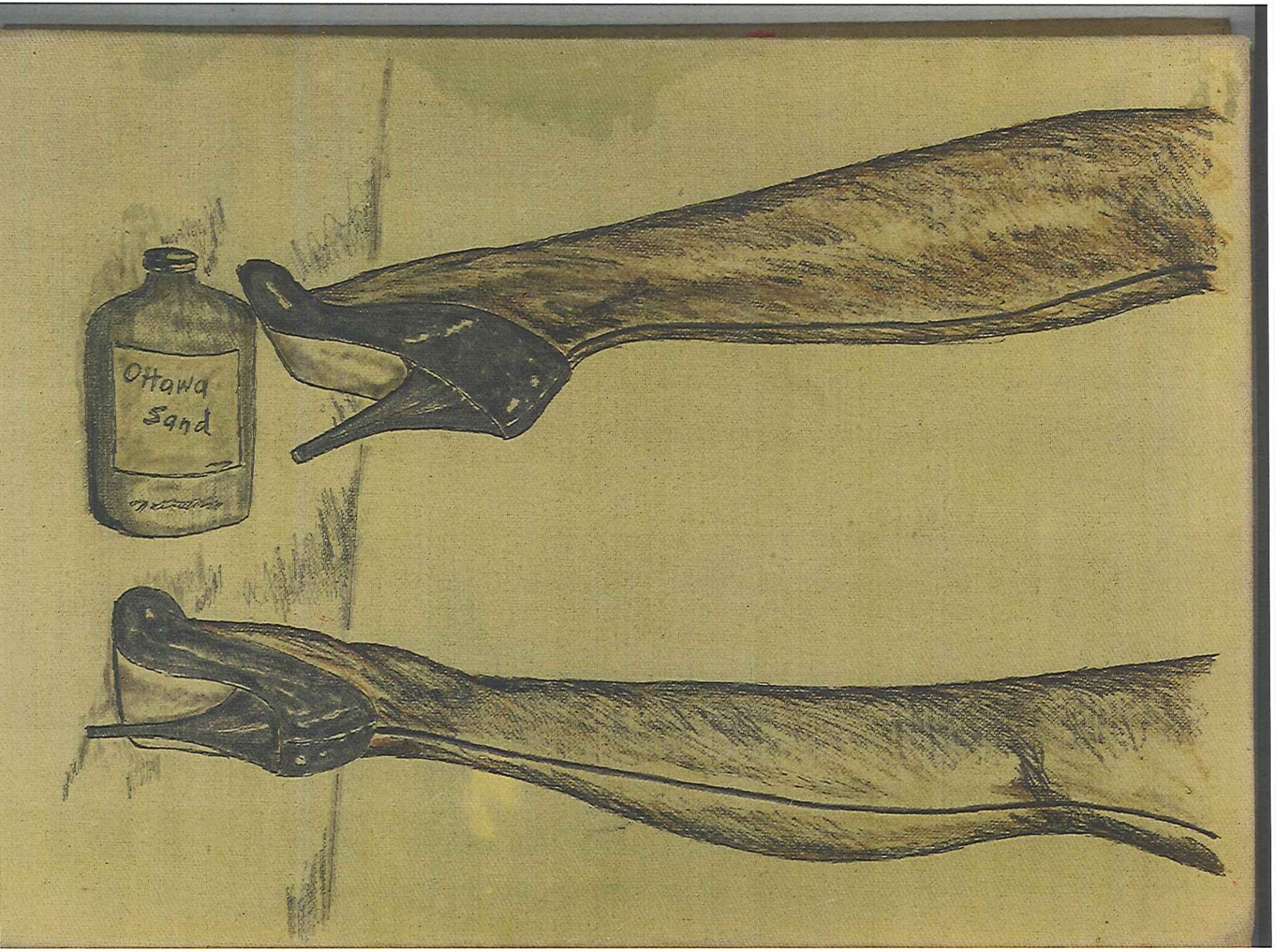

Ottawa
Sand

SPIKED "SOIL"

CRAP

A Spiked, Mixed-Radionuclide, Mock "Soil"

Marinelli-Beaker Calibration Standard

For γ-Ray Spectrometry

R. Collé
Radioactivity Group
NIST Physics Laboratory

Marinelli Beaker Specifications —

manufacturer/vendor
dimensions: Std? See J. Cessna

148.17 ± 0.13 g — total mass empty
unc. is std. deviation
with $\nu = 5$ for 6 determinations on 6 beakers

1211 ± 5 cm^3 (at 22°C) — contained
total volume
~~based on extrapolation to total capped volume~~
unc. is std. uncertainty
based on gravimetric determinations on 3 beakers with 3-point extrapolations to total capped volume.

