

Rheological Studies on Pretreated Feed and Melter Feed from C-104 and AZ-102

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January 2001



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Prepared for
CH2M Hill Hanford Group
under Project Number 41503

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Summary

Rheological and physical properties testing was conducted on actual AZ-102 and C-104 melter feed samples prior to the addition of glass formers and secondary waste products. Analyses were repeated on the C-104 samples following the addition of simulated Sr/TRU secondary waste. Analyses were repeated again following addition of glass formers to both AZ-102 and C-104 samples. Samples from both feeds were tested at the target solids concentrations of 5, 15, and 25 wt%¹. This data on actual waste is required to validate and qualify results obtained with simulants.

The AZ-102 feed was received for this task after washing and leaching. The AZ-102 feed contained 9.54 wt% solids. At this solids concentration, no standing liquid was observed in the AZ-102 feed. The C-104 feed was also received following washing and leaching. The AZ-102 feed contained 20 wt% solids and contained roughly 15 vol% standing liquid.

The initial AZ-102 and C-104 feeds displayed very different rheological properties. The initial 5 and 15 wt% C-104 feeds displayed near Newtonian behavior, and the 25 feed has a small yield stress of ~5 Pa giving it a slight Bingham Plastic component. The viscosity of the feeds at 33 s⁻¹ were 9.8, 15, and 160 cP for the 5, 15, and 25 wt% feeds respectively with very little if any thixotropic behavior. By comparison, the AZ-102 feed showed much higher initial viscosities of 12, 530, 900, and 4600 cP for the 5, 15, 20, and 25 wt% feeds. In addition, the AZ-102 feeds displayed significant irreversible shear thinning. Surprisingly, no significant temperature effects were seen for the C-104 or AZ-102 samples measured at 25 and 50°C.

Very little change in rheological properties was observed following secondary waste product and glass former addition to the C-104 feed while the yield and viscosity the AZ-102 feed dropped following glass former and secondary waste addition. Since the addition of dry glass formers to the AZ-102 feed should have increased the total solids load, it would have been expected to see an increase the rheological properties. The observed decrease is most likely the result of the irreversible shear thinning of the AZ-102 samples as the testing progressed.

A mixing and aging study was conducted on the 15 wt% AZ-102 and 25 wt% C-104 feeds following glass former and secondary waste product additions. The additions were made and the slurries were stirred at a rate that delivered the same energy per volume as expected in the River Protection Project Waste Treatment Plant flow sheet. Slurries were stirred at this rate for one week. The rheology of the mixed slurries were examined at 1 hr, 1 day and 1 week. The yield and viscosity of the AZ-102 slurry decreased over the one week mixing period consistent with the previous observations of irreversible shear thinning in this slurry. By contrast the yield and viscosity of the C-104 slurry increased over the one week mixing period. The C-104 slurry yield increased from 28 Pa after one hour to 56 Pa after one week. Over this same period, the viscosity of the C-104 slurry increased from 910 cP to 1700 cP at 33s⁻¹.

Following the mixing study, the 15 wt% AZ-102 and 25 wt% C-104 slurries were allowed to settle for one week. The AZ-102 sample contained standing liquid, which was removed, while the C-104 sample contained no standing liquid. The rheology of the settled solids were then examined. The yield and viscosity of the AZ-102 settled solids were higher than similar testing after one week of mixing. This increase was expected and attributed to increased solids loading

¹ In this report, wt% solids are based on residual mass after 24 hours at 105°C.

resulting from removal of the standing liquid. The viscosity of the C-104 settled material was similar to the results after one week of mixing, but the yield increased to approximately 80 Pa.

The results of the mixing and aging studies suggest that while the AZ-102 initial feed and final melter feed material may be very difficult to mix and transport, irreversible shear thinning significantly reduces the yield and viscosity. Therefore, exposing this material to some initial shearing may be an option for reducing these critical transport properties. By contrast, the yield and viscosity of the initial C-104 material did not display significant irreversible shear thinning. The yield and viscosity of the C-104 melter feed increased with mixing and the yield increased further with aging. These results suggest the final C-104 melter feed could be very difficult to mix and transport on a 25 wt% basis.

Table of Contents

1.0	Introduction	1.1
2.0	Experimental Approach	2.1
2.1	Simulated Secondary Waste Products.....	2.1
2.1.1	Cs Eluant Simulant.....	2.1
2.1.2	Sr/TRU Precipitate Simulant.....	2.3
2.2	Evaporation and Settling Study	2.5
2.3	Shear Stress Versus Shear Rate Analysis (Rheology).....	2.8
2.4	Mixing and Aging Study	2.9
3.0	Experimental Results	3.1
3.1	Density and Settling Study	3.1
3.2	Rheology	3.21
3.2.1	Rheology of Evaporated Feed Samples	3.21
3.2.2	Rheology of Melter Feed with Secondary Waste Products	3.24
3.2.3	Rheology of Melter Feed with Glass Formers	3.27
3.3	AZ-102 Mixing and Aging Study	3.30
3.4	C-104 Mixing and Aging Study.....	3.33
4.0	Conclusions	4.1
5.0	References	5.1
	Appendix A: Test Plans	A.1
	Appendix B: Rheograms.....	B.1
	Appendix C: Test Instruction.....	C.1

