track Recorder (SSTR). CR-39 polymer SSTRs are sensitive to alpha particles such as those produced in the above reaction, and can therefore be used to detect boron (^{10}B) or to detect KTBP via its boron content.

Three solutions were supplied, labeled as follows:

- (1) OOX filtrate 0.4 ppm KTBP 1.17 g/cc NaNO_3 , NaOH
- (2) 10X filtrate 4 ppm KTBP 1.17 g/cc NaNO_3 , NaOH
- (3) 100X Filtrate 40 ppm KTBP 1.17 g/cc NaNO_3 , NaOH

CR-39 polymer SSTR strips with approximate dimensions 1 cm x 1 cm x 0.1cm were immersed in each of the three solutions and a "blank" solution made at STC, which contained a solution made by mixing two parts water with one part 6N NaOH solution. After the SSTRs were placed in the vials, the solutions were agitated, and then allowed to settle in a position that would allow particles to come to rest on the SSTR top surface. All four solution bottles were positioned inside of a polyethylene-walled thermalization cavity and bombarded with neutrons originating from a 14 MeV D-T neutron generator. The samples were irradiated for a total of 2500 seconds at the full neutron generator

power of 1×10^8 neutrons per second. The resulting thermal neutron fluence within the thermalizing cavity was measured using ^{235}U SSTRs.

After the neutron irradiation, the CR-39 polymer SSTRs were etched with 6N NaOH for 2 hours at 70° C to develop the alpha tracks produced by neutron reactions in boron. The SSTRs were then manually scanned with an optical microscope to determine the number of alpha particles present. Because boron is expected to be present in solution, only correlated clusters of two or more tracks were counted. The clusters correspond to concentrated boron in precipitated form.

For solution (3), a total of 41 clusters were observed in an SSTR area of 0.55 cm^2 , and for solution (1), 5 clusters were found in an area of 0.52 cm^2 . Although the track densities, 74.5 ± 11.6 and 9.6 ± 4.3 , respectively, are not inconsistent with the expected KPTB amounts present, the method lacks sufficient sensitivity as presently applied.

The sensitivity of the method would improve by many orders of magnitude if the solution were filtered, and the analysis were carried out on the filter paper. In the preliminary measurements, only those precipitate particles which were settled out on or were within about 20 microns of the SSTR surface could be detected, because of the limited range of the alpha particle in the solution.

The conclusions of these preliminary measurements are:

- (1) The SSTR boron analysis method is capable of detecting KTBP particles, but lacks the required sensitivity when solutions are viewed directly.
- (2) The method would undoubtedly yield satisfactory results if the particles were filtered before analysis.

APPENDIX C

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SAVANNAH RIVER TECHNOLOGY CENTER

SRTC-ETS-93156

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May 10, 1993

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FROM: W.G. WINN, 735-A *WGW*

Low-Level Gamma Spectrometry of K-40 for Appraisal of DWPF/ITP Filters

A number of samples have been counted for IWT to appraise the performance of filters to be used for removing cesium/potassium tetraphenyl-borate precipitates after In Tank Precipitation for DWPF. Particulate potassium salt in the filtrate serves as a measure of the filter efficiency and the expected decontamination factor. Naturally occurring K-40 can be counted to measure the amount of particulate potassium collected.

The low-level gamma spectrometric capabilities of the ETS Underground Counting Facility allow quantifying K-40 at levels as low as 1 pCi. Coupling this sensitivity with techniques for evaporative concentration of a liquid sample on a small area (~10 cm²) has resulted in demonstrating DF's in excess of 40,000 for the filters studied. A chronological summary of the measurements on IWT test samples is given in Table 1, where brief comments identify the samples according to IWT sample labels.

The sample analyses in the Underground Counting Facility utilized a passive/active-shielded HPGe detector with 90% standard efficiency relative to a 3"x3" NaI(Tl) detector. The counting chamber is 50 ft below ground, and is shielded by low-background materials (4" thick pre-WWII steel walls surrounded by 4-7 ft of specular hematite). The facility is constructed as a Class 10,000 Clean Room, and the detector sample cavities are purged of radon backgrounds with nitrogen that evaporates from the detector dewars. The detector used in this work is constructed with low-background materials.

The above facility/detector design features reduce the backgrounds from cosmic-rays, natural radioactivity, and local

sources by orders of magnitude. Because the facility is well isolated from backgrounds from surface effects, the resulting low background is quite constant and thus suitable for long sample counting. In the present work, sample counting of 1-3 days was used. Because of a small K-40 contribution in the background, special background counts were conducted to affirm its value.

