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as produced by Alka Jain (AJ)

↳ RL 10/24/2006

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This scientific notebook documents work performed to study the thermal effects on hydraulic conductivity for vitric tuff. Laboratory experiments will be conducted to thermally alter the nonwelded tuffs and changes in hydraulic properties of tuff will be monitored.

AJ 3/13/03

Hydraulic conductivity measurements for vitric tuff:

Volume of Teflon sample holder for hydraulic conductivity measurements on all disturbed samples:
Length = 4.00 cm., Radius = 1.50 cm.
Vol. = $\pi R^2 L$
= 3.14 X 1.5 X 1.5 X 4.0 cm^3
= 28.26 cm^3
Bulk density for BB1 rock samples = 1.37 g/ cm^3 as calculated (ref 482/ pg. 32-36)
Mass of sample BB1 required for packing in Teflon sample holder = 1.37 X 28.26 = 38.72 g

AJ 3/17/03

Hydraulic conductivity measurements for BB1 vitric tuff:

1. Wt. of teflon sample holder (with caps lined with filter paper on each end) for packing sample BB1(2) = 43.717g

2. Wt. of teflon sample holder (with caps lined with filter paper on each end) for packing sample BB1(3) = 43.728g

3. ~ 37.39 g of BB1 rock sample was weighed and packed in each sample holder. The samples were labeled as BB1(2) and BB1(3) and placed in oven @ 90 C to dry overnight.

AJ 3/18/03

Hydraulic conductivity measurements for BB1 vitric tuff:

1. Wt. of teflon sample holder (with caps lined with filter paper on each end) + packed sample BB1(2) = 80.78g
2. Wt. of sample BB1(2) added to sample holder = 80.78 - 43.717 = 37.063g
3. Wt. of teflon sample holder (with caps lined with filter paper on each end) + packed sample BB1(3) = 80.85g
4. Wt. of sample BB1(3) added to sample holder = 80.85 - 43.728 = 37.122g
5. **Note: Samples BB1(2) and BB1(3) were packed @ 1.32 g/cm^3, slightly less than calculated bulk density of 1.37 g/cm^3**

Sample	Confining Press, psi	Inflow Press psi	Outflow Press psi	Diff. Press psig	Diff. Press cm H2O	Confin ml.	Inflow ml.	Outflow ml	Conf final ml.	Inflow final ml.	Outflow final ml.
BB1(2)Ptef	13	8	6	2	140.6144	0.3	1	14	0.3	11	4
BB1(2)Ptef	16	11	7	4	281.2288	1	1	14	1	11	4
BB1(2)Ptef	18	12	6	6	421.8432	1.4	1	14	1.4	11	4

Sample	Width (cm)	Height (cm)	Area (cm^2)	Inflow change, ml	Outflow change ml	Vol. Change ml	Elapsed time sec	Q, ml/sec.	Ksat, cm/sec.	Ksat, m/sec.
BB1(2)Ptef	3	4	7.065	10	10	10	197	0.050761	0.000204	2.04E-06
BB1(2)Ptef	3	4	7.065	10	10	10	93	0.107527	0.000216	2.16E-06
BB1(2)Ptef	3	4	7.065	10	10	10	68	0.147059	0.000197	1.97E-06

AJ 3/19/03

Hydraulic conductivity measurements for BB1 vitric tuff:

6. Wt. of teflon sample holder (with caps lined with filter paper on each end) for sample BB1(4) = 43.787 g
7. **Note: This sample BB1(3) was packed @ 1.32 g/cm^3, slightly less than calculated bulk density of 1.37 g/cm^3**

Sample	Confining Press, psi	Inflow Press psi	Outflow Press psi	Diff. Press psig	Diff. Press cm H2O	Conf ml.	Inflow ml.	Outflow ml	Conf final ml.	Inflow final ml.	Outflow final ml.
BB1(3)Ptef	13	8	6	2	140.6144	8.8	1	14	8.8	11	4
BB1(3)Ptef	16	11	7	4	281.2288	9	1	14	9	11	4
BB1(3)Ptef	18	12	6	6	421.8432	9.6	1	14	9.6	11	4

Sample	Width (cm)	Height (cm)	Area (cm^2)	Inflow change, ml.	Outflow change ml.	Vol. Change ml.	Elapsed time sec.	Q, ml/sec.	Ksat, cm/sec.	Ksat, m/sec.
BB1(3)Ptef	3	4	7.065	10	10	10	177	0.056497	0.000227	2.27E-06
BB1(3)Ptef	3	4	7.065	10	10	10	83	0.120482	0.000243	2.43E-06
BB1(3)Ptef	3	4	7.065	10	10	10	58	0.172414	0.000231	2.31E-06

AJ 3/20/03

Hydraulic conductivity measurements for BB1, BB3 vitric tuff:

1. Wt. of teflon sample holder (with caps lined with filter paper on each end) + packed sample BB1(4) = 81.11 g
7. Wt. of sample BB1(4) packed in sample holder = 81.11 - 43.787 = 37.323 g
8. **Note: This sample BB1(4) was packed @ 1.32 g/cm^3, slightly less than calculated bulk density of 1.37 g/cm^3**

Sample	Confining Press, psi	Inflow Press psi	Outflow Press psi	Diff. Press psig	Diff. Press cm H2O	Conf ml.	Inflow ml.	Outflow ml	Conf final ml.	Inflow final ml.	Outflow final ml.
BB1(4)Ptef	13	8	6	2	140.6144	13.3	1	14	13.3	11	4
BB1(4)Ptef	16	11	7	4	281.2288	9	1	14	9	11	4
BB1(4)Ptef	18	12	6	6	421.8432	9.6	1	14	9.6	11	4

Sample	Width (cm)	Height (cm)	Area (cm^2)	Inflow change, ml.	Outflow change ml.	Vol. Change ml.	Elapsed time sec.	Q, ml/sec.	Ksat, cm/sec.	Ksat, m/sec.
BB1(4)Ptef	3	4	7.065	10	10	10	268	0.037313	0.00015	1.50E-06
BB1(4)Ptef	3	4	7.065	10	10	10	110	0.090909	0.000183	1.83E-06
BB1(4)Ptef	3	4	7.065	10	10	10	73	0.136986	0.000184	1.84E-06

AJ 3/25/03

Sample	Confining Press Psi	Inflow Press Psi	Outflow Press Psi	Diff. Press psig	Diff. Press cm H2O	Confining ml.	Inflow ml.	Outflow ml	Conf final ml.	Inflow final ml.	Outflow final ml.
BB5Ptef	13	8	6	2	140.6144	8.6	1	14	8.6	11	4
BB5Ptef	16	11	7	4	281.2288	9.6	1	14	9.6	11	4
BB5Ptef	18	12	6	6	421.8432	10	1	14	10	11	4

Sample	Width (cm)	Height (cm)	Area (cm^2)	Inflow change, ml.	Outflow change ml.	Vol. Change ml.	Elapsed time sec.	Q, ml/sec.	Ksat, cm/sec.	Ksat, m/sec.
BB5Ptef	3	4	7.065	10	10	10	68	0.147059	0.000592	5.92E-06
BB5Ptef	3	4	7.065	10	10	10	38	0.263158	0.00053	5.30E-06
BB5Ptef	3	4	7.065	10	10	10	29	0.344828	0.000463	4.63E-06

Sample	Confining Press, psi	Inflow Press psi	Outflow Press psi	Diff. Press psig	Diff. Press cm H2O	Confining ml.	Inflow ml.	Outflow ml	Conf final ml.	Inflow final ml.	Outflow final ml.
BB5Ptef	13	8	6	2	140.6144	8.6	1	14	8.6	11	4
BB5Ptef	16	11	7	4	281.2288	9.6	1	14	9.6	11	4
BB5Ptef	18	12	6	6	421.8432	10	1	14	10	11	4

Sample	Width (cm)	Height (cm)	Area (cm^2)	Inflow change, ml.	Outflow change ml.	Vol. Change ml.	Elapsed time sec.	Q, ml/sec.	Ksat, cm/sec.	Ksat, m/sec.
BB5Ptef	3	4	7.065	10	10	10	85	0.117647	0.000474	4.74E-06
BB5Ptef	3	4	7.065	10	10	10	47	0.212766	0.000428	4.28E-06
BB5Ptef	3	4	7.065	10	10	10	35	0.285714	0.000383	3.83E-06

Note: This sample BB5 was packed at estimated bulk density to test the equipment performance and measurements on hydraulic conductivity may not be usable.

AJ 3/26/03

Hydraulic conductivity measurements for BB1, BB3 vitric tuff:

1. 50 ml. of UZ-14 perched water was added to sample holder of pressure vessel and sample BB1(2) (packed in teflon holder and saturated with UZ-14 perched water) was placed in 50 ml. of perched water. Pressure vessel was closed and placed oven @ 90 C for thermal treatment of sample BB1 (2).
   Note: Duct tape stayed on to prevent the movement of the caps of sample holder.

2. 50 ml. of UZ-14 perched water was added to sample holder of pressure vessel and sample BB1(3) (packed in teflon holder and saturated with UZ-14 perched water) was placed in 50 ml. of perched water. Pressure vessel was closed and placed oven @ 90 C for thermal treatment of sample BB1(3).
   Note: Duct tapes stayed on to prevent the movement of the caps of sample holder.

AJ 3/28/03

Hydraulic conductivity measurements for BB1, BB3 vitric tuff:

1. 50 ml. of UZ-14 perched water was added to sample holder of pressure vessel and sample BB1(4) (packed in Teflon holder and saturated with UZ-14 perched water) was placed in 50 ml. of perched water. Pressure vessel was closed and placed oven @ 90 C for thermal treatment of sample BB1(4).

2. Wt. of Teflon sample holder (with caps lined with filter paper on each end) for sample BB3(1) = 44.003 g

Note: Ksat measurements on samples BB1(2), BB1(3) and BB1(4) may not be usable as density used was less than bulk density.

AJ 3/31/03

Hydraulic conductivity measurements for BB3 vitric tuff:

1. Volume of Teflon sample holder ad calculated (ref. Pg. 1) = 28.26 cm^3
2. Bulk density for sample BB3(1) as calculated (ref. 482/ pg. 32-36) = 1.23 g/ cm^3
   Mass of BB1 rock required for packing in Teflon sample holder = 1.23 X 28.26 = 34.76 g

3. Wt. of teflon sample holder (with caps lined with filter paper on each end) for sample BB3(2) = 43.872 g

AJ 4/1/03

Hydraulic conductivity measurements for BB3 vitric tuff:

1. Wt. of teflon sample holder (with caps lined with filter paper on each end) + packed sample BB3(2) = 78.482 g
2. Wt. of sample BB3(2) packed in sample holder = 78.482 - 43.872 = 34.610 g

Sample	Confining Press, psi	Inflow Press psi	Outflow Press psi	Diff. Press psig	Diff. Press cm H2O	Conf ml.	Inflow ml.	Outflow ml	Conf final ml.	Inflow final ml.	Outflow final ml.
BB3(2)Ptef	13	8	6	2	140.6144	2.1	1	14	2.1	11	4
BB3(2)Ptef	16	11	7	4	281.2288	2.8	1	14	2.8	11	4
BB3(2)Ptef	18	12	6	6	421.8432	3.2	1	14	3.2	11	4

Sample	Width (cm)	Height (cm)	Area (cm^2)	Inflow change, ml.	Outflow change ml.	Vol. Change ml.	Elapsed time sec.	Q, ml/sec.	Ksat, cm/sec.	Ksat, m/sec.
BB3(2)Ptef	3	4	7.065	10	10	10	125	0.08	0.000322	3.22E-06
BB3(2)Ptef	3	4	7.065	10	10	10	73	0.136986	0.000276	2.76E-06
BB3(2)Ptef	3	4	7.065	10	10	10	49	0.204082	0.000274	2.74E-06

AJ 4/2/03

Hydraulic conductivity measurements for BB1, BB3 vitric tuff:

1. Wt. of Teflon sample holder (with caps lined with filter paper on each end) + packed sample BB3(1) = 78.887 g
2. Wt. of sample BB3(2) packed in sample holder = 78.887 - 44.003 = 34.884 g

Bulk Density Measurements for Sample BB5:

3. Wt. of beaker #1 + sample BB5 = 339.93 g
4. Wt. of beaker #2 + sample BB5 = 213.09 g
5. Wt. of beaker #3 + sample BB5 = 149.74 g
6. Wt. of beaker #4 + sample BB5 = 141.28 g

The samples were placed in oven @ 90 C for complete drying.

AJ 4/3/03

Sample	Confining Press, psi	Inflow Press psi	Outflow Press psi	Diff. Press psig	Diff. Press cm H2O	Conf ml.	Inflow ml.	Outflow ml	Conf final ml.	Inflow final ml.	Outflow final ml.
BB3(1)Ptef	13	8	6	2	140.6144	3.6	1	14	3.6	11	4
BB3(1)Ptef	16	11	7	4	281.2288	4.6	1	14	4.6	11	4
BB3(1)Ptef	18	12	6	6	421.8432	5	1	14	5	11	4

Sample	Width (cm)	Height (cm)	Area (cm^2)	Inflow change, ml.	Outflow change ml.	Vol. Change ml.	Elapsed time sec.	Q, ml/sec.	Ksat, cm/sec.	Ksat, m/sec.
BB3(1)Ptef	3	4	7.065	10	10	10	121	0.082645	0.000333	3.33E-06
BB3(1)Ptef	3	4	7.065	10	10	10	70	0.142857	0.000288	2.88E-06
BB3(1)Ptef	3	4	7.065	10	10	10	54	0.185185	0.000249	2.49E-06

AJ 4/4/03

Bulk Density Measurements for Sample BB5:
The samples were removed from the oven and dried in dessicator for several hours before weighing.

