308 --- Q199702060004
Scientific Notebook #083

K_{air} K_{54T}

RECORD

CNWRA
CONTROLLED
COPY 083

RTG Ronald T Green

Terrie Perry

Note: This notebook was used by Terry Perry during the summer of 1993 prior to initiation of strict labbook protocol. This notebook is no longer in use but will be retained for reference. 12/6/94 RH RON GREEN

Pages 1 through 131 of this Scientific Notebook were reviewed for compliance with QAP-001 in response to Corrective Action Request 94-02. Corrections and clarifications were made as appropriate. In some cases, the date of a change will reflect the date of this review rather than the date of the original Scientific Notebook entry.

Randy Fish
Sw RF-QA
12/7/94

Table of Contents

Air Permeability

Pages 3 Through 6 Are Intentionally
Left Blank

06/22/93 TP

Initial Entries

Instrumentation

Date	Initial	Manufacturer	Model
6/22/93	TP	Brainard-Kilman, PO Box 1959 Stone Mtn, GA 30086	S-480 Permeability Cell
6/22/93	TP	Meriam Instrument Div. of Scott & Fetzer Co. Cleveland, Ohio 44102	10AA25WIN U-Tube Manometer 10" Range (no calibration needed)
6/22/93	TP	Meriam Instrument Cleveland, Ohio 44102	20DA X 40TM 80" Range (no calibration needed)
6/22/93	TP	Nullmatic Moore Products Co Spring House, PA	40-50 Serial# 14870-6113MK 50psi range Pressure regulator Gage Calibrated: 03-17-93 (0-60psi)
6/22/93	TP	Nullmatic Moore Products Co Spring House, PA	40-100 Serial# 14870-7/14 MR 100 psi range Gage Calibrated: 06-09-93 (0-100 psi)
6/22/93	TP	Liquid Carbonic Chicago, Ill 60603	UN1066 Nitrogen

Information potentially subject to copyright protection was redacted from this location. The redacted material is from a user manual for a U-Tube Manometer: Manufacturer was Brainard-Kilman, Stone Mountain, Georgia.

Air Permeability Experimental Setup

Information potentially subject to copyright protection was redacted from this location. The redacted material is from a user manual for an S480 Permeability Cell: Manufacturer was Miriam Instrument in Cleveland, Ohio.

Specimen Holder

B-K S480 Permeability Cell

06/18/93 TP

Sample: Ceramic
Length: 2 in
Diameter: 1.9 in
Confining Pressure: 45 psi
$\mu = 1.76 \times 10^{-5}$ N·s/m² (20°C & 1 atm)

dp = the change in pressure across the sample

Pe = pressure at the sample's exit

V = volume of air flowing at the sample exit measured over a period of time

t = time

dP(in Hg)	Pe(in H_2O)	V(ml)	t(s)
1.8	1.1	500	76.70
1.9	1.2	500	68.91
2.0	1.3	500	65.75
2.1	1.4	500	62.56
2.2	1.5	500	60.36
2.4	1.6	500	56.28
2.5	2.95	500	51.753
3.3	3.3	500	40.06
3.6	3.4	500	36.063
5.0	3.5	500	25.10

Q = volumetric flowrate = V/t

P_i = pressure at sample inlet = Pe(psia) + ΔP(psi)

Eqn. for air permeability obtained from ASTM D4525 Standard Test Method for Permeability of Rocks By Flowing Air

$$K = \frac{2 Q_e P_e \mu L}{(P_i^2 - P_e^2) A}$$

$$= \frac{2 Q_e P_e \mu L}{(P_i - P_e)(P_i + P_e) A} = \frac{2 Q_e P_e \mu L}{(dP)(P_i + P_e) A}$$

$$K = \frac{2 Q_e P_e \mu L}{dP (P_i + P_e) A}$$

K (m²) = permeability

A = cross sectional area of the sample

TP 06/18/93

The ~~atmospheric~~ exit pressure was converted absolute pressure assuming atmospheric pressure to be 14.7 psi.

The permeability was calculated by inputting the data into a QPRO spreadsheet.

The values obtained through the spreadsheet were then checked with several hand calculations.

Pages 12 and 13 Are Intentionally
Left Blank

06/01/93 TP

Media: Ceramic
Length: 2in
Diameter: 1.9 in
Conf. Pressure: 45 psi

dP(in Hg)	Pe(in H_2O)	V(ml)	t(s)
1.0	0.4	500	135.36
			133.88
			133.57
			tave = 134.27
1.5	0.8	500	86.88
			87.37
			87.39
			tave = 87.21
2.0	1.2	500	65.16
			65.26
			65.91
			tave = 65.44
2.2	1.4	500	59.46
			59.70
			59.55
			tave 59.57

dP(in Hg)	Pe(in H_2O)	V(ml)	t(s)
2.4	1.6	500	54.51
			54.72
			54.31
			tave = 54.51
2.6	1.9	500	49.06
			49.26
			48.95
			tave = 49.09
2.8	2.1	500	46.56
			46.50
			46.78
			tave = 46.61
3.0	2.3	500	43.34
			43.41
			43.41
			tave = 43.39
3.2	2.5	500	39.80
			40.42
			40.31
			tave = 40.18
3.4	2.8		37.70
			37.81
			37.51
			tave = 37.67

TP 06/21/71

dPe (in Hg)	Pe (in H_2O)	V(ml)	t (s)
3.8	3.4	500	34.02
			33.92
			34.00
			tave = 33.98
			TP 06/21/71
4.0	3.6	500	32.27
			32.53
			32.52
			tave = 32.42
4.4	4.2	500	28.84
			28.98
			28.99
			tave = 28.94
4.6	4.5	500	27.58
			27.59
			27.80
			tave = 27.66
4.8	4.8	500	26.26
			26.31
			26.42
			tave = 26.33
5.0	5.1	500	25.51
			25.41
			25.61
			tave = 25.51

06/21/93 TP

Three times were taken at each differential pressure. The average of these times was then found. The times were averaged to reduce any human error in clocking the bubble.

The average times were used in calculating the flowrate as well as the permeability.

