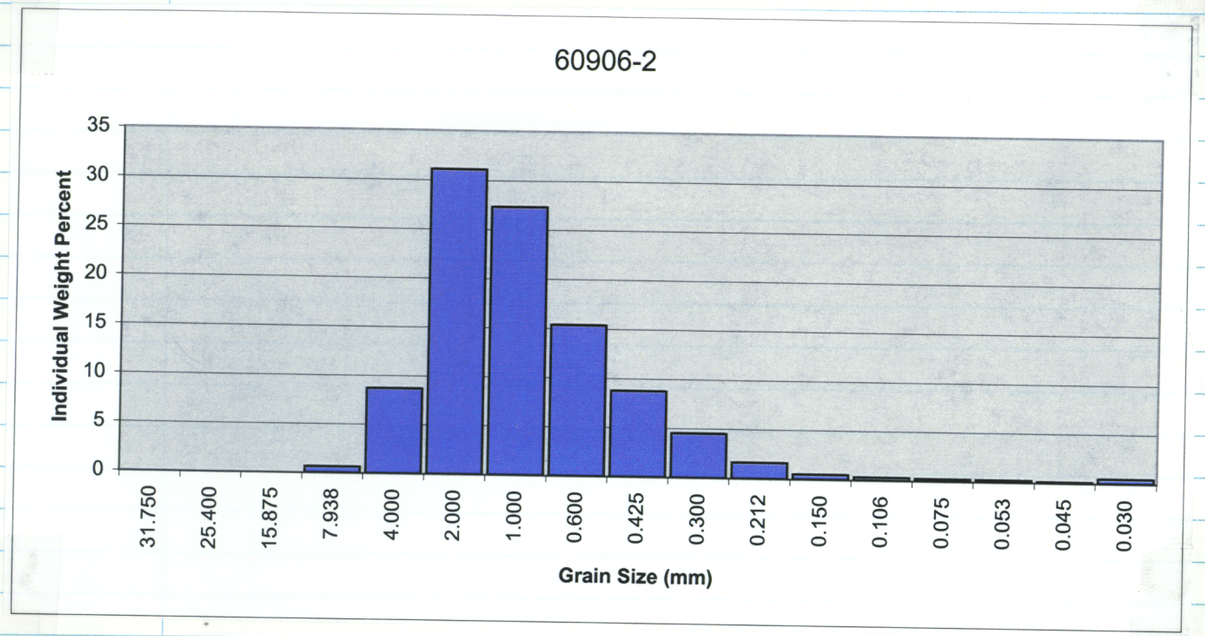


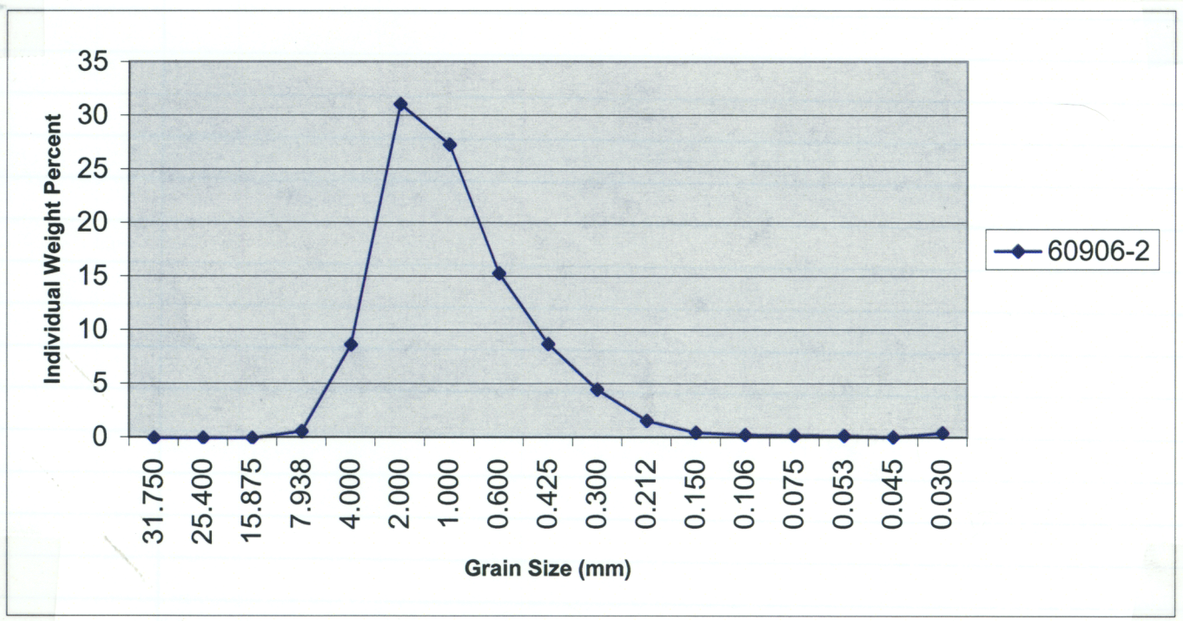




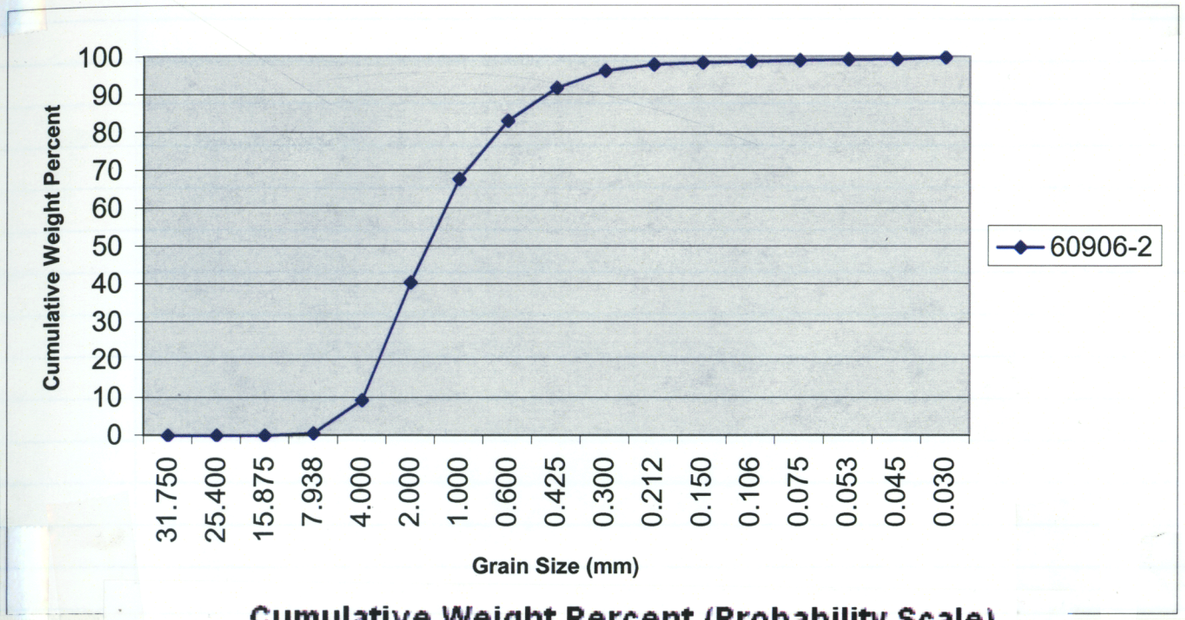


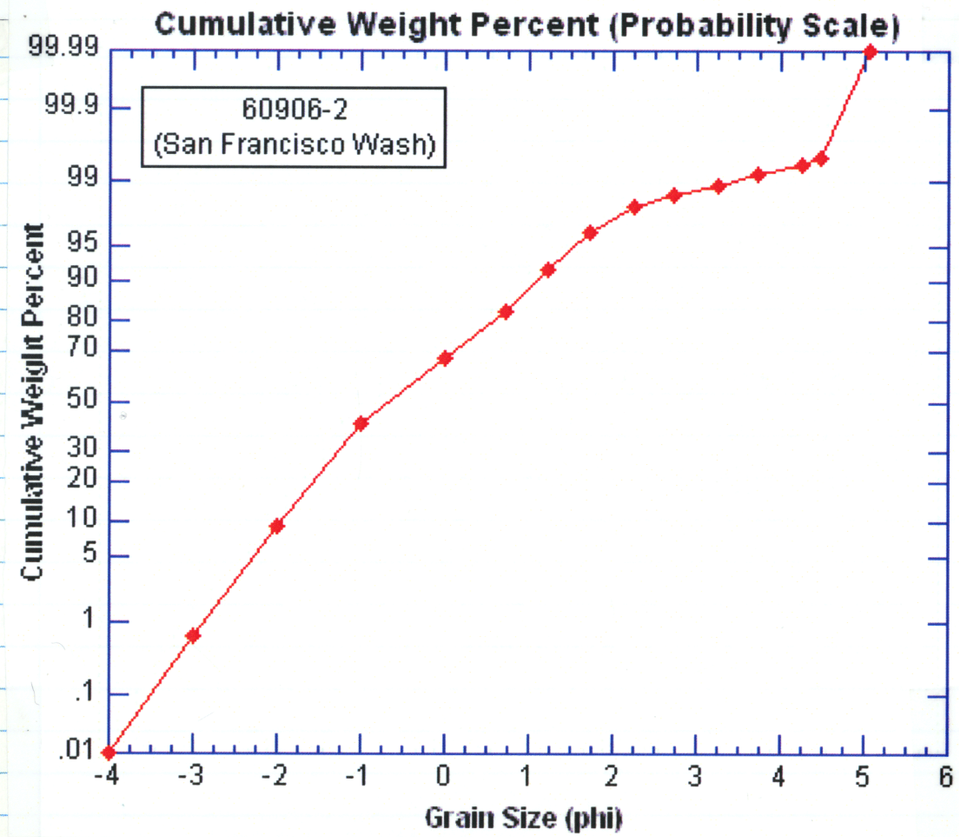


25 August 2006 Mr. S.

25 August 2006 M.S.

# Analysis of NIST Reference Material 8010

Task initially assigned to: Mark Silver

Background/Purpose: In order to monitor and validate the accuracy achieved with the currently used procedure and equipment for the sieve analysis, a standardized material with known mass percentages of different grain size is sieved and analyzed. The results from this analysis are then compared with the known values for the reference material, which exists as three samples with specific ranges of grain size. Agreeable results suggest that the procedure and equipment used during the sieve analysis are within a reasonable state and will provide data that is acceptable.

Objective: Perform sieve analysis for reference material 8010 and compare the obtained grain size distribution data with known values for that material.

Additional Equipment/materials:
- Dessicator
- NIST Reference material 8010 (ASTM Material A, C and D)

Measurement parameters/precision requirements: Mass measurements recorded to 0.001 g.

Identified sources of error: Refer to p. 3.

Procedure Followed: ASTM material A is sieved through a stack with sieve numbers 18, 30, 40, 50, 70, 100 and a pan. ASTM material C is sieved through numbers 50, 70, 100, 140, 200, 270 and a pan catcher finer material. ASTM material D is placed in a stack with numbers 70, 100, 140, 200, 270, 325 and a pan. The three materials are mechanically sieved with use of the shaker after being dried in an oven for 48 hours. Prior to sieving, the reference material is contained in a dessicator to prevent moisture absorption / mass gain.