1. Wt. of beaker #1 + dried sample BB5 = 327.28 g
2. Wt. of beaker #2 + dried sample BB5 = 206.07 g
3. Wt. of beaker #3 + dried sample BB5 = 146.72 g
4. Wt. of beaker #4 + dried sample BB5 = 139.33 g
5. Wt. of beaker #5 + dried sample BB5 = 364.14 g

AJ 4/7/03

Bulk Density Measurements for Sample BB5:
The samples were wrapped in saran wrap and duct tape to calculate volume by water volume displacement.

1. Vol. of water displaced by sample BB5 in beaker #1 = 140 ml.
2. Vol. of water displaced by sample BB5 in beaker #2 = 85 ml.
3. Vol. of water displaced by sample BB5 in beaker #3 = 35 ml.
4. Vol. of water displaced by sample BB5 in beaker #4 = 25 ml.

5. Wt. of beaker #1 + left over sample BB5 = 164.09 g
6. Wt. of beaker #2 + left over sample BB5 = 108.27g
7. Wt. of beaker #3 + left over sample BB5 = 106.34g
8. Wt. of beaker #4 + left over sample BB5 = 110.50g

9. Wt. of sample in beaker #1 = 327.28- 164.09 = 163.19g
10. Wt. of sample in beaker #2 = 206.07- 108.27 = 97.80g
11. Wt. of sample in beaker #3 = 146.72- 106.34 = 40.38g
12. Wt. of sample in beaker #4 = 139.33- 110.50 = 28.83g

Bulk density of BB5 from sample in beaker #1 = 1.17 g/ml
Bulk density of BB5 from sample in beaker #2 = 1.15 g/ml
Bulk density of BB5 from sample in beaker #3 = 1.15 g/ml
Bulk density of BB5 from sample in beaker #4 = 1.15 g/ml

13. Wt. of teflon sample holder (with caps lined with filter paper on each end) for sample BB3(3) = 43.804 g

AJ 4/10/03

Sample	Confining Press, psi	Inflow Press psi	Outflow Press psi	Diff. Press psig	Diff. Press cm H2O	Conf ml.	Inflow ml.	Outflow ml	Conf final ml.	Inflow final ml.	Outflow final ml.
BB3(3)Ptef	13	8	6	2	140.6144	0.5	1	14	0.5	11	4
BB3(3)Ptef	16	11	7	4	281.2288	1.5	1	14	1.5	11	4
BB3(3)Ptef	18	12	6	6	421.8432	2	1	14	2	11	4

Sample	Width (cm)	Height (cm)	Area (cm^2)	Inflow change, ml.	Outflow change ml.	Vol. Change ml.	Elapsed time sec.	Q, ml/sec.	Ksat, cm/sec.	Ksat, m/sec.
BB3(3)Ptef	3	4	7.065	10	10	10	140	0.082645	0.000288	2.88E-06
BB3(3)Ptef	3	4	7.065	10	10	10	70	0.142857	0.000288	2.88E-06
BB3(3)Ptef	3	4	7.065	10	10	10	54	0.185185	0.000249	2.49E-06

AJ 4/15/03

Bulk Density measurements for sample BB5:

1. Vol. of water displaced by sample BB5 in beaker #5 = 180 ml
2. Wt. of beaker #5 + left over sample BB5 = 156.49g
3. Wt. of sample in beaker #5 = 364.14- 156.49 = 207.65g
4. Bulk density of BB5 from sample in beaker #5 = 1.15 g/ml
5. **Average Bulk density BB5** = 1.17 + 1.15 + 1.15 + 1.15 +1.15 / 5 = **1.16 g/ml**
6. Wt. of BB5 required to pack Teflon sample holder = 1.16 g/ml X 28.26 cm^3 = 32.65 g

1. Wt. of Teflon sample holder (with caps lined with filter paper on each end) for BB5(1) = 43.415 g
2. Wt. of Teflon sample holder (with caps lined with filter paper on each end) + sample BB5(1) = 75.885g
3. Wt. of sample BB5(1) packed in Teflon sample holder = 75.885 – 43.415 = 32.470 g

AJ **4/16/03**

Sample	Confining Press psi	Inflow Press psi	Outflow Press psi	Diff. Press psig	Diff. Press cm H2O	Conf ml.	Inflow ml.	Outflow ml	Conf final ml.	Inflow final ml.	Outflow final ml.
BB3(3)Ptef	13	8	6	2	140.6144	5	1	14	5	11	4
BB3(3)Ptef	16	11	7	4	281.2288	6.2	1	14	6.2	11	4
BB3(3)Ptef	18	12	6	6	421.8432	6.7	1	14	6.7	11	4

Sample	Width (cm)	Height (cm)	Area (cm^2)	Inflow change, ml.	Outflow change ml.	Vol. Change ml.	Elapsed time sec.	Q, ml/sec.	Ksat, cm/sec.	Ksat, m/sec.
BB3(3)Ptef	3	4	7.065	10	10	10	165	0.060606	0.000244	2.44E-06
BB3(3)Ptef	3	4	7.065	10	10	10	71	0.140845	0.000284	2.84E-06
BB3(3)Ptef	3	4	7.065	10	10	10	52	0.192308	0.000258	2.58E-06

AJ **4/18/03**

1. **Average Bulk density BB1(ref 482/ pg. 32-36)** = 1.39 + 1.32 + 1.41= 4.12/3 = **1.37 g/ml**
2 Wt. of Teflon sample holder (with caps lined with filter paper on each end) for BB5(2) = 43.425 g
3 Wt. of Teflon sample holder (with caps lined with filter paper on each end) + sample BB5(2) = 76.303 g
4. Wt. of sample BB5(2) packed in Teflon sample holder = 76.303 – 43.425 = 32.878 g

Sample	Confining Press psi	Inflow Press psi	Outflow Press psi	Diff. Press psig	Diff. Press cm H2O	Conf ml.	Inflow ml.	Outflow ml	Conf final ml.	Inflow final ml.	Outflow final ml.
BB5(1)Ptef	13	8	6	2	140.6144	3.9	1	14	3.9	11	4
BB5(1)Ptef	13	8	6	2	140.6144	3.9	1	14	3.9	11	4
BB5(1)Ptef	13	8	6	2	140.6144	4.4	1	14	4.4	11	4
BB5(1)Ptef	13	4	2	2	140.6144	4.2	1	14	4.2	11	4

Sample	Width (cm)	Height (cm)	Area (cm^2)	Inflow change, ml.	Outflow change ml.	Vol. Change ml.	Elapsed time sec.	Q, ml/sec.	Ksat, cm/sec.	Ksat, m/sec.
BB5(1)Ptef	3	4	7.065	10	10	10	204	0.04902	0.000197	1.97E-06
BB5(1)Ptef	3	4	7.065	10	10	10	273	0.03663	0.000147	1.47E-06
BB5(1)Ptef	3	4	7.065	10	10	10	154	0.064935	0.000261	2.61E-06
BB5(1)Ptef	3	4	7.065	10	10	10	168	0.059524	0.00024	2.40E-06

Note: The above data could not be usable. The other measurements were inconsistent due to delayed response and sample seemed to be consolidated inside the sample holder. The similar observation was recorded with sample BB5(2) on 4/22/03.

AJ 4/23/03

1. Wt. of Teflon sample holder (with caps lined with filter paper on each end) for BB1(5) = 43.938 g
2. Wt. of Teflon sample holder (with caps lined with filter paper on each end) + sample BB1(5) = 82.80 g
3. Wt. of sample BB1(5) packed in Teflon sample holder = 82.80 – 43.938 = 38.862 g

4. Wt. of Teflon sample holder (with caps lined with filter paper on each end) for BB1(6) = 42.813 g
5. Wt. of Teflon sample holder (with caps lined with filter paper on each end) + sample BB1(6) = 81.82 g
6. Wt. of sample BB1(6) packed in Teflon sample holder = 81.82 – 42.813 = 39.007 g

7. Wt. of Teflon sample holder (with caps lined with filter paper on each end) for BB1(7) = 43.575 g
8. Wt. of Teflon sample holder (with caps lined with filter paper on each end) + sample BB1(7) = 82.50 g
9. Wt. of sample BB1(7) packed in Teflon sample holder = 82.50 – 43.575 = 38.925 g

10. Sample BB3(3) was saturated with UZ-14 perched water and interacted with 50 ml. of UZ-14 perched in Teflon liner of pressure vessel. The vessel was closed and placed in the oven @ 90C for thermal treatment of sample BB3(3).

AJ 4/24/03

The permeameter cell and triaxial lines were tested for blockage by performing a blank run (by removing the tuff sample from the permeameter cell). No blockage in the lines was found.

Sample	Confining Press, psi	Inflow Press psi	Outflow Press psi	Diff. Press psig	Diff. Press cm H2O	Confin ml.	Inflow ml.	Outflow ml	Conf final ml.	Inflow final ml.	Outflow final ml.
BB1(6)Ptef	13	8	6	2	140.6144	9	1	14	9	11	4
BB1(6)Ptef	16	11	7	4	281.2288	9.5	1	14	9.5	11	4
BB1(6)Ptef	18	12	6	6	421.8432	10	1	14	10	11	4

Sample	Width (cm)	Height (cm)	Area (cm^2)	Inflow change, ml.	Outflow change ml.	Vol. Change ml.	Elapsed time sec.	Q, ml/sec.	Ksat, cm/sec.	Ksat, m/sec.
BB1(6)Ptef	3	4	7.065	10	10	10	452	0.022124	8.91E-05	8.91E-07
BB1(6)Ptef	3	4	7.065	10	10	10	257	0.038911	7.83E-05	7.83E-07
BB1(6)Ptef	3	4	7.065	10	10	10	203	0.049261	6.61E-05	6.61E-07

Note: The second set of measurements on sample BB1(6) showed delayed response as obvious from the following measurements . The lines were checked again for blockage and were free from any blockage. This data may not be false and not usable.

Sample	Confining Press, psi	Inflow Press psi	Outflow Press psi	Diff. Press psig	Diff. Press cm H2O	Confin ml.	Inflow ml.	Outflow ml	Conf final ml.	Inflow final ml.	Outflow final ml.
BB1(6)Ptef	13	8	6	2	140.6144	9.4	1	13	9	11	3
BB1(6)Ptef	16	11	7	4	281.2288	10	1	13	9.5	11	3
BB1(6)Ptef	18	12	6	6	421.8432	10.5	1	13	10	11	3

Sample	Width (cm)	Height (cm)	Area (cm^2)	Inflow change, ml.	Outflow change ml.	Vol. Change ml.	Elapsed time sec.	Q, ml/sec.	Ksat, cm/sec.	Ksat, m/sec.
BB1(6)Ptef	3	4	7.065	10	10	10	710	0.014085	5.67E-05	5.67E-07
BB1(6)Ptef	3	4	7.065	10	10	10	355	0.028169	5.67E-05	5.67E-07
BB1(6)Ptef	3	4	7.065	10	10	10	280	0.035714	4.79E-05	4.79E-07

AJ 4/26/03

Sample	Confining Press, psi	Inflo w Pres	Outflow Press psi	Diff. Press psig	Diff. Press cm H2O	Confin ml.	Inflow ml.	Outflow ml	Conf final ml.	Inflow final ml.	Outflow final ml.
BB1(5)Ptef	13	8	6	2	140.6144	3.5	1	14	3.5	11	4
BB1(5)Ptef	16	11	7	4	281.2288	4	1	14	4	11	4
BB1(5)Ptef	18	12	6	6	421.8432	4.5	1	14	4.5	11	4

Sample	Width (cm)	Height (cm)	Area (cm^2)	Inflow change, ml.	Outflow change ml.	Vol. Change ml.	Elapsed time sec.	Q, ml/sec.	Ksat, cm/sec.	Ksat, m/sec.
BB1(5)Ptef	3	4	7.065	10	10	10	297	0.03367	0.000136	1.36E-06
BB1(5)Ptef	3	4	7.065	10	10	10	143	0.06993	0.000141	1.41E-06
BB1(5)Ptef	3	4	7.065	10	10	10	100	0.1	0.000134	1.34E-06

Sample	Confining Press, psi	Inflow Press psi	Outflow Press psi	Diff. Press psig	Diff. Press cm H2O	Confin ml.	Inflow ml.	Outflow ml	Conf final ml.	Inflow final ml.	Outflow final ml.
BB1(5)Ptef	13	8	6	2	140.6144	3.8	1	14	3.8	11	4
BB1(5)Ptef	16	11	7	4	281.2288	4.2	1	14	4.2	11	4
BB1(5)Ptef	18	12	6	6	421.8432	4.6	1	14	4.6	11	4

Sample	Width (cm)	Height (cm)	Area (cm^2)	Inflow change, ml.	Outflow change ml.	Vol. Change ml.	Elapsed time sec.	Q, ml/sec.	Ksat, cm/sec.	Ksat, m/sec.
BB1(5)Ptef	3	4	7.065	10	10	10	290	0.034483	0.000139	1.39E-06
BB1(5)Ptef	3	4	7.065	10	10	10	142	0.070423	0.000142	1.42E-06
BB1(5)Ptef	3	4	7.065	10	10	10	101	0.09901	0.000133	1.33E-06

Sample	Confining Press, psi	Inflow Press psi	Outflow Press psi	Diff. Press psig	Diff. Press cm H2O	Confin ml.	Inflow ml.	Outflow ml	Conf final ml.	Inflow final ml.	Outflow final ml.
BB1(7)Ptef	13	8	6	2	140.6144	8	1	14	8	11	4
BB1(7)Ptef	16	11	7	4	281.2288	8.8	1	14	8.8	11	4
BB1(7)Ptef	18	12	6	6	421.8432	9.2	1	14	9.2	11	4

Sample	Width (cm)	Height (cm)	Area (cm^2)	Inflow change, ml.	Outflow change ml.	Vol. Change ml.	Elapsed time sec.	Q , ml/sec.	Ksat, cm/sec.	Ksat, m/sec.
BB1(7)Ptef	3	4	7.065	10	10	10	785	0.012739	5.13E-05	5.13E-07
BB1(7)Ptef	3	4	7.065	10	10	10	536	0.018657	3.76E-05	3.76E-07
BB1(7)Ptef	3	4	7.065	10	10	10	473	0.021142	2.84E-05	2.84E-07

Note: The measurements on sample BB1(7) showed delayed response. The lines were free from any blockage. The results could not be attributed to blocked lines. This data may be false and not usable.

