

LA-UR-15-28901

Approved for public release; distribution is unlimited.

Title: Nitrate Salt Surrogate Blending Scoping Test Plan

Author(s): Anast, Kurt Roy

Intended for: Plan for Testing

Issued: 2015-11-13

Disclaimer:

Los Alamos National Laboratory, an affirmative action/equal opportunity employer, is operated by the Los Alamos National Security, LLC for the National Nuclear Security Administration of the U.S. Department of Energy under contract DE-AC52-06NA25396. By approving this article, the publisher recognizes that the U.S. Government retains nonexclusive, royalty-free license to publish or reproduce the published form of this contribution, or to allow others to do so, for U.S. Government purposes. Los Alamos National Laboratory requests that the publisher identify this article as work performed under the auspices of the U.S. Department of Energy. Los Alamos National Laboratory strongly supports academic freedom and a researcher's right to publish; as an institution, however, the Laboratory does not endorse the viewpoint of a publication or guarantee its technical correctness.

Nitrate Salt Surrogate Blending

Scoping Test Plan

Objective

Test blending equipment identified in the “Engineering Options Assessment Report: Nitrate Salt Waste Stream Processing”. Determine:

- if the equipment will provide adequate mixing of zeolite and surrogate salt/Swheat stream
- optimize equipment type and operational sequencing
- impact of baffles and inserts on mixing performance
- means of validating mixing performance

Equipment Needs

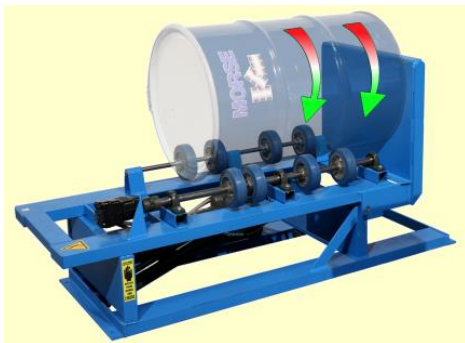
Two approaches will be examined to blend RNS surrogate and zeolite, a batch process and a drum blending process. A batch approach using a 5 gallon Hobart mixer. The largest unit that would likely fit into the WCRRF glovebox is the Hobart Legacy® Countertop 20 quart model.



KitchenAid 8 quart mixer

The unit can be ordered with a variety of mixer attachments that will need to be evaluated for effectiveness of blending our surrogates with zeolite.

The second approach is to load the drum with bulk zeolite and then add the RNS surrogate material in bulk and blend the contents in the drum using a drum tumbler and/or a drum roller. Internal baffles will be added to the interior of the drum to aid in blending. The baffles used for cementing DARHT post shot residues will be tried initially. A drum roller is already on hand and can be set up. A drum tumbler needs to be ordered, the Morse Model 309-3 is recommended.



Morse Drum roller



Morse Drum Tumbler

Equipment Information

- KitchenAid mixer (KitchenAid 8 qt mixer and attachments) (\$650 ea)
 - Available from National Restaurant Supply in Albuquerque
 - 505-998-2865
- Drum tumbler (Morse Model 309-3) (\$5,500)
 - 3 phase 460, 1.4 amp
 - GEK-309-3 enclosure Kit (\$2,350)
 - AC Control Package CP-309-3-460 NEMA 4/12 (\$2.100)
 - Model 284 Fork Hook (\$116)
 - Model 92 Below –Hook Drum Lifter (\$210)
 - Available from Caster's of Albuquerque 505-345-47777 (Steve)
- Drum roller (Morse Model 456-3-460 hydra-lift drum roller) (on-site)
 - 3 phase 460
 - GEK-309-3 enclosure Kit

Material Needs

In order to carry out scoping tests and verify blending performance of the selected equipment, various test materials will need to be purchased and prepared. Zeolite, Swheat and a surrogate salt are the ingredients used in all of the tests.

A purple colored salt used for melting ice is desired for these tests as it will provide a visual indication of the blending performance. The salt is from Kissner and is called Merlin Melts Like Magic. This is a sodium chloride salt that is dyed purple.



Merlts Like Magic Salt

Zeolite from KMI is needed for all of the testing. The 14 X 40 mesh size has been used in most of the testing to date. A coarser material, 8 x 14 mesh, may perform better in the drum blending tests and it should be evaluated before moving forward on all of the testing.



14 x 40 sample



8 x 14 sample

Swheat will be used in testing for preparing a surrogate RNS waste. The typical off the shelf Swheat is acceptable.