13 SEPT. 1994
B152

MERRINELLI BEAKERS 130-G looks like polyethylene

T = 21.6 ; 22.0 °C
P = 29.74z
RH = 41.5

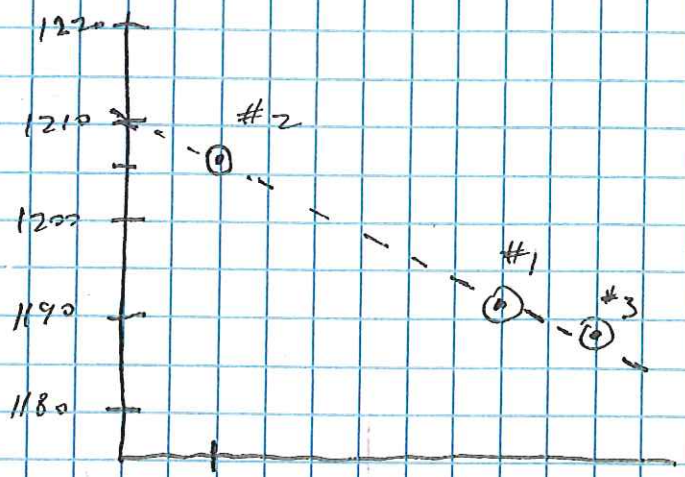
	empty mass	+ H_2O
#1	148.03457	1339.58226
	148.03428	1339.58119
#2	148.14625	1353.43262
	148.14649 (out of pan)	1353.43117
#3	148.32051	1335.39457
	148.32100	1335.39439

air voids
almost none in #2
#1 & #3 about same (small)
#1 > #3

m = 148.167183
S = .129
N = 5

148.17 ± 0.13 g

Volumes.
1192.7
1192.7
1206.5
1206.5
1188.3
1188.3



1.211 L ± 0.005 cm³

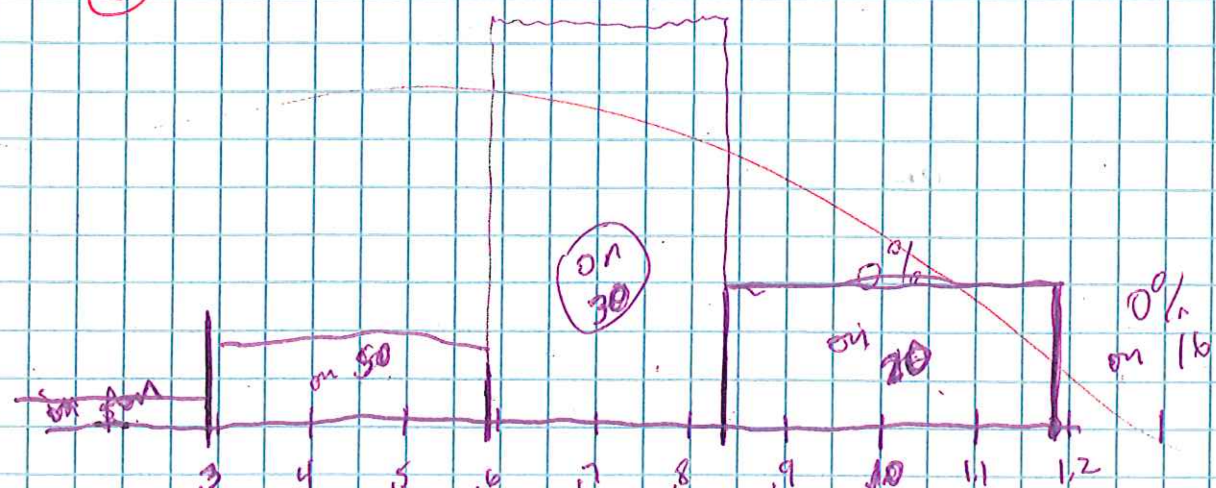
filter sieve. US std.

	No. 16	.0469 in	1190 microns ✓	
little (d)	No. 20	.0331	840 microns ✓	
most. (c)	No. 30	.0232 in	589 microns ✓	(.59 mm) ok
few (b)	No. 50	.0117 in	297 microns ✓	.297 mm
few (a)	pan			

(a) < 0.297 mm — % (a)

(b) < 0.589 mm — % (a) + (b)

(c)



Arun graph f(x) of Part. D.34 is OSPART

13 SEPT. 1994
B152

OTTAWA SAND DENSITY

500 ml flask #5680
500 ± .2

T = 21.8 ; 22.0
P = 29.74
RH = 41.5

(#2) empty = 192.75591 > 192.75606
192.75621

+ sand = 1057.69031 > 1057.69039
1057.69047

500 ml flask #5682

(#1) empty = ~~192.75621~~
186.15400 > 186.15418
186.15437

+ sand = 1046.02750 > 1046.02725
1046.02700

$\rho = 1.726 \pm 0.005$

1.73

1.72

depends on packing "settling"