AJ 4/28/03

Bulk Density Measurements for Sample BB7:

1. Wt. of beaker #1 + sample BB7 = 289.25 g
2. Wt. of beaker #2 + sample BB7 = 296.50 g
3. Wt. of beaker #3 + sample BB7 = 258.04 g
4. Wt. of beaker #4 + sample BB7 = 473.55 g
5. Wt. of beaker #1 + sample BB7 = 434.11 g

The samples were placed in oven @ 90 C for complete drying

6. Sample BB1(6) was saturated with UZ-14 perched water and interacted with 50 ml. of UZ-14 perched in Teflon holder of pressure vessel. The pressure vessel was closed and placed in the oven @ 90C for thermal treatment of sample BB1(6).
7. Wt. of Teflon sample holder (with caps lined with filter paper on each end) for BB5(3) = 43.431 g

AJ 4/29/03

1. Wt. of Teflon sample holder (with caps lined with filter paper on each end) + sample BB5(3) = 76.109 g
2. Wt. of sample BB5(3) packed in Teflon sample holder = 76.109 – 43.431 = 32.678 g
3. Sample BB1(7) was saturated with UZ-14 perched water and interacted with 50 ml. of UZ-14 perched in Teflon holder of pressure vessel. The vessel was closed and placed in the oven @ 90C for thermal treatment of sample BB1(7).

AJ 5/1/03

Sample BB1(5) was saturated with UZ-14 perched water and interacted with 50 ml. of UZ-14 perched in Teflon holder of pressure vessel. The vessel was closed and placed in the oven @ 90C for thermal treatment of sample BB1(5).

Sample	Confining Press, psi	Inflow Press psi	Outflow Press psi	Diff. Press psig	Diff. Press cm H2O	Confin ml.	Inflow ml.	Outflow ml	Conf final ml.	Inflow final ml.	Outflow final ml.
BB5(3)Ptef	13	8	6	2	140.6144	3.5	1	14	3.5	11	4
BB5(3)Ptef	16	11	7	4	281.2288	4.3	1	14	4.3	11	4
BB5(3)Ptef	18	12	6	6	421.8432	4.7	1	14	4.7	11	4

Sample	Width (cm)	Height (cm)	Area (cm^2)	Inflow change, ml.	Outflow change ml.	Vol. Change ml.	Elapsed time sec.	Q, ml/sec.	Ksat, cm/sec.	Ksat, m/sec.
BB5(3)Ptef	3	4	7.065	10	10	10	452	0.022124	8.91E-05	8.91E-07
BB5(3)Ptef	3	4	7.065	10	10	10	431	0.023202	9.34E-05	9.34E-07
BB5(3)Ptef	3	4	7.065	10	10	10	416	0.024038	9.68E-05	9.68E-07

Note: The measurements on sample BB5(3) showed delayed response. The lines were free from any blockage. The results could not be attributed to blocked lines. This data may be false and not usable.

AJ 5/5/03

Bulk Density Measurements for Sample BB7:
The samples were removed from the oven and dried in dessicator for several hours before weighing. The samples were wrapped in saran wrap and duck tape to calculate volume by water volume displacement.

1. Wt. of beaker #1 + dried sample BB7 = 282.36 g
2. Wt. of beaker #2 + dried sample BB7 = 288.94 g
3. Wt. of beaker #1 + left over sample BB7 in beaker = 166.27 g
4. Wt. of beaker #2 + left over sample BB7 in beaker = 161.86 g
5. Wt. of dried sample BB7 in beaker #1 = 282.36- 166.27= 116.09 g
6. Wt. of dried sample BB7 in beaker #2 = 288.94- 161.86= 127.08 g
7. Volume of water displaced by sample BB7 in beaker #1 = 350-255 = 95 ml
8. Volume of water displaced by sample BB7 in beaker #1 = 600-505 = 95 ml
9. Volume of water displaced by sample BB7 in beaker #2 = 700-600 = 100 ml
10. Volume of water displaced by sample BB7 in beaker #2 = 650-550 = 100 ml

AJ 5/6/03, 5/7/03

Bulk Density Measurements for Sample BB7:
The samples were removed from the oven and dried in dessicator for several hours before weighing. The samples were wrapped in saran wrap and duck tape to calculate volume by water volume displacement.

1. Wt. of beaker #3 + dried sample BB7 = 253.65 g
2. Wt. of beaker #4 + dried sample BB7 = 458.99 g
3. Wt. of beaker #3 + left over sample BB7 in beaker = 164.72 g
4. Wt. of beaker #4 + left over sample BB7 in beaker = 227.84 g
5. Wt. of dried sample BB7 in beaker #3 = 253.65- 164.72= 88.93 g
6. Wt. of dried sample BB7 in beaker #4 = 458.99- 227.84= 230.15 g
7. Volume of water displaced by sample BB7 in beaker #3 = 770-700 = 70 ml
8. Volume of water displaced by sample BB7 in beaker #3 = 670-600 = 70 ml
9. Volume of water displaced by sample BB7 in beaker #4 = 780-600 = 180 ml
10. Volume of water displaced by sample BB7 in beaker #4 = 680-500 = 180 ml

11. Wt. of Teflon sample holder with caps and filter paper at each end for BB7(1) = 43.238 g. ~ 35.6 g of BB7 was packed in the sample holder with aid of water and placed in oven to dry before saturation.

AJ **5/8/03**

Bulk Density Measurements for Sample BB7:
The samples were removed from the oven and dried in dessicator for several hours before weighing. The samples were wrapped in saran wrap and duck tape to calculate volume by water volume displacement

1. Wt. of beaker #5 + dried sample BB7 = 422.00 g
2. Wt. of beaker #5 + left over sample BB7 in beaker = 228.26 g
3. Wt. of dried sample BB7 in beaker #5 = 422.00- 228.26 = 88.93 g
4. Volume of water displaced by sample BB7 in beaker #5 = 855-700 = 155 ml
5. Volume of water displaced by sample BB7 in beaker #5 = 755-600 = 155 ml
6. Bulk density of BB7 from sample in beaker #1 = 116.09 / 95 = 1.22 g/ml
7. Bulk density of BB5 from sample in beaker #2 = 127.08/ 100 = 1.27 g/ml
8. Bulk density of BB5 from sample in beaker #3 = 88.93/ 70 = 1.27 g/ml
9. Bulk density of BB5 from sample in beaker #4 = 230.15/ 180 = 1.28 g/ml
10. Bulk density of BB5 from sample in beaker #5 = 193.74/155 = 1.25 g/ml

11. **Average Bulk density for BB7 = 1.22+1.27+1.27+1.28+1.25/ 5 = 1.26 g/ml**
12. Wt. of BB7 required to pack in Teflon sample holder = 1.26 g/ml X 28.26 cm^3 = 35.59 g

AJ **5/9/03**

Sample	Confining Press, psi	Inflow Press psi	Outflow Press psi	Diff. Press psig	Diff. Press cm H2O	Confin ml.	Inflow ml.	Outflow ml	Conf final ml.	Inflow final ml.	Outflow final ml.
BB7(1)Ptef	13	8	6	2	140.6144	1.4	1	14	1.4	11	4
BB7(1)Ptef	16	11	7	4	281.2288	3.0	1	14	3.0	11	4
BB7(1)Ptef	18	12	6	6	421.8432	3.8	1	14	3.8	11	4

Sample	Width (cm)	Height (cm)	Area (cm^2)	Inflow change, ml.	Outflow change ml.	Vol. Change ml.	Elapsed time sec.	Q, ml/sec.	Ksat, cm/sec.	Ksat, m/sec.
BB7(1)Ptef	3	4	7.065	10	10	10	1080	0.009259	3.73E-05	3.73E-07
BB7(1)Ptef	3	4	7.065	10	10	10	1063	0.009407	3.79E-05	3.79E-07
BB7(1)Ptef	3	4	7.065	10	10	10	889	0.011249	4.53E-05	4.53E-07

Note: The measurements on sample BB7(1) showed delayed response. The lines were all free from blockage. The results could not be attributed to blocked lines. This data may not be usable.

AJ 5/12/03

Sample	Confining Press, psi	Inflow Press psi	Outflow Press	Diff. Press psig	Diff. Press cm H2O	Confin ml.	Inflow ml.	Outflow ml	Conf final ml.	Inflow final ml.	Outflow final ml.
BB1(2)Ptef 6 Wks @ 90 C	13	8	6	2	140.6144	5.5	1	17	5.5	11	7
BB1(2)Ptef 6 Wks @ 90 C	16	11	7	4	281.2288	6.6	1	17	6.6	11	7
BB1(2)Ptef 6 Wks @ 90 C	18	12	6	6	421.8432	7.2	1	17	7.2	11	7

Sample	Width (cm)	Height (cm)	Area (cm^2)	Inflow change, ml.	Outflow change ml.	Vol. Change ml.	Elapsed time sec.	Q, ml/sec.	Ksat, cm/sec.	Ksat, m/sec.
BB1(2)Ptef 6 Wks @ 90 C	3	4	7.065	10	10	10	196	0.05102	0.000205	2.05E-06
BB1(2)Ptef 6 Wks @ 90 C	3	4	7.065	10	10	10	128	0.078125	0.000157	1.57E-06
BB1(2)Ptef 6 Wks @ 90 C	3	4	7.065	10	10	10	117	0.08547	0.000115	1.15E-06

Note: The measurements on sample BB1(2) was thermally treated with duct tape on the sample holder. UZ-14 perched water in contact with sample turned yellow. Possible contamination from duct tape on the sample holder. This data. may not be usable.

AJ 7/25/03

Sample	Confining Press, psi	Inflow Press psi	Outflow Press psi	Diff. Press psig	Diff. Press cm H2O	Confin ml.	Inflow ml.	Outflow ml	Conf final ml.	Inflow final ml.	Outflow final ml.
BB1(5)Ptef 17 Wks @ 90C	13	8	6	2	140.6144	6.5	1	14	5.5	11	4
BB1(5)Ptef 17 Wks @ 90C	16	11	7	4	281.2288	7.8	1	14	6.6	11	4
BB1(5)Ptef 17 Wks @ 90C	18	12	6	6	421.8432	8.5	1	17	7.2	11	4

Sample	Width (cm)	Height (cm)	Area (cm^2)	Inflow change, ml.	Outflow change ml.	Vol. Change ml.	Elapsed time sec.	Q, ml/sec.	Ksat, cm/sec.	Ksat, m/sec.
BB1(5)Ptef 17 Wks @ 90C	3	4	7.065	10	10	10	430	0.023256	9.36E-05	9.36E-07
BB1(5)Ptef 17 Wks @ 90C	3	4	7.065	10	10	10	270	0.037037	7.46E-05	7.46E-07
BB1(5)Ptef 17 Wks @ 90C	3	4	7.065	10	10	10	214	0.046729	6.27E-05	6.27E-07

Note: These measurements on sample BB1(5) showed delayed response. The lines were all free from blockage. The results could not be attributed to blocked lines. This data may not be usable.

AJ 7/28/03

Sample	Confining Press, psi	Inflow Press psi	Outflow Press psi	Diff. Press psig	Diff. Press cm H2O	Confin ml.	Inflow ml.	Outflow ml	Conf final ml.	Inflow final ml.	Outflow final ml.
BB1(5)Ptef 17 Wks @ 90C	13	8	6	2	140.6144	6.5	1	14	5.5	11	4

Sample	Width (cm)	Height (cm)	Area (cm^2)	Inflow change, ml.	Outflow change ml.	Vol. Change ml.	Elapsed time sec.	Q, ml/sec.	Ksat, cm/sec.	Ksat, m/sec.
BB1(5)Ptef 17 Wks @ 90 C	3	4	7.065	10	10	10	645	0.015504	6.24E-05	6.24E-07

Note: These measurements on sample BB1(5) were repeated to check reproducibility and showed significant delayed response. The lines were all free from blockage. The results could not be attributed to blocked lines. This data may not be usable.

