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FEB 9 2006

Mr. James A. Saric, Remedial Project Manager
United States Environmental Protection Agency
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77 West Jackson Boulevard
Chicago, Illinois 60604-3590

DOE-0071-06

Mr. Tom Schneider, Project Manager
Ohio Environmental Protection Agency
Southwest District Office
401 East 5th Street
Dayton, Ohio 45402-2911

Dear Mr. Saric and Mr. Schneider:

TRANSMITTAL OF THE SILOS WASTEWATER TREATMENT SYSTEM SAMPLING PLAN

Enclosed for your information is the Silos Wastewater Treatment Sampling Plan. This document was written as our response to verbal comments received from OEPA on the Functional Requirements/Design Basis Document for Silos 1 & 2 Wastewater Treatment Project.

If you have any questions regarding this transmittal, please contact me at (513) 648-3139.

Sincerely,

Johnny Reising

Johnny W. Reising
Director

Enclosures

cc:
Dennis Carr, Fluor Fernald, Inc./MS77
Cathy Glassmeyer, Fluor Fernald, Inc./MS12
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Administrative Record, MS6

Silos Wastewater Treatment System Sampling Plan

40750-PL-0024

January 30, 2006

Submitted:

Cathy Glassmeyer, SWT Project Engineer — 1/30/06 Date

Approval:

Dennis Carr, Silos Project Director for — 1-31-06 Date

Purpose

The purpose of this document is to detail the sampling and analysis plan for operation of the Silos Wastewater Treatment System. The basis for the sampling and analysis plan is a series of jar tests performed on water from the Silos TTA tank 2A and the Silos Supernatant Tank in December 2005 and January 2006. The results of the jar tests are also documented in this plan.

Description of Jar Tests

Approximately three liters of water were collected from Silos TTA Tank 2A and Supernatant Tank TNK-55-1000 in early December 2005 and January 2006. These samples were used to perform a series of jar tests to determine chemical additions, settling times, filtration media pore size and ion exchange resin radium removal capability. A baseline sample of water from each source was collected and analyzed for radium, uranium, lead and lead 210. See the highlighted rows in Table 1 for baseline results.

A five weight percent slurry of lime was added to the baseline samples and allowed to settle for various times. The adjusted pH numbers for each sample are included on Table 1. A sample of the supernatant was collected and submitted to the lab for analysis. The remainder of the supernatant was poured through paper filters of 1, 3 or 5 micron pore size. A laboratory pump was used to pressurize the water above the filter paper to simulate pressure filtering through the bag and cartridge filters. After filtration, a sample was collected of the filtrate and sent to the lab for analysis. In several of the tests, the remaining filtrate was filtered through a smaller pore size filter for additional filtration and a filtrate sample was sent to the lab. The final treatment step was to pass the filtrate through a bed of Dowex RSC radium specific resin. The filtrate from that step was then sent to the lab for analysis. Nalco 7768 polymer was added to two jars at the lime addition step to determine if polymer improved settling. Two milliliters of ferrous sulfate obtained from the Silo 3 project was added to two other samples at the lime addition step to determine if ferrous sulfate improved settling.

Results of Jar Tests

The results of the jar tests showed that lime addition and settling for more than four hours removed over eighty percent of radium, uranium and lead. Filtration of the supernatant through a three micron filter paper removed five to ten percent more radium, uranium and lead. Filtration of the filtrate through a one micron filter removed additional radium, uranium and lead. Pouring the filtrate through a bed of Dowex RSC resin reduced the radium concentration to less than 500 picocuries per liter in all cases and to non-detectable levels in most cases. Table 1 shows the analytical results for all jar tests and the percent reductions for radium, uranium and lead. Analytical results for lead 210 are included in the table for the samples that were analyzed for lead 210.

Sampling Plan for Silos Wastewater Treatment System

Figure 1 shows a flow diagram for the Silos Wastewater Treatment (SWT) System with the sampling points identified.