The counting geometries for these samples approximated those for which calibrations had been measured; in particular, a 3.2 cm diameter vial, calibrated as a function of sample filling, was assumed suitable for both liquid and filter samples. As a check, a filter sample standard of 21.7 mg K was counted, yielding a value of 16.3 ± 1.0 pCi for K-40, which is in reasonable agreement with 18.2 pCi calculated from the natural K-40 component of K. Based on this calibration check, a multiplicative correction factor of 1.12 ± 0.07 might be applied to the K-40 values of Table 1; however, such a correction is not very significant relative to the present study, and the correction factor is within 2σ of 1.00 which corresponds to no correction. Accordingly, no renormalization of the data has been applied.

Table 1. K-40 Results for IWT Filter Studies

Sample	Date	K-40	Comments
1	12/11/92	2.0 ± 0.6	Caustic 100X filtrate 40ppm KTBP
2	2/2/93	<1.6	0.14 filtrate ITP-041
3	2/3/93	<1.5	0.14 conc 11 ITP-041
4	4/2/93	<1.6	K-40 residue / overnite count / weekend count
4A	4/5/93	<1.0	
5	4/28/93	<1.6	0.7 g disk sample
6	4/30/93	14.3 ± 1.3	~20 mg K disk sample from slurry
7	5/3/93	<1.0	23 mg conc from 4 gal SIM-386/disk
8	5/5/93	16.3 ± 1.1	21.7 mg K of KCl on disk

GENERAL DESCRIPTION

MICRO-CARBOSEP® 20, 40 and 60 are tubular ultrafiltration and microfiltration modules, specially designed for processing small quantities. They are multi-purpose, easily adaptable and compact, and are an ideal tool for research laboratories. They are particularly suitable for feasibility studies.

The system can be sterilized in an autoclave and can process a wide variety of fluids. With a liquid channel 0.5 or 6 mm thick, it can operate at low pressure (<1.5 bar) or high pressure (>1.5 bar), at a low (30 l/h) or high (500 l/h) recirculation rate, depending on the product to be processed. It can stand on any laboratory bench and can be fed with a peristaltic pump found in all laboratories (see Appendix II).

21-May-

Particulate JF Calculations

WSRC-RP-93-768

E:\APP\ITP\DF.WQ1

K Mol Wt B35: 39.09

KTPB Mol Wt B36: 358.32

Solids/KTPB/Potassium Conversion Factor

Row 39	Col A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Item	Source	Density g/ml	Meas wt g	Meas vol ml	TOTAL SOLIDS		Total g	KTPB SOLIDS		Total mg	PARTICULATE K		Total mg	Solids DF	K-40 pCl	K mg	
FIRST ITP Filter Tests																	
Makeup Filtrate	ITP-019	1.171							1.40	16.39		0.153	1.788		1.00		
Makeup Slurry	ITP-053	1.096							2.23	24.44		0.243	2.666				
										mg/l			mg/l				
100X (In ITP-019)	TDR-010	1.171	0.4567	250						40.7	10.18		4.44	1.11	402	2	2
10X	100X	1.171	1.10 D1	250						4.1	1.02		0.44	0.11	4024		
1X	10X	1.171	1.10 D1	250						0.41	0.10		0.04	0.01	40243		
SECOND ITP Filter Tests																	
Filtrate 11.13.6	SIM-379	1.145				8.38	95.95		5.67	64.94		0.619	7.085		1.00		
										g/l			g/l				
Makeup Slurry 11.13.16	SIM-384	1.1				8.38											
11g/l Sample	SIM-379	1.126	199	940		2.00	17.74	16.68	1.35	12.01		0.147	1.310				
						3	2	1									
Control #2 (4/21)	*11g/l*		0.712					0.014			9.63			1.05		<1	<1
Control #3 (4/28)	*11g/l*		17.853					0.357			241.38			26.33		14	17
Control #4 (5/5)	KCl		0.0413											21.66		16.3	19
RESULTS, Filter Unit #3																	
ITP Filtrate Solids Wt	SIM-379	1.145	0.031	15000			0.0021	<.031							46428		
ITP Filtrate K-40 Count	SIM-379	1.145		15000		8.38	95.95	1439	5.67	64.94	974119	0.619	0.127	106269	55658	<1.5	<2
							mg/l			mg/l			mg/l				
ITP Filtrate	Calculate	1.145		15000			2.399	35.98		1.624	24.35		0.177	2.66	40000		

Shaded areas represent starting points for calculations

APPENDIX E