AJ 7/29/03

Note: The following measurements on sample BB1(5) were repeated after replacing the old filter paper inside the sample holder. The old filter paper was in use through out the thermal treatment for 17 weeks and could possibly be obstructed.
These measurements on sample BB1(5) showed drastic difference in Ksat values. This drastic change was much quicker response and could be attributed to the use of new filter paper. The blockage of old filter paper during thermal treatment seemed significant enough to show delayed response. The replacement of filter paper after thermal treatment may be necessary to obtain usable data.

Sample	Confining Press, psi	Inflow Press psi	Outflow Press psi	Diff. Press psig	Diff. Press cm H2O	Confin ml.	Inflow ml.	Outflow ml	Conf final ml.	Inflow final ml.	Outflow final ml.
BB1(5)Ptef 17 Wks @ 90C	13	8	6	2	140.6144	6.5	1	14	5.5	11	4
BB1(5)Ptef 17 Wks @ 90C	16	11	7	4	281.2288	7.8	1	14	6.6	11	4
BB1(5)Ptef 17 Wks @ 90C	18	12	6	6	421.8432	8.5	1	17	7.2	11	4

Sample	Width (cm)	Height (cm)	Area (cm^2)	Inflow change ml.	Outflow change ml.	Vol. Change ml.	Elapsed time sec.	Q, ml/sec.	Ksat, cm/sec.	Ksat, m/sec.
BB1(5)Ptef 17 Wks @ 90C	3	4	7.065	10	10	10	165	0.060606	0.000244	2.44E-06
BB1(5)Ptef 17 Wks @ 90C	3	4	7.065	10	10	10	81	0.123457	0.000249	2.49E-06
BB1(5)Ptef 17 Wks @ 90C	3	4	7.065	10	10	10	69	0.144928	0.000195	1.95E-06

AJ 7/30/03

Note: These following measurements on sample BB1(5) were repeated using the same filter paper as on 7/29/03 to test the reproducibility. Also, the sample was not removed from the permeameter cell on 7/29/03. The results show a slight delayed response and could be attributed to the blockage of filter paper. The replacement of filter paper after each test run may be required to obtain reproducible data.

Sample	Confining Press, psi	Inflow Press psi	Outflow Press psi	Diff. Press psig	Diff. Press cm H2O	Confin ml.	Inflow ml.	Outflow ml	Conf final ml.	Inflow final ml.	Outflow final ml.
BB1(5)Ptef 17 Wks @ 90C	13	8	6	2	140.6144	6.5	1	14	5.5	11	4
BB1(5)Ptef 17 Wks @ 90C	16	11	7	4	281.2288	7.8	1	14	6.6	11	4
BB1(5)Ptef 17 Wks @ 90C	18	12	6	6	421.8432	8.5	1	17	7.2	11	4

Sample	Width (cm)	Height (cm)	Area (cm^2)	Inflow change, ml.	Outflow change ml.	Vol. Change ml.	Elapsed time sec.	Q, ml/sec.	Ksat, cm/sec.	Ksat, m/sec.
BB1(5)Ptef 17 Wks @ 90C	3	4	7.065	10	10	10	182	0.054945	0.000221	2.21E-06
BB1(5)Ptef 17 Wks @ 90C	3	4	7.065	10	10	10	97	0.103093	0.000208	2.08E-06
BB1(5)Ptef 17 Wks @ 90C	3	4	7.065	10	10	10	73	0.136986	0.000184	1.84E-06

AJ 7/30/03

Note: The following measurements on sample BB1(5) were repeated after replacing the old filter paper inside the sample holder. The old filter paper was in use for only two set of measurements 7/29/03 and 7/30/03.
These measurements on sample BB1(5) showed difference in Ksat values. The observed difference was quicker response and could be attributed to the use of new filter paper. The blockage of filter paper seemed significant enough to show delayed response. The replacement of filter paper after each measurement may be necessary to obtain usable data.

Sample	Confining Press, psi	Inflow Press psi	Outflow Press psi	Diff. Press psig	Diff. Press cm H2O	Confin ml.	Inflow ml.	Outflow ml	Conf final ml.	Inflow final ml.	Outflow final ml.
BB1(5)Ptef 17 Wks @ 90C	13	8	6	2	140.6144	6.5	1	14	5.5	11	4
BB1(5)Ptef 17 Wks @ 90C	16	11	7	4	281.2288	7.8	1	14	6.6	11	4
BB1(5)Ptef 17 Wks @ 90C	18	12	6	6	421.8432	8.5	1	17	7.2	11	4

Sample	Width (cm)	Height (cm)	Area (cm^2)	Inflow change, ml.	Outflow change ml.	Vol. Change ml.	Elapsed time sec.	Q, ml/sec.	Ksat, cm/sec.	Ksat, m/sec.
BB1(5)Ptef 17 Wks @ 90C	3	4	7.065	10	10	10	142	0.070423	0.000284	2.84E-06
BB1(5)Ptef 17 Wks @ 90C	3	4	7.065	10	10	10	70	0.142857	0.000288	2.88E-06
BB1(5)Ptef 17 Wks @ 90C	3	4	7.065	10	10	10	51	0.196078	0.000263	2.63E-06

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7/30/03 AJ

Entries made into Scientific Notebook #584E for the period
March 13, 2003 to September 30, 2003 have been made by Alka Jain
(08/03/2003)

No original text or figures entered into this Scientific Notebook has been removed

08/03/2003 AJ

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NOTEBOOK NO.: 584E (continuation of scientific notebook # 482)

ISSUED TO: Randy Fedors, Roberto Pabalan, and Alka Jain (AJ)

RL 10/24/2006

ISSUED ON: March 2003

DEPARTMENT: CNWRA (DIV. 20)

PROJECT NUMBER: 20.060002.01.091(TEF), 20.060002.01.071(ENFE)

AJ 11/25/03

Water Retention characteristics on Quartz Sand:

To obtain the moisture retention curve on a porous sample, the moisture content of that sample must be measured at a fixed saturation. This is done by measuring the controlled outflow of liquid at a known pressure i.e. by equilibrating the liquid pore pressure of a moist sample at fixed saturation with succession of known pressure values. The amount of moisture that is retained in the sample after equilibrium is determined at each known pressure.

The moisture from saturated porous sample is removed by raising the air supply pressure in the outflow cell. Partially glazed or epoxy coated porous ceramic plate is used and serves two purposes: (1) serves as a hydraulic link for water to move from the porous sample to the outflow port of the outflow cell, (2) the glazed sides and outside edges provides an impervious surface to seal against the O-rings. The high pressure air will not pass through the pores in the ceramic plate since the pores are saturated with water. A reservoir of water is maintained underneath the ceramic plate in the base of outflow cell. During an experimental run, at any set pressure in the outflow cell, moisture from the porous sample will flow around sample particles and out through the ceramic plate to outflow port and finally in to the graduated burette. The stopcock valve is open during this stage. During equilibrium stage the stopcock valve is closed and there is redistribution of the wetting (water) and non-wetting phase (applied air pressure) within the sample. As a result a constant capillary pressure is established. At high saturations, the time required for equilibrium is relatively short. As the saturation decreases, the time required for equilibrium increases.

Particle density of quartz, $\rho_p = 2.65$ gm/cm^3

Bulk density, ρ_B is the density of sand as packed in the sample holder

Bulk density, ρ_B = wt. of sand as packed / volume of the sample holder

For cylindrical sample holder, Bulk density, $\rho_B = W/\pi r^2 h$

Where, r is the radius of sample holder

h is the height of the sample holder

Porosity, $\varphi = 1 - \rho_p / \rho_B$

Saturating Porous Ceramic Plate:

The objective is to remove trapped air from the porous ceramic plate. The outflow cell is assembled and ~ 1 bar vacuum is applied. The outflow cell is then partially filled with deaerated water and soaked overnight. Next day, apply a small pressure (~ 1 - 8 psi for 1 bar plate, should be less than air entry value of ceramic plate) to push 500 to 800 ml of water through the porous plate.

Weight of sample holder + plastic cap on one side = 26.486 gm

Weight of dry sand added = 34.780 gm

Saturating Sand Sample:
The objective is to remove trapped air from the pores of the sand sample. Load the dry sample in saturation chamber as shown in the figure (Parr Instument Company pressure vessel) and apply ~ 1 bar vacuum using bench top laboratory vacuum pump (KNF Neuberger Inc., Laboport model # UN810.3 FTP, SN 1/635750).The sample is then flushed with CO_2 using CO2 tank. Again apply ~ 1 bar vacuum to evacuate the chamber and then wet the sample with deaerated water slowly under vacuum.

Information potentially subject to coptyright protection was redacted from this location. The redacted material is a diagram from the KNF Neuberger Inc. company listed above.

The sample is then removed from saturation chamber and loaded on saturated ceramic plate in the outflow cell. The outflow cell is opened without disturbing the water reservoir under the ceramic plate. This is ensured by leaving the ceramic plate clamped between the base of outflow cell and the retaining ring.

Weight of saturated sample + sample holder + plastic cap = 68.012 gm
Weight of saturated sample = 68.012 – 26.486= 41.526 gm

The plastic cap was removed before loading the sample in the outflow cell.
The sample was loaded on 3 bar porous ceramic plate (SoilMoisture Equipment Corp., part # 0604D05-B03M1) in the outflow cell. The ceramic plate has impervious epoxy coating (SoilMoisture Equipment Corp., part # 0980V004) on outside edges and sides. A calibrated micro switch type differential pressure

transducer, 0-100 psi (Honeywell, 26PC series, model # 26PCFFA6D) is used to measure the capillary pressure. No additional pressure regulators other than air filter regulator (installed on the wall, Binks Oil and Water Extractor, model 86-963) were used for supply pressure. A portable absolute pressure standard (Paroscientific Inc., model 740-45A) is used to measure the supply pressure. The following figure shows the complete set up.

Information potentially subject to copyright protection was redacted from this location. The redacted material is a diagram belonging to the Paroscientific Inc. company as listed above.

Water Level in burette (ml)	Capillary Pressure (psi)	Equilibration Time	Air Supply Pressure (psi)
12.9	-0.05	20 min	0.41
12.8	-0.03	20 min	1.07
12.7	-0.18	35 min	1.61
12.6	-0.16	30 min	3.34
12.4	-0.16	30 min	5.53
12	-0.16	25 min	7.61
11.5	-0.16	45 min	11.52
10.5	-0.16	45 min	13.54
8.6	0.44	5 days	13.54
8	0.56	80 min	15.54
7.5	0.62	95 min	16.55
7.3	0.71	80 min	17.54
7.2	0.71	14 hrs.	18.52
6.8	1.02	2 hrs	19.52
6.3	1.25	90 min	19.52
6	1.45	105 min	19.52

This test is performed to test the proper function of the set up. The supply pressure varies significantly. The capillary pressure readings from transducer also fluctuate generously to accurately measure a stable value. This above data would not be usable.

AJ 12/2/03

Water Retention characteristics on Quartz Sand:
Particle density of quartz, $\rho_p = 2.65$ gm/cm^3

Weight of sample holder + plastic cap on one side = 26.582 gm
Weight of dry sand added = 36.860 gm

The sample and porous ceramic plate are saturated following the procedure on page 19.

Weight of saturated sample + sample holder + plastic cap = 70.412 gm
Weight of saturated sample = 70.412 – 26.582= 43.830 gm
The sample is loaded on 3 bar porous ceramic plate in the outflow cell.

Water Level in burette (ml)	Capillary Pressure (psi)	Equilibration Time	Air Supply Pressure (psi)
12	0.0		0
11.9	0.0	30 min.	1.01
11.8	-0.23	Left overnight	2.08
11.7	-0.22	30 min.	2.08
11.5	-0.18	30 min.	3.05
11.3	-0.16	35 min.	4.04
11.0	-0.09	45 min.	4.04
10.8	0.27	45 min.	4.04

The run was stopped on 12/3/03 as air bubble was detected in line and would cause erroneous values. The above data would not be used.
The sample stayed undisturbed on the ceramic plate in the outflow cell and 1.2 ml of water was added to the sample which was drained from the sample during run. The air and water lines were shortened by removing extra valves between outflow cell, main air supply, and burette to prevent access to air in the lines. The run was restarted only to test the performance of the system.

Water Level in burette (ml)	Capillary Pressure (psi)	Equilibration Time	Air Supply Pressure (psi)
12.9	-0.04	0	0
12.85	-0.04	30 min.	1.14
12.8	-0.02	30 min	1.14
12.7	-0.02	30 min	1.15
12.6	0.0	20 min	1.63

12.5	-0.28	Left overnight	1.57
12.4	-0.25	30 min	1.57
12.3	-0.21	30 min	1.55
12.2	-0.18	35 min	1.54
12.1	-0.15	30 min	2.02
12.0	-0.12	30 min	2.02
11.9	-0.09	45 min	2.24
11.8	-0.03	60 min	2.18
11.7	0.35	60 min	2.80
11.6	0.33	Left overnight	2.80
11.5	0.42	75 min	2.65
11.4	0.51	75 min	2.65
11.3	0.58	75 min	3.17
11.2	0.62	85 min	3.11
11.1	0.50	Left overnight	3.06
11.0	0.58	75 min	3.03
10.9	0.67	70 min	3.33
10.8	0.73	80 min	3.43
10.6	0.81	80 min	3.41
10.5	0.74	Left overnight	3.40
10.4	0.77	75 min	3.40
10.3	0.81	90 min	3.41
10.2	0.82	90 min	3.64
10.1	0.83	75 min	3.58
10.0	0.59	Left for one day	3.53
9.9	0.65	75 min	3.58
9.8	0.72	70 min	3.46

The above data would not be usable due to continuous variations in air supply, instability of transducer readings and pressure drops from equilibrium values over a period of several hours. Also, portable pressure standard measures absolute values and any slight change in atmospheric pressure changes the applied pressure values.