$\rho = 1.73 \pm .006$

particle sizing

Standard Ottawa Sand

14 sept. 1994

tare = 38.57295

(20) ~~tare~~ = 41.70519

(30) = 1147.09955

(50) = 1162.47309

on (16) none

on (20) 3.13224

on (30) 1105.39436

on (50) 15.37354

in pan 0.04709

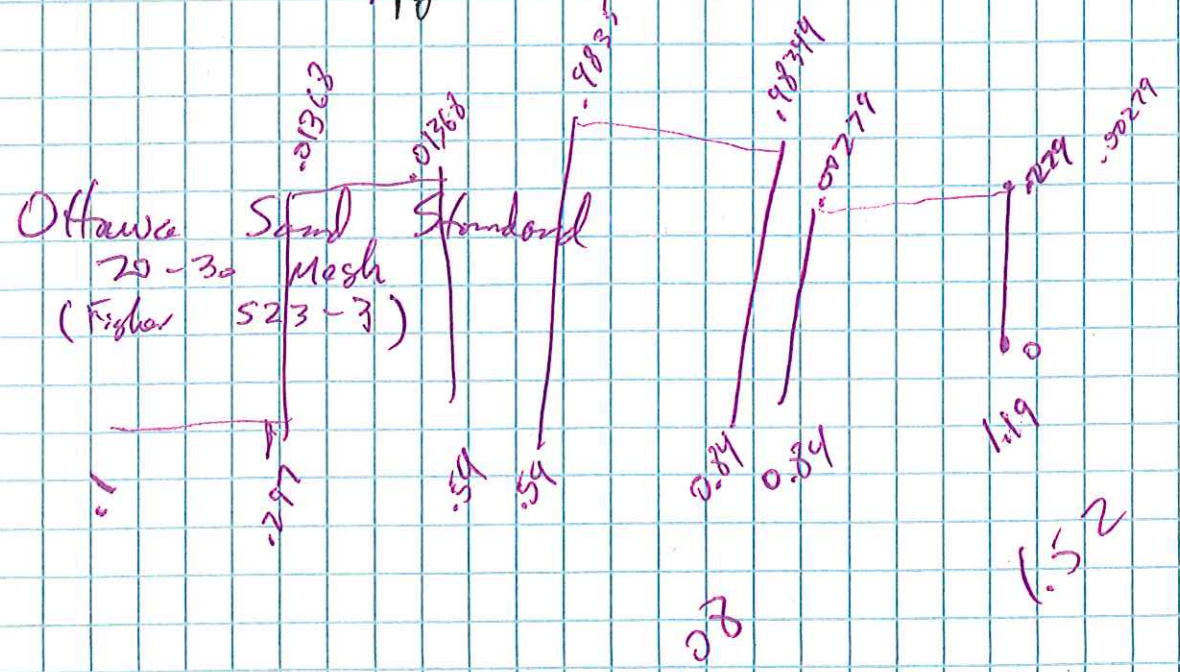
total = 1123.94723

(in pan) tare = 3.63046

3.67755

fractions are

0	
0.279 %	.00279
98.349	.9835
1.368	.0137
→ 0.00478	.00004



13 SEPT 1994
B15~

BOS Blank Ottawa Sand in Merrell beaker.