The current Safe Shutdown plan for the Silos 1 and 2 treatment system plans for the use of about 100,000 gallons of water. This water will be held in the Sluice/Flush tank (TNK-62-1000) and reused for flushing tanks and pipelines until all tanks and pipes except one feed tank and one mix tank have been flushed. A sample will be collected from the Sluice/Flush tank to provide a baseline for radium, uranium, lead and lead 210. The results of this sample will be compared to the baseline analyses of water used in the jar tests to determine how representative the jar test samples were. Lead 210 analysis results for the baseline sample will be used to determine if any additional lead 210 analyses are required. If the lead 210 concentrations in the baseline sample meet the effluent discharge levels, no additional lead 210 sampling will be performed.

Lime will be added to the Sluice/Flush tank to raise the pH to between 10.2 and 10.8. The contents of the tank will be pumped to the Clarifier (TNK-15-1004). The flow rate through the Clarifier will be approximately 50 gallons per minute to allow for 4 to 5 hours settling time. From the Clarifier the supernatant will overflow the weir to the Supernatant tank (TNK-55-1000). Solids will be pumped from the bottom of the Clarifier through the remaining Feed tank and Mixer to be packed in an IP-2 container in the same manner as material from Silos 1 and 2 was packaged.

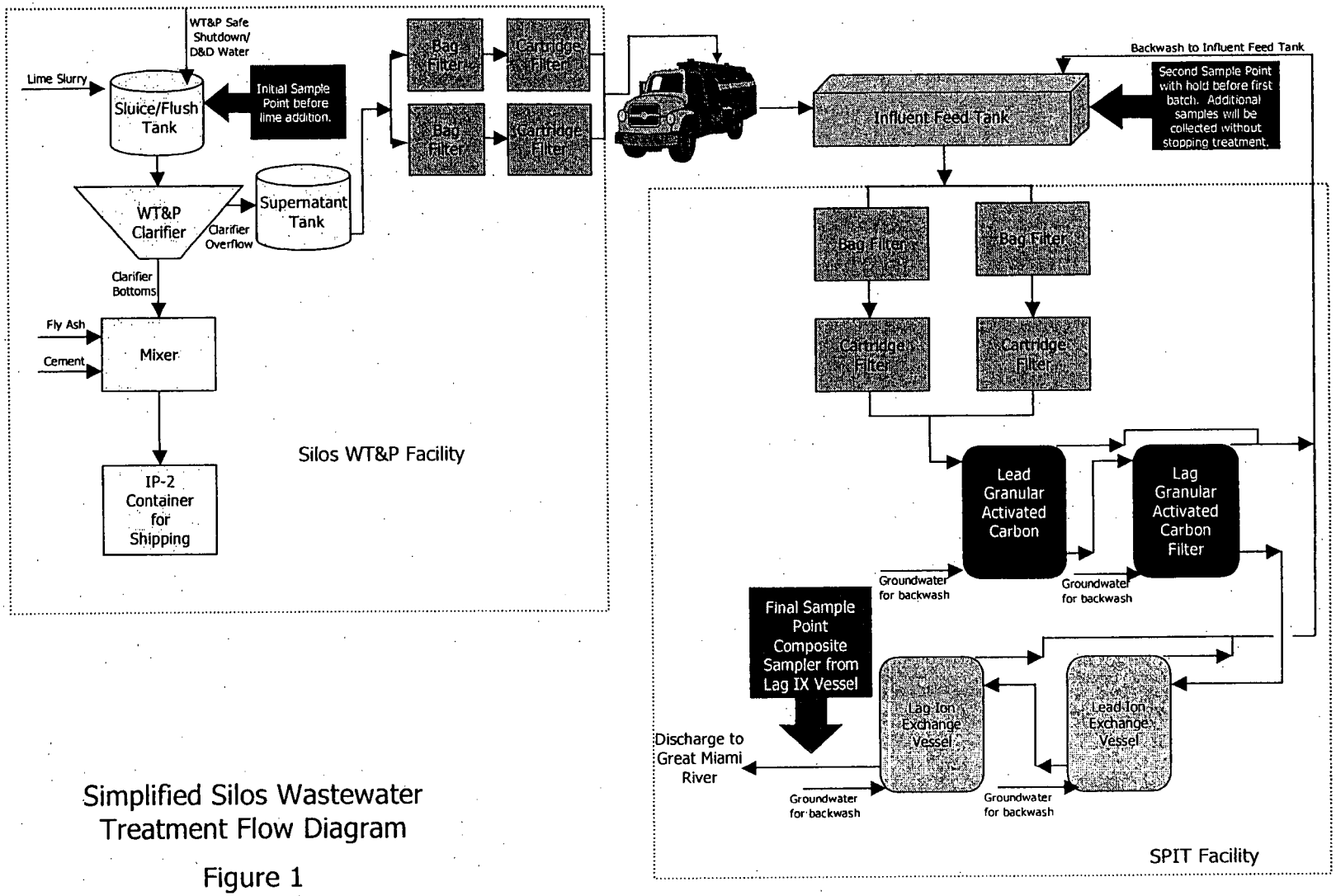
The supernatant from the Supernatant tank will be pumped through a three micron roughing filter (Bag Filter) and then through a three micron depth filter (Cartridge Filter.) The filtered water will be collected in a tanker truck until about 3500 gallons have been filtered. The water will be transported to the Influent Feed Tank for the SWT system located outside the former SPIT facility. After three to four tanker loads of water have been transported to the Influent Feed Tank, the filtration process will be stopped and samples collected from the tank and analyzed for radium, uranium, lead and lead 210. Treatment through the SWT system at the former SPIT facility will not start until analytical results are received from the Influent Feed Tank samples. The results of the sample analyses will be used to determine the flow rate through the SWT that will not cause an exceedance of the concentration limits at the Parshall Flume. After the initial sample, the Influent Feed tank will be sampled after each 20,000 gallons of water has been added to the tank. Processing will not wait until the results have been received, but the processing rate will be adjusted as necessary to maintain discharge limits.