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Test results: **Material A**

| | Mass of fraction: | Percent of fraction: | Deviation from reference value: |
|---|---|---|---|
| No. 18 | 0.000 g | 0.00 % | 0.00 % |
| No. 30 | 0.346 g | 0.27 % | 0.00 % |
| No. 40 | 29.483 g | 23.34 % | 0.00 % |
| No. 50 | 54.535 g | 42.45 % | 0.00 % |
| No. 70 | 23.601 g | 18.37 % | 0.00 % |
| No. 100 | 10.249 g | 7.98 % | 0.00 % |
| Pan | 9.769 g | 7.60 % | 0.00 % |
| Total | 128.483 g | 100.01 % | 0.00 % |

Reference values: **Material A**

| | Percent of fraction: | Uncertainty (+ or -): |
|---|---|---|
| No. 18 | 0.0 % | 0.0 % |
| No. 30 | 0.3 % | 0.3 % |
| No. 40 | 22.4 % | 6.0 % |
| No. 50 | 42.0 % | 7.1 % |
| No. 70 | 19.5 % | 3.9 % |
| No. 100 | 9.2 % | 1.5 % |
| Pan | 6.8 % | 1.5 % |

Test results: **Material C**

| | Mass of fraction: | Percent of fraction: | Deviation from reference value: |
|---|---|---|---|
| No. 50 | 0.554 g | 0.42 % | 0.00 % |
| No. 70 | 7.224 g | 5.53 % | 0.00 % |
| No. 100 | 47.415 g | 36.26 % | 0.00 % |
| No. 140 | 61.440 g | 46.99 % | 0.00 % |
| No. 200 | 12.481 g | 9.93 % | 0.00 % |
| No. 270 | 0.960 g | 0.73 % | 0.00 % |
| Pan | 0.176 g | 0.13 % | 0.00 % |
| Total | 130.750 g | 99.99 % | 0.00 % |

Reference values: **Material C**

| | Percent of fraction: | Uncertainty (+ or -): |
|---|---|---|
| No. 50 | 0.2 % | 0.4 % |
| No. 70 | 5.7 % | 1.9 % |
| No. 100 | 41.4 % | 5.1 % |
| No. 140 | 41.4 % | 6.1 % |
| No. 200 | 10.4 % | 2.2 % |
| No. 270 | 0.7 % | 0.6 % |
| Pan | 0.1 % | 0.5 % |

Test results: **Material D**

| | Mass of fraction: | Percent of fraction: | Deviation from reference value: |
|---|---|---|---|
| No. 70 | 0.180 g | 0.14 % | 0.00 % |
| No. 100 | 4.295 g | 3.41 % | 0.00 % |
| No. 140 | 40.204 g | 31.90 % | 0.10 % |
| No. 200 | 33.223 g | 26.36 % | 0.00 % |
| No. 270 | 27.826 g | 22.08 % | 0.00 % |
| No. 325 | 11.445 g | 9.08 % | 0.00 % |
| Pan | 8.839 g | 7.01 % | 0.00 % |
| Total | 126.012 g | 99.98 % | 0.10 % |

Reference values: **Material D**

| | Percent of fraction: | Uncertainty (+ or -): |
|---|---|---|
| No. 70 | 0.1 % | 0.6 % |
| No. 100 | 5.4 % | 3.6 % |
| No. 140 | 28.5 % | 3.3 % |
| No. 200 | 27.7 % | 4.8 % |
| No. 270 | 23.3 % | 4.2 % |
| No. 325 | 7.2 % | 4.5 % |
| Pan | 8.2 % | 3.2 % |

Conclusion: The current procedure for the sieve analysis produces acceptable results.

Reference values for test material 8010 were taken from the following source:

Kaiser, Debra L., and Robert L. Watters, Jr. Reference Material 8010: Sand for Sieve Analysis. May 2004. National Institute of Standards and Technology. 12 September 2006. <https://srmors.nist.gov/reports/8010.pdf>

25 August 2006 M.S.

## Control Experiment: Moisture absorption

Task initially assigned to: Mark Silver

Background: Dried and prepared sample splits gain mass when carried through the procedure for the sieve analysis. This investigation has been prepared in order to monitor whether or not this gain in mass occurs within a sample before being carried through the sieve analysis while the sample is openly exposed to various laboratory environments (involved in the sample analyses).

Objective: To determine the rate and extent of mass gain due to moisture absorption from the atmosphere in base sample 50406-2 when let to interact with typical and un-controlled laboratory conditions.

Additional equipment/materials:
- Dessication cabinet
- Drierite (dessicating agent)
- Mettler Toledo scale, type PR5002 (Mass range: 5100g - 0.01g SN: 1122142733 Cal: 5/9/06)

Measurement parameters/Precision requirements: all mass measurements shall be recorded to 0.01 g.

Identified Sources of Error: Refer to p. 3.

Procedure Followed:

1. Sample is dried in an oven at 65°C for at least 48 hours.
2. Dried sample is then immediately transferred into Dessication cabinet with Drierite.
3. Sample is allowed to cool completely to room temperature within Dessication cabinet.
4. Sample is removed from the cabinet and immediately the mass is measured = dry mass.
5. Mass measurements are then periodically taken during the duration that the sample is left uncovered to interact with the humidity of laboratory environments. The mass is recorded with the location, date and time of the measurement.



Initial (dry) Mass of 50406-2 2201.02 g 09/05/06 5:00 pm

| | | | Location: | Date: | Time: | |
|---|---|---|---|---|---|---|
| Note: Relative humidity inside of the Dessication Cabinet ≈ 32% | 1.) | 2201.63 g | B-57, L106, Rad Lab | 09/05/06 | 5:10 pm | |
| | 2.) | 2202.06 g | B-57, L106, Rad Lab | 09/05/06 | 5:20 pm | |
| | 3.) | 2202.30 g | B-57, L106, Rad Lab | 09/05/06 | 5:30 pm | |
| | 4.) | 2202.65 g | B-57, L106, Rad Lab | 09/05/06 | 5:40 pm | |
| | 5.) | 2202.95 g | B-57, L106, Rad Lab | 09/05/06 | 5:50 pm | |
| Note: Relative humidity of L106, Rad Lab ≈ 79% 09/05/06 | 6.) | 2203.17 g | B-57, L106, Rad Lab | 09/05/06 | 6:00 pm | |
| | 7.) | 2204.59 g | B-57, L102, Petrography | 09/05/06 | 7:00 pm | |
| | 8.) | 2205.60 g | B-57, L102, Petrography | 09/05/06 | 8:00 pm | |
| | 9.) | 2206.53 g | B-57, L102, Petrography | 09/05/06 | 9:10 pm | |
| | 10.) | 2212.96 g | B-57, high-bay area | 09/06/06 | 9:38 am | |
| | 11.) | 2215.66 g | B-57, L102 Petrography | 09/07/06 | 11:45 am | |
| Note: Relative humidity of L102, Petrography Lab ≈ 83% to 79% 09/05/06 | 12.) | 2216.71 g | B-57, L102 Petrography | 09/08/06 | 8:07 am | |
| | 13.) | 2217.00 g | B-57, L106, Rad Lab | 09/11/06 | 8:15 am | |
| | 14.) | 2216.87 g | B-57, L106, Rad Lab | 09/12/06 | 4:00 pm | Note: 68% RH |
| | 15.) | 2216.72 g | B-57, L106, Rad Lab | 09/14/06 | 4:45 pm | Note: 72% RH |
| | 16.) | 2218.68 g | B-57, L102 Petrography | 09/19/06 | 11:15 am | |
| | 17.) | 2216.42 g | B-57, L106, Rad Lab | 09/21/06 | 10:13 am | Note: 67% RH |
| Note: Relative humidity of B-57 high-bay area ≈ 85% 09/05/06 | 18.) | 2219.87 g | B-57, high-bay area | 10/03/06 | 6:35 pm | |
| | 19.) | 2218.36 g | B-57, L106, Rad Lab | 10/04/06 | 6:00 pm | |
| | 20.) | 2219.41 g | B-57, L102, Petrography | 10/10/06 | 2:50 pm | |
| Note: Relative humidity of B-57 L102 ≈ 67% 09/21/06 | | | | | | |

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**Mass of base sample and moisture content:**

| Sample ID: | Mass: |
|---|---|
| 50406-2 | 2226.7 g |
| 60406-4 | 2017.8 g |
| 81605-2 | 1783.8 g |
| 81605-3 | 1869.1 g |

**Mass of respectively labeled drying pans:**

1671.2 g
1685.2 g
1674.6 g
1697.6 g

**Mass of dried sample and pan:**

| | Sample ID: | Mass: |
|---|---|---|
| * | 50406-2 | 3885.4 g |
| | 60906-4 | 3702.8 g |
| | 81605-2 | 3417.0 g |
| | 81605-3 | 3548.7 g |

Note: Mass may only be taken once sample and pan have cooled to room temperature.

**Mass of dried sample** (calculated):

| | Sample ID: | Mass: |
|---|---|---|
| * | 50406-2 | 2214.2 g |
| | 60906-4 | 2017.6 g |
| | 81605-2 | 1742.4 g |
| | 81605-3 | 1851.1 g |

**Mass of water lost from base sample** (calculated):

| | Sample ID: | Mass: |
|---|---|---|
| * | 50406-2 | 12.5 g |
| | 60906-4 | 0.2 g |
| | 81605-2 | 41.4 g |
| | 81605-3 | 18.0 g |

**Mass (M) of sub-sample bag:**

$M_{avg}$ 6.8 g (Previously calculated, P. 8)



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**Mass of the sample split and sub-sample bag:** **Mass of sample split** (calculated):

| Sample ID: | | | | Mass: |
|---|---|---|---|---|
| 50406-2 | #1 | 581.0 g | -6.8 g = | 574.2 g * |
| | #2 | 587.2 g | -6.8 g = | 580.4 g |
| | #3 | 603.8 g | -6.8 g = | 597.0 g |
| | #4 | 466.9 g | -6.8 g = | 460.1 g |
| 60906-4 | #1 | 500.8 g | -6.8 g = | 494.0 g |
| | #2 | 523.1 g | -6.8 g = | 516.3 g |
| | #3 | 523.1 g | -6.8 g = | 516.3 g |
| | #4 | 496.6 g | -6.8 g = | 489.8 g |
| 81605-2 | #1 | 457.8 g | -6.8 g = | 451.0 g |
| | #2 | 415.2 g | -6.8 g = | 408.4 g |
| | #3 | 454.2 g | -6.8 g = | 447.4 g |
| | #4 | 460.0 g | -6.8 g = | 453.2 g |
| 81605-3 | #1 | 502.7 g | -6.8 g = | 495.9 g |
| | #2 | 471.8 g | -6.8 g = | 465.0 g |
| | #3 | 458.0 g | -6.8 g = | 451.2 g |
| | #4 | 445.2 g | -6.8 g = | 438.4 g |

**Re-evaluation of total sample mass** (calculated):

| | Sample ID: | Mass: |
|---|---|---|
| | 60906-4 | 2016.4 g (-1.2 g from original calculation for dried sample mass) |
| | 81605-2 | 1760.0 g (+17.6 from original calculation for dried sample mass) |
| | 81605-3 | 1850.5 g (-0.6 from original calculation for dried sample mass) |
| * | 50406-2 | 2211.7 g (-2.5 from original calculation for dried sample mass) |

* Currently involved in another experiment (see P. 30-31) sample splits for 50406-2 will be measured and dated at a later time. ⇒ 10/18/06 M.S.