Figures

Figure 3.1. Volume Percent Settled Solids Versus Time for AZ-102 Evaporated Feed Using a Linear Scale.....	3.5
Figure 3.2. Volume Percent Settled Solids Versus Time for AZ-102 Evaporated Feed Using a Semi-Log Scale.....	3.6
Figure 3.3. Settling Rates for AZ-102 Evaporated Feed	3.8
Figure 3.4. Volume Percent Settled Solids Versus Time for AZ-102 Evaporated Feed With Glass Formers Using a Linear Scale	3.9
Figure 3.5. Volume Percent Settled Solids Versus Time for AZ-102 Evaporated Feed With Glass Formers Using a Semi-Log Scale	3.10
Figure 3.6. Settling Rates for AZ-102 Evaporated Feed with Glass Formers.....	3.11
Figure 3.7. Volume Percent Settled Solids Versus Time for C-104 Evaporated Feed Using a Linear Scale.....	3.12
Figure 3.8. Volume Percent Settled Solids Versus Time for C-104 Evaporated Feed Using a Semi-Log Scale.....	3.13
Figure 3.9. Settling Rates for C-104 Evaporated Feed	3.14
Figure 3.10. Volume Percent Settled Solids Versus Time for C-104 Evaporated Feed With Secondary Waste Using a Linear Scale.....	3.15
Figure 3.11. Volume Percent Settled Solids Versus Time for C-104 Evaporated Feed With Secondary Waste Using a Semi-Log Scale	3.16
Figure 3.12. Settling Rates for C-104 Evaporated Feed With Secondary Waste Products.....	3.17
Figure 3.13. Volume Percent Settled Solids Versus Time for C-104 Evaporated Feed With Secondary Waste and Glass Formers Using a Linear Scale	3.18
Figure 3.14. Volume Percent Settled Solids Versus Time for C-104 Evaporated Feed With Secondary Waste and Glass Formers Using a Semi-Log Scale.....	3.19
Figure 3.15. Settling Rates for C-104 Evaporated Feed With Secondary Waste Products and Glass Formers	3.20
Figure 3.16. Rheograms for C-104 Initial Evaporated Feeds at 25°C.....	3.22
Figure 3.17. Rheograms for AZ-102 Initial Feeds at 25°C.....	3.26
Figure 3.18. Comparison of C-104 25 wt% Feed Initial Alone, With Secondary Waste and With Glass Formers and Secondary Waste at 25°C.....	3.28
Figure 3.19. Comparison of AZ-102 15 wt% Feed Alone and With Glass Former at 25°C.....	3.29
Figure 3.20. Rheograms for AZ-102 15 wt% Mixing Study, Measurement Performed at 25°C.....	3.31
Figure 3.21. Rheograms for AZ-102 15 wt% Aging Study Measurements Performed at 25°C.....	3.32
Figure 3.22. Rheograms for C-104 15 wt% Mixing Study Measurement Performed at 25°C.....	3.34
Figure 3.23. Rheograms for C-104 25 wt% Aging Study Measurement Performed at 25°C.....	3.35

Tables

Table 2.1. Components in Evaporated Cs Eluant Simulant	2.2
Table 2.2. Density Measurements for Simulant Solution	2.3
Table 2.3 Compositional Data on AN-107 Filtrate Simulant.....	2.4
Table 2.4. Sr/TRU Precipitate Simulant ICP Results for Dried Solids from Subsamples SM-05 and SM-06. Results Are in $\mu\text{g/g}$ of Dried Solids.	2.5
Table 2.5. Mass of Samples and Secondary Waste Products For C-104 Tests	2.7
Table 2.6. Mass of Samples and Glass Formers in Grams Added to AZ-102 Samples. Sample 15 wt%-2 Was Used for Mixing and Aging Study.....	2.7
Table 2.7. Mass of Samples and Glass Formers Added to C-104 Samples	2.8
Table 3.1. Density of AN-107 and AW-101 Samples at 25°C and 50°C With and Without Addition of Glass Formers in g/ml.....	3.2
Table 3.2. Volume Percent Settles Solids for the AZ-102 Samples	3.3
Table 3.3. Viscosity Data for Evaporated Feeds	3.23
Table 3.4. Viscosity Data (cP) for C-104 with Secondary Waste	3.25
Table 3.5. Viscosity Data for Evaporated Feeds with Secondary Waste and Glass Formers	3.27
Table 3.6. Viscosity Data for AZ-102 Mixing and Aging Study Measured at 25°C.....	3.30
Table 3.7. Viscosity Data for C-104 Mixing and Aging Study Measured at 25°C	3.33