T = 22.0°C
P = 29.74"
RH = 4%

empty beaker = 148.35659 > 148.35695
148.35732

1.72

+ 1000 mL sand = 1873.14860 > 1873.14876
1873.14892

1725.6542

mass = 1726.5 ± g ± 0.6 g

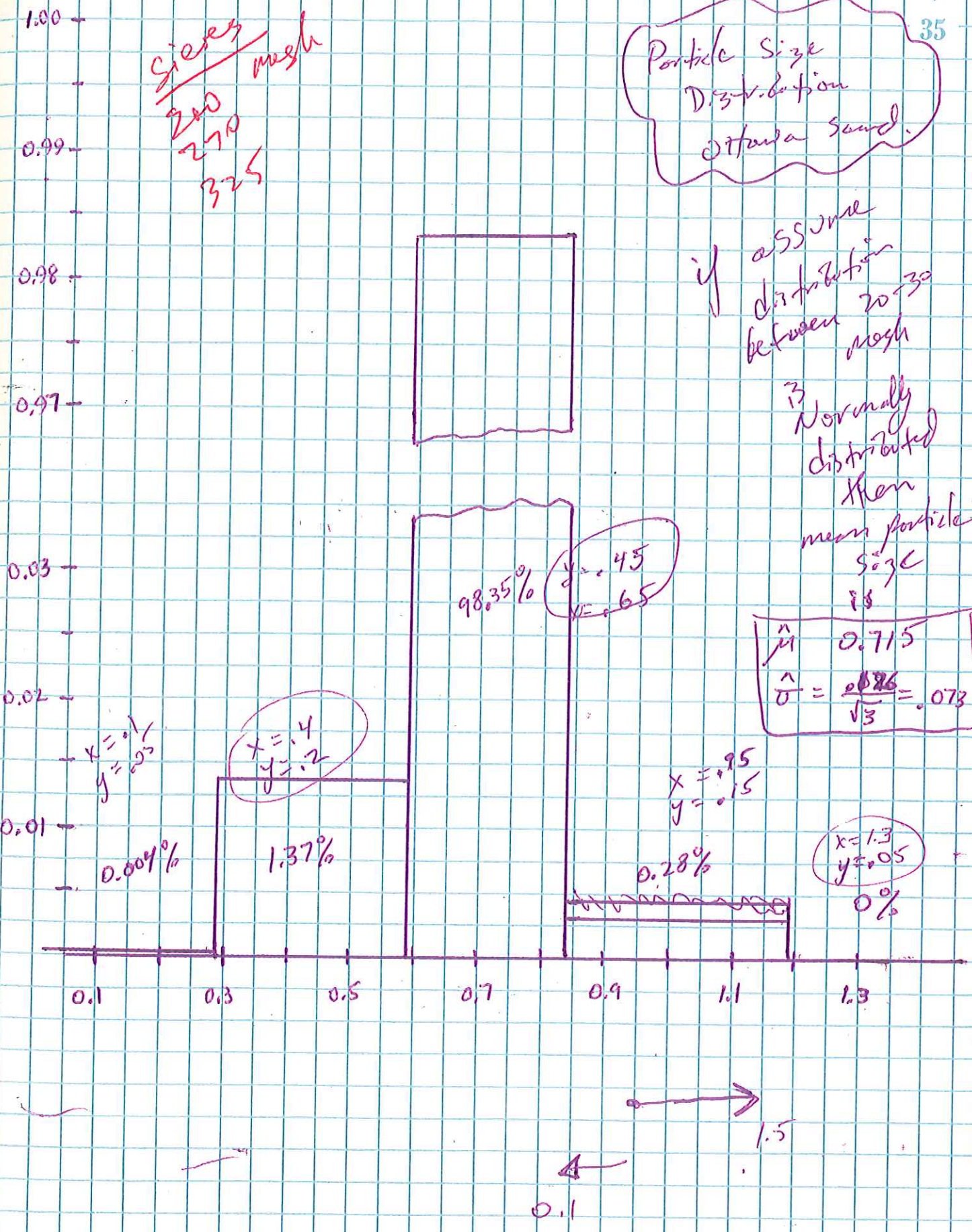
vol. = 1000 ± 6 cm³

Ottawa Sand Standard 20-30 mesh
Fisher Chemical S23-3
Lot No. 942855 (4) (8 kg)
941959 (1) (4 kg)

GA-MA & Associates, Inc.
GA-MA Bunker BOG

Particle Size Distribution of Ottawa Sand.

Sieves / mesh
200
270
325



if assume distribution between 20-30 mesh is Normally distributed then mean particle size is

$\hat{\mu}$ 0.715

$\hat{\sigma} = \frac{.086}{\sqrt{3}} = .073$

from

Consider V_A / V_S

again ignore mass air

$$\rho_C = \frac{m_S}{V_S + V_a} = \frac{\rho_S V_S}{V_S + V_A} = \frac{\rho_S}{1 + \frac{V_A}{V_S}}$$

$$\rho_C \left(1 + \frac{V_A}{V_S}\right) = \rho_S$$

$$\boxed{\frac{V_A}{V_S} = \frac{\rho_S}{\rho_C} - 1}$$

if consider mass air

$$\rho_C = \frac{m_S + m_a}{V_S + V_a} = \text{[illegible]}$$

$$= \frac{\rho_S V_S + \rho_A V_A}{V_S + V_A} = \frac{\rho_S + \rho_A \left(\frac{V_A}{V_S}\right)}{1 + \frac{V_A}{V_S}}$$

$$\rho_C \left(1 + \frac{V_A}{V_S}\right) = \rho_S + \rho_A \left(\frac{V_A}{V_S}\right)$$

$$\rho_C \left(\frac{V_A}{V_S}\right) + \rho_A \left(\frac{V_A}{V_S}\right) = \rho_S - \rho_C$$

$$\frac{V_A}{V_S} \left(\rho_C - \rho_A\right) = \text{[illegible]}$$

$$\boxed{\frac{V_A}{V_S} = \frac{\rho_S - \rho_a}{\rho_C - \rho_A}}$$

15 sept 1994

Density considerations

S ≡ solid
C ≡ composite of solid & air
A ≡ air

1st if ignore mass of air

obtain $\rho_S = \frac{m_S}{V_S}$

$\rho_C = \frac{m_S}{V_C}$

$\frac{V_S}{V_C} = \left(\frac{m_S}{\rho_S}\right)\left(\frac{\rho_C}{m_C}\right) = \boxed{\frac{\rho_C}{\rho_S} = \frac{V_S}{V_C}}$ ← vol. ratio solid to total

2nd if consider mass of air

$\rho_C = \frac{m_S + m_A}{V_C} = \frac{\rho_S V_S + \rho_A V_A}{V_C}$ $\quad V_A = V_C - V_S$

$= \frac{\rho_S V_S + \rho_A (V_C - V_S)}{V_C}$

$= \frac{\rho_S V_S - \rho_A V_S + \rho_A V_C}{V_C}$

$= \frac{V_S}{V_C}(\rho_S - \rho_A) + \rho_A$

$\boxed{\frac{V_S}{V_C} = \frac{\rho_C - \rho_A}{\rho_S - \rho_A}}$

$\frac{V_S}{V_C} = .$

$\frac{V_S}{V_C} = .741$

$\frac{1.72}{3.6} = .48$

OS to spike

{total mass}

T = 21.4
P = 29.67
RH = 43.5

#1
tare = ~~192.75616~~ 186.15485
tsmd = ~~1043.53655~~ 1043.55796
1043.57937

x1.0005

857.8325

ρ = 1.7157

#2
tare = ~~1057.69039~~ 192.75606
tsmd = 1049.18403
1049.13952

1049.16175

856.8339

1.7137

4 extra for 4 samples
tare = 38.71704
tsmd = 170.48600

131.83484

~~total~~ = 1845.5012 g

#1 and/or #2 may contain extra 2.5130 g because of hanging wire ??!!