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## Sample 50406-2 Analysis
Fortymile wash

| | Mass of fraction #1 of 4: | Percent of fraction #1 of 4: | Mass of fraction #2 of 4: | Percent of fraction #2 of 4: | Mass of combined 1 and 2: | Combined percentage: |
|---|---|---|---|---|---|---|
| 1 1/4" | 0.0 g | 0.00 % | 0.0 g | 0.00 % | 0.0 g | 0.00 % |
| 1" | 0.0 g | 0.00 % | 36.7 g | 6.33 % | 36.7 g | 3.18 % |
| 5/8" | 64.8 g | 11.28 % | 45.1 g | 7.78 % | 109.9 g | 9.52 % |
| 5/16" | 111.8 g | 19.47 % | 129.2 g | 22.29 % | 241.0 g | 20.89 % |
| No. 5 | 90.7 g | 15.79 % | 85.3 g | 14.72 % | 176.0 g | 15.25 % |
| No. 10 | 72.8 g | 12.68 % | 61.9 g | 10.68 % | 134.7 g | 11.67 % |
| No. 18 | 60.0 g | 10.45 % | 53.7 g | 9.27 % | 113.7 g | 9.85 % |
| No. 30 | 43.6 g | 7.59 % | 41.0 g | 7.07 % | 84.6 g | 7.33 % |
| No. 40 | 31.0 g | 5.40 % | 29.8 g | 5.14 % | 60.8 g | 5.27 % |
| No. 50 | 30.1 g | 5.24 % | 29.0 g | 5.00 % | 59.1 g | 5.12 % |
| No. 70 | 22.5 g | 3.92 % | 21.9 g | 3.78 % | 44.4 g | 3.85 % |
| No. 100 | 15.7 g | 2.73 % | 15.6 g | 2.69 % | 31.3 g | 2.71 % |
| No. 140 | 13.7 g | 2.39 % | 13.6 g | 2.35 % | 27.3 g | 2.37 % |
| No. 200 | 6.162 g | 1.07 % | 6.055 g | 1.04 % | 12.2 g | 1.06 % |
| No. 270 | 4.523 g | 0.79 % | 4.314 g | 0.74 % | 8.837 g | 0.77 % |
| No. 325 | 1.837 g | 0.32 % | 1.712 g | 0.30 % | 3.549 g | 0.31 % |
| Pan | 5.094 g | 0.89 % | 4.667 g | 0.81 % | 9.761 g | 0.85 % |
| Total | 574.3 g | 100.00 % | 579.5 g | 100.00 % | 1153.9 g | 100.00 % |
| minus original mass | - 574.2 g | | - 580.4 g | | | |
| | = 0.1 g gain | | = 0.9 g LOSS | | | |
| | 12/15/06 M.S. | | 12/28/06 M.S. | | | |

Base sample density:

2214.2 g / 1414 cm³

= 1.566 g/cm³

= 1566 kg/m³

| | Cumulative Percentage: |
|---|---|
| 1 1/4" | 0.00 % |
| 1" | 3.18 % |
| 5/8" | 12.41 % |
| 5/16" | 33.59 % |
| No. 5 | 48.84 % |
| No. 10 | 60.52 % |
| No. 18 | 70.37 % |
| No. 30 | 77.70 % |
| No. 40 | 82.97 % |
| No. 50 | 88.10 % |
| No. 70 | 91.94 % |
| No. 100 | 94.66 % |
| No. 140 | 97.02 % |
| No. 200 | 98.08 % |
| No. 270 | 98.85 % |
| No. 325 | 99.15 % |
| Pan | 100.00 % |
| Total | 100.00 % |

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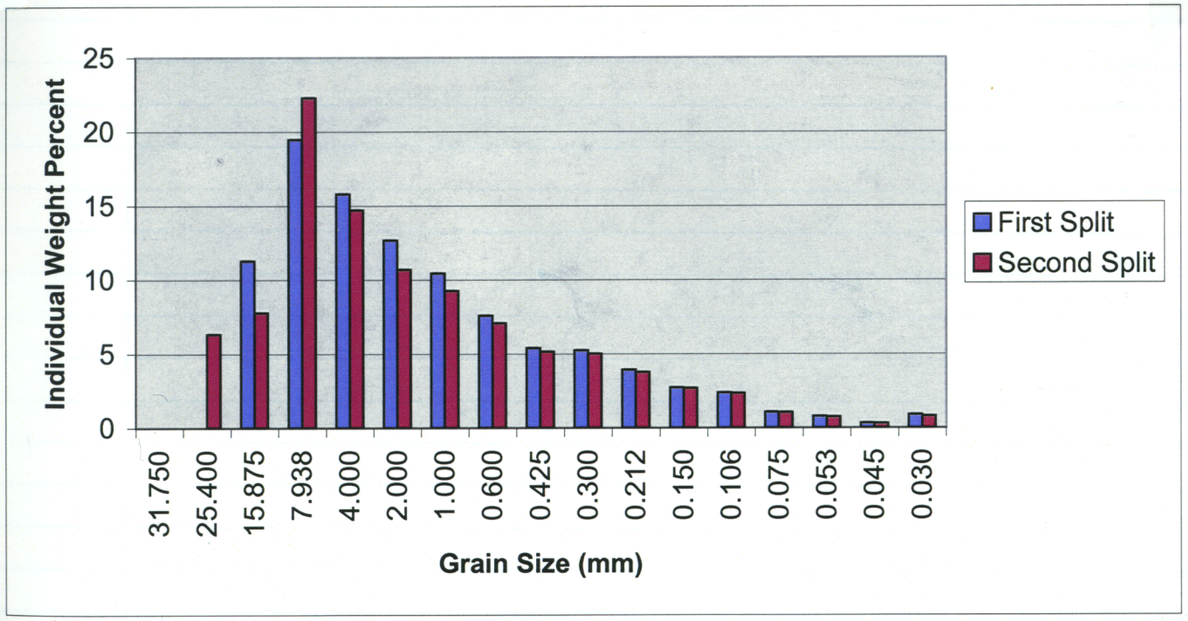
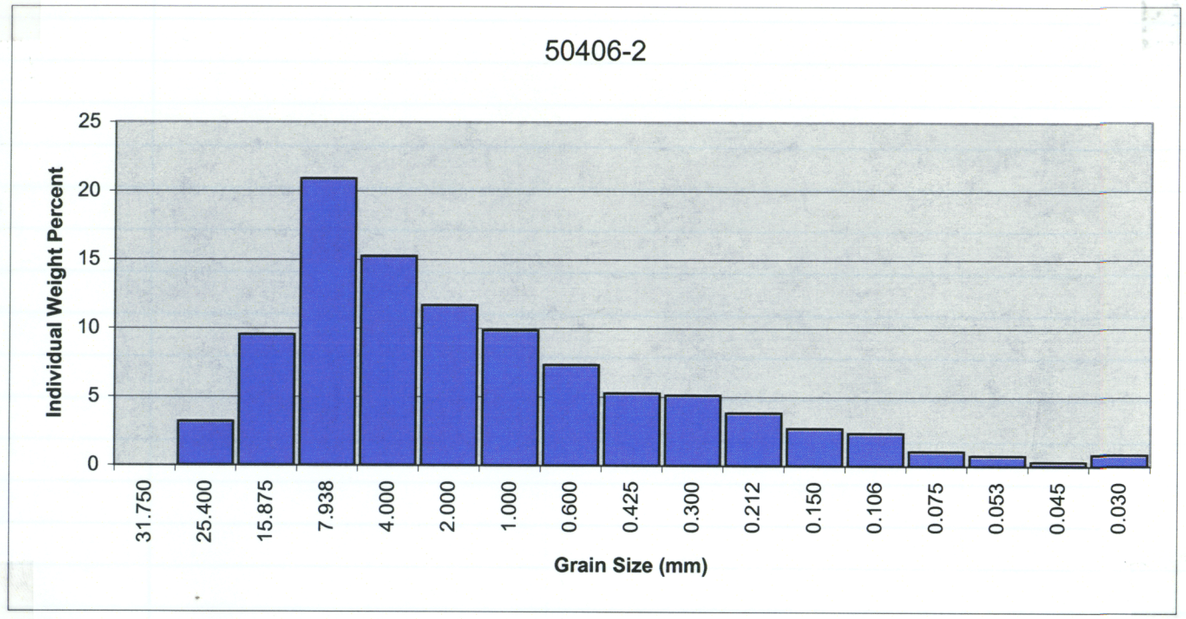
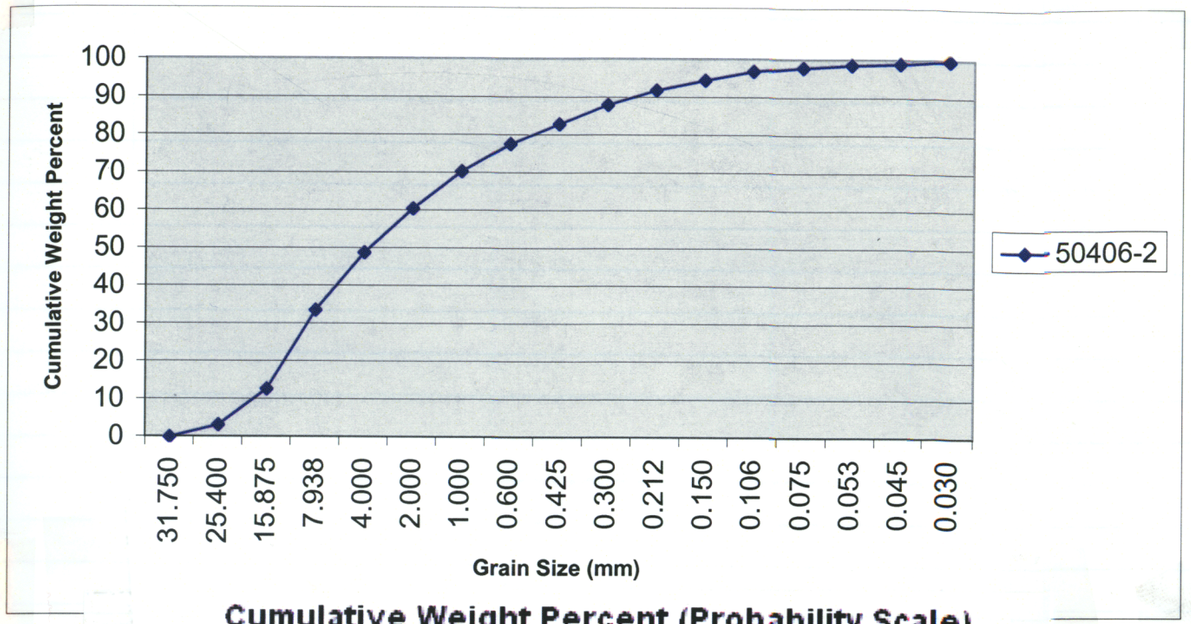
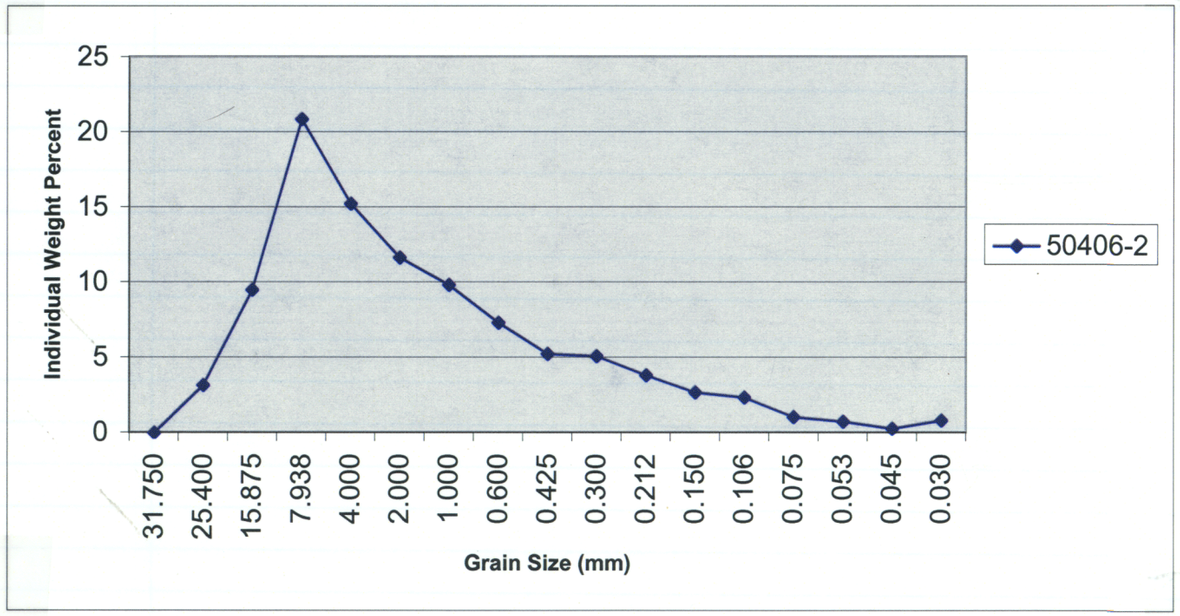
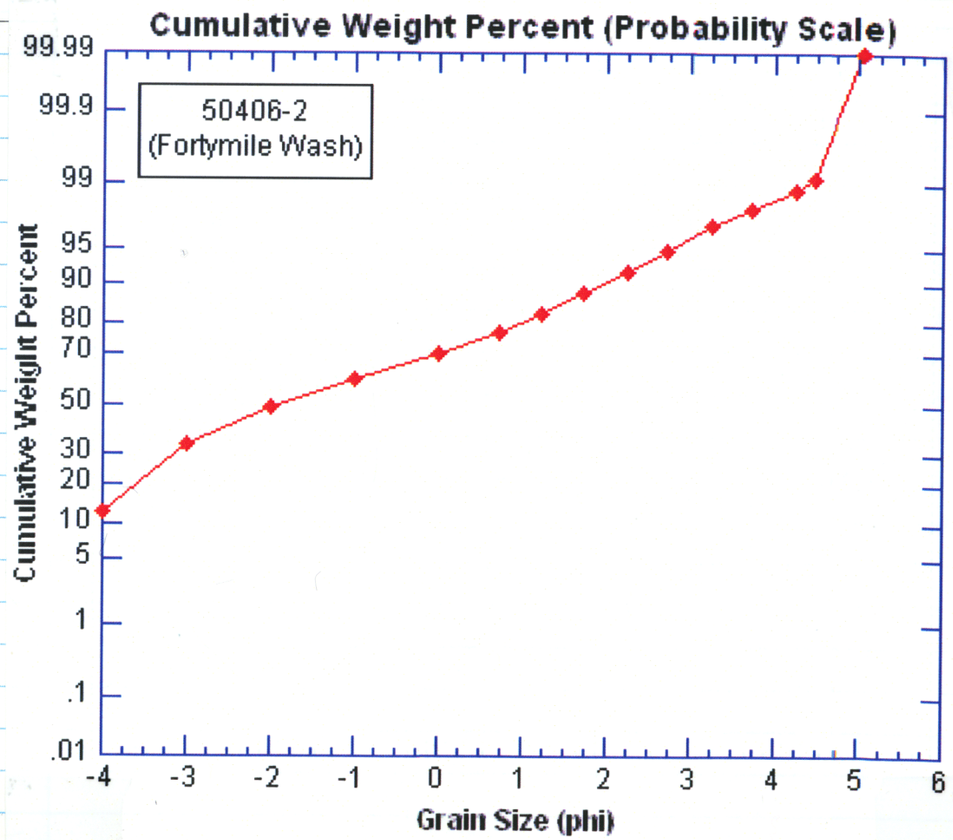