A sample will also be collected from the effluent of the lag ion exchange vessel each day using a composite sampler. This sample will be analyzed daily for uranium to determine if the flow rate should be changed to ensure compliance with the OU5 ROD monthly average uranium concentration limit of 30 μg/L. Additional samples will be

collected from the composite sampler after each batch of 20,000 gallons has been treated to be analyzed for radium, lead and lead 210. These results will be used to determine if the ion exchange resin or carbon beds are becoming exhausted and need to be replaced.

Table 2 shows an Excel spreadsheet being used to determine the maximum flow rate through the SWT that will not cause the concentration at the Parshall Flume to exceed regulatory limits for any contaminant of concern.

Table 3 shows the calculations used to determine how much Dowex RSC radium removing ion exchange resin would be required to remove all the radium from the Silos Wastewater based on the radium concentration found during the jar test. Consultations with technical experts from Dow indicated that a minimum resin bed depth of four feet is recommended for optimal performance. Since the lead time for resin delivery is about six months, the project team purchased the amount of resin required to fill two ion exchange vessels to four foot bed depth and enough to replace the resin in one vessel, if needed.



Simplified Silos Wastewater Treatment Flow Diagram

Figure 1

Document 6110

Table 1
Jar Test Analytical Results

Source	Sample	Ra (pCi/L)	% Ra Red.	U (ug/L)	% U Red.	Pb (ug/L)	% Pb Red.	Pb-210 (pCi/L)	pH	Treatment Steps
TTA 2A	SWT1-0	518,300		103,000		21.1		<1840	8.1	none
TTA 2A	SWT1-1	200,500		845		8.1			9.8	lime, one drop Nalco 7768 (1:99)
TTA 2A	SWT1-2	205,300		132,000		681			10.5	lime, one drop Nalco 7768 (1:99)
TTA 2A	SWT1-3	154,100		133,000		3220			11	lime, 3 hours settling
TTA 2A	SWT1-4	184,400		135,000		3720			11.2	lime, 15 min. settle, filter 5 um filter paper
TTA 2A	SWT1-5	262,400		141,000		3000		10800	10.2	lime, 15 min. settle, filter 5 um filter paper
TTA 2A	SWT1-6	179,400	65%	96,000	7%	239	-1033%		10.6	lime, 10 min. settle
TTA 2A	SWT1-7	58,430	89%	40,200	61%	162	-668%		10.6	lime, settled for 10 minutes, filtered through 1um paper
TTA 2A	SWT1-8	18,370	96%	32,000	69%	162	-668%		10.6	lime, 10 min. settle, filtered 1um paper, resin
Supernatant	SWT2-0	20,540		126,000		769		2720	8.2	none
Supernatant	SWT2-1	9,913	52%	50,400	60%	162	79%	<1520	10.8	lime, settled 10 min.
Supernatant	SWT2-2	2,538	88%	11,100	91%	162	79%		10.8	lime, 10 min. settle, filtered 3 um paper