AJ 12/18/03

Double Regulation:
The pressure regulation is of great importance in these experiments as accuracy of equilibrium values will be no more accurate than the regulation of air supply. Therefore, the air supply is connected with two pressure regulators (Fairchild Industrial products company's precision regulator- Model 10273, range 3-200 psig and Moore Products Company's nullmatic pressure regulator – model 40-15, range 0.5-15psig) in series for double regulation. The double regulation will provide regulated pressure to within 1/100 psi. The pressure regulation using double regulators is tested before starting measurements on sand. A portable pressure standard is used for read out values.

Main supply Pressure (psi)	Regulator Pressure Model 10273 (psi)	Regulator Pressure Model 40-15 (psi)	Time	Portable standard read out (psi)
40	10	~ 1	0	0.887
			15 min	0.8868
			40 min	0.8855
			95 min	0.8758
			135min	0.867
			160 min	0.8631
			180 min	0.8626
			195 min	0.8613
			18 hrs	0.9667
		~ 1.5	0	1.520
			35 min	1.514
			60 min	1.5021
			85 min	1.4949
			120 min	1.4696
			150 min	1.4597

AJ 1/05/04

Main supply Pressure (psi)	Regulator Pressure Model 10273 (psi)	Regulator Pressure Model 40-15 (psi)	Time	Portable standard read out (psi)
40	10	~ 5	0	4.9917
			5 min	4.993
			28 min	4.9916
			70 min	4.992
			115 min	4.982
			140 min	4.9792

The values of the portable standard in the data tables above (from 2/18/03 and 1/5/04) show continuous down trend. There could be a possible leak through one of the regulators. Regulator Model 40-15 has a sticker stating "leaks" and is changed with Model 40-50 as it is available in house.

AJ 1/6/04 to 1/14/04

Main supply	Regulator	Regulator	Time	Portable

Pressure (psi)	Pressure Model 10273 (psi)	Pressure Model 40-50 (psi)		standard read out (psi)
40	10	~1	0	1.0443
			45 min	1.0533
			75 min	1.0555
			12.75 hrs	1.0885
			0	1.0508
			1 hr.	1.0426
			3 hrs	0.9932
			4.5 hrs	0.9766
			0	1.0424
			45 min	1.0395
		~2	0	2.0401
			Next day	1.963
			0	2.042
			45 min	2.0363
			2 hr	2.0231
			Next day	2.1249
		~3	0	3.044
			30 min	3.0286
			After 2 days	3.0483

The values of the portable standard in the data table above (from 1/6/04 and 1/14/04) show continuous down trend. The change of regulator did not show any improvement and pressure values still show continuous down trend. This may imply that the portable absolute pressure standard used for pressure read out may be faulty.

AJ 1/15/04

Main supply Pressure (psi)	Regulator Pressure Model 10273 (psi)	Regulator Pressure Model 40-15 (psi)	Time	Portable standard read out (psi)
40	10	~ 1	0	1.0184
			45 min	1.0146
			65 min	1.0100
			185 min	0.9609
			3.75 hrs	0.9536
			4.25 hrs	0.9471
			4.75 hrs	0.9457
			2 days	1.2643
		~2	0	2.0275
			45 min	2.0258
			1.25 hrs	2.0226

			2 hrs	2.0050
			3.25	1.9689
			3.75 hrs	1.9593
			4.25 hrs	1.9507
			Overnight	1.9701
		~3	0	2.9782
			30 min	2.9771
			1.5 hrs	2.9746
			130 min	2.9677
			175 min	2.9562

The values of the portable standard in the data table above shows continuous down trend. The portable pressure standard used for pressure read out may be faulty.

AJ 1/20/04

Paroscientific portable pressure standard seems to fluctuate continuously with time. The value of atmospheric pressure keeps on decreasing continuously. This unit also has limited calibration and does not seem to function properly.

Applied Pressure (psi)	Time	Portable Standard reading of atmospheric pressure (psi)
0	0	14.3462
0	45 min	14.3440
0	80 min	14.3349
0	100 min	14.3306
0	120 min	14.3293
0	overnight	14.4296

Paroscientific portable standard is replaced with calibrated differential digital manometer (Dwyer Instruments, Inc., model 475-6 Mark II, range 0-19.99 psid) to read the accurate applied pressure.

AJ 1/21/04

A new glass graduated burette with two #7 ace threads at the T-end (custom made by Specialty Glass Inc.) would be used for water retention measurements. The complete set up as shown in the following figure includes a new glass burette with two #7 ace threads at the T-end, two pressure regulators in series (double regulation) for air supply and digital manometer.

Information potentially subject to copyright protection was redacted from this location. The redacted material is a diagram from the Moore Products Company as listed on p. 23 of this scientific notebook.

Weight of sample holder + filter paper +wire = 26.597 gm
Weight of dry sand added to sample holder = 36.573 gm

The filter paper is tied with a metal wire on one side of the sample holder to hold the sand in sample holder.

AJ 1/22/04

The sample and porous ceramic plate are saturated following the procedure on page 19.

Weight of saturated sand + sample holder + filter paper + wire = 71.557 gm
Weight of saturated sand = 71.557 - 26.597 = 44.960 gm

The filter paper and wire were removed from the sample before loading it in the outflow cell.

Water Level in burette (ml)	Capillary Pressure (psi)	Air Supply Pressure (psi)
12.5	0.05-0.06	0
12.55	0.05-0.06	0.5
12.4	0.05-0.06	0.8
12.3	0.05-0.06	1
12.1	0.05-0.06	1.5

11.9	0.05-0.06	1.5
11.7	0.05-0.06	1.5
11.5	0.05-0.06	1.5
11.3	0.05-0.06	1.5
11.1	0.05-0.06	1.5
10.9	0.05-0.06	1.5
10.7	0.05-0.06	1.5
10.5	0.05-0.06	1.5
10.3	0.05-0.06	1.5
10.1	0.06-0.07	1.5
9.9	0.05-0.06	1.5
9.7	0.05-0.06	1.5
9.5	0.06-0.07	1.5
9.3	0.05-0.06	1.5
9.1	0.05-0.06	1.5
8.9	0.07-0.08	1.5
8.7	0.05-0.06	1.5
8.5	0.04-0.05	1.5
8.3	0.03-0.04	1.5
8.1	0.03-0.04	1.5
7.9	0.05-0.06	1.5
7.7	0.04-0.05	1.5
7.5	0.05-0.06	1.5
7.3	0.06-0.07	1.5
7.1	0.06-0.07	1.5
6.9	0.05-0.06	1.5
6.7	0.06-0.07	1.5
6.5	0.06-0.07	1.5
6.3	0.05-0.06	1.5
6.1	0.06-0.07	1.5
5.9	0.08-0.09	1.5
5.7	0.06-0.07	1.5
5.5	0.06-0.07	1.5
5.3	0.08-0.09	1.5
5.1	0.07-0.08	1.5
4.9	0.06-0.07	1.5
3.7	0.08-0.09	1.5
3.0	0.07-0.08	1.5

The data in above table shows that there may not be hydraulic contact between ceramic plate and the sand or there may be excessive water in the cell. The chamber is opened on 1/26/04 and filter paper and wire is removed to put sand in direct contact with sand. The test is continued but data would not be usable.
Weight of wet filter paper and wire removed = 2.122 gm
Weight water added to sample = 2.1 gm.
The run is continued as follows:

Water Level in burette (ml)	Capillary Pressure (psi)	Air Supply Pressure (psi)
12.5	0.14-0.15	0
12.2	0.14-0.15	0.5
11.9	0.14-0.15	0.8
11.5	0.14-0.15	1
11	0.14-0.15	1.5
10.5	0.14-0.15	1.5
10	0.14-0.15	1.5
9.5	0.14-0.15	1.5
9	0.14-0.15	1.5
8.6	0.14-0.15	1.5
8.2	0.14-0.15	1.5
7.8	0.14-0.15	1.5
7	0.14-0.15	1.5
6	0.14-0.15	1.5
5.5	0.14-0.15	1.5
5	0.14-0.15	1.5
4	0.14-0.15	1.5
3.6	0.69	1.5
3.5	0.72	1.5
3.3	0.76	1.5
3.2	0.79	1.5
3	0.84	1.5
2.9	0.86	1.5
2.7	0.89	1.5

AJ 1/27/04, 1/28/04

The run from 1/26/04 continued as follows:

Water Level in burette (ml)	Capillary Pressure (psi)	Air Supply Pressure (psi)
2.7	0.33 (dropped from 0.89 after leaving over night)	2.0
2.4	0.64	2.0
2.1	0.76	2.0
1.9	0.81	2.0
1.7	0.84	2.0
1.5	0.87	2.0
1.3	0.88	2.0
1.1	0.90	2.0

0.8	0.94	2.0
0.5	0.55 (dropped from 0.94 after leaving over night)	2.0
0.0 (water was removed by pipette to set the level at 9.9 ml	0.76	2.0
9.5	0.90	2.0
9.3	0.92	2.0
8.8	1.00	2.0
8.4	1.05	2.0
8	1.08	2.0
7.7	1.09	2.0
7.3	1.10	2.0

AJ 1/29/04 – 2/2/04

The run from 1/26/04 continued as follows:

Water Level in burette (ml)	Capillary Pressure (psi)	Air Supply Pressure (psi)
6.9	0.70(dropped from 1.10 after leaving over night)	2.2
6.4	0.84	2.2
6	0.97	2.2

The run is stopped as DOS files of work bench software were accidentally deleted from the computer. This data from 1/21/04 to 1/27/04 would not be usable as there is continuous pressure drop after leaving the system overnight. This could lead to a possible minute leak in the system or instability of the transducer.

The new software "DASYLAB 5.5 version" was successfully installed to record the data.

AJ 2/3/04

The filter paper is tied with a metal wire on one side of the sample holder to hold the sand in sample holder.

1 bar (Soilmoisture Equipment Corp., part # 0604D05-B01M1) ceramic plate with its outside edges and sides coated with thin paint able epoxy (Aremco, Corr Paint # 2070) will be used in place of 3 bar ceramic plate.
The porous ceramic plate is saturated differently by applying a 50 centibar vacuum to the out flow port of outflow cell and pull 500 to 800 ml of de-aerated water through the plate. The pressure difference between the top and bottom of the plate should be less than the air entry value of the ceramic plate to ensure no air passing through the pores of the plate during saturation.

Weight of dry sand added = 39.110 gm
The sample is saturated under vacuum. The sample is flushed with CO_2 and then wetted with de-aerated water slowly under vacuum.

Weight of saturated sample + sample holder + filter paper + wire = 78.106 gm

The filter paper and wire are removed before loading the sample in the outflow cell.
Weight of wet filter paper and wire = 1.536 gm

Water Level in burette (ml)	Capillary Pressure (psi)	Air Supply Pressure (psi)
13.0	-0.1808	0
11.8	-0.1808	1

The run is interrupted as air bubbles detected in water line.

AJ 2/4/04 – 2/7/04

The cell is opened and ceramic plate and sample are re-saturated carefully.

Weight of saturated sample + sample holder + wire = 76.912 gm
Weight of saturated filter paper + sand grains on filter paper + wire = 1.825 gm

Water Level in burette (ml)	Capillary Pressure (psi) Transducer reading	Air Supply Pressure (psi)
8.1	0.14 – 0.16	1.0
7.7	0.14 – 0.16	1.0
7.3	0.14 – 0.16	1.0
7.0	0.14 – 0.16	1.0
6.7	0.14 – 0.16	1.0
6.3	0.14 – 0.16	1.0
6.0	0.15 – 0.17	1.0
5.7	0.15 – 0.17	1.0
5.4	0.16 – 0.18	1.0
5.0	0.17 – 0.19	1.0
4.7	0.18 – 0.19	1.0
4.4	0.39	1.0
4.2	0.41	1.0
4.0	0.60	1.0
3.8	0.10 (dropped from 1.10 after leaving over night)	1.0
3.5	0.10	1.0
3.1	0.10	1.0

2.5	0.10	1.5
1.8	0.30	1.5
1.5	0.44	1.5
1.2	0.46	1.5
0.7	0.64	1.5
0.4	0.78	1.5

On 2/7/04, a large air bubble is detected in the water line which caused the water to splatter out of the burette during outflow from the sample. The origin of the bubble seems to be from the outflow cell. The outflow cell was opened to check the cause of air bubble. The water reservoir under the ceramic plate seemed to lack water as cavity is partially filled. The other possible cause could be- water is allowed to pull thru the ceramic plate to saturate the plate. The outflow port must be clamped before releasing the vacuum if water is allowed to pull thru the plate to saturate the plate. If it is not done correctly, air could trap in the cavity under the plate.

Also, the data from 2/3/04 to 2/7/04 still shows a continuous drop in capillary pressure from the equilibrium value if the system is left overnight or for more than one day. There could be a possible slow leak in the system thru the ace threads or stop cock.