Splits from sample: 50406-2

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## Sample 60906-4 Analysis

| | Mass of fraction #1 of 4: | Percent of fraction #1 of 4: | Mass of fraction #2 of 4: | Percent of fraction #2 of 4: | Mass of combined 1 and 2: | Combined percentage: |
|---|---|---|---|---|---|---|
| 1 1/4" | 0.0 g | 0.00 % | 0.0 g | 0.00 % | 0.00 g | 0.00 % |
| 1" | 0.0 g | 0.00 % | 0.0 g | 0.00 % | 0.0 g | 0.00 % |
| 5/8" | 0.0 g | 0.00 % | 0.0 g | 0.00 % | 0.0 g | 0.00 % |
| 5/16" | 0.0 g | 0.00 % | 0.0 g | 0.00 % | 0.0 g | 0.00 % |
| No. 5 | 0.0 g | 0.00 % | 0.05 g | 0.01 % | 0.05 g | 0.00 % |
| No. 10 | 8.00 g | 1.62 % | 7.49 g | 1.45 % | 15.49 g | 1.53 % |
| No. 18 | 187.5 g | 37.99 % | 186.7 g | 36.17 % | 374.2 g | 37.1 % |
| No. 30 | 142.4 g | 28.85 % | 150.1 g | 29.08 % | 292.5 g | 28.97 % |
| No. 40 | 58.9 g | 11.93 % | 63.9 g | 12.38 % | 122.8 g | 12.16 % |
| No. 50 | 43.0 g | 8.71 % | 48.2 g | 9.34 % | 91.2 g | 9.03 % |
| No. 70 | 29.5 g | 5.98 % | 32.6 g | 6.32 % | 62.1 g | 6.15 % |
| No. 100 | 15.0 g | 3.04 % | 17.0 g | 3.29 % | 32.0 g | 3.17 % |
| No. 140 | 7.11 g | 1.44 % | 7.80 g | 1.51 % | 14.91 g | 1.48 % |
| No. 200 | 1.39 g | 0.28 % | 1.51 g | 0.29 % | 2.90 g | 0.29 % |
| No. 270 | 0.46 g | 0.09 % | 0.49 g | 0.09 % | 0.95 g | 0.09 % |
| No. 325 | 0.07 g | 0.01 % | 0.10 g | 0.02 % | 0.17 g | 0.02 % |
| Pan | 0.27 g | 0.05 % | 0.24 g | 0.05 % | 0.51 g | 0.05 % |
| Total | 493.6 g | 99.99 % | 516.2 g | 100.00 % | 1009.8 g | 100.04 % |

minus original mass - 494.0 g = 0.4 g Lost

- 516.3 g = 0.1 g Lost

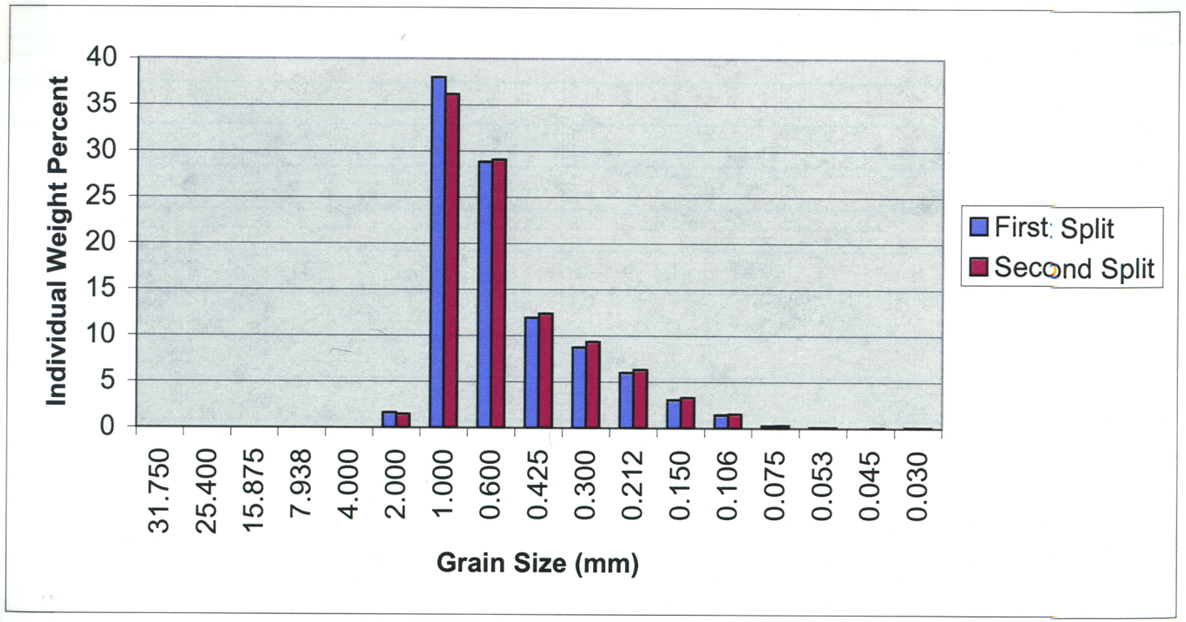
Base sample density:

