PNNL-13359
WTP-RPT-004, Rev. 0
(Formerly BNFL-RPT-040)

Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy

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

P. R. Bredt
L. K. Jagoda
D. E. Rinehart

January 2001

Prepared for the U.S. Department of Energy under
Contract DE-AC06-76RL01830

PACIFIC NORTHWEST NATIONAL LABORATORY
operated by
BATTELLE
for the
UNITED STATES DEPARTMENT OF ENERGY
under Contract DE-AC06-76RL01830

Printed in the United States of America

Available to DOE and DOE contractors from the
Office of Scientific and Technical Information,
P.O. Box 62, Oak Ridge, TN 37831-0062;
ph: (865) 576-8401
fax: (865) 576-5728
email: reports@adonis.osti.gov

Available to the public from the National Technical Information Service,
U.S. Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161
ph: (800) 553-6847
fax: (703) 605-6900
email: orders@ntis.fedworld.gov
online ordering: http://www.ntis.gov/ordering.htm

This document was printed on recycled paper.

(8/00)

PNNL-13359
WTP-RPT-004, Rev. 0
(Formerly BNFL-RPT-040)

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

P. R. Bredt
L. K. Jagoda
D. E. Rinehart

January 2001

Prepared for
CH2M Hill Hanford Group
under Project Number 41503

Pacific Northwest National Laboratory
Richland, Washington 99352

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

Figures

Tables