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11-AMRC-0208

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Mr. D. A. Faulk, Program Manager
Office of Environmental Cleanup
Hanford Project Office
U.S. Environmental Protection Agency
309 Bradley Blvd, Suite 115
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Dear Mr. Faulk:

COMPLETION OF HANFORD FEDERAL FACILITY AGREEMENT AND CONSENT ORDER (TRI-PARTY AGREEMENT) MILESTONE M-016-170, COMPLETE KNOCK-OUT POT (KOP) MATERIAL PRE-TREATMENT

The purpose of this letter is to notify the U.S. Environmental Protection Agency that Tri-Party Agreement Milestone M-016-170, "Complete KOP Material Pre-Treatment," has been completed in accordance with DOE/RL-2010-63, Rev. 0, Addendum 1, "Remedial Design/Remedial Action Work Plan for the K Basins Interim Remedial Action: Removal of K Basins Sludge from the River Corridor to the Central Plateau; and Removal of Knock Out Pot Contents from the K Basins," and TPA-CN-468. The milestone due date is September 30, 2011.

KOP pre-treatment was completed in the 105-K West Basin using basin operating procedures. Pre-treatment results documented in PRC-STP-00522, Rev. 0, "STP KOP Disposition Subproject Completion of Pretreatment Report," is enclosed.

A de minimis quantity of KOP material may be generated in 2012 from cleaning 105-KW Basin found fuel and fuel received from burial ground cleanup. This material is not expected to require pre-treatment and will be evaluated prior to processing KOP material for drying at the Cold Vacuum Drying Facility.

If you have questions, please contact me or your staff may contact Tom Teynor, of my staff, on (509) 376-6363.

Sincerely,

Mark S French for

Joe R. Franco, Assistant Manager
for the River Corridor

AMRC:SCS

Enclosure

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M-016-170

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PRC-STP-00522
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STP KOP Disposition Subproject Completion of Pretreatment Report

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

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Document Type: RPT Program/Project: STP

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Date Published
September 2011

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
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Total Pages: 33

STP KOP DISPOSITION SUBPROJECT COMPLETION OF PRETREATMENT *REPORT*

Table of Contents

1.0 INTRODUCTION 1
2.0 SCOPE 1
3.0 SUMMARY 2
4.0 PRETREATMENT PROCESS DESCRIPTION 4
5.0 KOP MATERIAL STREAM DESCRIPTION 5
5.1 Origin and Background of KOP Material 5
5.2 Quantity of KOP Material 7
5.3 Density of KOP Material 7
6.0 BUOYANCY CORRECTION 8
7.0 PRETREATMENT BASIN OPERATIONS CAMPAIGN 9
7.1 Results of Density Separation 9
7.2 Results of Size Reduction 11
7.3 Results of Wire Separation 12
8.0 REFERENCES 13

APPENDICES

Appendix A
Data Tables

Appendix B
Pretreatment Photos

Figures

Figure 4-1. KOP Pretreatment Simplified Flow Diagram. 5
Figure 5-1. KOP Material Origination 6

Tables

Table 3-1. Pretreatment Material Balance 4
Table 5-1. KOP Source Material - Initial Measurements 7
Table 5-2. Average Bulk Wet Density of KOP Material Prior to Pretreatment. 8
Table 7-1. High Density KOP Material – Post Density Separation 9
Table 7-2. Low-Density Retrieval Strainer Material – Post Density Separation 10
Table 7-3. Density Separation Material Balance 10
Table 7-4. Size Reduction Material Balance 11

Definitions

KOP material: Knockout Pot (KOP) material is the material collected in the Primary Cleaning Machine strainers, on the Primary Processing Table, KOPs, and strainers downstream of the KOPs during the washing of spent nuclear fuel (SNF).

Pretreated KOP material: Pretreated KOP material is the separated fractions of KOP material produced by the KOP pretreatment process that will be subsequently managed as KOP waste material or will be further processed in the KOP Processing System (KPS) to produce KOP product material.

KOP waste material: KOP waste material is that sludge and debris separated from the KOP material during KOP pretreatment or KPS processing that will be subsequently managed as transuranic or low-level waste based on its radiological characteristics.

KOP product material: KOP product material is that separated fraction of KOP material that will be packaged and removed from the KW Basin to be subsequently managed as SNF.

Agitators: Steel or tungsten balls that can be added to screened canisters to increase the rate of size reduction of friable materials.

Aluminum wire: Wire pieces that have broken off the open-bottom style fuel canisters. The wire is typically up to 3 cm (1.25 in.) long and 0.15 cm (0.0625 in.) in diameter.

High-density material: Material that is primarily uranium metal.

Low-density material: Material that is primarily non-uranium , including non-uranium materials, such as Grafoil[1], aluminum wire, aluminum hydroxides, and iron hydroxides. This material may contain small quantities of radioactive materials.

[1] Grafoil® is a registered trademark of Graftech International Holdings, Inc., Parma, Ohio.

Acronyms

ADS	Accountability Data Sheet
µm	Micro meter
CVDF	Cold Vacuum Drying Facility
DOE	Department of Energy
IWTS	Integrated Water Treatment System
KOP	Knockout Pot
KPS	Knockout Pot Processing System
KW	K West
MCO	Multi-Canister Overpack
OCRWM	Office of Civilian Radioactive Waste Management
PCM	Primary Cleaning Machine
PPT	Primary Processing Table
SNF	Spent Nuclear Fuel
STP	Sludge Treatment Project

1.0 INTRODUCTION

The Sludge Treatment Project (STP) is responsible for the disposition of Knockout Pot (KOP) material currently stored in the 105-K West (KW) Basin. KOP material consists of size segregated material from the spent nuclear fuel (SNF) and SNF scrap cleaning process used in the K West Basin.

The KOP Disposition Subproject scope consists of in-basin inspections, pretreatment activities, the KOP Processing System (KPS), and Multi-Canister Overpack (MCO) loading, transportation, and processing activities. The in-basin inspections completed prior to the pretreatment campaign provide information regarding the characteristics and composition of the KOP material.

The KOP material has undergone pretreatment to remove fines and some of the non-uranium constituents containing chemically bound water. The pretreated KOP material will undergo further processing with the KPS to remove material less than 600 μm, after which it is referred to as KOP product material. The KOP product material will then be loaded into a MCO, dried at the Cold Vacuum Drying Facility (CVDF) and stored in the Canister Storage Building. This process is patterned after the successful drying of 2100 metric tons of spent fuel, and uses the same facilities and much of the same equipment that was used for drying fuel and scrap in addition to new equipment associated with the pretreatment process.