2017.6g / 1414 cm³

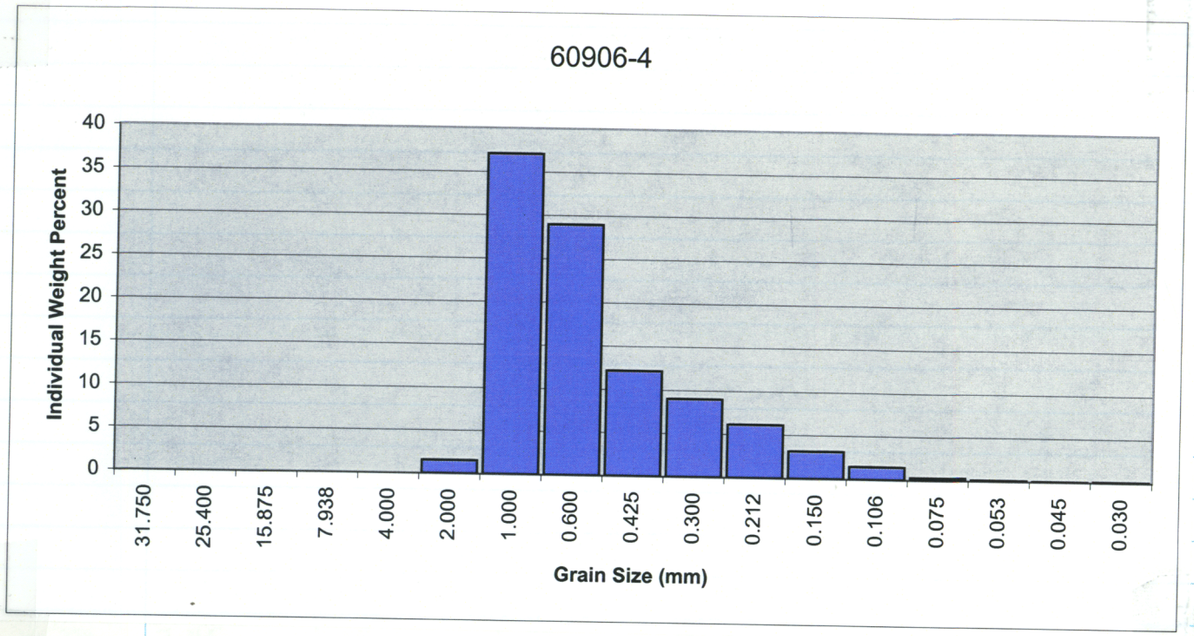
= 1.43 g/cm³

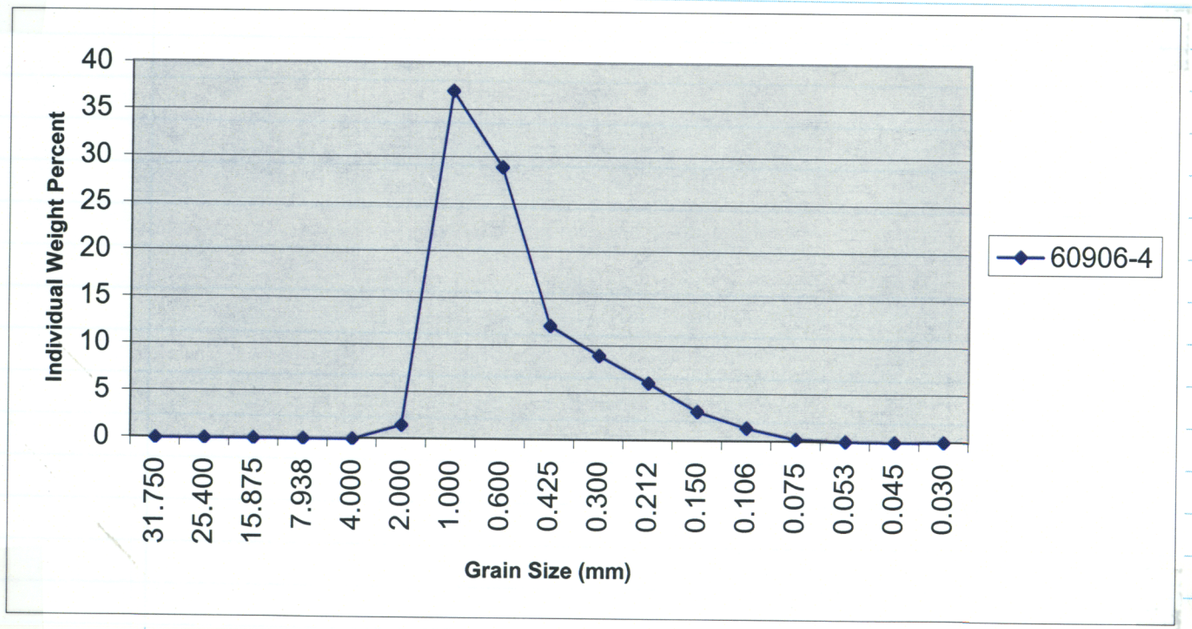
= 1430 kg/M³

| | Cumulative Percentage: |
|---|---|
| 1 1/4" | 0.00 % |
| 1" | 0.00 % |
| 5/8" | 0.00 % |
| 5/16" | 0.00 % |
| No. 5 | 0.00 % |
| No. 10 | 1.53 % |
| No. 18 | 38.63 % |
| No. 30 | 67.60 % |
| No. 40 | 79.76 % |
| No. 50 | 88.79 % |
| No. 70 | 94.94 % |
| No. 100 | 98.11 % |
| No. 140 | 99.59 % |
| No. 200 | 99.88 % |
| No. 270 | 99.97 % |
| No. 325 | 99.99 % |
| Pan | 100.04 % |
| Total | 100.04 % |

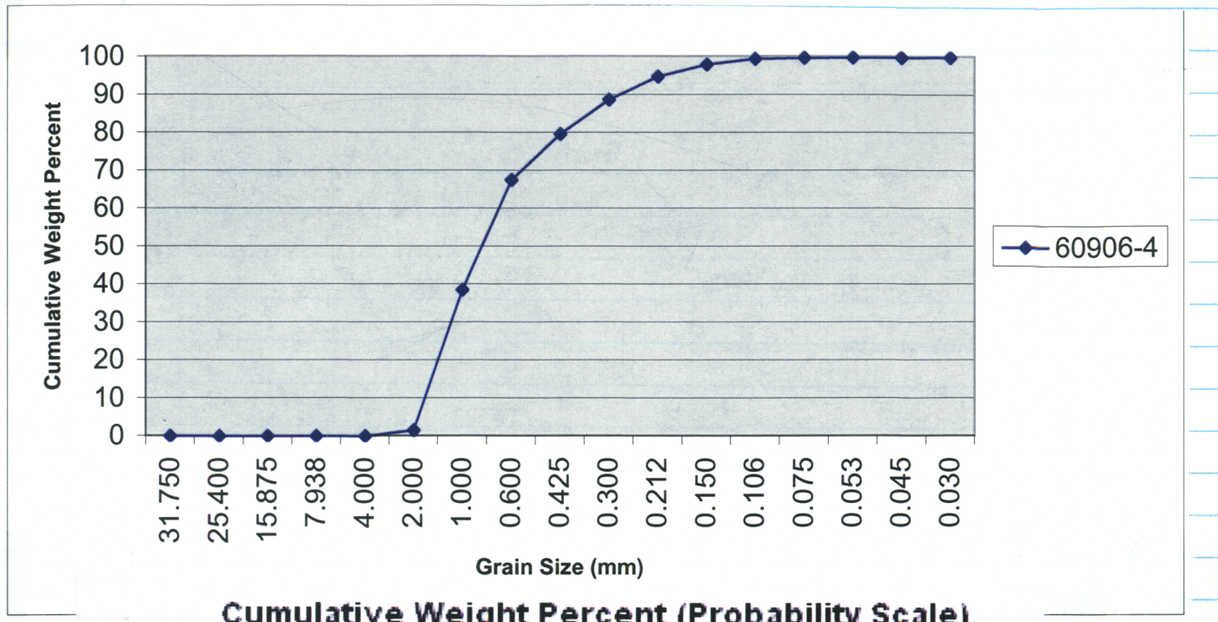


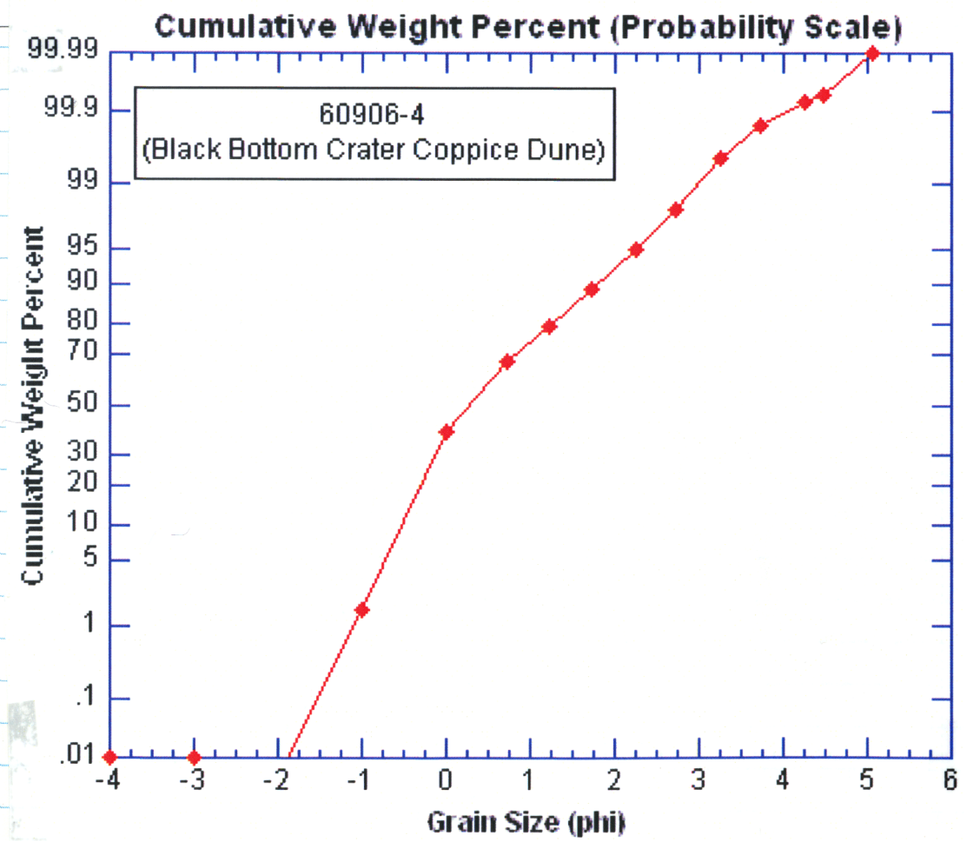

Splits from sample: 60906-4






19 September 2006 M.S.

## Sample 81605-2 Analysis

| | Mass of fraction #__of 4: | Percent of fraction #__of 4: | Mass of fraction #__of 4: | Percent of fraction #__of 4: | Mass of combined __and__: | Combined percentage: |
|---|---|---|---|---|---|---|
| $1^1/_4$" | | | | ___ % | _____ g | _____ % |
| 1" | | | | ___ % | _____ g | _____ % |
| $^5/_8$" | | | | ___ % | _____ g | _____ % |
| $^5/_{16}$" | | | | ___ % | _____ g | _____ % |
| No. 5 | | | | ___ % | _____ g | _____ % |
| No. 10 | | | | ___ % | _____ g | _____ % |
| No. 18 | | | | ___ % | _____ g | _____ % |
| No. 30 | | | | ___ % | _____ g | _____ % |
| No. 40 | _____ g | _____ % | _____ g | _____ % | _____ g | _____ % |
| No. 50 | _____ g | _____ % | _____ g | _____ % | _____ g | _____ % |
| No. 70 | _____ g | _____ % | _____ g | _____ % | _____ g | _____ % |
| No. 100 | _____ g | _____ % | _____ g | _____ % | _____ g | _____ % |
| No. 140 | _____ g | _____ % | _____ g | _____ % | _____ g | _____ % |
| No. 200 | _____ g | _____ % | _____ g | _____ % | _____ g | _____ % |
| No. 270 | _____ g | _____ % | _____ g | _____ % | _____ g | _____ % |
| No. 325 | _____ g | _____ % | _____ g | _____ % | _____ g | _____ % |
| Pan | _____ g | _____ % | _____ g | _____ % | _____ g | _____ % |
| Total | _____ g | _____ % | _____ g | _____ % | _____ g | _____ % |
| minus original mass | - _____ g = _____ g | | - _____ g = _____ g | | | |

Worksheet added as a placeholder. Sample split, but not sieved. Sample never analyzed before departure of Mark Silver.

- Donald Hooper (June 21, 2007)

Base sample density:

_____

= _____

= _____

D.H. 21 June 2007

**Cumulative Percentage:**

| | |
|---|---|
| $1^1/_4$" | _____ % |
| 1" | _____ % |
| $^5/_8$" | _____ % |
| $^5/_{16}$" | _____ % |
| No. 5 | _____ % |
| No. 10 | _____ % |
| No. 18 | _____ % |
| No. 30 | _____ % |
| No. 40 | _____ % |
| No. 50 | _____ % |
| No. 70 | _____ % |
| No. 100 | _____ % |
| No. 140 | _____ % |
| No. 200 | _____ % |
| No. 270 | _____ % |
| No. 325 | _____ % |
| Pan | _____ % |
| Total | _____ % |



Pages are a placeholder for analyses (graphs). Analyses not conducted before departure of Mark Silver.

- Donald Hooper (June 21, 2007)

D.H. 21 June 2007

Pages are a placeholder for analyses (graphs). Analyses not conducted before departure of Mark Silver.

- Donald Hooper (June 21, 2007)

D.H. 21 June 2007



Pages are a placeholder for analyses (graphs). Analyses not conducted before departure of Mark Silver.

- Donald Hooper (June 21, 2007)

D.H. 21 June 2007

## Sample 81605-3 Analysis

| | Mass of fraction #__of 4: | Percent of fraction #__of 4: | Mass of fraction #__of 4: | Percent of fraction #__of 4: | Mass of combined __and__: | Combined percentage: |
|---|---|---|---|---|---|---|
| 1 1/4" | | % | | % | g | % |
| 1" | | | | % | g | % |
| 5/8" | | | | % | g | % |
| 5/16" | | | | % | g | % |
| No. 5 | | | | % | g | % |
| No. 10 | | | | % | g | % |
| No. 18 | | | | % | g | % |
| No. 30 | | | | % | g | % |
| No. 40 | | | | % | g | % |
| No. 50 | g | % | g | % | g | % |
| No. 70 | g | % | g | % | g | % |
| No. 100 | g | % | g | % | g | % |
| No. 140 | g | % | g | % | g | % |
| No. 200 | g | % | g | % | g | % |
| No. 270 | g | % | g | % | g | % |
| No. 325 | g | % | g | % | g | % |
| Pan | g | % | g | % | g | % |
| Total | g | % | g | % | g | % |
| minus original mass | - g | | - g | | | |
| | = g | | = g | | | |

Worksheet added as a placeholder. Sample split, but not sieved. Sample never analyzed before departure of Mark Silver.

- Donald Hooper (June 21, 2007)

Base sample density:

_____

= _____

= _____

| | Cumulative Percentage: |
|---|---|
| 1 1/4" | % |
| 1" | % |
| 5/8" | % |
| 5/16" | % |
| No. 5 | % |
| No. 10 | % |
| No. 18 | % |
| No. 30 | % |
| No. 40 | % |
| No. 50 | % |
| No. 70 | % |
| No. 100 | % |
| No. 140 | % |
| No. 200 | % |
| No. 270 | % |
| No. 325 | % |
| Pan | % |
| Total | % |

QA 21 June 2007



Pages are a placeholder for analyses (graphs). Analyses not conducted before departure of Mark Silver.