A burette with 1/4" bubbler tubes (no ace threads) at the T-end, and threaded vacuum stop cock with PTFE needle valve could be beneficial in preventing the leaks. These changes in burette were requested from Specialty Glass Inc.

The other problem observed is the instability of the transducer which makes it difficult to read accurate capillary pressure. This instability could possibly be attributed to the noise signal from power supply used for excitation voltage to transducer.
This data would not be usable.

AJ 2/19/04 – 2/24/04

A 12V battery (Universal battery, UB1270, 12V, 7Ah, non spill able) in place of power supply is used to excite the transducer in order to test the stability of the transducer.
Battery reading = 13.35 volts with calibrated Fluke 87 True RMS multimeter (sn # 61880517, An # 003674, Calibration date 8/12/03 – 8/11/04)

Date	Multimeter reading, volts	Time
2/20/04	13.19	10:00 am
2/20/04	13.18	1:30 pm
2/20/04	13.18	3:30 pm
2/23/04	13.10	9:30 am

2/23/04	13.10	3:45 pm
2/24/04	13.08	

The above table shows a continuous drift from battery output and may not be good choice for transducer excitation voltage. These types of variations in excitation voltage of transducer could lead to output variations and could possibly be more significant than the noise from the power supply.

Rosemount 3051 smart pressure transmitter (Rosemount Inc., model # 3051S CD2A22A1AES, range 0 – 250" of H_20) is tested overnight for performance as a possible alternative choice for capillary pressure measurements. The unit was not calibrated.

The new design burette with 3/8" bubbler tube on T-end and vacuum stop cock with PTFE needle valve is received from Specialty Glass Inc.

AJ 3/4/04

The bubbler tubes at the T-end of burette are damaged during handling. The broken burette end is converted to T-end with 3/8" polyurethane tubing (NewAge Industries Inc., part # 2121854-100, lot # 0115), hose clamp and acetal push to connect 3/8" union T connectors(NewAge Industries Inc., part # 520-4787).

The transducer is switched with un-calibrated Rosemount 3051 smart pressure transmitter, range set to 0 – 100" of H_20, output 4-20 ma (mill ampere) to test the performance of the set up.
4 ma output @ 0" of H_20
20 ma output @ 100" of H_20
Output is measured across 250 ohms high precision resistor (Vishay, model # S102C-250R00) to yield 1 -5 V (volts) output.
Rosemount transducer reads 0.994 @ 0" of H_20
Rosemount transducer reads 4.997 @ 100" of H_20

The following figure shows the complete revised set up.

Information potentially subject to copyright protection was redacted from this location. The redacted material is a diagram from the NewAge Industries Inc. company as listed on p. 33 of this scientific notebook.

Weight of sample holder + filter paper + wire = 18.924 gm
Weight of dry sand added to the sample holder = 40.324 gm

The sample and porous ceramic plate are saturated following the procedure on page 19.
Weight of saturated sand = 46. 966 gm

AJ 3/5/04 – 3/16/04

Water Level in burette (ml)	Capillary Pressure (psi) Transducer reading	Air Supply Pressure (psi)
14.3	0.99	0
13.9	1.00	1.0
13.5	1.00	1.0
13.0	1.00	1.0
12.5	1.00	1.0
12.0	1.00	1.0
11.5	1.00	1.0
11.0	1.01	1.0
10.7	1.01	1.0
10.5	1.01	1.0
10.2	1.01	1.0
9.9	1.01	1.0
9.6	1.01	1.0
9.3	1.01	1.0
9	1.01	1.0

8.7	1.01	1.0
8.4	1.01	1.0
8.0	1.02	1.0
7.7	1.02	1.0
7.4	1.02	1.0
7.2	1.02	1.0
6.8	1.02	1.0
6.6	1.02	1.0
6.2	1.02	1.5
5.9	1.02	1.5
5.5	1.02	1.5
5.0	1.02	1.5
4.5	1.02	1.5
4.0	1.02	1.5
3.5	1.02	1.5
3.1	1.02	1.5
2.68	1.02	1.5
2.5	0.98	1.5
1.9	0.98	1.5
1.6	0.98	1.5
1.3	0.98	1.5
1.0	1.02	1.5
0.7	1.02	1.5
0.5	1.33	1.5
0.3	1.33	1.5
0.0	1.40	1.5
10.5 (removed water from burette to adjust level)	1.40	1.75
10.3	1.43	1.75
9.9	1.48	1.75
9.5	1.52	1.75
9.1	1.56	1.75
8.7	1.60	1.75
8.4	1.63	1.75
8.0	1.66	1.75
7.4	1.69	1.75
7.0	1.73	1.75
6.6	1.77	1.75
6.3	1.79	1.85
6.0	1.83	2.0
5.7	1.86	2.0
5.4	1.88	2.0
5.1	1.93	2.0
4.8	2.02	2.25

4.6	2.18	2.5
4.4	2.34	2.52
4.1	3.71	3.5
3.6	> 5.199 beyond set range	8.25

Weight of sand after removing from outflow cell + filter paper + sample holder = 57.591 gm
The sand was dried in the oven @ 95C for two days.

AJ 3/ 17 / 04
Weight of dried sand + sample holder + filter paper + wire = 58.180 gm
Weight of dried sand = 58.180 – 18.924 = 39.256 gm
Initial water content = weight of saturated sand – wt. of dried sand
= 46. 966 – 39.256 = 7.71 gm
This data from 3/4/04 to 3/17/04 would not be usable as transducer was not calibrated.

AJ 3/15/04 - 3/21/04

The second burette is received with ace # 7 threads at the T-end and threaded vacuum stop cock with PTFE needle valve. This burette is tested with ace threaded tubing connectors for ¼" tubing (Ace Glass Inc., part # 5853-06) at 7 psi pressure overnight. The system released part of the pressure by next morning indicating slow leaks.

The burette is also tested with bushings and O-rings supplied with the burette by Specialty Glass Inc. The system still showed leaks.

After discussion with Ace Glass technical support, PTFE ferrules (Ace Glass Inc., part # 11710-07) are used with bushings (Ace Glass Inc., part # 5029-05) in place of the O-rings. The reason is that #7 ace threads with O-ring accepts a 7 mm O.D. tubing and by inserting ferrules in place of the O-rings, the #7 ace thread will now accept the 6.4 mm (¼ " tubing). The system is still not free of leaks.

The burette is then tested with bushings, O-rings and PTFE-FEP heat shrinkable tubing (Ace Glass Inc., part # 12685-38) to enlarge the O.D. of ¼" tubing to adapt #7 ace threads with O-rings. The system still showed leaks.

AJ 3/22/04 – 3/31/04

Another test is performed to test the reproducibility of measurements. The data would not be usable as un-calibrated Rosemount transducer is in use.

Sample holder height, H = 1.308+1.3085+1.308+1.3075 / 4 = 1.31"

Diameter = 1.8945=1.8980+1.8895 +1.8935 / 4 = 1.89"
Radius, R = 1.89/2 = 0.945"
Volume of the sample holder = $\pi R^2 H$ = 3.14 x 0.945 x 0.945 x 1.89 = 3.673 in^3
= 3.673 x $(2.54)^3$ cm^3 = 60.196 cm^3

Weight of sample holder + dry filter paper +wire = 22.118 gm
Weight of sample holder + wet filter paper + wire = 24.030 gm
Weight of dry sand added to sample holder = 126.02 gm

Bulk density, ρ_B = Weight of sand packed in sample holder/ vol. of sample holder
= 126.02 / 60.196 = 2.09 gm/cm^3
Particle density, ρ_P = 2.65 gm/cm^3 for quartz sand
Porosity = 1- ρ_B / ρ_P

Weight of saturated sand + sample holder + wet filter paper + wire = 174.330 gm
Weight of saturated sand = 174.330 - 24.030 = 150.300 gm

The filter paper and wire were removed from the sample before loading it in the outflow cell.

Water Level in burette (ml)	Capillary Pressure (psi) Transducer reading	Air Supply Pressure (psi)
21.7	-0.02	0
20.5	0.34	1.0
19.5	0.44	1.5
18.0	0.50	1.5
16.5	0.55	1.5
14.8	0.59	1.5
13.3	0.63	1.5
11.8	0.65	2.0
10.3	0.69	2.0
8.8	0.74	2.0
7.0	0.78	2.25
5.5	0.82	2.25
3.7	0.87	2.25
2.0	0.94	2.25
1.4	0.97	2.25
0.6	1.05	2.25
0	1.30	3.0
6.9 (removed water from burette to adjust level)	1.30	3.62
6.4	2.30	3.62
6.2 (range of transducer is changed to 250" of water)	3.75	6.0
6.0	4.54	6.0

5.7	6.38	9.0

AJ 4/12/04

Water Retention Data using Pressure Plate Extractor (SoilMoisture Equipment Corp., model 1500):
The following system will be used for water retention measurements @ 0.6 bars or greater than 0.6 bars. The essential components shown in the following figure are (1) pressure plate extractor (Soilmoisture Equipment Co., model # 1500) (2) a porous ceramic plate with rubber backing sheet (3) a air pressure supply (4) a set of lead weights.
The outflow system consists of the connection from the outlet from the plate, and a beaker of water with the outflow tube dipped into the water. A layer of screen between the plate and the rubber backing expedites lateral movement of water to the outlet.
Note: No extra regulators were equipped for precise pressure regulation.

Information potentially subject to copyright protection was redacted from this location. The redacted material is a diagram from the Soilmoisture Equipment Company as listed above.

	Sample #1	Sample #2	Sample #3
wt. of Sample holder (gm)	20.568	124.439	124.998
Wt. of sample holder + dry filter paper + wire (gm)	22.092	126.42	126.94
Wt. of dry filter paper + wire (gm)	1.524	1.981	1.942
Wt. of dry sand added to holder (gm)	133.598	192.34	188.82

Saturating Sand Samples:
The objective is to remove trapped air from the pores of the sand sample. The samples are saturated outside the extractor in a tray of water. Place the samples in an empty tray and slowly add de-aerated water to soak the samples that is at a level just below the top of the samples. More than one sample can be saturated at the same time. The samples are soaked for one day.

AJ 4/14/04

	Sample #1	Sample #2	Sample #3
Wt. of saturated sand sample + sample holder + wet filter paper + wire (gm)	184.51	360.09	358.02
Wt. of water left on balance (gm)	1.139	1.969	3.049
Wt. of wire + wet filter paper + sand on filter paper (gm)	2.89	5.117	5.009
Wt. of saturated sand sample (gm)	159.913	228.565	224.964

Filter paper and wire were removed from the samples before placing in the pressure extractor plate using 3 bar porous ceramic plate. The pressure applied was set at 0.8 bars and no pressure regulator was used. The samples were treated for 12 days. The pressure fluctuated from 0.8 bars significantly and data may not be usable.

AJ 4/26/04

The samples along with sample holders were then removed from pressure extractor and placed in beakers covered with glass Petri dishes for drying in the oven.

	Sample #1	Sample #2	Sample #3
Wt. of glass beaker (gm)	104.04	103.6	107.43
Wt. of petri dish (gm)	42.26	45.43	45.37
Wt. of beaker + sample holder + sand sample (gm)	259.52	422.53	423.15
Wt. of sample after pressure treatment @ 0.8 bars for 12 days (gm)	134.912	194.491	190.722
Wt. of water removed from sand sample @ 0.8 bars (gm)	25.001	34.074	34.242

The samples were then placed in the oven @ 95 C for 4 days.

AJ 4/30/04

The samples were removed from the oven after 4 days and cooled in the desiccators before weighing.

	Sample #1	Sample #2	Sample #3
Wt. of beaker + petri dish +	300.03	465.13	465.75

sample holder + sand sample after drying (gm)			
Wt.of dried sand sample (gm)	133.162	191.661	187.952
Initial water content (gm)	26.715	36.904	37.012
Saturation @ 0.6 bar	6.54 %	7.67 %	7.48 %

This data may not be usable due to unregulated pressure supply.

AJ 4/27/04 – 5/20/04

Water Retention characteristics on Quartz Sand using Outflow Cell:
Calibrated Rosemount transducer 3051, range set to 0-250" of H2O, output 2 -10 V will be used for these measurements. Output is measured across 500 ohms high precision resistor (Vishay, model # S102C-500R00) to yield 2 -10 V (volts) output.
Weight of sample holder = 17.387 gm
Weight of filter paper +wire = 1.655 gm
Weight of dry sand added to sample holder = 116.059 gm
The filter paper is tied with a metal wire on one side of the sample holder to hold the sand in sample holder.
The sample and porous ceramic plate are saturated following the procedure on page 19.
Weight of saturated sand + wet filter paper + wire + sample holder =160.66 gm
Weight of water left on scale = 2.647 gm
Weight of wet filter paper removed from sample with some sand grains + wire = 2.353 gm
Weight of saturated sand = 160.66 – 2.647 – 2.353 -17.387 = 138.273 gm

Water Level in burette (ml)	Transducer reading Capillary Pressure (inches of H2O)	Air Supply Pressure (inches of H2O)
15.8	-1.463	0
14.8	-1.461	27.68
14.2	10.537	27.68
13.7	12.515	27.68
12.8	14.833	34.60
12	16.441	34.60
11	17.766	34.60
10	18.291	41.52
9	18.761	41.52
5.4	21.285	41.52
4.4	22.227	48.44
3.4	22.778	48.44
2.4	23.819	48.44
1.4	24.964	48.44
0	25.905	55.36

15.8 (removed water from burette to adjust level)	25.905	55.36
14.8	26.698	55.36
13.8	28.143	55.36
12.8	30.872	55.36
12.5	31.937	62.28
12.3	32.552	69.20
12.2	33.979	124.56
11.9	36.0 to 46.0(fluctuates)	124.56

This data shows fluctuation at low saturation points and makes it difficult to record the accurate measurements. The different components of the system are tested carefully to explain ~ 10.0" of H2O fluctuation at low saturations.