Pages 18 and 19 Are Intentionally
Left Blank

06/22/93 TP

Media: JRT B3
Length: 0.25 in
Diameter: 1.9 in
Weight: 23.5g

dP (in Hg)	Pe (in H_2O)	V (ml)	t (s)
18	atm (0.0)	10	148.12
			149.26
			149.66
		tav =	149.01
20	0.0	10	132.66
			134.16
			132.84
		tave =	133.22
22	0.0	10	120.74
			121.03
			121.51
		tave =	121.09
24	0.0	10	110.26
			111.21
			111.19
		tave =	110.89
26	0.0	10	101.56
			102.41
			102.38
		tave	102.12

06/22/93

dP (in Hg)	Pe (in H_2O)	V (ml)	t (s)
28	0.0	10	93.64
			94.42
			93.91
		tave =	93.99
30	0.0	10	91.11
			89.46
			88.75
		tave =	89.77
31	0.0	10	86.73
			85.27
			85.40
		tave =	85.80
35	0.0	10	76.13
			75.64
			75.31
		tave =	75.69
40	0.0	10	65.08
			65.21
			65.03
		tave =	65.11
45	0.0	10	56.20
			56.36
			56.36
		tave =	56.31

dP(in Hg)	Pe (in H_2O)	V(ml)	t(s)
50	0.0	10	51.93
			51.01
			50.85
		tave =	51.26
55	0.0	10	46.40
			45.50
			45.51
		tave =	45.80
60	0.0	10	42.16
			41.74
			41.20
		tave =	41.70
65	0.0	10	38.42
			37.93
			37.59
		tave	37.98
70	0.0	10	35.50
			34.53
			34.82
		tave	34.95

Referenced disk cannot be located.

Above is the disk contained the programs used to evaluate the air permeability.

For the bubble flow mete
program: AIRBUBBLE.BAS

For digital flowmeter
program: AIRFLOW.BAS

06/23/93 TP

Media: ALT. B4
Diameter: 1.9 in
Length:
Weight:
* visible fracture across rock

dP(inHg)	Pe (in H_2O)	V(ml)	t(s)
2	0.0	10	41.51
			41.58
			41.16
			tave 41.42
4	0.0	10	21.45
			21.26
			21.30
			tave 21.34
6	0.0	10	14.32
			14.34
			14.52
			tave 14.39

Test terminated;
Volume changed to increase time.

8	0.0	100	99.10
			98.66
			99.82
			tave 99.19

dP (in Hg)	Pe (in H_2O)	V (ml)	t (s)
10	0.0	100	79.52
			77.45
			79.05
			tave 78.67
12	0.0	100	67.46
			67.32
			67.82
			tave 67.53
14	0.0	100	57.69
			58.33
			57.72
			tave 57.91
16	0.2	100	54.52
			53.56
			53.99
			tave 54.02
18	0.2	100	47.79
			47.79
			47.92
			tave 47.83
20	0.2	100	43.34
			42.39
			42.43
			tave 42.79

dP (in Hg)	Pe (in H_2O)	V (ml)	t (s)
22	0.2	100	38.87
			39.27
			39.26
			tave ~~78.67~~ 39.13
			39.11
24	0.2	100	35.86
			36.80
			35.31
			tave 35.99
26	0.4	100	32.53
			33.10
			32.63
			tave 32.75
28	0.4	100	30.37
			30.77
			30.35
			tave 30.50
30	0.4	100	28.34
			28.34
			28.42
			tave 28.37
32	0.5	100	26.55
			26.35
			26.82
			tave 26.57

dP (in Hg)	Pe (in H_2O)	V (ml)	t (s)
34	0.5	100	25.16
			24.86
			24.90
			tave 24.97
36	0.5	100	23.27
			23.40
			23.36
			tave 23.34
38	0.6	100	22.16
			21.84
			22.19
			tave 22.06
40	0.6	100	21.44
			20.98
			21.34
			tave 21.25
42	0.7	100	20.07
			20.40
			19.81
			tave 20.09
44	0.7	100	18.94
			19.24
			18.92
			tave 19.03

dP (in Hg)	Pe (in H_2O)	V (ml)	t (s)
46	0.7	100	18.15
			18.43
			18.39
			tave 18.32
48	TP 06/23 0.7	100	17.77
			17.53
			17.56
			tave 17.62
50	0.8	100	17.09
			17.09
			16.87
			tave 17.02
6	0.0	100	127.53
			127.52
			125.27
			tave 126.77

Pages 30 and 31 Are Intentionally
Left Blank

07/01/93

Media : JRT.B2
Diameter : 1.9"
Length :
Weight : 28.299g

dP(in Hg)	Pe(in H_2O)	V(ml)	t(s)
30	0.0	10	147.57
			148.79
			147.90
		tave =	147.89
40	0.0	10	108.10
			108.61
			107.79
		tave	108.17
48	0.0	10	88.52
			88.21
			87.75
		tave	88.16
50	0.0	10	84.75
			85.00
			85.08
			84.94

dP(in Hg)	Pe(in H_2O)	V(ml)	t(s)
52	0.0	10	82.38
			81.84
			82.04
		tave	82.09
54	0.0	10	78.09
			78.06
			77.84
		tave	78.00
56	0.0		74.31
			74.22
			TP 07/01/93 73.88
		tave	74.14
58	0.0	10	71.58
			71.77
			71.85
		tave	71.73
60	0.0	10	68.92
			69.20
			67.76
			68.63
64	0.0	10	66.43
			66.28
			65.95
			66.22

dP (in Hg)	Pe (in H_2O)	V (ml)	t (s)
66	0.0	10	61.77
			61.14
			61.67
		tave	61.53
68	0.0	10	59.75
			59.46
			59.84
		tave	59.68
70	0.0	10	57.50
			57.40
			57.12
		tave	57.34
72	0.0	10	55.38
			55.69
			55.27
		tave	55.45
74	0.0	10	53.95
			53.70
			53.52
		tave	53.72
76	0.0	10	52.41
			51.99
			51.77
		tave	52.06

dP (in Hg)	Pe (in H_2O)	V (ml)	t (s)
TP07/01/93 ~~39~~ 78	0.0	10	50.50
			50.11
			50.05
		tave	50.22
79.6	0.0	10	49.21
			TP07/01/93 ~~2~~ 20 48.90
			48.72
		tave	48.94