2.0 SCOPE

This document presents the results of pretreatment activities that occurred in the KW Basin between May, 2011 and July, 2011. Pretreatment activities were conducted in accordance with PRC-STP-00424, *KOP Pretreatment Campaign Plan* (Duncan 2011) and technical procedure OP-70-152W, *Knock-Out Pot Pre-Treatment Operation,* and as described in DOE/RL-2010-63-ADD1, *Remedial Design/Remedial Action Work Plan for the K Basins Interim Remedial Action: Removal of K Basins Sludge from the River Corridor to the Central Plateau; and Removal of Knock Out Pot Contents from the K Basins*. The objective of the campaign stated in the campaign plan is to remove non-uranium based material and particulated material smaller than 600 μm, thereby reducing the total volume and removing water bearing compounds. This report discusses the extent to which pretreatment activities achieved the stated objective. Additionally, this document summarizes the design (i.e., processes) and associated technologies that were developed for the pretreatment of the KOP material. Pretreatment activities included density separation, size reduction, and aluminum wire separation. Pretreatment activities were performed to reduce the volume of the KOP material that will subsequently undergo further processing with the KPS.

The material balance numbers presented for pretreatment activities in the body of this report are expressed in liters for volume and kilograms for mass. Mass has been corrected for buoyancy and are presented on a solids basis using a 40% void volume, consistent with the material balances presented in PRC-STP-00315, *Pretreatment of KOP Material Process Description, Process Control Plan and Material Balance*, and PRC-STP-00316, *KOP Processing System Process Description, Process Control Plan and Material Balance*. Section 6.0 provides additional information on buoyancy correction.

3.0 SUMMARY

Pretreatment activities achieved the objectives stated in the Tri-Party Agreement pretreatment completion criteria (TPA-CN-468) and KOP Pretreatment campaign plan (PRC-STP-00424). All three sub-streams inventories (PCM/PPT Strainer, IWTS Strainer, and KOP contents) of the KOP material were processed through the KOP pretreatment process. All of the material collected in the low-density retrieval strainer during the density separation was processed through the size reduction and wire separation equipment at least once. Sufficient low-density material was removed KOP material such that the pretreated high-density material achieved a bulk wet density greater than 9 kg/L.

KOP material consists primarily of uranium, Grafoil, and aluminum and iron compounds between 600 μm (0.0236-in.) and 6,350 μm (0.25-in.) in particle size from the fuel and scrap cleaning process used in the SNF process at K Basin. The KOP material stream was pretreated to remove the non-uranium based material to the extent practical. Optimizing the removal of non-uranium based material will enable the KOP Disposition Subproject to more cost-effectively package and treat the KOP product material stream (i.e., uranium-based materials) in a manner similar to SNF by reducing the volume of the KOP material that will subsequently undergo further processing with the KOP KPS.

Prior to pretreatment, the volume of KOP material was measured to be 137 liters, which is slightly less than the volume of 152 liters previously reported. At the conclusion of the KOP in-basin inspections, the volume of KOP material was estimated to be 152 liters based on volume measurements of the KOP material stored in canisters and estimates of the quantity of material in the in process components of the IWTS system. The actual volume of KOP material measured after all the KOP material in the IWTS components was transferred into canisters was 137 liters.

The inventory of KOP material was reduced from initial mass of 713.3 kg (average density of 5.6 kg/L) to 559.8 kg, a reduction of more than 20%. The KOP material was separated into 498.4 kg of high density material with an average density of 9.8 kg/L, 61.4 kg of lower density material (2.6 kg/L to 4.6 kg/L) collected on strainer baskets, and 30.8 kg of aluminum wire/debris (3.0 kg/L. Approximately 122.7 kg of material (less than 600 μm) was transferred to the Integrated Water Treatment System (IWTS) settler tubes during pretreatment activities. The results of the pretreatment campaign provide input to an update to the material balance (Feldmann, 2011), load plan (Sexton 2011) and reduce the estimated of the number of MCOs required to process and store KOP product material.

Pretreatment activities were carried out in three phases: density separation, size reduction of the less dense non-uranium bearing fraction and friable portions of the KOP material in the Primary Cleaning Machine (PCM), and aluminum wire separation (See Section 4.0). These activities occurred between May 5, 2011 and July 26, 2011 in accordance with technical procedure OP-70-152W, *Knock-Out Pot Pre-Treatment Operation*. The overall objective of pretreatment was met, achieving a bulk wet density greater than the target of 9.0 kg/L for the higher density fraction of the pretreated KOP material. The final bulk wet density of the high density fraction of the pretreated KOP material is 9.8 kg/L. Material removed from the high density stream was size reduced in the PCM and underwent aluminum wire separation.

During density separation 214.9 kg of material were removed from the KOP feed stream, yielding 498.4 kg of high density material with a bulk wet density 9.8 kg/L. The high-uranium content material that fell through the density separation funnel was placed in covered in Mark II fuel canisters and will undergo further processing with the KPS. The material removed from the KOP starting inventory was either captured in the low-density retrieval strainer (176.4 kg) or transferred to the IWTS (38.5 kg).

The material captured in the low-density retrieval strainer (176.4 kg) was transferred to a screened canister for size reduction in the PCM. Material passing through the 600-μm screened canister was collected in the PCM strainer basket, the IWTS strainer basket or was transferred to the IWTS settler tubes. Approximately 30.8 kg of material remained in the screened canister; this material was staged for wire separation. Another 34.4 kg of material was collected in the PCM strainer basket and 27.0 kg of material was captured in the IWTS strainer basket. However, some of the material captured in the IWTS strainer may have been collected during density separation, as measurements were not taken to differentiate the amount of material collected in the IWTS strainer for each of these two activities. It is also important to note that this material passed through the 600-μm screened canister, but did not pass through to the IWTS settler tubes. Similarly, the material collected in the PCM strainer basket passed through the 600-μm screened canister, but settled out in the bottom of the PCM. The material captured in the strainers may be processed within KPS or be dispositioned as KOP waste material. Removal of material smaller than 600 μm from KOP material is required to support assumptions used in CVDF process calculations and ensure thermal stability during CVDF operations.

Due to the effectiveness of the density separation and size reduction steps, the material staged for wire separation consisted primarily of aluminum wire and Grafoil. This material was processed in several batches using the wire separation device. The process equipment was designed and successfully tested to retain the wire in the wire separation drum while allowing the uranium material and other small particles to fall through wire separation drum lid into a canister staged below the drum. Upon investigation of the KOP material after wire separation, the KOP material retained in the wire separation drum and the canister holding the material that fell through the wire separations lid were nearly identical, the primary difference between the two being the length of the wires. Further separation could have been attempted with drum lid designed for the shorter wire lengths. However due to the efficiency of the density separation and size reduction activities, both the material retained in the wire separation drum and the product stream were and determined to be debris. Further separation was not required. The aluminum wire will be dispositioned consistent with the normal disposition of debris in the Basin.