The performance of transducer with temperature and time is tested with varying air differential pressures and air-water differential pressures. The temperature effect seems to be negligibly small. The total variations in differential pressure ranged between 0.11 to 0.70 inches of H2O which is well below performance specifications of the transducer. This data is stored in file "calibratedsandtest4-27to5-19.xls" and can be viewed from disk submitted with lab book.

Secondly, if there was a leak in the system, these types of fluctuations would be apparent at each data point. The possible weak points of the system were sealed with silicone sealant (Dow Corning silicone sealant, RTV 748) as a precautionary measure to avoid any errors due to leakage.

AJ 5/9/04

Water Retention Data on Quartz sand using Pressure Plate Extractor:
The essential components shown in the following figure are (1) pressure plate extractor (Soilmoisture Equipment Co., model # 1500) (2) a porous ceramic plate with rubber backing sheet (3) a air pressure supply (4) pressure regulation system (double regulation) capable of control in the range of 0.01 psi (5) a set of lead weights.
The outflow system consists of the connection from the outlet from the plate, and a beaker of water with the outflow tube dipped into the water. A layer of screen between the plate and the rubber backing expedites lateral movement of water to the outlet.
Double Regulation: The pressure regulation is of great importance in these experiments as accuracy of equilibrium values will be no more accurate than the regulation of air supply. Therefore, the air supply is connected with two pressure regulators (Fairchild Industrial products company's precision regulator- Model 10273, range 3-200 psig and Moore Products Company's nullmatic pressure regulator – model 40-50, range 0.5-50 psig) in series for double regulation. The double regulation will provide regulated pressure to within 1/100 psi.

Information potentially subject to copyright protection was redacted from this location. The redacted material is a diagram from Soilmoisture Equipment Co., Fairchild Industrial Products and Moore Products Company. as listed on p. 41 of this scientific \notebook.

	Sample #1	Sample #2	Sample #3
wt. of Sample holder (gm)	20.568	124.44	124.99
Wt. of sample holder + dry filter paper + wire (gm)	22.093	126.175	126.722
Wt. of dry filter paper + wire (gm)	1.525	1.735	1.732
Wt. of dry sand added to holder (gm)	132.93	186.6	187.83

Saturating Sand Samples:
The objective is to remove trapped air from the pores of the sand sample. The samples are saturated outside the extractor in a tray of water. The samples were prepared and placed in a container. The container was slowly filled with de-aerated water that is at a level just below the top of the sample. The samples were left three days.

AJ 5/13/04

	Sample #1	Sample #2	Sample #3
Wt. of saturated sand sample + sample holder + wet filter paper + wire (gm)	183.88	351.24	353.7
Wt. of water left on balance (gm)	1.053	0.94	1.232
Wt. of wire + wet filter paper + sand on filter paper (gm)	2.905	3.2	3.14
Wt. of saturated sand sample (gm)	159.354	222.66	224.338

Filter paper and wire were removed from the samples before placing in the pressure extractor plate using 3 bar porous ceramic plate. The pressure applied was set at 1.0 bar through two pressure regulators in series. The samples were treated at 1.0 bar for 7 days.

AJ 5/20/04

The samples were then removed from pressure extractor and placed in pre-weighed beakers covered with glass Petri dishes. The weight of samples after pressure treatment is recorded and samples are then placed in the oven @ 95 C for drying.

	Sample #1	Sample #2	Sample #3
Wt. of glass beaker (gm)	104.07	103.65	107.41
Wt. of petri dish (gm)	42.26	45.438	45.366
Wt. of beaker + sample holder + sand sample (gm)	259.16	417.5	423.08
Wt. of sand sample after pressure treatment @ 1 bar for 7 days (gm)	134.522	189.41	190.68
Wt. of water removed from sand sample @1 bar (gm)	24.832	33.25	33.658

	Outflow cell sand sample from 4/27/04 run
Wt. of glass beaker (gm)	55.093
Wt. of petri dish (gm)	37.840
Wt. of sample holder + partially wet sand sample before putting in oven (gm)	134.13
Wt. of sand ample before putting in oven	116.743

The samples were then placed in the oven @ 95 C.

AJ 6/3/04

The samples were removed from the oven after 4 days and cooled in the desiccators before weighing.

	Sample #1	Sample #2	Sample #3
Wt. of beaker + petri dish + sample holder + sample after drying (gm)	299.63	459.81	465.33
Wt.of dried sample (gm)	132.732	186.282	187.564
Initial water content (gm)	26.622	36.378	36.774
Saturation @ 1.0 bars	6.72 %	8.60 %	8.47 %

	Outflow cell sand sample from 4/27/04 run
Wt. of beaker + petri dish + sample holder + sand	225.35

sample after drying (gm)	
Wt.of dried sand sample (gm)	115.03
Initial water content (gm)	23.243

AJ 6/10/04

Water Retention Data on Quartz using Pressure Plate Extractor:

	Sample #1	Sample #2	Sample #3
wt. of Sample holder (gm)	20.576	124.44	124.98
Wt. of sample holder + dry filter paper + wire (gm)	22.316	126.171	126.758
Wt. of dry filter paper + wire (gm)	1.740	1.731	1.778
Wt. of dry sand added to holder (gm)	132.25	186.38	185.05

Saturating the Sand samples: The sand samples were then placed in a container and the container was slowly filled with de-aerated water that is at a level just below the top of the sample. The samples were left for 3 days.

AJ 6/14/04

	Sample #1	Sample #2	Sample #3
Wt. of saturated sand sample + sample holder + wet filter paper + wire (gm)	183.85	352.02	351.8
Wt. of water left on balance (gm)	1.236	0.992	1.302
Wt. of wire + wet filter paper + sand on filter paper (gm)	3.208	3.368	3.307
Wt. of saturated sand sample (gm)	158.83	223.22	222.211

Filter paper and wire were removed from the samples before placing in the pressure extractor plate using 3 bar porous ceramic plate. The pressure applied was set at 0.6 bars through two pressure regulators in series. The samples were treated at 0.6 bars for 8 days.

AJ 6/23/04

The sand samples were then removed from pressure extractor and placed in beakers covered with glass Petri dishes. The sand samples are weighed and placed in the oven for drying.

	Sample #1	Sample #2	Sample #3
Wt. of glass beaker (gm)	104.11	103.67	107.42
Wt. of petri dish (gm)	42.261	45.437	45.365
Wt. of beaker+ petri dish + sample holder + sand sample (gm)	259.54	462.88	466.76
Wt. of sand sample after pressure treatment @ 0.6 bar for 8 days (gm)	134.854	189.333	188.995
Wt. of water removed from sand sample @ 0.6 bar (gm)	23.976	33.887	33.216

The sand samples were then placed in the oven @ 95 C for six days

AJ 6/30/04

The sand samples were removed from the oven after 4 days and cooled in the desiccators before weighing.

	Sample #1	Sample #2	Sample #3
Wt. of beaker + Petri dish + sample holder + sand sample after drying (gm)	298.86	459.51	462.49
Wt. of dried sand sample (gm)	131.913	185.963	184.725
Initial water content (gm)	26.917	37.257	37.486
Saturation of sand @ 0.6 bars	10.93 %	9.05 %	11.39 %

AJ 6/24/04 – 7/30/04

Water Retention characteristics on Quartz Sand Using Outflow Cell:
Weight of sample holder = 17.394 gm
Weight Of filter paper = 0.641 gm
Weight of filter paper +wire = 1.641 gm
Weight of dry sand added to sample holder = 111.81 gm

The filter paper is tied with a metal wire on one side of the sample holder to hold the sand in sample holder.
The sample and porous ceramic plate are saturated following the procedure on page 19.
The set up used is same as on page 34.

Weight of saturated sand + wet filter paper + wire + sample holder =157.64 gm
Weight of water left on scale + Weight of wet filter paper removed from sample with some sand grains + wire = 3.927gm
Weight of saturated sand = 157.64- 3.927-17.394 = 136.319 gm

Water Level in burette (ml)	Transducer reading Capillary Pressure (inches of H2O)	Air Supply Pressure (inches of H2O)
21.8	-1.46	0
21.1	-1.16	27.68
20.2	-1.18	27.68
19.4	-1.18	27.68
18.5	9.53	27.68
18.2	13.80	27.68
17.7	14.88	27.68

17.1	16.09	41.52
16.4	16.21	41.52
15.9	16.13	41.52
14.9	17.72	41.52
14.4	17.82	41.52
13.5	18.99	41.52
12.8	18.98	41.52
11.7	19.06	41.52
10.6	20.30	41.52
9.0	20.82	41.52
8.0	21.36	41.52
7.0	22.09	41.52
6.4	22.62	41.52
5.4	22.98	55.36
4.4	24.00	55.36
11.3.39	24.95	55.36
2.3	27.04	55.36
1.4	29.84	55.36
1.1	31.12	55.36
1.0	Average 35.04	83.04
0.7	Average 50.31	110.72
0.4	Average 63.18	138.4
0.0	Average 71.96	193.76

AJ 7/6/04

Water Retention Data on vitric tuff rock sample BB3 using Pressure Plate Extractor:

Sample Preparation:

Calculated BB3 density = 1.26 g/ cm^3 and the amount of dry BB3 sample required to pack in each sample holder can be calculated using $M= \rho_B V=1.26V$

Sample Holder #1	Height, H (inches)	Diameter (inches)	Radius, R (inches)	Volume $V= \pi R^2 H$ (in^3)	Volume (cm^3)	Wt. of dry sample required (gm)
	1.3080	1.8945				
	1.3085	1.8980				
	1.3080	1.8895				
	1.3075	1.8935				
Average	1.308	1.8939	0.9469	3.68	60.35	76.04

Sample Holder #2	Height, H (inches)	Diameter (inches)	Radius, R (inches)	Volume $V= \pi R^2 H$ (in^3)	Volume (cm^3)	Wt. of dry sample required (gm)
	1.9920	1.9870				
	1.9860	1.9830				
	1.9900	1.9935				
	1.9930	1.9910				
	1.9940	1.9890				
Average	1.9910	1.9887	0.9944	6.18	101.29	127.63

Sample Holder #3	Height, H (inches)	Diameter (inches)	Radius, R (inches)	Volume $V= \pi R^2 H$ (in^3)	Volume (cm^3)	Wt. of dry sample required (gm)
	1.9890	2.0010				
	1.9920	2.0035				
	1.9800	2.0030				
	1.9885	1.9995				
	1.9850	1.9995				
Average	1.9869	2.0013	1.0007	6.2470	102.37	128.99

Sample Holder #4	Height, H (inches)	Diameter (inches)	Radius, R (inches)	Volume $V= \pi R^2 H$ (in^3)	Volume (cm^3)	Wt. of dry sample required (gm)
	1.4600	1.1020				
	1.4640	1.0860				
	1.4630	1.0970				
	1.4600	1.0975				
	1.4610	1.1015				
Average	1.4616	1.0968	0.5484	1.38	22.62	28.50

Place enough sample to pack the desired number of sample holders in a plastic bag, such as Ziploc bag. Add sufficient water to the sample to make it slightly cohesive. A water content of about 5% (weight basis) is generally suitable for sands, 8 to 10% is suitable for soils of finer texture. A water content of ~ 6% was used for BB3 samples. Close the bag to minimize evaporation of water, and mix the sample thoroughly three to five times over a period of 2-3 days to allow the

water to distribute throughout the sample. From the volume of the sample holder, V, the desired bulk density, ρ_B, and the water content of the sample, p_w, calculate the weight of the moist sample, M, that will give the desired bulk density in the sample holder.

$$M = \rho_B (1+ p_w) V$$

Weight of BB3 sample placed in Ziploc plastic bag = 354.5 gm
Weight of water added to bag = 20 ml

Weight of sample holder #1 = 20.568 gm, weight of screen and rubber band = 2.66 gm

Weight of sample holder #4 = 29.437 gm, weight of screen and rubber band = 2.362 gm

Weight of sample holder #5 = 29.432 gm

AJ 7/7/04

BB3 sample in Ziploc bag is mixed thoroughly to distribute the water throughout the sample.
Weight of sample holder #2 = 124.43 gm, weight of filter paper and rubber band = 3.142 gm

Weight of sample holder #3 = 124.98 gm, weight of filter paper and rubber band = 1.778 gm

AJ 7/8/04

BB3 sample in Ziploc bag is mixed thoroughly to distribute the water throughout the sample.
Weight of wet BB3 sample required to pack in sample holder #1 = $\rho_B (1+ p_w) V$ = 1.26(1+5.5%) 60.35 = 80.22 gm

Weight of wet BB3 sample required to pack in sample holder #2 = $\rho_B (1+ p_w) V$ = 1.26(1+5.5%) 101.29 = 134.65 gm

Weight of wet BB3 sample required to pack in sample holder #3 = $\rho_B (1+ p_w) V$ = 1.26(1+5.5%) 128.99 = 171.47 gm

Weight of wet BB3 sample required to pack in sample holder #4 = $\rho_B (1+ p_w) V$ = 1.26(1+5.5%) 22.62 = 30.07 gm

Weight of wet BB3 sample required to pack in sample holder #5 = $\rho_B (1+ p_w) V$

= 1.26(1+5.5%) 22.63 = 30.08 gm

Samples were packed but could not fit the required wet weight of the samples in the holder (e.g. sample holder could fit only 127 gm instead of 134.65 gm).