Pages 36 and 37 Are Intentionally
Left Blank

07/07/93 TP

Media: NRG1, Bxy. 1
Length: .700 cm
Diameter: 1.9 in
Pconf: 60 psi

dP (in Hg)	Pe (in H_2O)	V (ml)	t (s)
2	atm (0.0)	10	TP 07/07/93 ~~61.58~~
			TP 07/07/93 ~~60~~
			180.13
			177.24
			179.96
		tave	179.11
4	(0.0)	10	91.12
			91.66
			91.05
		tave	91.28
6	0.0	10	61.58
			60.28
			60.38
		tave	60.75
8	0.0	10	44.85
			44.73
			44.24
		tave	44.61

dP (in Hg)	Pe (in H_2O)	V (ml)	t (s)
10	0.0	10	35.20
			34.98
			34.84
			tave = 35.01
15	0.0	10	TP 07/07/93 ~~35.20~~
			TP 07/07/93 ~~32.60~~
			22.40.
			22.26
			tave = 22.42
20	0.0	10	16.59
			16.38
			16.38
			tave = 16.45
25	0.0	100	124.02
			121.71
			125.38
			tave: 123.70
30	0.0	100	99.88
			101.81
			98.86
			tave: 100.18

dP (in Hg)	Pe (in H_2O)	V (ml)	t (s)
35	0.0	100	84.45
			84.17
			84.33
			tave: 84.32
40	0.0	100	70.89
			71.10
			71.04
			tave 71.01
45	0.1	100	61.23
			61.14
			61.91
			tave 61.43
50	0.2	100	54.00
			54.10
			54.16
			tave 54.09
55	0.2	100	48.77
			48.36
			48.32
			tave 48.48
60	0.25	100	43.39
			43.60
			43.99
			tave 43.66

dP (in Hg)	Pe (in H_2O)	V (ml)	t (s)
65	0.3	100	38.77
			38.50
			39.32
			tave 38.86
70	0.3	100	35.18
			35.48
			35.15
			tave 35.27
75	0.45	100	31.87
			32.45
			31.22
			tave 31.85
80	0.45	100	29.07
			29.39
			29.34
			tave 29.27

SAMPLE: NRG1.BXY.1
DIAMETER: 5.01 cm
LENGTH: 0.70 cm

dP (in Hg)	Pe (in H20)	2/(Pi+Pe) Pa^-1	Vol (ml)	Time (s)	Q (ml/s)	k (m^2)
2	0.00	9.55E-06	10	179.11	0.056	4.99E-16
4	0.00	9.25E-06	10	91.28	0.110	4.74E-16
6	0.00	8.97E-06	10	60.75	0.165	4.60E-16
8	0.00	8.70E-06	10	44.61	0.224	4.56E-16
10	0.00	8.45E-06	10	35.01	0.286	4.52E-16
15	0.00	7.89E-06	10	22.42	0.446	4.39E-16
20	0.00	7.40E-06	10	16.45	0.608	4.21E-16
25	0.00	6.96E-06	100	123.7	0.808	4.21E-16
30	0.00	6.57E-06	100	100.18	0.998	4.09E-16
35	0.00	6.23E-06	100	84.32	1.186	3.95E-16
40	0.00	5.91E-06	100	71.01	1.408	3.90E-16
45	0.10	5.63E-06	100	61.43	1.628	3.81E-16
50	0.20	5.37E-06	100	54.09	1.849	3.72E-16
55	0.20	5.14E-06	100	48.48	2.063	3.61E-16
60	0.25	4.93E-06	100	43.66	2.290	3.52E-16
65	0.30	4.73E-06	100	38.86	2.573	3.50E-16
70	0.30	4.55E-06	100	35.27	2.835	3.45E-16
75	0.45	4.38E-06	100	31.85	3.140	3.43E-16
80	0.45	4.22E-06	100	29.27	3.416	3.38E-16

07/08/93 TP

Media = NRG1.BZ.1
Length = .75cm
Diameter = 5.01cm
Weight = 26.864g

ΔP (in Hg)	Pe (in H_2O)	V (ml)	t (s)
2	0.0	10	193.69
			195.99
			197.24
		tave =	195.64
4	0.0	10	97.59
			98.12
			98.34
		tave =	98.02
6	0.0	10	64.34
			63.87
			63.79
		tave	64.0
8	0.0	10	47.66
			47.97
			47.84
			47.82

ΔP (in Hg)	Pe (in H_2O)	V (ml)	t (s)
~~10 TP 07/08/93~~	~~0.0~~	~~10~~	~~24.38~~
		TP 07/08/93	~~24.56~~
		TP 07/08/93	~~24.45~~
10	0.0	10	37.34
			37.87
			37.48
		tave	37.56
~~15 TP 07/08/93~~ ~~12~~	0.0	10	24.38
			24.56
			24.45
		tave	24.46
20	0.0	10	17.99
			18.10
			18.03
		tave	18.04
Increase Volume			
20	0.0	100	177.10
			176.85
			173.59
		tave	176.85
25	0.0	100	134.84
			135.50
			135.64
			135.33

07/08/93 TP

ΔP (in Hg)	Pe (in H_2O)	V (ml)	t (s)
30	0.0	100	109.38
			110.99
			111.24
		tave	110.54
35	0.0	100	94.12
			94.13
			94.46
		tave	94.24
40	0.0	100	80.73
			79.77
			79.91
		tave	80.14
45	0.1	100	70.75
			69.86
			69.93
		tave	70.18
50	0.1	100	60.48
			61.56
			61.38
		tave	61.14
55	0.1	100	55.45
			54.29
			53.95
		tave	54.56

ΔP (in Hg)	Pe (in H_2O)	V (ml)	t (s)
60	0.2	100	48.74
			48.52
			48.63
		tave	48.63
65	0.2	100	44.20
			44.84
			43.93
		tave	44.32
70	0.25	100	39.88
			39.99
			40.17
		tave	40.01
75	0.3	100	37.59
			36.78
			36.50
			36.95
80	0.3	100	33.69
			33.87
			33.88
			33.81