OS samples in plastic vials. for N.T

Fri. 16 Sept, 1994

$T = 21.1$
$P = 29.67$
$RH = 44.$

$\rho_{OS} = 1.73$
$\rho_{BW} = 7.76$

		[vial tares]	[+ sand]
for filters: masses not needed	F-OS		
	BF-OS		
	S-OS	7.6034	39.4864
	B-OS	7.8656	40.8126
for impurities	H1-OS	7.7908	41.46272
	H2-OS	7.9967	40.54920
	H3-OS	7.6350	40.93455
	H4-OS	7.9944	38.9666

23 Sept.
$T = 20.5$
$P = 29.41$
$RH = 43.5\%$
$C = 1.0005$

33.68876
32.5688
33.31620
30.9877

F-OS
C-OS
C2-OS

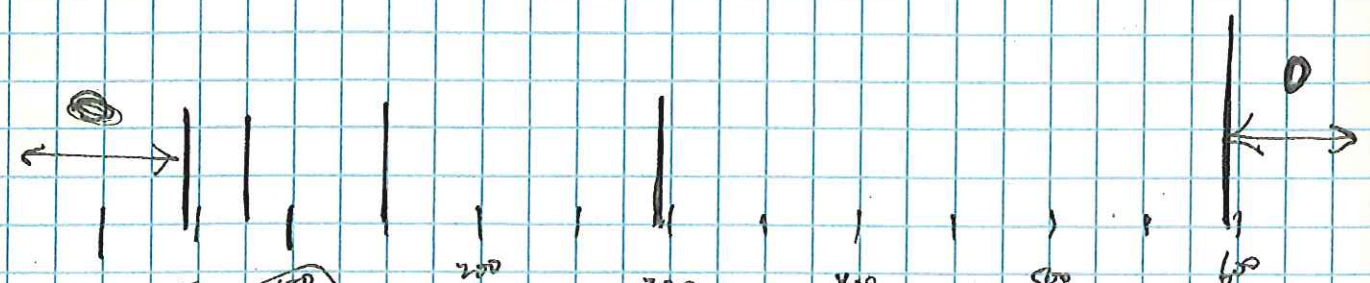
GS sieving — 12 mins

(our screen)

No. 16	1190 μm	— none		
20	840 μm	— none	few joined grains / crystals.	fractions
30	589 μm	38.73151 55.84041 >	17.10890	0.01853
50	297 μm	759.19599	703.35568	0.761980
100	150 μm	958.94412	197.74813	0.21423
200	75 μm	961.19678	4.25266	0.004607
325	45 μm	4.56260 4.90698	0.34438	0.000373
pan	< 45 μm	5.16069	0.25371	0.000274
		Σt =	923.06336	Σ_i = 0.999995

(101)

.10 – 1000



Range Blender

Start at 1215 μm

1400 ↑

Step ↓

← to look at distribution after 1-2 hours.

~25 rotations per min

Granulated salt for density 16 sept. 1994

1000 mL flask

$T = 21.5$
$P = 29.67$
$RH = 43.5$

tare = 266.20281

+NaCl = 1615.90410

1.36 ± 0.02

used in BGS Clark Marinelli

266.21497

$\frac{1616}{266}$

$\rho = \frac{1350}{1.350}$ g·cm^3

mass in = 1350.3640 g

1.37 ± 0.02

0.985 L

Sodium chloride, granular, USP/FCC

Fisher Chemical S640-10

Lot # 941930

Re-sieve QS after cleaning

16 Sept. 1994

47

all pass No. 16 & No. 20

20	.840			
30	.589 mm	38.74078	14.56342	0.015802
		53.30420		
50	.297	748.24232	694.93812	0.754026
		955.31860		
100	.150		207.07628	0.224683
200	.075	959.87809	4.55949	0.004947
325	.045	~~964.048~~ 964.048	0.37432	0.000406 15
		5.01480		
Pan	< .045	~~5.101~~ 5.14048	0.12568	0.000136 37
			921.63731	$\sum = 1.000000052$

void space in volume
for spheres of equal radii
= 25.9 % of total volume

.259
.741
1.00

mass of sand grains

T = 23.3
P = 29.72
RH = 46.5

Mon. 19 sept. 1994

C_{Bw} = 1.00054

1 (100) 1.499264
1.568517

0.0006929 g/grain $\rho = 3.62$ g·cm^3

2 (100) 1.499219
1.566086

0.00066903 g/grain $\rho = 3.50$ g·cm^3

3 (50) 1.499094
1.532919

0.00067686 g/grain $\rho = 3.54$

wgt. ave. = 3.56 ± 0.83

.0006929 (100)
.0006690 (100)
.0006769 (50)

.767

OS size = ~~0.715 ± 0.052 mm~~ NO
= 0.0715 ± ~~0.052~~ cm
= 0.03575 cm
R = 0.03575 cm
$V = 4/3 \pi R^3$ = 0.000191388 cm^3/grain OK
± 23.4%

.06929
.06690
.033845

0.000680 g/grain

3.55 + 2.81
−1.37

ρ = 3.55 < 2.183
6.36

.841 ↔ .589 .367 / .350

$\hat{\mu}$ = .715
$\hat{\sigma}$ = .126

d = .841
d = .589
d = .715

V = .000311448 cm^3
V = .000106999
V = .000191388

mass fraction	mean d.sm.	mean radius (r)	mean V vol. $= 4/3\pi r^3$	relative number fraction $\left(\frac{m}{\text{vol}}\right)/r^3$	number fraction
.003485	1.0155	.5075		.02662754	.001171
.98485	0.715	.3575		21.55469842	.94773
0.01162	0.443	.2215		1.089263978	.04791
0.0000585	0.1715	.08575		.09277981	.004079
$\frac{m}{2} = 1.0000135$				22.74336 ✓	

$\rho = 3.56\ g/cm^3$

$m \rightarrow$ ~~[illegible]~~ $n m_i$ $\rightarrow$ # particles $= \frac{m}{m_i}$