Using the data collected by operations during pretreatment processing, a material balance was completed to estimate the quantity of material transferred to the settler tubes. The material balance for pretreatment activities is presented in Table 3-1. It is estimated that approximately 122.7 kg of material was transferred to the IWTS settler tubes.

Table 3-1. Pretreatment Material Balance

KOP Material	Volume	Bulk Wet Density	Free Water[1]	Buoyancy Corrected Solids
	[Liters]	[kg/L]	[kg]	[kg]
Total Starting Inventory	137.0[2]	5.6	54.8	713.3
High Density KOP Material (Staged for KPS)	52.8	9.8	21.1	498.4
Material Collected in the IWTS Strainer Baskets (Staged for KPS or to be dispositioned as KOP waste material)	12.4	2.6	5.0	27.0
Material Collected in the PCM Strainer Baskets (Staged for KPS or to be dispositioned as KOP waste material)	8.2	4.6	3.3	34.4
Aluminum Wire (KOP waste material)	12.0	3.0	4.8	30.8
Material Transferred to Settler Tubes (by Difference)	n/a		20.7	122.7

Note: (1) Assumes 40 volume percent void space.
(2) Actual measured volume prior to pretreatment campaign. Previous volumes reported (152 L) in the in-basin inspections included estimates of the quantity of KOP material in the in-process IWTS equipment.

4.0 PRETREATMENT PROCESS DESCRIPTION

KOP material contains significant quantities of non-uranium based components (such as Grafoil, aluminum and iron compounds, and aluminum wire); the KOP material stream was pretreated to remove the non-uranium based material to the extent practical. Optimizing the removal of non-uranium based material enables the KOP Disposition Subproject to more cost-effectively package and treat the KOP material stream (i.e., uranium-based materials) in a manner similar to SNF by reducing the volume of the KOP material that will subsequently undergo further processing with the KOP Processing System (KPS).

In order to decrease the loading of non-uranium based material into the MCOs and reduce the load on the Primary Clean Machine (PCM), the KOP material was first subjected to a density separation. The low-density material was removed from the KOP material stream via a density separation funnel. The material separated from the KOP material with the density separation funnel was captured in the low-density retrieval strainer. The material collected in the low-density retrieval strainer was then transferred to a screened canister. The material in the screened canister was size reduced in the PCM to further remove low density / water bearing materials. Material reduced to less than 600 μm passed through the screened canister to the existing IWTS.

When a size reduction batch was complete, the remaining material in the screened canisters was processed through the Wire Separation Device. The wire separation step removed aluminum wire. Following wire separation, the wire remaining in the drum of the wire separation device was removed and placed on a dump table. A visual survey of the wire was performed. It was confirmed as non-fuel, and segregated as debris.

The high-density, high-uranium content material that passed through the density separation funnel will undergo further processing in the KPS. A simplified process flow diagram of the pretreatment activities is provided as Figure 4-1. A detailed description of the pretreatment process and associated equipment can be found in PRC-STP-00315, *Pretreatment of KOP Material Process Description, Process Control Plan and Material Balance.*

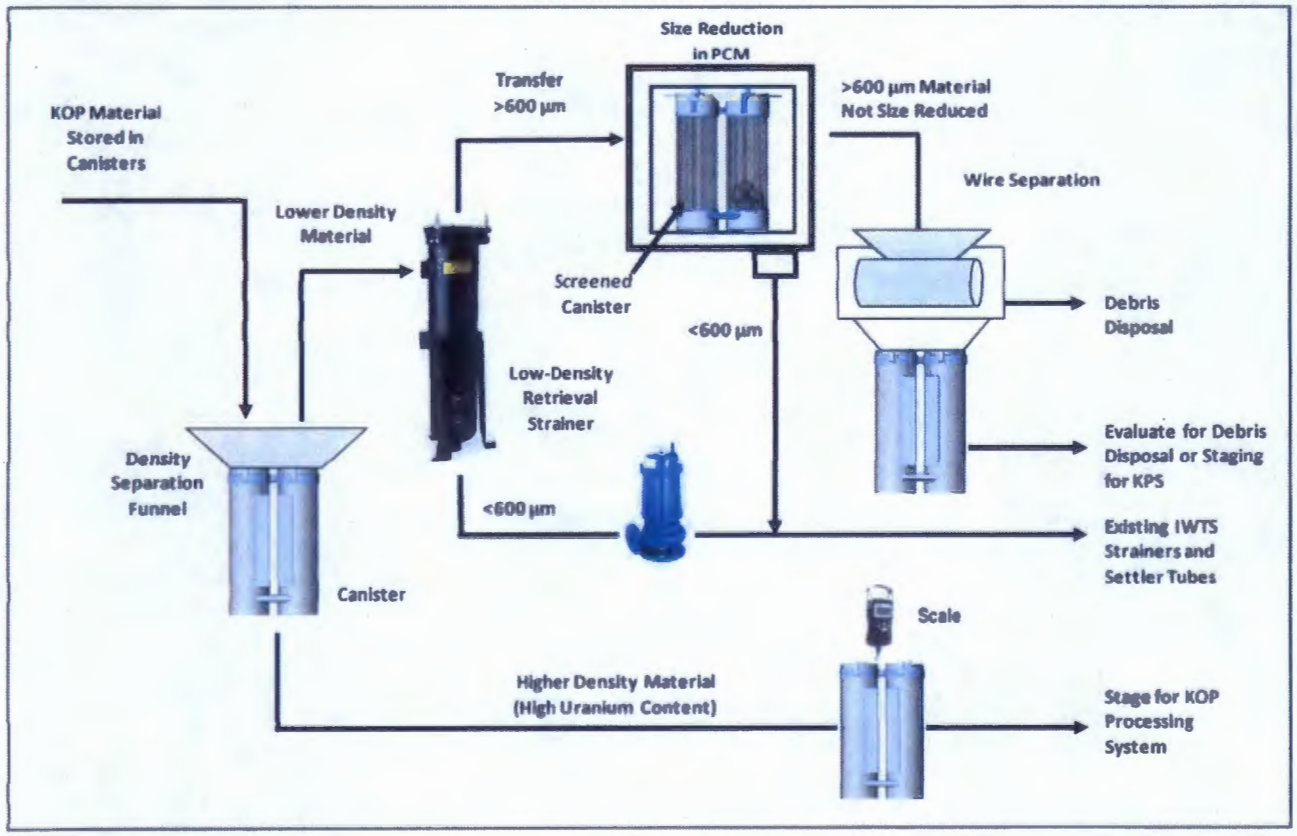

Figure 4-1. KOP Pretreatment Simplified Flow Diagram.