MEDIA: NRG1.BZ.1

LENGTH (m)	0.0075
DIAMETER (m)	0.0501
u (Ns/m^2)	1.76E-05

RECORDED DATA							
Volume (ml)	10	10	10	10	10	10	10
t (sec)	195.64	98.02	64.00	47.82	37.56	24.46	18.04
dP (in Hg)	2.00	4.00	6.00	8.00	10.00	15.00	20.00
Pe (in H20)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CALCULATIONS							
Volume (m^3)	1E-05	1E-05	1E-05	1E-05	1E-05	1E-05	1E-05
t (sec)	195.64	98.02	64.00	47.82	37.56	24.46	18.04
dP (Pa)	6772.78	13545.55	20318.33	27091.11	33863.88	50795.82	67727.76
Pe (Pa)	101325.00	101325.00	101325.00	101325.00	101325.00	101325.00	101325.00
Pi (Pa)	108097.78	114870.55	121643.33	128416.11	135188.88	152120.82	169052.76
Q (ml/s)	0.05111	0.10202	0.15625	0.20912	0.26624	0.40883	0.55432
2/(Pi+Pe) (1/kPa)	0.00955	0.00925	0.00897	0.00871	0.00846	0.00789	0.00740
k(m^2)	4.890E-16	4.727E-16	4.680E-16	4.559E-16	4.511E-16	4.309E-16	4.108E-16

RECORDED DATA													
Volume (ml)	100	100	100	100	100	100	100	100	100	100	100	100	100
t (sec)	176.85	135.33	110.54	94.54	80.14	70.18	61.14	54.56	48.63	44.32	40.01	36.95	33.81
dP (in Hg)	20.00	25.00	30.00	35.00	40.00	45.00	50.00	55	60	65	70	75	80
Pe (in H20)	0.00	0.00	0.00	0.00	0.00	0.10	0.10	0.1	0.2	0.2	0.25	0.3	0.3
CALCULATIONS													
Volume (m^3)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
t (sec)	176.85	135.33	110.54	94.54	80.14	70.18	61.14	54.56	48.63	44.32	40.01	36.95	33.81
dP (Pa)	67727.76	84659.70	101591.64	118523.59	135455.53	152387.47	169319.41	186251.35	203183.29	220115.23	237047.17	253979.11	270911.05
Pe (Pa)	101325.00	101325.00	101325.00	101325.00	101325.00	101349.88	101349.88	101349.88	101374.77	101374.77	101387.21	101399.65	101399.65
Pi (Pa)	169052.76	185984.70	202916.64	219848.59	236780.53	253737.35	270669.29	287601.23	304558.06	321490.00	338434.38	355378.76	372310.70
Q (ml/s)	5.655E-01	7.389E-01	9.046E-01	1.058E+00	1.248E+00	1.425E+00	1.636E+00	1.833E+00	2.056E+00	2.256E+00	2.499E+00	2.706E+00	2.958E+00
2/(Pi+Pe) (1/kPa)	7.397E-03	6.961E-03	6.574E-03	6.227E-03	5.915E-03	5.632E-03	5.376E-03	5.142E-03	4.927E-03	4.730E-03	4.547E-03	4.378E-03	4.222E-03
k(m^2)	4.190E-16	4.122E-16	3.972E-16	3.770E-16	3.697E-16	3.574E-16	3.524E-16	3.434E-16	3.385E-16	3.291E-16	3.255E-16	3.168E-16	3.130E-16

07/09/93 TP

Media: NRG2. BYx. 1
Length: 0.63 cm
Diameter 5.01 cm

ΔP (in Hg)	Pe (in H_2O)	V (ml)	t (s)
0	0.0	10	333.09
			329.27
			330.60
		tave	= 330.99
4	0.0	10	166.34
			166.22
			165.50
		tave	166.03
6	0.0	10	108.49
			108.55
			108.56
			108.53
8	0.0	10	80.40
			80.26
			80.37
		tave	80.34
10	0.0	10	07/09/93 TP 63.52 ~~63.72~~
			63.99
			63.66
		tave	63.72

TP 07/09/93

ΔP (in Hg)	Pe (in H_2O)	V (ml)	t (s)
15	0.0	10	41.37
			41.28
			41.44
		tave	41.36
20	0.0	10	30.03
			29.92
			30.33
		tave	30.09
25	0.0	10	23.53
			23.61
			23.42
		tave	23.52
30	0.0	10	19.18
			19.07
			19.02
		tave	19.09
Increase volume to 100 ml			
30	0.0	100	182.21
			184.88
			183.94
		tave	183.68
35	0.0	100	TP 07/09/93 155.~~62~~ 74
			157.59
			153.52
			155.62

TP 07/09/93

ΔP (in Hg)	Pe (in H_2O)	V (ml)	t (s)
40	0.0	100	132.06
			132.83
			132.08
		tave	132.32
45	0.0	100	116.27
			116.13
			116.48
		tave	116.29
50	0.0	100	102.22
			102.86
			103.26
		tave	102.78
55	0.0	100	91.34
			90.02
			89.35
		tave	90.24
60	0.0	100	81.12
			81.13
			82.01
		tave	81.42
65	0.0	100	73.16
			73.49
			73.32
		tave	73.32

TP 07/09/93

ΔP (in Hg)	Pe (in H_2O)	V (ml)	t (s)
70	0.1	100	66.74
			66.88
			65.88
		tave	66.50
75	0.1	100	60.28
			60.99
			60.68
		tave	60.65
80	0.15	100	54.76
			55.00
			54.88
		tave	54.88