Saturating BB3 samples: The samples were then placed in a container and the container was slowly filled with de-aerated water that is at a level just below the top of the sample. The samples were left overnight.

AJ 7/9/04

	Sample #1	Sample #2	Sample #3	Sample #4
Wt. of saturated BB3 sample + sample holder + filter paper or screen + rubber band (gm)	130.67	291.46	291.02	67.123
Wt. of water left on balance (gm)	0.637	1.951	1.652	0.552
Wt. of saturated BB3 sample (gm)	106.805	161.937	162.61	34.772

Filter paper or screen and rubber band were not removed before placing the samples in the pressure extractor plate. A 3 bar porous ceramic plate is used for measurements. The pressure applied was set at 1.0 bar through two pressure regulators in series. The samples were treated at 1.0 bar for 10 days.
The weights ranging between 358 – 575 gm and plastic disks are used to impose an external load on the samples in order to maintain hydraulic contact between the plate and the samples.

The new o-rings, bushing and 5853 connectors for ace #7 threads on burette are received and connected to the T-end of burette with ace threads. A pressure of 13.5 psi was applied and burette was isolated from the supply.

AJ 7/12/04
The pressure gage connected at T-end of burette with ace threads is reading ~ 5.0 psi. The pressure dropped from 13.5 psi to 5 psi in 2 days indicating a slow leak. The metal fittings connecting the gage and push to connect fittings are sealed with RTV 748 and left overnight to cure.

AJ 7/13/04
A pressure of 13.5 psi is applied to the T-end of burette with ace threads and leaves it overnight.

AJ 7/14/04
The pressure applied to the T-end of burette with ace threads dropped from 13.5 psi to 9 psi in 1 day indicating a slow leak. The space between bushing and 5853 connector is sealed with RTV 748 and left overnight to cure.

AJ 7/15/04
A pressure of 13.5 psi is applied to the T-end of burette with ace threads and leaves it overnight.

AJ 7/16/04
The pressure applied to the T-end of burette with ace threads dropped from 13.5 psi to 10 psi in 1 day indicating a slow leak. The space between ace threads on burette and bushing is sealed with RTV 748 and left overnight to cure.

Water Retention Data on Quartz using Pressure Plate Extractor:

	Sample #6	Sample #7	Sample #8	Sample #9
wt. of sample holder (gm)	124.53	75.797	125.19	52.035
Wt. of sample holder + dry filter paper + rubber band (gm)	126.70	76.831	126.68	53.483
Wt. of sample holder + dry filter paper + rubber band + dry sand (gm)	310.00	217.01	317.14	249.58
Wt. of dry sand added to holder (gm)	183.300	140.179	190.46	196.097

AJ 7/19/04
A pressure of 7.9 psi is applied to the T-end of burette with ace threads and leaves it overnight.

BB3 samples are removed from extractor plate after treatment @ 1 bar for 10 days. The samples are transferred to pre-weighed beakers, reweighed and covered with Petri dish.

	Sample #1	Sample #2	Sample #3	Sample #4
Wt. of glass beaker (gm)	104.07	103.63	107.42	55.091
Wt. of petri dish (gm)	42.262	45.435	45.364	37.843
Wt. of beaker+ sample holder + BB3 sample (gm)	205.24	351.56	359.18	111.06
Wt. of BB3 sample after pressure treatment @ 1.0 bar for 10 days (gm)	80.602	123.50	126.78	26.532
Wt. of water removed from BB3 sample @1 bar (gm)	26.203	38.437	35.83	8.24

BB3 samples were then placed in the oven @ 95 C for four days.

AJ 7/20/04
The pressure applied to the T-end of burette with ace threads dropped from 7.9 psi to 3 psi in 1 day indicating leak.

	Sample #6	Sample #7	Sample #8	Sample #9
Wt. of saturated sand sample + sample	350.57	251.12	359.98	

holder + wet filter paper + rubber band (gm)				292.83
Wt. of water left on balance (gm)	1.89	3.634	2.738	2.551
Wt. of water left on balance + wet filter paper + rubber band +sand on filter paper (gm)	7.128	7.814	7.200	6.998
Wt. of saturated sand sample (gm)	218.912	167.509	227.59	233.797

Filter paper and rubber band were removed from the sand samples before placing in the pressure extractor plate using 3 bar porous ceramic plate. The pressure applied was set at 0.6 bars through two pressure regulators in series. The samples were treated at 0.6 bars for 8 days.

AJ 7/21/04
A pressure of 7.9 psi is applied to the T-end of burette with ace threads and leaves it overnight.

AJ 7/22/04
The pressure applied to the T-end of burette with ace threads dropped from 7.9 psi to 5 psi in 1 day indicating a slow leak. Apply RTV 748 on other bushing and leave it to cure overnight.

AJ 7/23/04
A pressure of 7.9 psi is applied to the t-end of burette with ace threads and leaves it overnight.

BB3 samples are removed from the oven after 4 days and cooled in the desiccators before weighing.

	Sample #1	Sample #2	Sample #3	Sample #4
Wt. of beaker + Petri dish + sample holder + BB3 sample after drying (gm)	241.45	389.99	396.18	146.94
Wt. of dried sample (gm)	74.55	116.495	118.416	24.569
Initial water content (gm)	32.255	45.442	44.194	10.203
Saturation @ 1.0 bar	18.8 %	15.4 %	18.9 %	19.2 %

AJ 7/26/04
The pressure applied to the T-end of burette with ace threads dropped from 7.9 psi to 3psi in three days indicating a slow leak. Apply RTV 748 on tubing and metal nut and leave it to cure overnight.

A new burette with barbed end bubbler tubes at the T-end received from Specialty Glass, Inc. Barbed end bubbler tube O.D. is larger than ¼" and it is difficult to fit ¼" tubing over it. The tubing is heated to slide over barbed ends. ParoScientific portable absolute pressure standard is connected to read pressure applied to T-end of the burette and reads 23.2 absolute psi

AJ 7/27/04
A pressure of 7.9 psi is applied to the t-end of burette with ace threads and leaves it overnight.

ParoScientific portable absolute pressure standard connected to barbed T-end of the burette reads 23.02 absolute psi.

AJ 7/28/04
The pressure to the t-end of burette with ace threads dropped from 7.9 psi to 6 psi in one day indicating a slow leak.

ParoScientific portable absolute pressure standard connected to barbed T-end of the burette reads 22.95 absolute psi. The ParoScientific portable absolute pressure standard is disconnected and a pressure gage is connected. The gage reads 9 psi.

The sand samples are removed from pressure extractor after treatment @ 0.6 bar for 8 days. The sand samples are transferred to pre-weighed beakers covered with glass Petri dishes. The sand samples weights after pressure treatment are recorded and are then placed in the oven @ 95 C for drying.

	Sample #6	Sample #7	Sample #8	Sample #9
Wt. of glass beaker (gm)	103.64	103.99	107.27	106.33
Wt. of petri dish (gm)	45.435	42.261	45.365	37.843
Wt. of beaker+ sample holder + sand sample (gm)	413.9	321.56	426.00	357.71
Wt. of sand sample after pressure treatment @ 0.6 bar for 8 days (gm)	185.73	141.773	193.54	199.345
Wt. of water removed from sample @0.6 bar (gm)	33.182	25.736	34.05	34.452

The samples were placed in the oven @ 95 C for drying.

AJ 7/30/04
The pressure gage connected to barb T-end of the burette reads 9 psi and indicates no leaks.

AJ 8/16/04
The pressure gage connected to barb T-end of the burette reads 8 psi after 2 weeks and indicate very slow leak.
The pressure gage connected to barb T-end of the burette is replaced with ParoScientific absolute pressure standard. ParoScientific absolute pressure standard reads applied pressure as 23.21 psia.

AJ 8/17/04

ParoScientific absolute pressure standard connected to barb T-end of the burette reads 23.21 psia and indicates no leak at this time.

The samples were removed from the oven after 20 days and cooled in the desiccators before weighing.

	Sample #6	Sample #7	Sample #8	Sample #9
Wt. of beaker + Petri dish + sample holder + sample after drying (gm)	456.38	361.55	467.84	392.42
Wt. of dried sample (gm)	182.775	139.502	190.015	196.212
Initial water content (gm)	36.137	28.007	37.575	37.585
Saturation @ 0.6 bar	8.2%	8.1%	9.4%	8.3%

AJ 8/18/04
ParoScientific absolute pressure standard connected to barb T-end of the burette reads 23.13 psia and indicate possibility of leak at this time.

The sand sample from outflow cell is removed and placed in pre-weighed beaker. The sand sample is then weighed and covered with petri dish. Finally, the sand sample is placed in oven @ 95 C for drying.

	Sand Sample
Wt. of glass beaker (gm)	55.092
Wt. of petri dish (gm)	43.273
Wt. of beaker+ sample holder + partially wet sand sample (gm)	202.36

AJ 8/19/04
ParoScientific absolute pressure standard connected to barb T-end of the burette reads 22.83 psia and indicates leak at this time.

AJ 8/20/04
ParoScientific absolute pressure standard connected to barb T-end of the burette reads 14.32 psia and indicates leak.

ParoScientific absolute pressure standard is now connected to ace threaded T-end of the burette and reads applied pressure as 23.15 psia.

AJ 8/23/04
ParoScientific absolute pressure standard connected to ace threaded T-end of the burette reads18.56 psia and indicates leak.

AJ 8/24/04
The tubing connected to barb T-end burette loosened and came apart. This tubing was initially heated for expansion to fit over barb ends. This connection

could have been possible cause of leak. The new tubing and Dwyer manometer are connected to retest the system. The push- to connect fittings are replaced with hard plumb fittings. The manometer reads applied pressure as 7.00 psi.

AJ 8/26/04
The manometer connected to barb T-end burette reads 5.80 psi. The pressure dropped from 7.00 psi to 5.80 psi and indicates leak. The fittings are tightened and pressure of 7.00 psi is applied.

AJ 8/27/04
The pressure dropped from 7.00 psi to 6.52 psi and indicates leak.The fittings were rechecked and tightened. The manometer reads applied pressure as 8.02 psi. The system is left over the weekened.

AJ 8/30/04
The manometer connected to barb T-end burette reads 6.02 psi. The pressure dropped from 8.02 psi to 6.02 psi and indicates leak.

A pressure of 8.02 psi is applied to the broken end burette with T-end using three-way push to connect fitting and leaves it overnight. The two sides of three way push to connect fitting has RTV 748.

AJ 8/31/04
The manometer connected to broken end burette with T-end using three-way push to connect fitting reads 7.46 psi. The pressure dropped from 8.02 psi to 7.46 psi and indicates leak.
The fittings are rechecked and tightened. A pressure of 8.02 is applied again and left overnight.

AJ 9/1/04
The manometer connected to broken end burette with T-end using three-way push to connect fitting reads 7.69 psi. The pressure dropped from 8.02 psi to 7.69 psi and indicates leak.

AJ 9/2/04
The pressure dropped further from 7.69 psi to 7.48 psi next day and indicates leak. The third end of push to connect three way fitting is also sealed with RTV 748 and left overnight to cure.

The push to connect fittings connected to T-end of burette with ace threads are replaced with hard plumbed fittings and a pressure of 7.0 psi is applied and left overnight.

AJ 9/3/04

A pressure of 8.00 psi is applied to broken end burette with T-end using three-way push to connect fitting (RTV on all three ends of three way fitting).

AJ 9/7/04
The manometer connected to broken end burette with T-end using three-way push to connect fitting reads 6.83si. The pressure dropped from 8.02 psi to 6.83psi and indicates leak.

The gage connected to T-end of burette with ace threads reads 2.0 psi indicating leak.

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09/13/04 AJ

Entries made into Scientific Notebook #584E for the period
September 30, 2003 to September 13, 2004 have been made by Alka Jain
(09/13/2004)

No original text or figures entered into this Scientific Notebook has been removed

09/13/2004 AJ

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GEOSCIENCES AND ENGINEERING DIVISION

SCIENTIFIC NOTEBOOK REVIEW CHECKLIST RECORD

Scientific Notebook No.: 584 E Date Turned In: 10/24/2006

Accomplished

✓	1. Initial entries per QAP-001
✓	2. Dating of entries
N/A	3. Corrections (crossed out, one line through w/initials/date)
✓	4. No White out used
✓	5. Page number visible on copy or original notebook
✓	6. In process entries per QAP-001
✓	7. Figure information present
✓	8. Text readable
✓	9. Copyrighted material is identified
✓	10. Permanent ink or type only
✓	11. Signing of entries (not required on each page)
N/A	12. Electronic media in the scientific notebook properly labeled
✓	13. NRC Supplementary Scientific Notebook Questions are addressed. (send completed form to P. Mackin)

Any discrepancies must be resolved before notebook closeout.

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I have reviewed this scientific notebook and find it in agreement with QAP-001.

Manager's Signature 10/24/2006 Date

Form QAP-01 (9/2006)