5.0 KOP MATERIAL STREAM DESCRIPTION

5.1 Origin and Background of KOP Material

KOP material consists of material between 600 µm (0.0236-in.) and 6,350 µm (0.25-in.) in particle size from the fuel and scrap cleaning process used in the SNF process at K Basin. Fuel was cleaned in the PCM, which provided mechanical agitation and flushing to remove particulate

from fuel by slowly tumbling the fuel canisters past high-pressure water jets. Particulate material in the fuel canisters, small uranium metal fragments and internal fuel particulate from damaged fuel assemblies, and coatings on fuel assemblies and fuel canisters were also removed during the cleaning process. The material removed from the fuel canisters during the cleaning process was collected in the PCM strainers, the Primary Process Table (PPT), KOP vessels, IWTS strainers and settler tubes. The PCM strainers retained material greater than 1/8-in. (3,175 µm) particle size. The KOP vessels and IWTS strainers were designed to capture heavy material and material greater-than-600-µm particle size that passed through the PCM strainers. The material less-than-600-µm particle size was captured in the settler tubes and annular filters. The material collected from the PCM strainers, PPT, KOP vessels, and IWTS strainers has been designated as KOP material. Figure 5-1 provides a pictorial overview of the KOP material origination and the process described above.

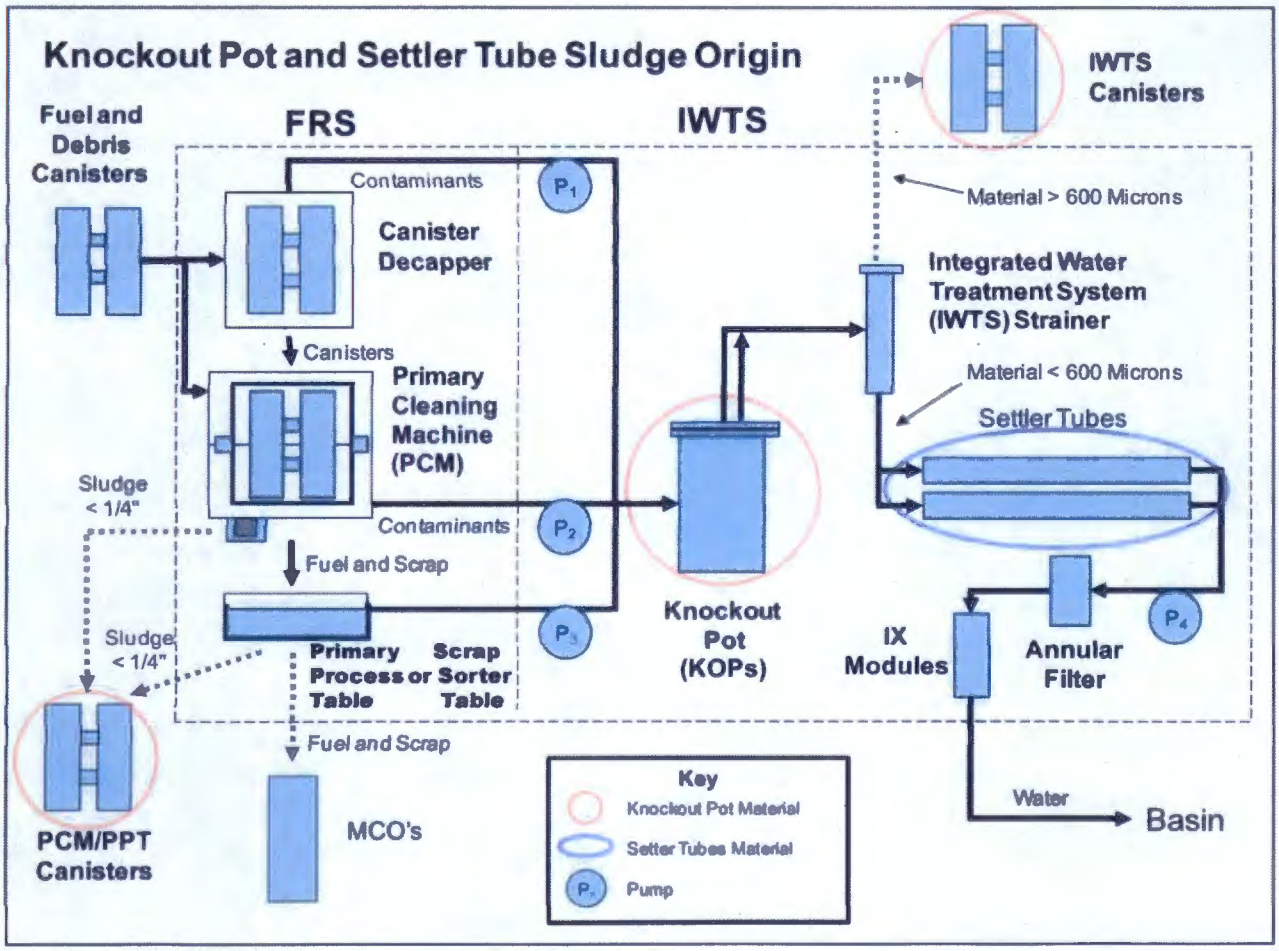

Figure 5-1. KOP Material Origination

5.2 Quantity of KOP Material

Prior to the commencement of pretreatment activities, KOP material was stored in 19 Mark II fuel canisters. Before density separation, several of the canisters containing KOP material were combined, resulting in 11 canisters of KOP material to be processed through the density separation funnel. The initial measurements of the KOP material contained in these 11 canisters are presented in Table 5-1. The buoyancy corrected weight solids weight was determined for each canister of KOP material using the methods described in Section 6.0.

Table 5-1. KOP Source Material - Initial Measurements

KOP Material Inventory	Volume	Bulk Wet Density	Free Water(1)	Buoyancy Corrected Solids Weight
ID No.	[Liters]	[kg/L]	[kg]	[kg]
S-003	3.4	4.5	1.3	13.8
S-010	7.5	7.1	3.0	49.9
S-011	14.3	6.3	5.7	84.0
S-018	14.4	5.5	5.8	74.0
S-027	8.2	7.1	3.3	55.3
S-014 (C) Combined Canisters S-012, S-013, S-014, S-019 and S-033	6.1	6.0	2.5	34.6
S-017B (C) Combined Canisters S-017A, S-017B, and S-017C	6.5	7.8	2.6	48.4
S-042 (C) Combined Canisters S-041, S-021 and S-042	31.3	2.9	12.5	77.3
S-001	20.1	2.1	8.0	34.7
KOP 11B	12.3	10.2	4.9	119.9
KOP 12	12.9	9.8	5.2	121.3
Total	137.0(2)	5.6(3)	54.8	713.3

Notes: (C) Denotes combined canisters of KOP material.
(1) Assumes 40 volume percent void space.
(2) Sum of actual measured volumes prior to pretreatment. Previous volumes reported (152 L) in the in-basin inspections included estimates of the quantity of KOP material in the in-process IWTS equipment.
(3) Average Bulk Wet Density.