SAMPLE: NRG2BYX1
DIAMETER: 5.01 cm
LENGTH: 0.63 cm

dP (in Hg)	Pe (in H20	2/(Pi+Pe) Pa^-1	Vol (ml)	Time (s)	Q (ml/s)	k (m^2)
2	0.00	9.55E-06	10	330.99	0.03	2.43E-16
4	0.00	9.25E-06	10	166.03	0.06	2.34E-16
6	0.00	8.97E-06	10	108.53	0.09	2.32E-16
8	0.00	8.70E-06	10	80.34	0.12	2.28E-16
10	0.00	8.45E-06	10	63.72	0.16	2.23E-16
15	0.00	7.89E-06	10	41.36	0.24	2.14E-16
20	0.00	7.40E-06	10	30.09	0.33	2.07E-16
25	0.00	6.96E-06	10	23.52	0.43	1.99E-16
30	0.00	6.57E-06	10	19.09	0.52	1.93E-16
30	0.00	6.57E-06	100	183.68	0.54	2.01E-16
35	0.00	6.23E-06	100	155.62	0.64	1.92E-16
40	0.00	5.91E-06	100	132.32	0.76	1.88E-16
45	0.00	5.63E-06	100	116.29	0.86	1.81E-16
50	0.00	5.38E-06	100	102.78	0.97	1.76E-16
55	0.00	5.14E-06	100	90.24	1.11	1.74E-16
60	0.00	4.93E-06	100	81.42	1.23	1.70E-16
65	0.00	4.73E-06	100	73.32	1.36	1.67E-16
70	0.10	4.55E-06	100	66.50	1.50	1.65E-16
75	0.10	4.38E-06	100	60.65	1.65	1.62E-16
80	0.15	4.22E-06	100	54.88	1.82	1.62E-16

07/12/93 TP

Media: NRG2.BZ.1
Length: 0.6 cm
Diameter: 5.01 cm
Confining Pressure: 62 psi

ΔP (in Hg)	Pe (in H_2O)	V (ml)	t (s)
2	0.0	10	104.41
			104.34
			104.30
		tave	104.35
4	0.0	10	51.0
			51.07
			51.22
		tave	51.10
6	0.0	10	32.71
			32.88
			32.58
		tave	32.72
TP 07/12/93 ~~8~~ 10	0.0	10	19.22
			19.25
			19.27
		tave	19.25
8 ~~10~~	0.0	10	24.39
			24.45
			24.48
		tave	24.44

TP 07/~~06~~12/93

ΔP (in Hg)	Pe (in H_2O)	V (ml)	t (s)
12	0.0	10	15.65
			15.58
			15.66
		tave	15.63
change volume to 100 ml			
12	0.0	100	155.22
			155.30
			154.46
		tave	154.99
15	0.0	100	116.72
			116.24
			115.62
		tave	116.19
20	0.0	100	81.32
			82.59
			82.59
		tave	82.17
25	0.1	100	63.27
			62.94
			64.71
		tave	63.64
30	0.2	100	48.15
			48.31
			48.39
			48.28

TP 07/12/93

ΔP (in Hg)	Pe (in H_2O)	V (ml)	t (s)
35	0.2	100	41.01
			41.09
			41.19
		tave	41.10
40	0.3	100	34.16
			34.48
			34.41
			34.35
45	0.4	100	29.58
			29.51
			29.52
			29.54
50	0.5	100	25.18
			25.38
			24.87
			25.14
55	0.6	100	21.91
			21.95
			21.76
			21.87
60	0.70	100	19.2
			19.35
			18.91
			19.15

07/12/93 TP

ΔP (in Hg)	Pe (in H_2O)	V (ml)	t (s)
65	0.80	100	16.26
			17.02
			16.74
			16.67
70	1.0	100	14.90
			14.97
			15.12
			15.00
75	1.2	100	12.99
			13.33
			13.10
			13.14
8	1.4	100	11.55
			11.81
			11.79
			11.72

SAMPLE: NRG2.BZ.1
DIAMETER: 5.01 cm
LENGTH: 0.60 cm

dP (in Hg)	Pe (in H2	2/(Pi+Pe)	Vol (ml)	Time (s)	Q (ml/s)	k (m^2)
2	0.00	9.55E-06	10	104.35	0.10	7.33E-16
4	0.00	9.25E-06	10	51.10	0.20	7.25E-16
6	0.00	8.97E-06	10	32.72	0.31	7.32E-16
10	0.00	8.45E-06	10	19.25	0.52	7.04E-16
8	0.00	8.70E-06	10	24.44	0.41	7.14E-16
12	0.00	8.22E-06	10	15.63	0.64	7.03E-16
12	0.00	8.22E-06	100	154.99	0.65	7.09E-16
15	0.00	7.89E-06	100	116.19	0.86	7.26E-16
20	0.00	7.40E-06	100	82.17	1.22	7.22E-16
25	0.10	6.96E-06	100	63.64	1.57	7.01E-16
30	0.20	6.57E-06	100	48.28	2.07	7.28E-16
35	0.20	6.22E-06	100	41.10	2.43	6.94E-16
40	0.30	5.91E-06	100	34.35	2.91	6.90E-16
45	0.40	5.63E-06	100	29.54	3.39	6.80E-16
50	0.50	5.37E-06	100	25.14	3.98	6.86E-16
55	0.60	5.14E-06	100	21.87	4.57	6.86E-16
60	0.70	4.92E-06	100	19.15	5.22	6.88E-16
65	0.80	4.73E-06	100	16.67	6.00	7.01E-16
70	1.00	4.54E-06	100	15.00	6.67	6.95E-16
75	1.20	4.37E-06	100	13.14	7.61	7.14E-16
80	1.40	4.22E-06	100	11.72	8.53	7.24E-16

TP 07/13/93

Media: NRG2 .Bxy.2

Length: .64 cm

Diameter: .0501 m

ΔP (in Hg)	Pe (in H_2O)	V (ml)	t (s)
4	0.0	10	189.82
			189.87
			188.09
		tave	189.26
6	0.0	10	121.74
			122.06
			122.21
		tave	122.00
8	0.0	10	93.98
			92.56
			91.95
		tave	92.83
10	0.0	10	72.58
			72.49
			72.85
		tave	72.64
12	0.0	10	59.70
			59.66
			59.05
		tave	59.47