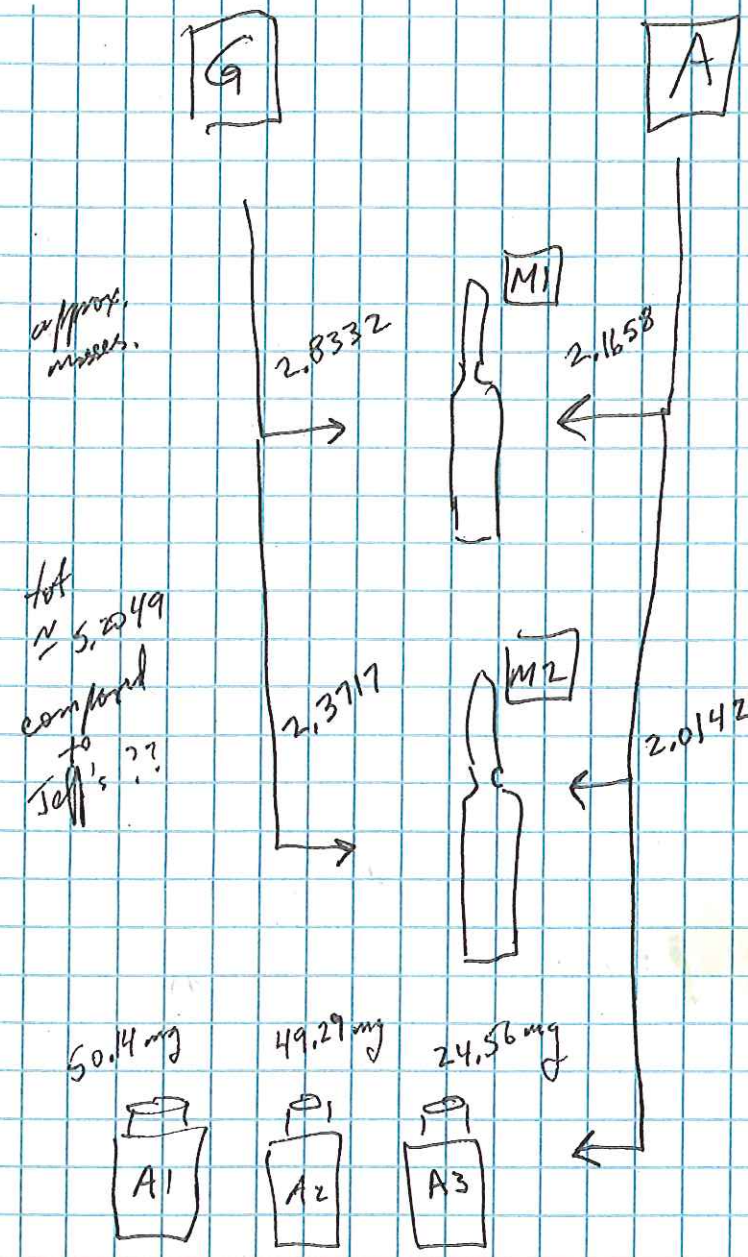
$r \rightarrow V \rightarrow V \times \rho = m_i$

$= \frac{m}{\rho \frac{4}{3}\pi r^3}$

Number fractions of particles obtained from mean particle diameter assuming constant dens. — normalized to d^3

0.5
1.5 = 0.5 + 1
3.0 = 1.5 × 2
6.0

TUES. 20 SEPT 1994



T = 23.5; 24.0
P = 29.82
RH = 46

f_{ow} = 7.76
f_G = (4
f_A = (2
1

Solv G

pyc. full = 6.302685
into M1 = 3.472339
into M2 = [1.102990] 1.103050

Solv A

pyc. full = 5.610029
into A1 = 5.559934
A2 = 5.510696
A3 = 5.486156

into M1 = 3.322568
into M2 = 1.310416

Corrected masses

A1	.050145
A2	.049287
A3	0.024565

Soln A

TUES. 20 SEPT. 1994

TRANSFER ^{241}Am ampoule
LUCAS

U.S. Department of Commerce
National Bureau of Standards
^{241}Am Radioactivity Standard
Amount ~ 15 kBq
Date 15 NOV 1992
LL92-241-2
CAUTION RADIOACTIVE (LUCAS)
NBS-19 (Rev. 3/83)
KBAY
HCl

Use 2N HCl
picked up w/ 2 mL
then transferred back & forth
4x w/ ~3 mL
~

top label
^{241}Am
LL92-241-2
2 ML AMP

called A

45 vials used
~14 mL
Ultima Gold AB (Packard)