5.3 Density of KOP Material

During in-basin inspections (Feldmann, et. al., 2011), direct underwater measurements of volume and mass (corrected for buoyancy) of KOP material contained in the Mark II fuel canisters were used to determine the bulk wet density. The KOP material had significant variation in density between canisters. Measured bulk wet densities in the individual canisters ranged from 1.7 to 10.4 kg/L. Prior to pretreatment, several of the canisters of KOP material were combined. The

measured densities of the canisters of KOP material after the combining of KOP material ranged from 2.1 kg/L to 10.2 kg/L. The average bulk wet density of all of the KOP material measured prior to pretreatment was 5.6 kg/L.

The bulk-wet density for each KOP material stream measured during in-basin inspections prior to pretreatment are shown in Table 5-2. The target bulk wet density for the high density KOP material after pretreatment and KPS activities is 9 kg/L (Rourk, 2010).

Table 5-2. Average Bulk Wet Density of KOP Material Prior to Pretreatment.

KOP Material Type	Average Bulk Wet Density kg/L	Average Bulk Wet Density kg/L
PCM Strainer/PPT	5.7	5.6
IWTS Strainer	2.7	
KOP	10.4	

6.0 BUOYANCY CORRECTION

Process control for pretreatment activities in the KW Basin was primarily based on volume and weight measurements. During pretreatment activities, KW Basin operations recorded the weight of KOP material at various stages of processing. The weights were recorded on accountability data sheets (ADS) and on procedure data sheets as underwater weights. The weight data from the pretreatment process was measured underwater by operations and needs to be corrected for buoyancy to make comparisons and calculations.

The buoyancy corrected weight is determined by adding the equivalent mass of water displaced by the material being weighed. For example, if 1 L of material weighed 5 kg, the buoyancy corrected weight is 6 kg, 5 kg material plus 1 kg (weight of one liter of water, density of water is 1 kg/L). In order to calculate the true weight, or buoyancy corrected solids weight, of the material, a void faction adjustment must be made. This is done by using the void fraction, multiplying by the density of water and by the volume of the material measured, then subtracting this value from the buoyancy corrected weight. A design basis void fraction of 40 volume percent is used, as documented in Sexton, 2010, to determine the solids mass of KOP material in this report. The buoyancy corrected solids weight for the example given above is determined to be 6 kg - (0.4 x 1 kg /L x 1 L) = 5.6 kg.

Buoyancy corrected solids weight are presented in both the pretreatment and KPS material balances presented in PRC-STP-00315 and PRC-STP-00316. All weights presented in Section 7.0 of this document are presented in terms of buoyancy corrected solids weight, identified as "Buoyancy Corrected Solids Weight" in the last column of each summary table. The underwater weight measurements can be found in Appendix A.

7.0 PRETREATMENT BASIN OPERATIONS CAMPAIGN

Using technical procedure OP-70-152 W, *Knock-Out Pot Pre-Treatment Operation*, KOP material was processed through the density separation equipment, sized reduction equipment and wire separation equipment. The following subsections describe the pretreatment basin operations campaign and present the results.

7.1 Results of Density Separation

During density separation, the KOP material in each fuel canister was poured into the density separation funnel. All the PCM strainer material and IWTS strainer material canisters required several passes through the density separation funnel to achieve a bulk wet density of greater than 9 kg/L (buoyancy corrected). The KOP material in two canisters, KOP-11B and KOP-12, required only one pass through the density separation funnel. The starting bulk wet density of the material in these two canisters was greater than 9 kg/L. However, the material in these two canisters was still processed through the density separation funnel to remove any low-density material. Upon completion of pretreatment activities, several of the canisters containing high density material were combined to reduce uncertainty in weight and volume measurements of the of the high density material. The volumes, weights, and densities for the high density canisters of KOP material processed through the density separation funnel are shown in Table 7-1. The buoyancy corrected solids weight was determined for the material in each canister using the methods described in Section 6.0 using the design basis void fraction, 0.4.

Table 7-1. High Density KOP Material – Post Density Separation

High Density Material Inventory	Volume	Bulk Wet Density	Free Water(1)	Buoyancy Corrected Solids Weight
ID No.	[Liters]	[kg/L]	[kg]	[kg]
S-011	7.39	9.4	2.96	66.6
S-018(C) Combined Product Canisters of S-027, S-001, S-042	11.83	9.6	4.73	108.8
S-017B (C) Combined Product Canisters of S-014(C), S-010, and S-003	12.17	9.5	4.87	111.3
KOP 11B	11.16	9.9	4.46	106.6
KOP 12	10.24	10.7	4.10	105.1
Total	52.79	9.8(2)	21.1	498.4

Notes: (C) denotes combined canisters of KOP material.
(1) Assumes 40 volume percent void space.
(2) Average Bulk Wet Density.

Low-density KOP material separated from the KOP material with the density separation funnel was collected in the low-density retrieval strainer. Some material passed through the low-density retrieval strainer onto the IWTS. Material captured in the low-density retrieval strainer baskets

was transferred into empty Mark II fuel canisters and staged for size reduction. A summary of the material transferred to these canisters is presented in Table 7-2. The buoyancy corrected solids weight was determined for each canister containing KOP material using the methods described in Section 6.0.

Table 7-2. Low-Density Retrieval Strainer Material – Post Density Separation

Low-Density Retrieval Strainer Material Inventory	Volume	Bulk Wet Density	Free Water(1)	Buoyancy Corrected Solids Weight
ID No.	[Liters]	[kg/L]	[kg]	[kg]
S-046	23.4	2.1	9.4	40.8
S-044	12.3	3.4	4.9	37.3
S-043	29.8	3.0	11.9	78.2
S-045	5.3	4.2	2.1	20.0
Total	70.7	2.9(2)	28.3	176.4

Note: (1) Assumes 40 volume percent void space.
(2) Average Bulk Wet Density.

Some KOP material less-than 600 μm passed through the low-density retrieval strainer and was transferred to the IWTS (IWTS strainers and settler tubes). Based on the post density separation KOP material measurements, it was determined that approximately 38.5 kg of KOP material passed through the low-density retrieval strainer and was transferred to the IWTS strainers and settler tubes. The IWTS strainer baskets were not emptied at the conclusion of density separation, therefore a determination of the quantity of material that passed through the IWTS strainer to the IWTS settler tubes was available for density separation. A material balance for density separation is presented in Table 7-3.