TP 07/13/93

ΔP (in Hg)	Pe (in H_2O)	V (ml)	t (s)
15	0.0	10	47.02
			46.63
			46.27
		tave	46.64
20	0.0	10	34.43
			34.30
			34.31
		tave	34.35
25	0.0	10	26.75
			26.84
			26.89
		tave	26.83
30	0.0	10	21.83
			21.73
			21.74
		tave	21.77
Increase Volume			
30	0.0	100	210.55
			208.89
			212.06
		tave	210.50
35	0.0	100	178.46
			176.50
			177.95
		tave	177.64

TP 07/13/93

ΔP (in Hg)	Pe (in H_2O)	V (ml)	t (s)
40	0.0	100	150.74
			152.74
			152.63
			tave 152.04
45	0.0	100	132.51
			134.56
			134.27
			tave 133.78
50	0.0	100	117.58
			118.59
			117.96
			tave 118.04
55	0.0	100	105.53
			103.13
			104.00
			tave 104.22
60	0.0	100	93.66
			93.91
			92.52
			tave 93.36
65	0.0	100	84.59
			83.95
			85.02
			tave 84.52

TP 07/13/93

ΔP (in Hg)	Pe (in H_2O)	V (ml)	t (s)
70	0.1	100	77.92
			76.66
			77.71
			tave 77.43
75	0.1	100	70.43
			69.79
			70.45
			tave 70.22
80	0.1	100	63.63
			62.42
			64.28
			63.44

SAMPLE: NRG2BXY2
DIAMETER: 5.01 cm
LENGTH: 0.64 cm

dP (in Hg)	Pe (in H2	2/(Pi+Pe)	Vol (ml)	Time (s)	Q (ml/s)	k (m^2)
4	0.00	9.25E-06	10	189.26	0.05	2.09E-16
6	0.00	8.97E-06	10	122.00	0.08	2.10E-16
8	0.00	8.70E-06	10	92.83	0.11	2.00E-16
10	0.00	8.45E-06	10	72.64	0.14	1.99E-16
12	0.00	8.22E-06	10	59.47	0.17	1.97E-16
15	0.00	7.89E-06	10	46.64	0.21	1.93E-16
20	0.00	7.40E-06	10	34.35	0.29	1.84E-16
25	0.00	6.96E-06	10	26.83	0.37	1.77E-16
30	0.00	6.57E-06	10	21.77	0.46	1.72E-16
30	0.00	6.57E-06	100	210.50	0.48	1.78E-16
35	0.00	6.23E-06	100	177.64	0.56	1.71E-16
40	0.00	5.91E-06	100	152.04	0.66	1.66E-16
45	0.00	5.63E-06	100	133.78	0.75	1.60E-16
50	0.00	5.38E-06	100	118.04	0.85	1.56E-16
55	0.00	5.14E-06	100	104.22	0.96	1.53E-16
60	0.00	4.93E-06	100	93.36	1.07	1.50E-16
65	0.00	4.73E-06	100	84.52	1.18	1.47E-16
70	0.10	4.55E-06	100	77.43	1.29	1.44E-16
75	0.10	4.38E-06	100	70.22	1.42	1.42E-16
80	0.10	4.22E-06	100	63.44	1.58	1.42E-16

07/13/93 TP

Media: NRG2.BXY.2

Length: 0.64 cm

Diameter: .0501 m

The soap bubble meter is replaced with ADM 1000 Intelligent Flowmeter.

ΔP	Pe	Q (ml/min)
2.0	0.0	1.23
4.0	0.0	2.69
6.0	0.0	4.13
8.0	0.0	5.68
10.0	0.0	7.23
12.0	0.0	8.80
15.0	0.0	11.2
20.0	0.0	15.7
25.0	0.0	20.2
30.0	0.0	24.8
35.0	0.0	29.9
40.0	0.0	35.1
45.0	0.0	40.5
50.0	0.0	46.1
55.0	0.10	51.9
60.0	0.15	58.3
65.0	~~0.20~~ 0.15 TP 07/13	64.9
70.0	~~0.25~~ 0.20 TP 07/13	71.6
75.0	0.25	79.4
80.0	0.30	86.8

SAMPLE: NRG2.BXY.2
DIAMETER: 5.01 cm
LENGTH: 0.60 cm

dP (in Hg)	Pe (in H2	2/(Pi+Pe) Pa^-	Q (ml/min	Q (ml/s)	k (m^2)
2	0.00	9.55E-06	1.23	0.02	3.46E-16
4	0.00	9.25E-06	2.69	0.04	3.78E-16
6	0.00	8.97E-06	4.13	0.07	3.87E-16
8	0.00	8.70E-06	5.68	0.09	3.99E-16
10	0.00	8.45E-06	7.23	0.12	4.07E-16
12	0.00	8.22E-06	8.8	0.15	4.12E-16
15	0.00	7.89E-06	11.2	0.19	4.20E-16
20	0.00	7.40E-06	15.7	0.26	4.42E-16
25	0.00	6.96E-06	20.2	0.34	4.54E-16
30	0.00	6.57E-06	24.8	0.41	4.65E-16
35	0.00	6.23E-06	29.9	0.50	4.81E-16
40	0.00	5.91E-06	35.1	0.59	4.94E-16
45	0.00	5.63E-06	40.5	0.68	5.06E-16
50	0.00	5.38E-06	46.1	0.77	5.19E-16
55	0.10	5.14E-06	51.9	0.87	5.31E-16
60	0.15	4.93E-06	58.3	0.97	5.47E-16
65	0.15	4.73E-06	64.9	1.08	5.62E-16
70	0.20	4.55E-06	71.6	1.19	5.75E-16
75	0.25	4.38E-06	79.4	1.32	5.95E-16
80	0.30	4.22E-06	86.8	1.45	6.10E-16

07/15/93 TP

Media: NRG2 BZ2
Length: 0.60cm

ΔP (in Hg)	Pe (in H_2O)	Q (mL/min)
2	—	3.79
4	—	8.05
6	—	12.4
8	—	17.2
10	—	not stable
12	0.05	22.3
15	0.05	38.0
20	0.10	55.7
25	0.20	77.3
30	0.25	102
35	0.30	131
40	0.7	166
45	0.9	210
50	1.2	256
55	1.7	319
60	2.1	374
65	2.8	449
70	3.~~8~~5 TP07/15	522
75	4.5	615
80	5.5	overflow