Supernatant	SWT2-3	nondetect	99%	8,130	94%	162	79%	<1210	10.8	lime, 10 min. settle, filtered 3 um paper, resin
Supernatant	SWT3-1	2,802	86%	7490	94%	78.3	90%	<1670	10.9	lime, settled 5.5 hours
Supernatant	SWT3-2	2,315	89%	126	100%	8.1	99%		10.9	lime, settled 5.5 hours, filtered 3 um paper
Supernatant	SWT3-3	4,111	80%	119	100%	8.1	99%		10.9	lime, settled 5.5 hours, filtered 3 um paper, filtered 1 um paper
Supernatant	SWT3-4	nondetect	99%	3470	97%	8.1	99%	<1170	10.9	lime, settled 5.5 hours, filtered 3 um paper, filtered 1 um paper, resin
Supernatant	SWT4-1	3,178	85%	27700	78%	0.193	100%		10.1	lime, settled for 4.5 hours
Supernatant	SWT4-2	4,222	79%	8890	93%	0.081	100%		10.1	lime, settled for 4.5 hours, filtered 3 um paper
Supernatant	SWT4-3	nondetect	99%	9630	92%	0.081	100%		10.1	lime, settled for 4.5 hours, filtered 3 um paper, filtered 1 um paper
Supernatant	SWT4-4	407	98%	9900	92%	0.081	100%		10.1	lime, settled for 4.5 hours, filtered 3 um paper, filtered 1 um paper, resin
Supernatant	SWT4-5	4,674	77%	9250	93%	1.72	100%		6.8	lime, settled 4.5 hours, added 2 ml ferrous sulfate
Supernatant	SWT4-6	nondetect	99%	9560	92%	0.081	100%		6.8	lime, settled 4.5 hours, added 2 ml ferrous sulfate, filtered 3 um paper

Table 2
Silos Wastewater Treatment System Effluent Maximum Concentration Allowed to Meet DOE DCGs, NPDES and OU5 ROD Effluent Limits

Parshall Flume Flow (gpm)	3500
WTS Flow (gpm)	50

Nuclide	DCG (pCi/L)	Actual Existing Avg. PF4001 Conc. (pCi/L)	**Target WTS Effluent Concentration**
Ac-227	10	0	710
Pb-210	30	2.79	1,935
Po-210	80	0	5,680
Pa-231	10	0	710
Ra-224	400	0	28,400
Ra-226	100	0.573	7,060
Ra-228	100	2.23	6,944
Th-228	400	0	28,400
Th-230	300	0	21,300
Th-232	50	0	3,550
U-234	500	0	35,500
U-235	600	0	42,600
U-238	600	0	42,600

	NPDES/ROD Limits (ug/L)	Est. Existing Actual PF 4001 Conc. (ug/L)	
Pb(total)	73	5	4833
U(total)	30	20	730

Table 3
Calculation of Dow RSC Resin Required

Basis: Resin exchange capacity from Dow documentation 10-20 nanocuries per gram

Use capacity of :	10,000	picocuries per gram
Waste Stream Estimate (actual Supernatant)	20,540	picocuries per liter
	100,000	total gallons to be treated
Convert to total estimated picocuries in waste:	7,774,390,000	total pCi to be removed from water
Resin needed for radium removal:	1,712	pounds of resin
Resin needed for minimum bed depth 4':	226	Cubic feet for 2 IX vessels
	11,084	pounds of resin
Resin purchased:	353	cubic feet @ 49 lb/cubic foot
enough for 2 vessels in service and 1 vessel replacement	17,297	pounds of resin