Table 7-3. Density Separation Material Balance

	Volume	Average Bulk Wet Density	Free Water(1)	Buoyancy Corrected Solids Weight
Kop Material	[Liters]	[kg/L]	[kg]	[kg]
Initial Measurements of KOP Material (Table 5-1)	137.0(2)	5.6	54.8	713.3
Total High Density Material (Table 7-1)	52.8	9.8	21.1	498.4
Total Material Collected in Low-Density Retrieval Strainer (Table 7-2)	70.7	2.9	28.3	176.4
Material transferred to IWTS (Strainers and Settler Tubes)	n/a		5.4	38.5

Note: (1) Assumes 40 volume percent void space.
(2) Actual measured volume prior to pretreatment campaign. Previous volumes reported (152 L) in the in-basin inspections included estimates of the quantity of KOP material in the in-process IWTS equipment.

7.2 Results of Size Reduction

The material collected in the low-density retrieval strainer (Table 7-2) was transferred to a screened canister for size reduction in the PCM at least once. Each barrel of the screened canister was filled with approximately 7 liters of the material that was collected in the low-density retrieval strainer. Twelve stainless steel agitator balls were added to each barrel of the screened canister. With the screened canister placed in the PCM, the PCM was operated for approximately 30 minute intervals. At the conclusion of each interval, the material remaining in the screened canister was evaluated for further size reduction in the PCM.

Size reduced material passed through the 600- μm screened canister, the PCM strainer basket and transferred to the IWTS. When the PCM was opened following processing activities, it was observed that some material less than 600 μm had settled out in the bottom of the PCM and in the bottom PCM strainer basket. Thus, during size reduction processing, the interior of the PCM was periodically cleaned. This material was sparged into the IWTS system where it was collected in the IWTS strainer basket or transferred to the settler tubes. Any remaining material was collected in the PCM strainer basket and transferred to a Mark II fuel canister. The material captured in the strainers may be processed within KPS or be dispositioned as KOP waste material. Material not sized reduced to less than 600 μm that was retained in the screened canister was staged for wire separation processing. A material balance for size reduction is shown in Table 7-4.

Table 7-4. Size Reduction Material Balance

KOP Material	Volume	Average Bulk Wet Density	Free Water(1)	Buoyancy Corrected Solids Weight
	[Liters]	[kg/L]	[kg]	[kg]
Total Material Collected in Low-Density Retrieval Strainer (Table 7-2)	70.7	2.9	28.3	176.4
Material Collected in the IWTS Strainer Baskets	12.4	2.6	5.0	27.0
Material Collected in the PCM Strainer Baskets	8.2	4.6	3.3	34.4
Material Staged for Wire Separation	12.0	3.0	4.8	30.8
Material Transferred to Settler Tubes (by Difference)	n/a		20.7	122.7

Note: (1) Assumes 40 volume percent void space.

7.3 Results of Wire Separation

Approximately 30.8 kg of material was staged for wire separation. Due to the effectiveness of the density separation and size reduction steps, the staged material primarily consisted of aluminum wire, aluminum hydroxide, Grafoil, and small particulated uranium and uranium oxide. The staged material was processed in several batches using the wire separation device. Each batch was placed in the wire separation drum and the drum was operated for approximately 40 minutes. The process equipment was designed and successfully tested to retain the wire in the wire separation drum while allowing the uranium material and other small particles to fall through the wire separation drum lid into a canister staged below the drum. Because the feed material was almost exclusively aluminum wire, the wire separation device did not produce the expected results. Upon visual investigation of the KOP material after wire separation, the material retained in the wire separation drum and the canister holding the material that fell through the wire separations lid were nearly identical (see Appendix B Figure B-8 and Figure B-9). The primary difference between the two was the length of the wires, which appeared to be shorter than previously identified during the phased inspections (Feldmann, et. al., 2009). The wire may have been broken by the agitator balls in the PCM during size reduction. Photos of the material retained in the wire separation drum and the material that exited the drum are provided in Appendix B. Further separation could have been attempted with drum lid designed for the shorter wire lengths. However due to the efficiency of the density separation and size reduction activities, both the material retained in the wire separation drum and the product stream were determined to be debris. Further separation was not required. This material will be dispositioned consistent with the normal disposition of debris in the Basin under the existing K-Basin Data Quality Objective, HNF-6273, *Data Quality Objective Process for Designation of K-Basins Debris*.

8.0 REFERENCES

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APPENDIX A

DATA TABLES

Table A-1. KOP Source Material - Initial Measurements

KOP Material Inventory	Weight (Underwater Weight)		Volume	Bulk Wet Density	Total Buoyancy Corrected Weight	Free Water(1)	Buoyancy Corrected Solids Weight
ID No.	[lbs.]	[kg]	[Liters]	[kg/L]	[kg]	[kg]	[kg]
S-003	26	11.8	3.4	4.5	15.2	1.3	13.8
S-010	100	45.4	7.5	7.1	52.9	3.0	49.9
S-011	166	75.4	14.3	6.3	89.7	5.7	84.0
S-018	144	65.4	14.4	5.5	79.8	5.	74.0
S-027	111	50.4	8.2	7.1	58.6	3.29	55.3
S-014 (C) Combined Canisters S-012, S-013, S-014, S-019 and S-033	68	30.9	6.1	6.0	37.0	2.45	34.6
S-017B (C) Combined Canisters S-017A, S-017B, and S-017C	98	44.5	6.5	7.8	51.0	2.62	48.4
S-042 (C) Combined Canisters S-041, S-021 and S-042	129	58.6	31.3	2.9	89.9	12.52	77.3
S-001	50	22.7	20.1	2.1	42.8	8.02	34.7
KOP 11B	248	112.6	12.3	10.2	124.8	4.90	119.9
KOP 12	250	113.5	12.9	9.8	126.4	5.17	121.3
Total	1390.0	631.1	137.0(2)	5.6(3)	768.1	54.80	713.3

Notes: (C) denotes combined canisters.
(1) Assumes 40 volume percent void space.
(2) Actual measured volume prior to pretreatment campaign. Previous volumes reported (152 L) in the in-basin inspections included estimates of the quantity of KOP material in the in-process IWTS equipment.
(3) Average Bulk Wet Density.