SAMPLE: NRG2.BZ.2
DIAMETER: 5.01 cm
LENGTH: 0.64 cm

dP (in Hg)	Pe (in H20)	2/(Pi+Pe) Pa^-1	Q (ml/min	Q (ml/s)	k (m^2)
2	0.00	9.55E-06	3.79	0.06	1.05E-15
4	0.00	9.25E-06	8.05	0.13	1.11E-15
6	0.00	8.97E-06	12.4	0.21	1.14E-15
8	0.00	8.70E-06	17.2	0.29	1.19E-15
12	0.05	8.22E-06	22.3	0.37	1.03E-15
15	0.05	7.89E-06	38.0	0.63	1.40E-15
20	0.10	7.39E-06	55.7	0.93	1.54E-15
25	0.20	6.96E-06	77.3	1.29	1.71E-15
30	0.25	6.57E-06	102	1.70	1.88E-15
35	0.30	6.22E-06	131	2.18	2.07E-15
70	0.70	4.54E-06	166	2.77	1.31E-15
45	0.90	5.63E-06	210	3.50	2.58E-15
50	1.20	5.37E-06	256	4.27	2.84E-15
55	1.70	5.13E-06	319	5.32	3.21E-15
60	2.10	4.91E-06	374	6.23	3.45E-15
65	2.80	4.71E-06	449	7.48	3.82E-15
70	3.50	4.53E-06	522	8.70	4.13E-15
75	4.50	4.36E-06	615	10.25	4.54E-15

07/19/93

Media: NRG1 BYX1
Length: 0.63 cm

ΔP (in Hg)	Pe (in H_2O)	Q (mL/min)
0.2	–	1.49
0.4	–	3.90
0.6	–	5.00
0.8	–	7.82
1.0	–	8.55
2.0	–	17.4
4.0	–	34.3
6.0	0.1	51.7
8	0.15	69.1
10	0.3	86.3
12	0.3	104
15	0.5	131
20	0.7	176
25	1.05	222
30	1.3	271
35	1.7	320
40	2.1	367
45	2.5	416
50	3.0	467
55	3.5	518
60	4.1	563
65	4.7	615
70	5.3	666
75	6.0	730
80	6.7	793

SAMPLE: NRG1BYX1
DIAMETER: 5.01 cm
LENGTH: 0.63 cm

dP (in Hg)	Pe (in H20	2/(Pi+Pe) Pa^-1	Q (ml/min)	Q (ml/s)	k (m^2)
0.2	0.00	9.83E-06	1.49	0.02	4.13E-15
0.4	0.00	9.80E-06	3.90	0.07	5.40E-15
0.6	0.00	9.77E-06	5.00	0.08	4.61E-15
0.8	0.00	9.74E-06	7.82	0.13	5.41E-15
1	0.00	9.70E-06	8.55	0.14	4.73E-15
2	0.00	9.55E-06	17.4	0.29	4.82E-15
4	0.00	9.25E-06	34.3	0.57	4.75E-15
6	0.10	8.97E-06	51.7	0.86	4.77E-15
8	0.15	8.70E-06	69.1	1.15	4.78E-15
10	0.30	8.45E-06	86.3	1.44	4.78E-15
12	0.30	8.21E-06	104	1.73	4.80E-15
15	0.50	7.88E-06	131	2.18	4.84E-15
20	0.70	7.39E-06	176	2.93	4.87E-15
25	1.05	6.95E-06	222	3.70	4.92E-15
30	1.30	6.56E-06	271	4.52	5.00E-15
35	1.70	6.21E-06	320	5.33	5.06E-15
40	2.10	5.90E-06	367	6.12	5.08E-15
45	2.50	5.61E-06	416	6.93	5.12E-15
50	3.00	5.35E-06	467	7.78	5.17E-15
55	3.50	5.12E-06	518	8.63	5.21E-15
60	4.10	4.90E-06	563	9.38	5.20E-15
65	4.70	4.70E-06	615	10.25	5.24E-15
70	5.30	4.52E-06	666	11.10	5.27E-15
75	6.00	4.35E-06	730	12.17	5.39E-15
80	6.70	4.19E-06	793	13.22	5.49E-15

07/21/93 TP

Media: NRIBX1 , Length:

dP(in Hg)	Pe(in H_2O)	Q(m^3/s)
2	—	3.2
4	—	6.97
6	—	10.8
8	—	14.9
10	—	19.0
.2	—	.14
.4	—	.54
.8	—	1.16
1	—	1.5
12	—	23.3
15	0.1	29.8
20	0.1	41.2
25	0.15	53.9
30	0.2	66.8
35	0.3	80.7
40	0.3	95.6
45	0.35	111
50	0.5	127
55	0.55	143
60	0.65	161
65	0.7	179
70	0.85	197
75	1.0	216
80	1.1	237

Pages 75 Through 100 Are Intentionally
Left Blank

08/27/93 TP

Below is the program used to evaluate the saturated permeabilities of the unconsolidated media. The program is with in the ksat directory

Referenced disk cannot be located.

07/30/93 TP

Media - T-64 100 Mesh Alumina
(149 micron)

Diameter - 2.8 inches

Length - 2 3/8 inches = 2.375 in

$\mu = 850 \times 10^{-6}$ N

P_{conf} = 30 psi

Volume = 23 ml

P (in Hg)	t	t (s)
5	5:29:29	(329.29)
5	5:20:68	(320.68)
5	5:16:01	(316.01)
5	5:09:38	(309.38)
5	5:05:92	(305.92)
10	2:46:84	(166.84)
10	2:46:39	(166.39)
10	2:~~26~~ 45 TP 07/30/93 : 49	(165.49)
10	2:44:47	(164.47)
10	2:41:69	(161.69)
20	1:13:92	(73.92)
20	1:13:68	(73.68)
20	1:13:51	(73.51)
20	1:13:14	(73.14)
20	1:12:52	(72.52)
25	51.68	(51.68)
25	52.29	(52.29)
25	51.95	(51.95)
25	51.25	(51.25)
25	52.19	(52.19)