- Donald Hooper (June 21, 2007)

QA 21 June 2007

Pages are a placeholder for analyses (graphs). Analyses not conducted before departure of Mark Silver.

- Donald Hooper (June 21, 2007)

D.H. 21 June 2007



Pages are a placeholder for analyses (graphs). Analyses not conducted before departure of Mark Silver.

- Donald Hooper (June 21, 2007)

D.H. 21 June 2007

**Mass of base sample and moisture content:**

| Sample ID: | Mass: |
|---|---|
| 60606-4 | 1150.4 g |
| 60606-3 | 1223.3 g |
| 60606-2 | 1274.5 g |
| 60606-1 | 1247.8 g |

**Mass of respectively labeled drying pans:**

1675.0 g
1685.6 g
1698.0 g
1671.5 g

13 December 2006 M.S.

**Mass of dried sample and pan:**

| Sample ID: | Mass: |
|---|---|
| 60606-4 | 2748.0 g |
| 60606-3 | g |
| 60606-2 | g |
| 60606-1 | g |

Q.H. 21 June 2007

**Mass of dried sample** (calculated)**:**

| Sample ID: | Mass: |
|---|---|
| 60606-4 | 1073.0 g |
| 60606-3 | g |
| 60606-2 | g |
| 60606-1 | g |

Q.H 21 June 2007

**Mass of water lost from base sample** (calculated)**:**

| Sample ID: | Mass: |
|---|---|
| 60606-4 | 77.4 g |
| 60606-3 | g |
| 60606-2 | g |
| 60606-1 | g |

Q.H. 21 June 2007

Note: 60606-4 was very moist when received as there was considerable condensation within the sample bag.

**Mass (M) of sub-sample bag:**

$\underline{M}_{avg}$ 6.8 g (Previously calculated, P.8)



**Mass of the sample split and sub-sample bag:** **Mass of sample split** (calculated)**:**

| Sample ID: | | | | Mass: |
|---|---|---|---|---|
| 60606-4 | #1 | 280.8 g | -6.8 g = | 274.0 g |
| | #2 | 276.4 g | -6.8 g = | 269.6 g |
| | #3 | 251.2 g | -6.8 g = | 244.4 g |
| | #4 | 290.2 g | -6.8 g = | 283.4 g |
| 60606-3 | #1 | g | -6.8 g = | g |
| | #2 | g | -6.8 g = | g |
| | #3 | g | -6.8 g = | g |
| | #4 | g | -6.8 g = | g |
| 60606-2 | #1 | g | -6.8 g = | g |
| | #2 | g | -6.8 g = | g |
| | #3 | g | -6.8 g = | g |
| | #4 | g | -6.8 g = | g |
| 60606-1 | #1 | g | -6.8 g = | g |
| | #2 | g | -6.8 g = | g |
| | #3 | g | -6.8 g = | g |
| | #4 | g | -6.8 g = | g |

31 October 2006 M.S.

Q.H. 21 June 2007

**Re-evaluation of total sample mass** (calculated)**:**

| Sample ID: | Mass: | |
|---|---|---|
| 60606-4 | 1071.4 g | (-1.6 from original calculation for dried sample mass) |
| 60606-3 | g | ( from original calculation for dried sample mass) |
| 60606-2 | g | ( from original calculation for dried sample mass) |
| 60606-1 | g | ( from original calculation for dried sample mass) |

Q.H 21 June 2007

3 November 2006 M.S.

1 November 2006 M.S.

## Sample 60606-4 Analysis

| | Mass of fraction #1 of 4: | Percent of fraction #1 of 4: | Mass of fraction #2 of 4: | Percent of fraction #2 of 4: | Mass of combined 1 and 2: | Combined percentage: | Cumulative percentage: |
|---|---|---|---|---|---|---|---|
| 1 1/4" | 0.0 g | 0.00 % | 0.0 g | 0.00 % | 0.0 g | 0.00 % | 0.00 % |
| 1" | 0.0 g | 0.00 % | 0.0 g | 0.00 % | 0.0 g | 0.00 % | 0.00 % |
| 5/8" | 3.770 g | 1.38 % | 0.0 g | 0.00 % | 3.77 g | 0.69 % | 0.70 % |
| 5/16" | 22.4 g | 8.19 % | 35.2 g | 13.08 % | 57.6 g | 10.61 % | 11.31 % |
| No. 5 | 115.0 g | 42.03 % | 109.6 g | 40.73 % | 224.6 g | 41.39 % | 52.70 % |
| No. 10 | 83.6 g | 30.56 % | 76.8 g | 28.54 % | 160.4 g | 29.56 % | 82.25 % |
| No. 18 | 31.4 g | 11.48 % | 30.5 g | 11.34 % | 61.9 g | 11.41 % | 93.66 % |
| No. 30 | 8.134 g | 2.97 % | 7.613 g | 2.83 % | 15.7 g | 2.90 % | 96.56 % |
| No. 40 | 2.211 g | 0.81 % | 2.188 g | 0.81 % | 4.40 g | 0.81 % | 97.37 % |
| No. 50 | 1.559 g | 0.57 % | 1.626 g | 0.60 % | 3.185 g | 0.59 % | 97.96 % |
| No. 70 | 1.207 g | 0.44 % | 1.237 g | 0.46 % | 2.444 g | 0.45 % | 98.41 % |
| No. 100 | 1.038 g | 0.38 % | 1.022 g | 0.38 % | 2.060 g | 0.38 % | 98.79 % |
| No. 140 | 0.978 g | 0.36 % | 0.973 g | 0.36 % | 1.951 g | 0.36 % | 99.15 % |
| No. 200 | 0.677 g | 0.25 % | 0.644 g | 0.24 % | 1.321 g | 0.24 % | 99.39 % |
| No. 270 | 0.512 g | 0.19 % | 0.504 g | 0.19 % | 1.016 g | 0.19 % | 99.58 % |
| No. 325 | 0.250 g | 0.09 % | 0.237 g | 0.09 % | 0.487 g | 0.09 % | 99.67 % |
| Pan | 0.863 g | 0.32 % | 0.928 g | 0.34 % | 1.791 g | 0.33 % | 100.00 % |
| Total | 273.6 g | 100.02 % | 269.1 g | 100.00 % | 542.7 g | 100.00 % | |
| minus original mass | - 274.0 g | | - 269.6 g | | | | |
| | = 0.4 g loss | | = 0.5 g loss | | | | |

Base sample density:

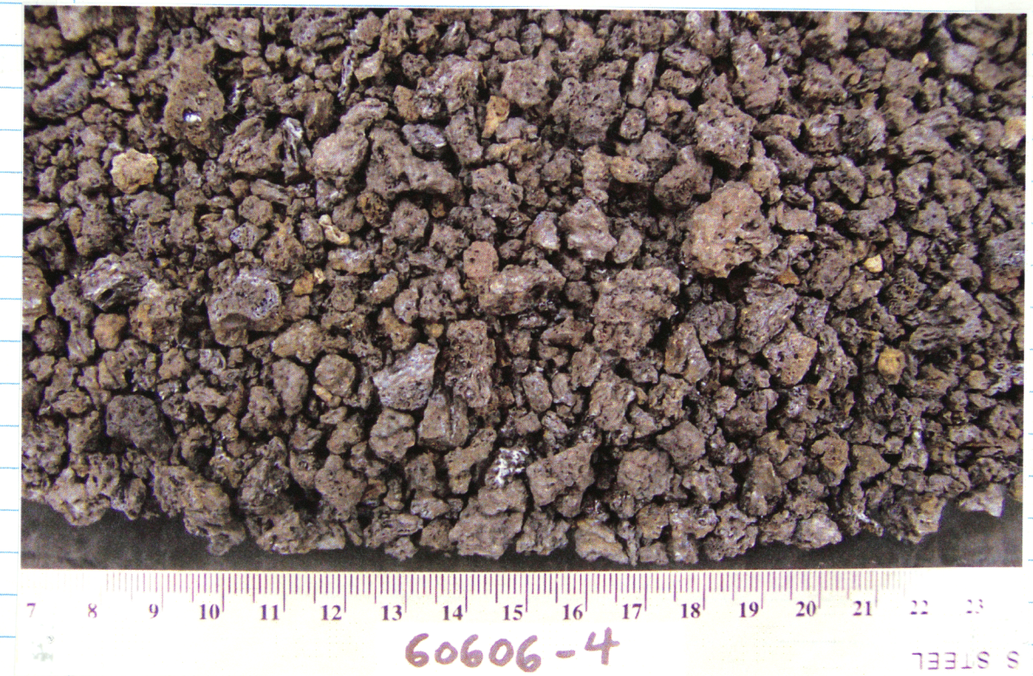
1073.0g / 1414cm$^3$

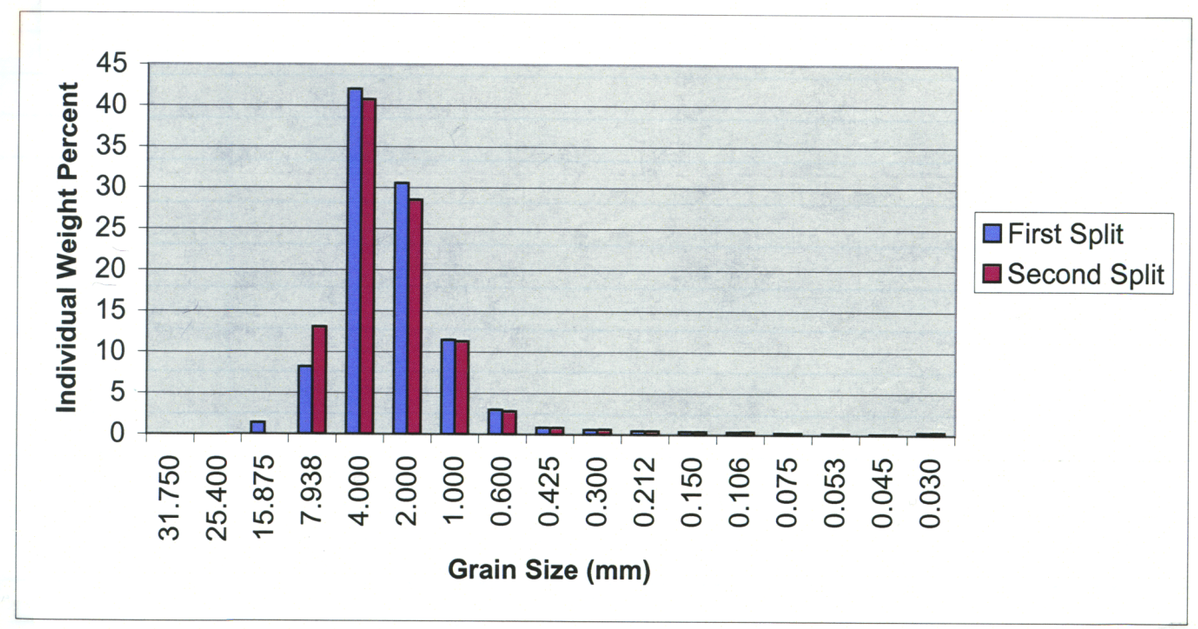
= 0.76g/cm$^3$

= 760kg/M$^3$

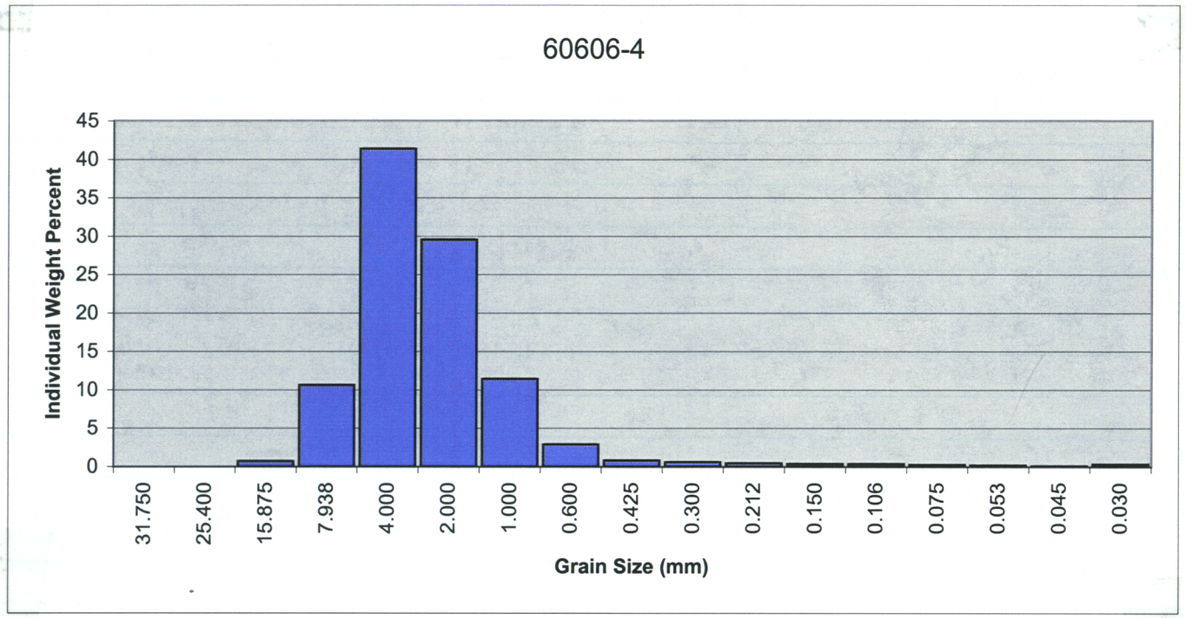


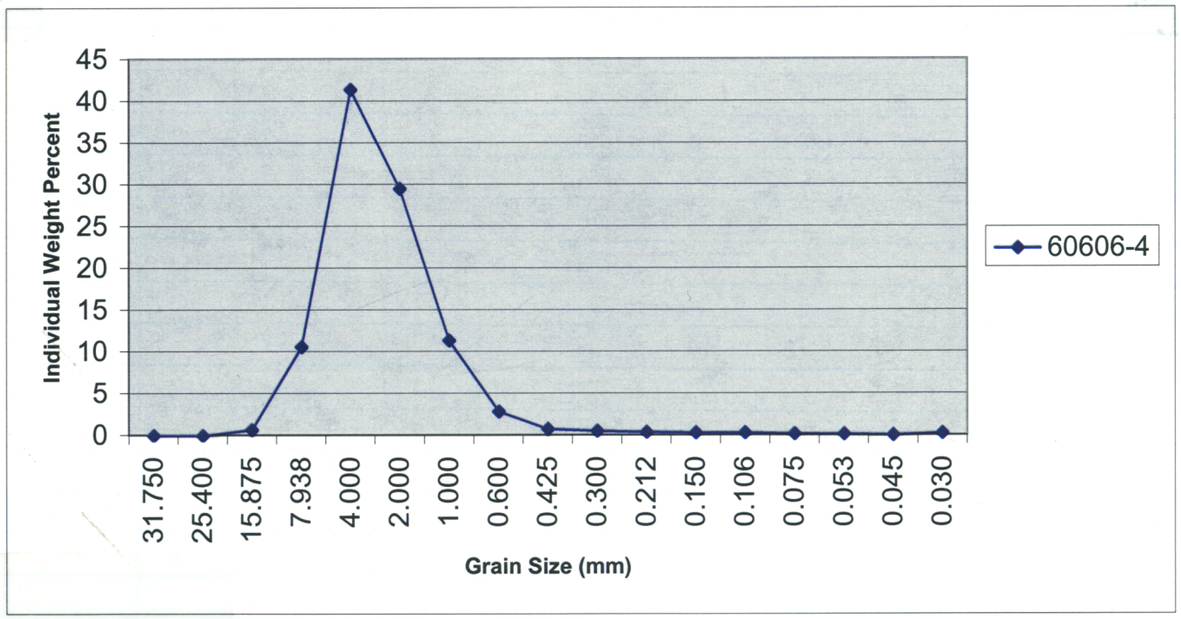
1 November 2006 M.S.



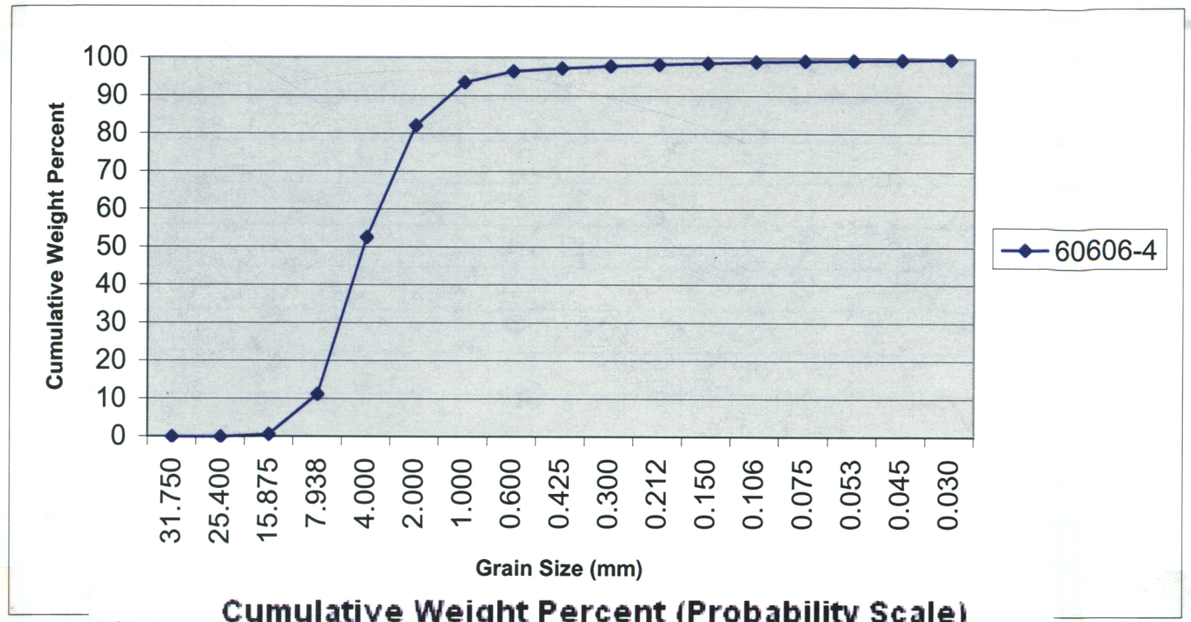



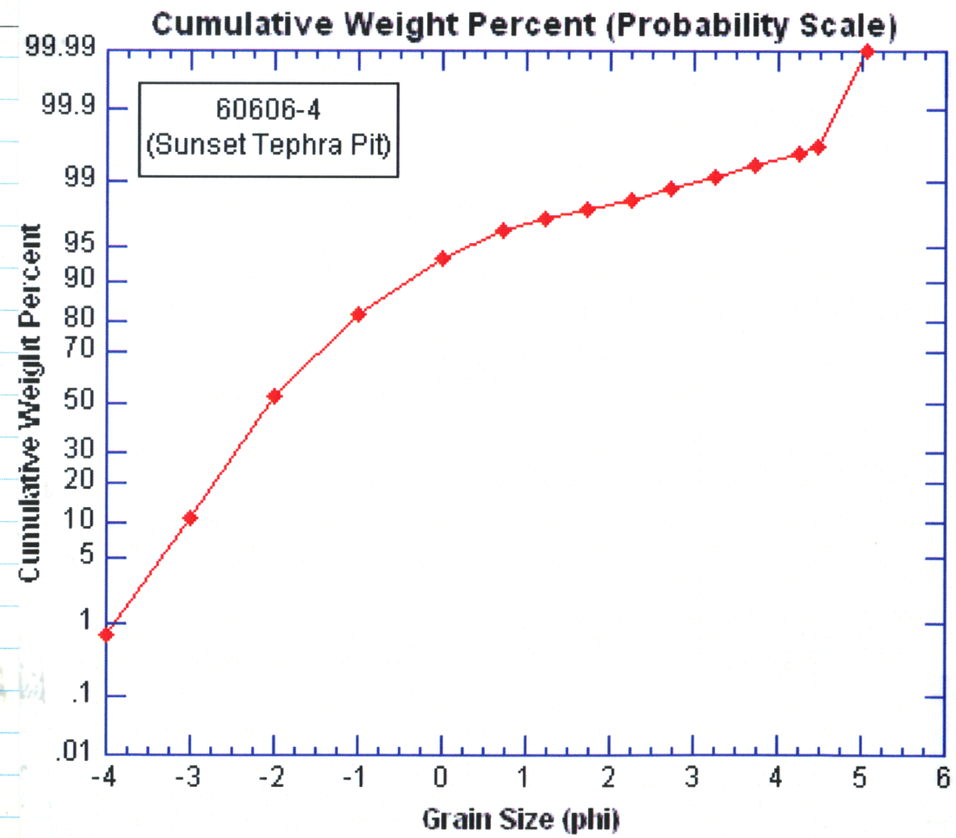

Splits from sample: 60606-4






1 March 29, 2006 MS

## Sample 606063 Analysis

| | Mass of fraction #__of 4: | Percent of fraction #__of 4: | Mass of fraction #__of 4: | Percent of fraction #__of 4: | Mass of combined __and__: | Combined percentage: | Cumulative percentage: |
|---|---|---|---|---|---|---|---|
| $1^1/_4$" | _____ g | _____ % | _____ g | _____ % | _____ g | _____ % | _____ % |
| 1" | | | | | _____ g | _____ % | _____ % |
| $^5/_8$" | | | | | _____ g | _____ % | _____ % |
| $^5/_{16}$" | | | | | _____ g | _____ % | _____ % |
| No. 5 | | | | | _____ g | _____ % | _____ % |
| No. 10 | | | | | _____ g | _____ % | _____ % |
| No. 18 | | | | | _____ g | _____ % | _____ % |
| No. 30 | | | | | _____ g | _____ % | _____ % |
| No. 40 | | | | | _____ g | _____ % | _____ % |
| No. 50 | _____ g | _____ % | _____ g | _____ % | _____ g | _____ % | _____ % |
| No. 70 | _____ g | _____ % | _____ g | _____ % | _____ g | _____ % | _____ % |
| No. 100 | _____ g | _____ % | _____ g | _____ % | _____ g | _____ % | _____ % |
| No. 140 | _____ g | _____ % | _____ g | _____ % | _____ g | _____ % | _____ % |
| No. 200 | _____ g | _____ % | _____ g | _____ % | _____ g | _____ % | _____ % |
| No. 270 | _____ g | _____ % | _____ g | _____ % | _____ g | _____ % | _____ % |
| No. 325 | _____ g | _____ % | _____ g | _____ % | _____ g | _____ % | _____ % |
| Pan | _____ g | _____ % | _____ g | _____ % | _____ g | _____ % | _____ % |
| Total | _____ g | _____ % | _____ g | _____ % | _____ g | _____ % | |
| minus original mass | - _____ g | | - _____ g | | | | |
| | = _____ g | | = _____ g | | | | |

Worksheet was added as a placeholder. Sample was not sieved before departure of Mark Silver.

- Donald Hooper (June 21, 2007)

Base sample density:

_____

= _____

= _____

D.H. 21 June 2007



Pages are a placeholder for analyses (graphs). Analyses not conducted before departure of Mark Silver.