Table A-2. High Density KOP Material – Post Density Separation

High Density Material Inventory	Weight (Underwater Weight)		Volume	Bulk Wet Density	Total Buoyancy Corrected Weight	Free Water[1]	Buoyancy Corrected Solids Weight
ID No.	[lbs.]	[kg]	[Liters]	[kg/L]	[kg]	[kg]	[kg]
S-011	137.0[2]	62.2	7.4	9.4	69.6	3.0	66.6
S-018(C) Combined Product Canisters of S-027, S-001, S-042	224.0	101.7	11.8	9.6	113.5	4.7	108.8
S-017B (C) Combined Product Canisters of S-014(C), S-010, and S-003	229.0	104.0	12.2	9.5	116.1	4.9	111.3
KOP 11B	220.0	99.9	11.2	9.9	111.0	4.5	106.6
KOP 12	218.0	99.0	10.2	10.7	109.2	4.1	105.1
Total	1028.0	466.7	52.8	9.8[3]	519.5	21.1	498.4

Notes: (C) denotes combined canisters.
(1) Assumes 40 volume percent void space.
(2) Actual measured volume prior to pretreatment campaign. Previous volumes reported (152 L) in the in-basin inspections included estimates of the quantity of KOP material in the in-process IWTS equipment.
(3) Average Bulk Wet Density.

Table A-3. Low-Density Retrieval Strainer Material – Post Density Separation

Low-Density Material Inventory	Weight (Underwater Weight)		Volume	Bulk Wet Density	Total Buoyancy Corrected Weight	Free Water[1]	Buoyancy Corrected Solids Weight
ID No.	[lbs.]	[kg]	[Liters]	[kg/L]	[kg]	[kg]	[kg]
S-046	59	26.8	23.4	2.1	50.2	9.4	40.8
S-044	66	30.0	12.3	3.4	42.2	4.9	37.3
S-043	133	60.4	29.8	3.0	90.2	11.9	78.2
S-045	37	16.8	5.3	4.2	22.1	2.1	20.0
Total	295.0	133.9	70.7	2.9[2]	204.7	28.3	176.4

Notes: (C) denotes combined canisters.
(1) Assumes 40 volume percent void space.
(2) Average Bulk Wet Density.

Table A-4. Density Separation Material Balance

Kop Material	Weight (Underwater Weight)		Volume	Average Bulk Wet Density	Total Buoyancy Corrected Weight	Free Water[1]	Buoyancy Corrected Solids Weight
	[lbs.]	[kg]	[Liters]	[kg/L]	[kg]	[kg]	[kg]
Initial Measurements of KOP Material (Table 5-1)	1390.0	631.1	137.0[2]	5.6	768.1	54.8	713.3
Total High Density Material (Table 7-1)	1028.0	466.7	52.8	9.8	519.5	21.1	498.4
Total Material Collected in Low-Density Retrieval Strainer (Table 7-2)	295.0	133.9	70.7	2.9	204.7	28.3	176.4
Material transferred to IWTS (Strainers and Settler Tubes)	n/a				43.9	5.4	38.5

Notes: (1) Assumes 40 volume percent void space.
(2) Actual measured volume prior to pretreatment campaign. Previous volumes reported (152 L) in the in-basin inspections included estimates of the quantity of KOP material in the in-process IWTS equipment.

Table A-5. Size Separation Material Balance

KOP Material	Weight (Underwater Weight)		Volume	Average Bulk Wet Density	Total Buoyancy Corrected Weight	Free Water[1]	Buoyancy Corrected Solids Weight
	[lbs.]	[kg]	[Liters]	[kg/L]	[kg]	[kg]	[kg]
Total Material Collected in Low-Density Retrieval Strainer (Table 7-2)	295.0	133.9	70.7	2.9	204.7	28.3	176.4
Material Collected in the IWTS Strainer Baskets	43	19.5	12.4	2.6	31.9	5.0	27.0
Material Collected in the PCM Strainer Baskets	65	29.5	8.2	4.6	37.7	3.3	34.4
Material Staged for Wire Separation	52	23.6	12.0	3.0	35.6	4.8	30.8

Notes: (1) Assumes 40 volume percent void space.

Table A-6. Pretreatment Material Balance

KOP Material	Weight (Underwater Weight)		Volume	Average Bulk Wet Density	Total Buoyancy Corrected Weight	Free Water[1]	Buoyancy Corrected Solids Weight
	[lbs.]	[kg]	[Liters]	[kg/L]	[kg]	[kg]	[kg]
Total Starting Inventory	1390.0	631.1	137.0[2]	5.6	768.1	54.8	713.3
High Density KOP Material (Staged for KPS)	1028.0	466.7	52.79	9.8	519.5	21.1	498.4
Material Collected in the IWTS Strainer Baskets (Staged for KPS or to be dispositioned as KOP waste material)	43	19.5	12.4	2.6	31.9	5.0	27.0
Material Collected in the PCM Strainer Baskets (Staged for KPS or to be dispositioned as KOP waste material)	65	29.5	8.2	4.6	37.7	3.3	34.4
Aluminum Wire (KOP waste material)	52	23.6	12.0	3.0	35.6	4.8	30.8
Material Transferred to Settler Tubes (by Difference)	n/a				143.3	20.7	122.7

Notes: (1) Assumes 40 volume percent void space.
(2) Actual measured volume prior to pretreatment campaign. Previous volumes reported (152 L) in the in-basin inspections included estimates of the quantity of KOP material in the in-process IWTS equipment.

APPENDIX B

PRETREATMENT PHOTOS

Figure B-1. Material Being Processed in the Density Separation Funnel

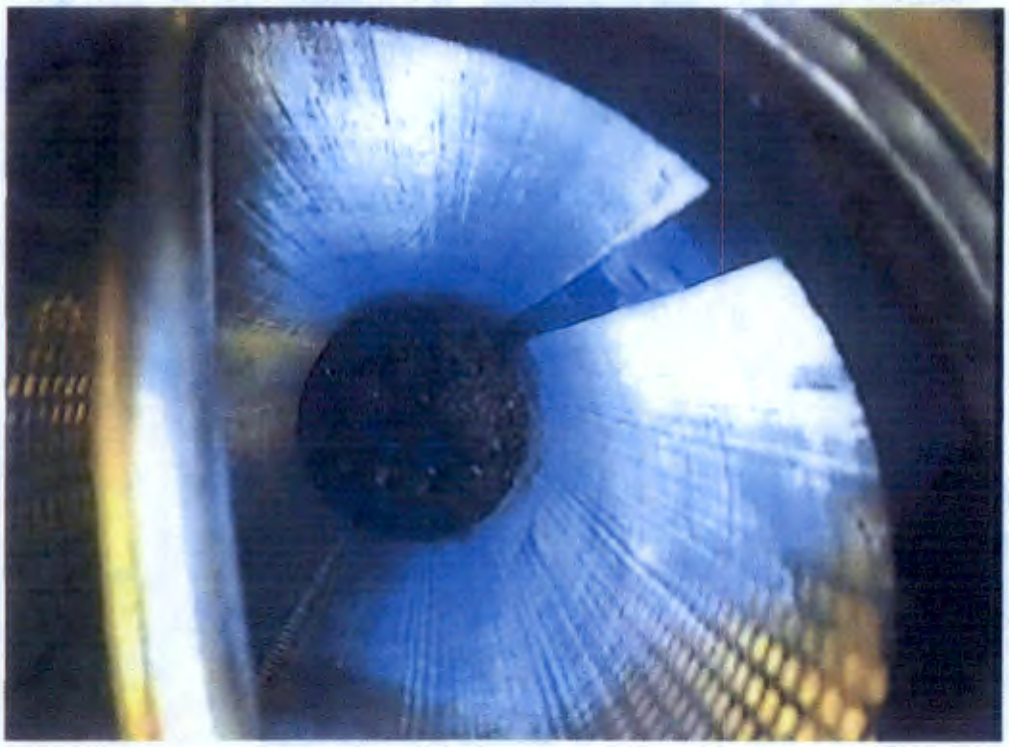

Figure B-2. Material Captured in Low-Density Retrieval Strainer during Density Separation.