Soln G

mixed γ from Jeff Cessna

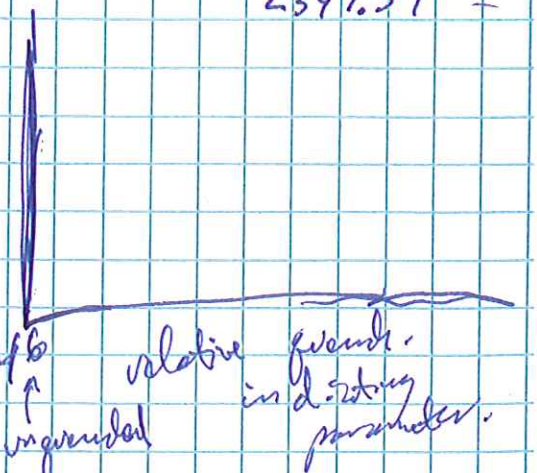
label →

MIXED γ
R4-110-4a
7/14/94
JTC

YTTX LS Assay of ^{24}Am amp. A

	cpm	bcpm	cps = (cpm − bcpm)/60	mass	
1st cycle					
A1	7178.22	56.93	118.6865	.050145	2366.9
A2	7047.33	55.84	116.505	.049287	2363.8
A3	3539.60	58.73	58.0428	.024565	2362.8
		56.73			
2nd	7170.13	58.76	118.55		2364.2
	7033.84	55.20	116.28		2359.2
	3532.51	57.03	57.9247		2358.0
3rd	7163.36		118.44		2361.98
	7035.62		116.31		2359.8
	3543.16		58.102		2365.2 +
4th	7149.71		118.21		2357.4
	7032.00		116.29		2359.0
	3536.31		57.988		2360.6 +
5th	7161.80		118.41		2361.41
	7018.42		116.02		2354.0
	3513.80		57.613		2345.32 −
6th	7140.80		118.06		2354.4
	7024.84		116.13		2356.2
	3516.82		57.663		2347.37 −

Now, re-do analyses.



cps = A_0 + slope (H#)
= i + S(H#)

by sample (NB. H# → w/ samples)

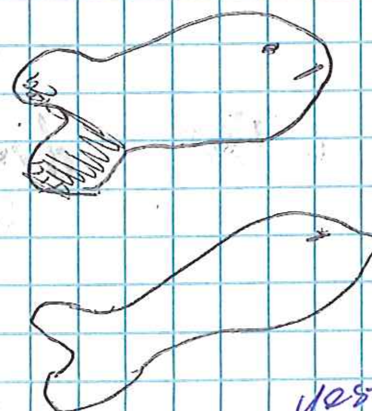
A1	A2	A3
2367	2364	2363
2364	2359	2358
2362	2360	2365
2357	2359	2361
2361	2354	2345
2354	2356	2347
2361	2359	2357

2359 Bg·g-1

by cycle

		H#	$H^{\#}_{0}$
2367 2364 2363	2365	52.6 52.2 49.2	46.0
2364 2359 2358	2360	51.0 51.2 47.8	45.6
2362 2360 2365	2362	51.6 50.8 47.4	45.6
4th 2361 2354 2345	2353	51.4 50.8 48.8	45.4
2354 2356 2347	2352	50.2 50.0 47.6	45.4
2357 2359 2361	2359	50.6 50.8 48.8	46.0

(for Arthur! ? -- fishy's)



yesterday morning. —

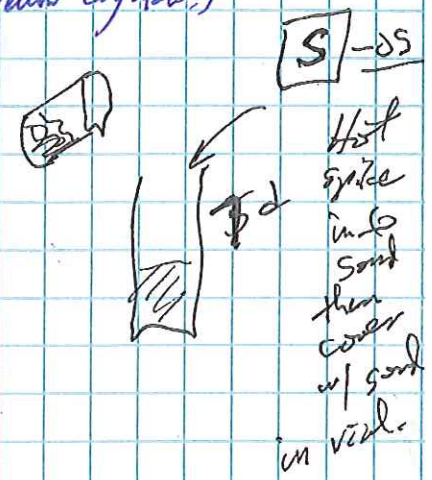
i.e. 20 Sept. 1994

21 Sept.

under heat lamp at 1315

yellow crystals forming w/ drying, I seem after 30 min.

to air at 1415 (still yellow crystals!)



22 Sept, yellow

0930 dry — crystals

OS SPIKING

use soln M1

(1) ~~tare~~ =
filter = 2.58861
~~filter~~ tare = 170.48931
~~filter~~ sand = 38.72158
(into filter)
tare = 1043.58199
into filter = 811.44571

T = 22.2; 22.4
P = 29.76
RH = 40.5

ρ_{BW} = 7.95
ρ_{paper} =
ρ_{sand} = 1.72

232.4 g sand in filter

(2) soln M1

pyc full = 6.206591
~~into~~ hot spike = 6.122277
into sand = 1.244985

T = 23.4 · 23.5
P = 29.82
RH = 47

ρ_{BW} = 7.76
$\rho_{soln\ 3N}$ =

hot spike = 0.0843938 314

spike = 4.882169

(3) Sand in blender

~~empty blender~~ =
tare = 811.44571
(051) into blender = 186.16522

22 Sept.
T = 21.6
P = 29.64
RH = 41.5

(052) tare = 1049.14420
into blender = 192.76670

OS densities

1.7157
1.7136
1.7308 1.765
1.7297
1.7259

out Merrell blender tare =
+ sand =

11 samples.