- Donald Hooper (June 21, 2007)

D.H. 21 June 2007

Mark Silver intended pages 56-140 to be reserved for future "depth" sample analysis. Chapter 2 begins on p. 141.

- Donald Hooper (June 21, 2007)

Pages are a placeholder for analyses (graphs). Analyses not conducted before departure of Mark Silver.

- Donald Hooper (June 21, 2007)

21 June 2007



Pages are a placeholder for analyses (graphs). Analyses not conducted before departure of Mark Silver.

- Donald Hooper (June 21, 2007)

21 June 2007

## Sample 60606-2 Analysis

| | Mass of fraction #__of 4: | Percent of fraction #__of 4: | Mass of fraction #__of 4: | Percent of fraction #__of 4: | Mass of combined __and__: | Combined percentage: | Cumulative percentage: |
|---|---|---|---|---|---|---|---|
| 1 1/4" | _____ g | _____ % | _____ g | _____ % | _____ g | _____ % | _____ % |
| 1" | _ g | % | g | % | _____ g | _____ % | _____ % |
| 5/8" | _ | | | | _____ g | _____ % | _____ % |
| 5/16" | _ | | | | _____ g | _____ % | _____ % |
| No. 5 | _ | | | | _____ g | _____ % | _____ % |
| No. 10 | _ | | | | _____ g | _____ % | _____ % |
| No. 18 | _ | | | | _____ g | _____ % | _____ % |
| No. 30 | _ | | | | _____ g | _____ % | _____ % |
| No. 40 | _ | | | | _____ g | _____ % | _____ % |
| No. 50 | _ | | | | _____ g | _____ % | _____ % |
| No. 70 | _____ g | _____ % | _____ g | _____ % | _____ g | _____ % | _____ % |
| No. 100 | _____ g | _____ % | _____ g | _____ % | _____ g | _____ % | _____ % |
| No. 140 | _____ g | _____ % | _____ g | _____ % | _____ g | _____ % | _____ % |
| No. 200 | _____ g | _____ % | _____ g | _____ % | _____ g | _____ % | _____ % |
| No. 270 | _____ g | _____ % | _____ g | _____ % | _____ g | _____ % | _____ % |
| No. 325 | _____ g | _____ % | _____ g | _____ % | _____ g | _____ % | _____ % |
| Pan | _____ g | _____ % | _____ g | _____ % | _____ g | _____ % | _____ % |
| Total | _____ g | _____ % | _____ g | _____ % | _____ g | _____ % | |
| minus original mass | - _____ g | | - _____ g | | | | |
| | = _____ g | | = _____ g | | | | |

Worksheet was added as a placeholder. Sample was not sieved before departure of Mark Silver.

- Donald Hooper (June 21, 2007)

Base sample density:

_____

= _____

= _____

D.H. 21 June 2007



Pages are a placeholder for analyses (graphs). Analyses not conducted before departure of Mark Silver.

- Donald Hooper (June 21, 2007)

D.H. 21 June 2007

Pages are a placeholder for analyses (graphs). Analyses not conducted before departure of Mark Silver.

- Donald Hooper (June 21, 2007)

21 June 2007

D.H.



Pages are a placeholder for analyses (graphs). Analyses were not conducted before departure of Mark Silver.

- Donald Hooper (June 21, 2007)

21 June 2007

D.H.

## Sample 60606-1 Analysis

| | Mass of fraction #__of 4: | Percent of fraction #__of 4: | Mass of fraction #__of 4: | Percent of fraction #__of 4: | Mass of combined __and__: | Combined percentage: | Cumulative percentage: |
|---|---|---|---|---|---|---|---|
| $1^1/_4$" | | | | | ____ g | ____ % | ____ % |
| 1" | | | | | ____ g | ____ % | ____ % |
| $^5/_8$" | | | | | ____ g | ____ % | ____ % |
| $^5/_{16}$" | | | | | ____ g | ____ % | ____ % |
| No. 5 | | | | | ____ g | ____ % | ____ % |
| No. 10 | | | | | ____ g | ____ % | ____ % |
| No. 18 | | | | | ____ g | ____ % | ____ % |
| No. 30 | | | | | ____ g | ____ % | ____ % |
| No. 40 | ____ g | ____ % | ____ g | ____ % | ____ g | ____ % | ____ % |
| No. 50 | ____ g | ____ % | ____ g | ____ % | ____ g | ____ % | ____ % |
| No. 70 | ____ g | ____ % | ____ g | ____ % | ____ g | ____ % | ____ % |
| No. 100 | ____ g | ____ % | ____ g | ____ % | ____ g | ____ % | ____ % |
| No. 140 | ____ g | ____ % | ____ g | ____ % | ____ g | ____ % | ____ % |
| No. 200 | ____ g | ____ % | ____ g | ____ % | ____ g | ____ % | ____ % |
| No. 270 | ____ g | ____ % | ____ g | ____ % | ____ g | ____ % | ____ % |
| No. 325 | ____ g | ____ % | ____ g | ____ % | ____ g | ____ % | ____ % |
| Pan | ____ g | ____ % | ____ g | ____ % | ____ g | ____ % | ____ % |
| Total | ____ g | ____ % | ____ g | ____ % | ____ g | ____ % | |
| minus original mass | - ____ g | | - ____ g | | | | |
| | = ____ g | | ____ g | | | | |

Worksheet was added as a placeholder. Sample was not sieved before departure of Mark Silver.

- Donald Hooper (June 21, 2007)

Base sample density:

____

= ____

= ____

D.H. 21 June 2007



Pages are a placeholder for analyses (graphs). Analyses were not conducted before departure of Mark Silver.

- Donald Hooper (June 21, 2007)

D.H. 21 June 2007

Pages are a placeholder for analyses (graphs). Analyses not conducted before departure of Mark Silver.

- Donald Hooper (June 21, 2007)

21 June 2007

D.H.



Pages are a placeholder for analyses (graphs). Analyses were not conducted before departure of Mark Silver.

- Donald Hooper (June 21, 2007)

21 June 2007

D.H.

**Mass of base sample and moisture content:**

| Sample ID: | Mass: |
|---|---|
| 546-1 | 1256.7 g |
| 546-2 | g |
| 546-3 | g |
| 546-4 | g |

Q.H. 21 June 2007

**Mass of respectively labeled drying pans:**

1675.0 g
g
g
g

Q.H. 21 June 2007

**Mass of dried sample and pan:**

| Sample ID: | Mass: |
|---|---|
| _____ | _____ g |
| _____ | _____ g |
| _____ | _____ g |
| _____ | _____ g |

Q.H. 21 June 2007

**Mass of dried sample** (calculated)**:**

| Sample ID: | Mass: |
|---|---|
| _____ | _____ g |
| _____ | _____ g |
| _____ | g |
| _____ | |

**Mass of water los**

Worksheet was added as a placeholder. Sample was not sieved before departure of Mark Silver.

- Donald Hooper (June 21, 2007)

| Sample ID: | |
|---|---|
| _____ | |
| _____ | |
| _____ | _____ g |
| _____ | _____ g |

**Mass (M) of sub-sample bag:**

$\underline{M}_{avg}$ 6.8 g (Previously calculated, P.8)



**Mass of the sample split and sub-sample bag:**

**Mass of sample split** (calculated)**:**

| Sample ID: | | | | Mass: |
|---|---|---|---|---|
| _____ | #1 | _____ g | -6.8 g = | _____ g |
| | #2 | _____ g | -6.8 g = | _____ g |
| | #3 | _____ g | -6.8 g = | _____ g |
| | #4 | _____ g | -6.8 g = | _____ g |
| _____ | #1 | _____ g | -6.8 g = | _____ g |
| | #2 | _____ g | -6.8 g = | _____ g |
| | #3 | _____ g | -6.8 g = | _____ g |
| | #4 | _____ g | -6.8 g = | _____ g |
| _____ | #1 | _____ g | -6.8 g = | _____ g |
| | #2 | _____ g | -6.8 g = | _____ g |
| | #3 | _____ g | -6.8 g = | _____ g |
| | #4 | _____ g | -6.8 g = | _____ g |
| _____ | #1 | _____ g | -6.8 g = | _____ g |
| | #2 | _____ g | -6.8 g = | _____ g |
| | #3 | _____ g | -6.8 g = | _____ g |
| | #4 | _____ g | -6.8 g = | _____ g |

Q.H. 21 June 2007

**Re-evaluation of total sample mass** (calculated)**:**

| Sample ID: | Mass: |
|---|---|
| _____ | _____ g ( _____ from original calculation for dried sample mass) |
| _____ | _____ g ( _____ from original calculation for dried sample mass) |
| _____ | _____ g ( _____ from original calculation for dried sample mass) |
| _____ | _____ g ( _____ from original calculation for dried sample mass) |

Worksheet was added as a placeholder. Sample was not sieved before departure of Mark Silver.

- Donald Hooper (June 21, 2007)

## Sample 546-1 Analysis

| | Mass of fraction #__of 4: | Percent of fraction #__of 4: | Mass of fraction #__of 4: | Percent of fraction #__of 4: | Mass of combined __and__: | Combined percentage: | Cumulative percentage: |
|---|---|---|---|---|---|---|---|
| $1^1/_4$" | ____ g | ____ % | ____ g | ____ % | ____ g | ____ % | ____ % |
| 1" | ____ g | ____ % | ____ g | ____ % | ____ g | ____ % | ____ % |
| $^5/_8$" | | | | | ____ g | ____ % | ____ % |
| $^5/_{16}$" | | | | | ____ g | ____ % | ____ % |
| No. 5 | | | | | ____ g | ____ % | ____ % |
| No. 10 | | | | | ____ g | ____ % | ____ % |
| No. 18 | | | | | ____ g | ____ % | ____ % |
| No. 30 | | | | | ____ g | ____ % | ____ % |
| No. 40 | | | | | ____ g | ____ % | ____ % |
| No. 50 | | | | | ____ g | ____ % | ____ % |
| No. 70 | ____ g | ____ % | ____ g | ____ % | ____ g | ____ % | ____ % |
| No. 100 | ____ g | ____ % | ____ g | ____ % | ____ g | ____ % | ____ % |
| No. 140 | ____ g | ____ % | ____ g | ____ % | ____ g | ____ % | ____ % |
| No. 200 | ____ g | ____ % | ____ g | ____ % | ____ g | ____ % | ____ % |
| No. 270 | ____ g | ____ % | ____ g | ____ % | ____ g | ____ % | ____ % |
| No. 325 | ____ g | ____ % | ____ g | ____ % | ____ g | ____ % | ____ % |
| Pan | ____ g | ____ % | ____ g | ____ % | ____ g | ____ % | ____ % |
| Total | ____ g | ____ % | ____ g | ____ % | ____ g | ____ % | |
| minus original mass | - ____ g | | - ____ g | | | | |
| | = ____ g | | = ____ g | | | | |

Worksheet was added as a placeholder. Sample was not sieved before departure of Mark Silver.

- Donald Hooper (June 21, 2007)

Base sample density:

____

= ____

= ____

Q.H. 21 June 2007



Pages were a placeholder for analyses (graphs). Analyses were not conducted before the departure of Mark Silver.

- Donald Hooper (June 21, 2007)

Q.H. 21 June 2007

Pages were a placeholder for analyses (graphs). Analyses were not conducted before the departure of Mark Silver.

- Donald Hooper (June 21, 2007)

D.H. 21 June 2007



Pages were a placeholder for analyses (graphs). Analyses were not conducted before the departure of Mark Silver.

- Donald Hooper (June 21, 2007)

D.H. 21 June 2007

Pages 74 through 140 are blank. Chapter 2 begins on p. 141. Mark Silver estimated the number of pages needed for future grain-size analyses and began Chapter 2 on p. 141. However, the analyses were not completed before his departure from CNWRA. The anticipated analyses will be conducted by another person and recorded in a different scientific notebook.

– Donald Hooper DH
21 June 2007