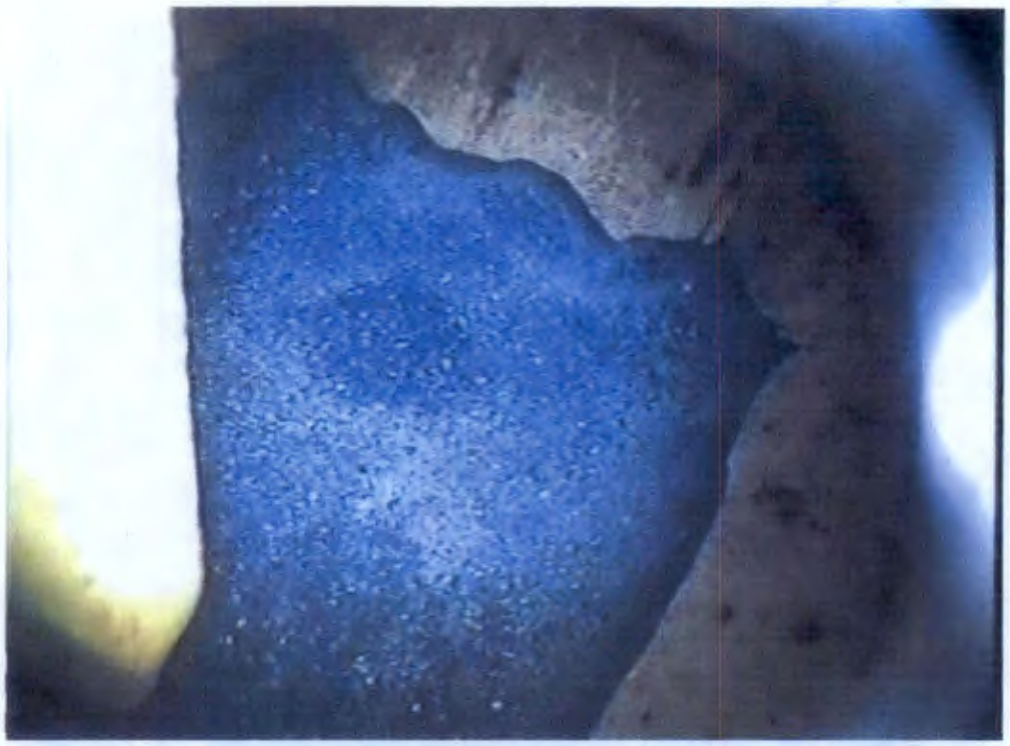

Figure B-3. Material Collected in Bottom of PCM during Size Reduction.

Figure B-4. Material Collected in Bottom of PCM during Size Reduction.

Figure B-5. Material being Removed from Screened Canister after Size Reduction.

Figure B-6. Stainless Steel Agitator Balls and Ball Retriever Tool Used during Size Reduction.

Figure B-7. Grafoil (black) and Aluminum Wire Suspended in the Side of the Base Unit after Passing through the Wire Separation Drum Lid

Figure B8. Material Retained in Wire Separation Drum: Longer Aluminum Wires, Grafoil (black) and Aluminum Hydroxide

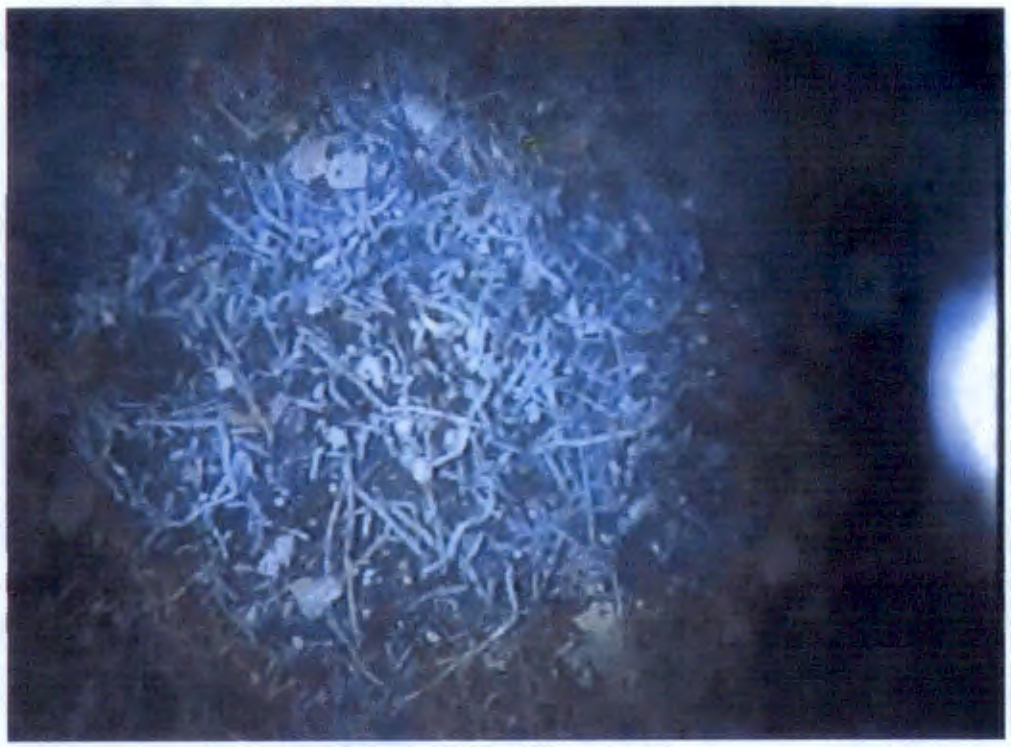

Figure B-9. Material Collected Canister Under Wire Separation Drum: Shorter Aluminum Wires, Grafoil (black) and Aluminum Hydroxide