08/02/93

Media : Glass Beads 1420/2740
Length: 2.5in

P(in Hg)	t(s)	
2	91.66, 88.73, 86.85	AVE 89.08
3	55.2, 53.10, 53.06	AVE 53.7
4	40.92, 41.23, 39.65	AVE 40.6
5	32.59, 32.77, 33.08	AVE 32.8
6	21.28, 20.43, 19.99	AVE 20.5
7	17.37, 16.56, 17.09	AVE 17.0
8	14.69, 14.82, 14.82	AVE 14.7

08/09 TP

Media: 60 Mesh (249 μm)
Length: 2 7/8 in
V = 23 mL

P (in Hg)	t
5	415.30
5	421.53
	422.31
	417.30
	419.2
ave	~~4.42~~ 417.14

08/09

10	190 83
	197.08
	197.24
	197.97
	198.03
	196.23

20	89.66
	89.89
	90.84
	92.26
	93.08
	91.14

08/09 TP

P (in Hg)	t (s)
25	71.87
	73.29
	73.16
	73.06
	75.26
AVE	73.33

MEDIA: 60 MESH
DIAMETER: 2.8 IN
LENGTH: 2 7/8 IN
VOLUME: 23 ml

P (in Hg)	Time (s)	ksat (m^
5	415.3	5.11E-14
5	421.53	5.04E-14
5	422.31	5.03E-14
5	417.3	5.09E-14
5	419.2	5.06E-14
10	190.83	5.56E-14
10	197.08	5.38E-14
10	197.24	5.38E-14
10	197.97	5.36E-14
10	198.03	5.36E-14
20	89.66	5.92E-14
20	89.89	5.9E-14
20	90.84	5.84E-14
20	92.26	5.75E-14
20	93.08	5.7E-14
25	71.87	5.91E-14
25	73.16	5.8E-14
25	73.29	5.79E-14
25	73.06	5.81E-14
25	75.26	5.64E-14

08/12/93TP

media: 60 mesh Alumina
Length: 2.75 in
Vol: 24 ml

P(in Hg)	t(s)
5	423.22
	421.04
	421.11
	418.02
	415.18
10	173.35
	174.06
	174.61
	174.82
	175.05
20	86.05
	86.81
	87.15
	87.59
	87.80

08/12/93TP

P(in Hg)	t(s)
25	67.61
	68.99
	68.96
	69.19

MEDIA: 60 MESH ALUMINA
DIAMETER: 2.8 in
LENGTH: 2.75 in
VOLUME: 24 ml

P (in Hg)	Time (s)	ksat (m^
5	423.22	5.01E-14
5	421.04	5.03E-14
5	421.11	5.03E-14
5	418.02	5.07E-14
5	415.18	5.1E-14
10	173.35	6.11E-14
10	174.06	6.09E-14
10	174.61	6.07E-14
10	174.82	6.06E-14
10	175.05	6.05E-14
20	86.05	6.15E-14
20	86.81	6.1E-14
20	87.15	6.08E-14
20	87.59	6.05E-14
20	87.8	6.03E-14
25	67.61	6.27E-14
25	68.99	6.14E-14
25	68.96	6.14E-14
25	69.27	6.12E-14
25	69.19	6.12E-14

08/13/93 TP

Media: 100 mesh L= V=24mL

P(in Hg)	t(s)
5	419.37
10	196.25
15	124.69
20	91.15
25	72.88
5	435.41
10	196.49
15	125.70
20	91.91
25	71.87
5	416.02
10	196.72
15	126.72
20	91.63
25	73.48
5	384.78
10	186.11
15	120.71
20	91.84
25	70.79

MEDIA: 100 mesh alumina
DIAMETER: 2.8 in
LENGTH:
VOLUME: 24 ml

P (in Hg)	Time (s)	ksat (m^
5	329.29	5.32E-14
5	320.68	5.47E-14
5	316.01	5.55E-14
5	309.38	5.67E-14
5	305.92	5.73E-14
10	166.84	5.25E-14
10	166.39	5.27E-14
10	165.49	5.3E-14
10	164.47	5.33E-14
10	161.69	5.42E-14
20	73.92	5.93E-14
20	73.68	5.95E-14
20	73.51	5.96E-14
20	73.14	5.99E-14
20	72.52	6.04E-14
25	51.68	6.79E-14
25	52.29	6.71E-14
25	51.95	6.75E-14
25	51.25	6.84E-14
25	52.19	6.72E-14

Pages 112 Through 129 Are Intentionally
Left Blank

ADDITIONAL INFORMATION FOR SCIENTIFIC NOTEBOOK #: 083

Document Date:	12/06/1994
Availability:	Southwest Research Institute® Center for Nuclear Waste Regulatory Analyses 6220 Culebra Road San Antonio, Texas 78228
Contact:	Southwest Research Institute® Center for Nuclear Waste Regulatory Analyses 6220 Culebra Road San Antonio, TX 78228-5166 Attn.: Director of Administration 210.522.5054
Data Sensitivity:	■"Non-Sensitive" □ Sensitive □"Non-Sensitive - Copyright" □ Sensitive - Copyright
Date Generated:	1993
Operating System: (including version number)	NA
Application Used: (including version number)	Various
Media Type: (CDs, 3 1/2, 5 1/4 disks, etc.)	1 - 3 ½ disk
File Types: (.exe, .bat, .zip, etc.)	Various
Remarks: (computer runs, etc.)	Media contains: Program used to communicate the experiment setup to measure the weight gain of a rock core immersed only slightly in water; net liquid infiltration.

07/01 Net LIQUID INFILTRATION

This experiment was setup to measure the weight gain of a rock core immersed only slighty in water. The disk below contains the program used to communicate.

07/01 TP

The disk on the previous page contains a program to record the weight as a function of time.

To enter program:

A:\ cd scale
A:\scale\ gwbasic

Load Scale.bas

then execute.

The times to take weights are listed in the file "timdat.dat"

E.C. 1/17/57

I have reviewed this notebook for compliance with QAP-001. It appears deficient in some respects, but pages 1-131 have been previously reviewed by R. GOLCK for compliance.

E.C. Perry
1/17/57

This project ended some time ago AND this notebook is now being closed.

E.C. Perry
1/17/57