Batch testing of the KitchenAid mixer will require about 20 tests. Each test will prepare 4 gallons of product. The test will require 500 pounds of zeolite, 200 pounds of salt and 100 pounds of Swheat. Drum testing of the roller and the drum tumbler will require about 15 tests. These tests will require 3000 pounds of zeolite, 1500 pounds of salt and 800 pounds of Swheat. Before ordering the large lot of zeolite it would be beneficial to do a few scoping tests to see if the zeolite size impacts bulk blending performance. The expected material needs are:

- Zeolite: 4000 pounds
- Swheat: 1000 pounds
- Ice Melt: 2000 pounds (Merlin Melts Like Magic from Kissner, Purple in color)
- 55-gal Drums: 5 Metal with bung tops
- Drum baffles: get 5 sets of baffles from DARHT vessel ops

Equipment Configuration

Equipment should be set up inside at a location that allows space for setting the drum roller and drum tumbler as well as setting up the Hobart mixer. Power requirements for the Hobart and the Drum Tumbler will be based upon the easiest means of installation at WCRRF. Both the tumbler and the Hobart mixer can be provided as single or three phase units. The drum units will require a protective cage to meet OSHA requirements. The drum units need to be secured to the floor as do the protective cages. The drum units will also need the controls connected to the systems.

The test work will be with surrogate salts (sodium chloride) and insert materials like zeolite and kitty litter. It is not necessary to operate in a rad area. Preferable to operate in a location with easy access and minimal training requirements.

Testing Plans

Test work will focus on evaluating the three pieces of equipment for use in blending the RNS waste with zeolite. Initial scoping tests will be done to understand what problems might be expected with either approach and identify possible solutions. The effectiveness of the blending process will be measured by using a colored salt (purple) and dyeing or painting the Swheat (red). Visual characterization can be done of the individual 4 gallon batches as well as the drums batches at various levels. Once a desired blend is achieved, RTR can be tested on drums to compare preblending RTR images with post blending images. This may provide a means to verify blending performance for actual RNS drums without opening or sampling.

Until testing the equipment, it is difficult to specify exactly what tests need to be performed. The KitchenAid mixer will be fairly straight forward and the various mixing attachments can be evaluated to see if one is better than the others for this application. Initially some comparison of drum rolling vs tumbling can be evaluated to understand how each impacts blending. A comparison test with different zeolite mesh size can also be examined to see if there are any apparent differences. After initial scoping tests are completed then a more specific tests sequence can be prepared. An initial test set is identified below but this set may be altered once scoping tests are completed.

1. Prepare surrogate Salt/Swheat
 - a. Prepare colored Swheat by absorbing red colored dye onto the Swheat and drying or painting for purposes of evaluating blending effectiveness
 - b. Combine salt with water to make a wet salt residue
 - c. Blend salt and Swheat together by hand or using the HOBART mixer

- d. Via testing with varying amounts of water, salt and Swheat identify a surrogate RNS recipe for use in equipment testing
 - e. Prepare surrogate RNS for equipment tests
- 2. Batch KitchenAid Tests:
 - a. Evaluate various attachments for blending of salt and Swheat for preparing RNS surrogate
 - b. Evaluate various attachments for blending of Salt/Swheat and Zeolite
 - i. Test 2:1 Zeolite-to-Surrogate RNS
 - ii. Test 3:1 Zeolite-to-Surrogate RNS
 - iii. Test 4:1 zeolite-to surrogate RNS
 - iv. Document work with pictures and recipe details
 - c. Evaluate various attachment for blending of Salt and Zeolite
 - i. Test 2:1 Zeolite-to-Salt
 - ii. Test 3:1 Zeolite-to-Salt
 - iii. Test 4:1 Zeolite-to Salt
 - iv. Test 3:1 Wet Zeolite-to-Zeolite (wet zeolite is soaked in salt solution)
 - v. Document work with pictures and recipe details
 - d. Prepare a procedure for batch blending of RNS surrogate and zeolite
 - e. Prepare a procedure for batch blending of UNS surrogate and zeolite
- 3. Drum tests:
 - a. Prepare drum with drum baffles
 - b. Evaluate blending of drum tumbler
 - i. Test 3:1 Zeolite-to-RNS Surrogate (195 lbs to 65 lbs)
 - ii. Test 3:1 Zeolite-to-salt (195 lbs to 65 lbs)
 - iii. Document work with pictures and recipe details
 - c. Evaluate blending of drum roller
 - i. Test 3:1 Zeolite-to-RNS Surrogate (195 lbs to 65 lbs)
 - ii. Test 3:1 Zeolite-to-salt (195 lbs to 65 lbs)
 - iii. Document work with pictures and recipe details
 - d. Evaluate blending of drum tumbler followed by drum roller
 - i. Test 3:1 Zeolite-to-RNS Surrogate (195 lbs to 65 lbs)
 - ii. Test 3:1 Zeolite-to-salt (195 lbs to 65 lbs)
 - iii. Document work with pictures and recipe details
 - e. Evaluate the effectiveness of using RTR to verify blending performance
 - i. Test 3:1 Zeolite-to-RNS Surrogate using best blending procedure (195 lbs to 65 lbs)
 - ii. Test 3:1 Zeolite-to-salt using best blending procedure (195 lbs to 65 lbs)
 - iii. Document work with pictures and recipe details & RTR reports and video
 - f. Prepare a procedure for drum blending using drum tumbler and or drum roller for RNS surrogate and zeolite