see p. 43

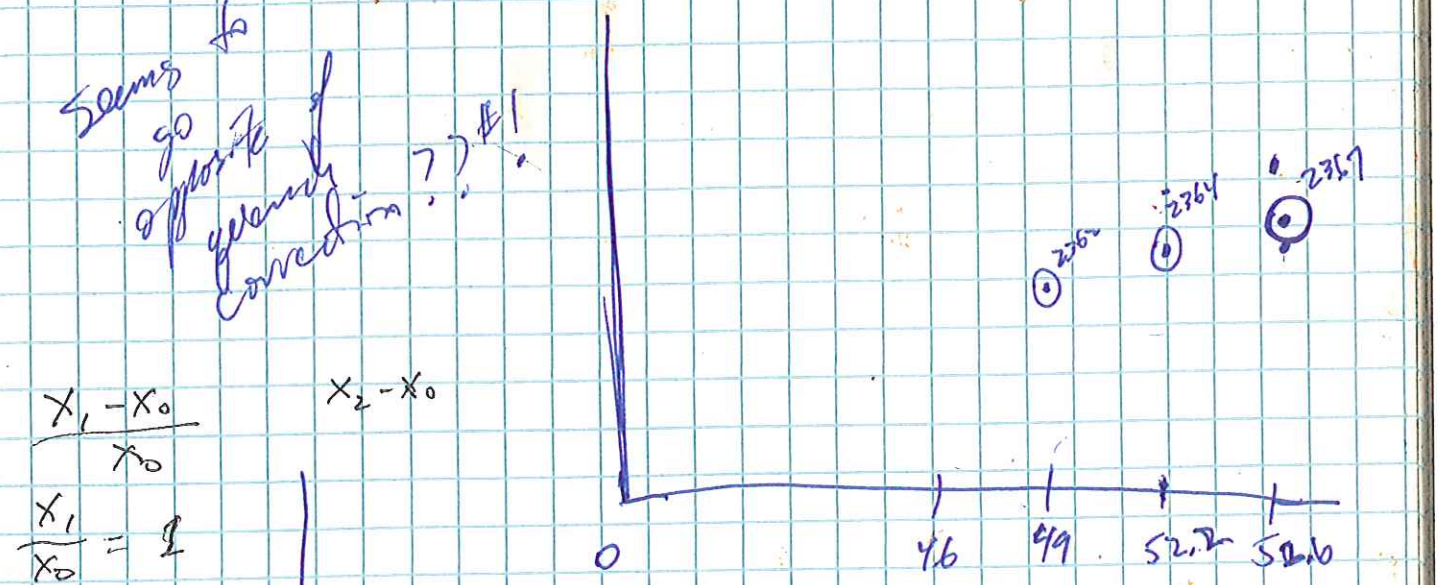
$cps = i_0 + S(H^{\#})$

for $H^{\#}_B$

$cps = i_0 + S(H^{\#}_b)$

[unguarded]

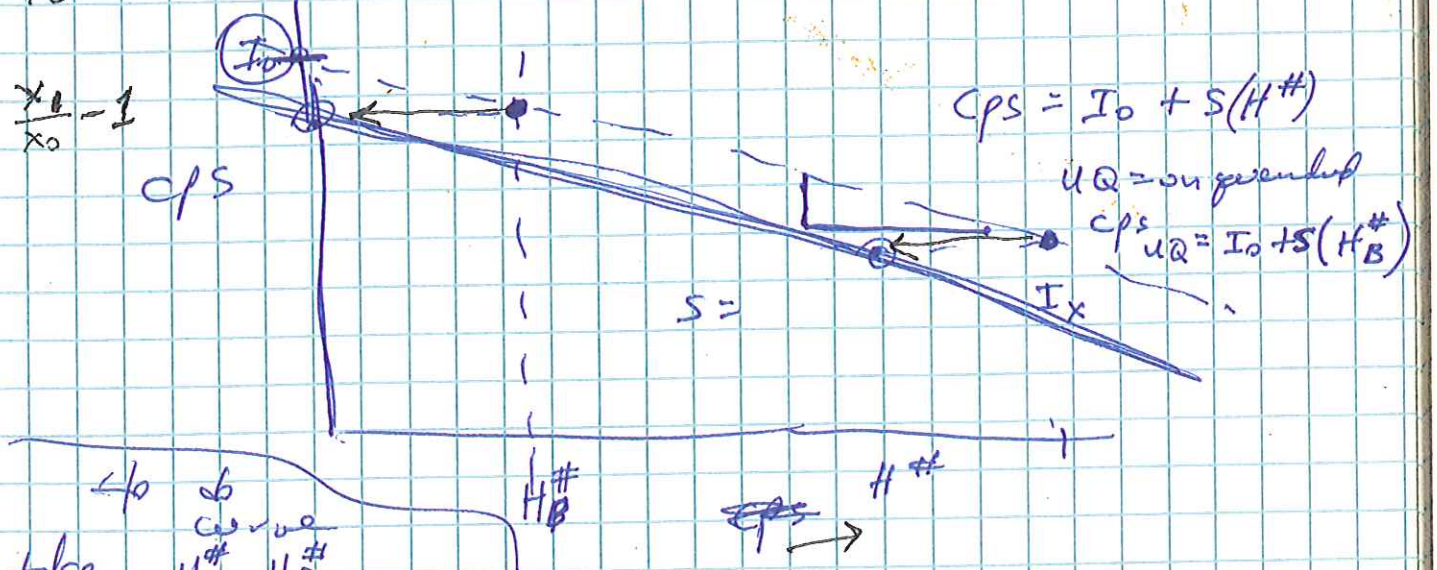
Seems to go opposite of guard condition ?? #1.



$\frac{X_1 - X_0}{X_0}$ $\quad X_2 - X_0$

$\frac{X_1}{X_0} = 1$

$\frac{X_2}{X_0} - 1$



H_0 H_b

Curve

take $H^{\#}_x - H^{\#}_B$

to get "relative QIP"

52.6

46.0

$slope = \frac{I_0 - I_x}{H_0 - H_x}$

$cps_{UQ} = I_0 + \frac{(I_0 - I_x)}{(H_0 - H_x)} H_x$

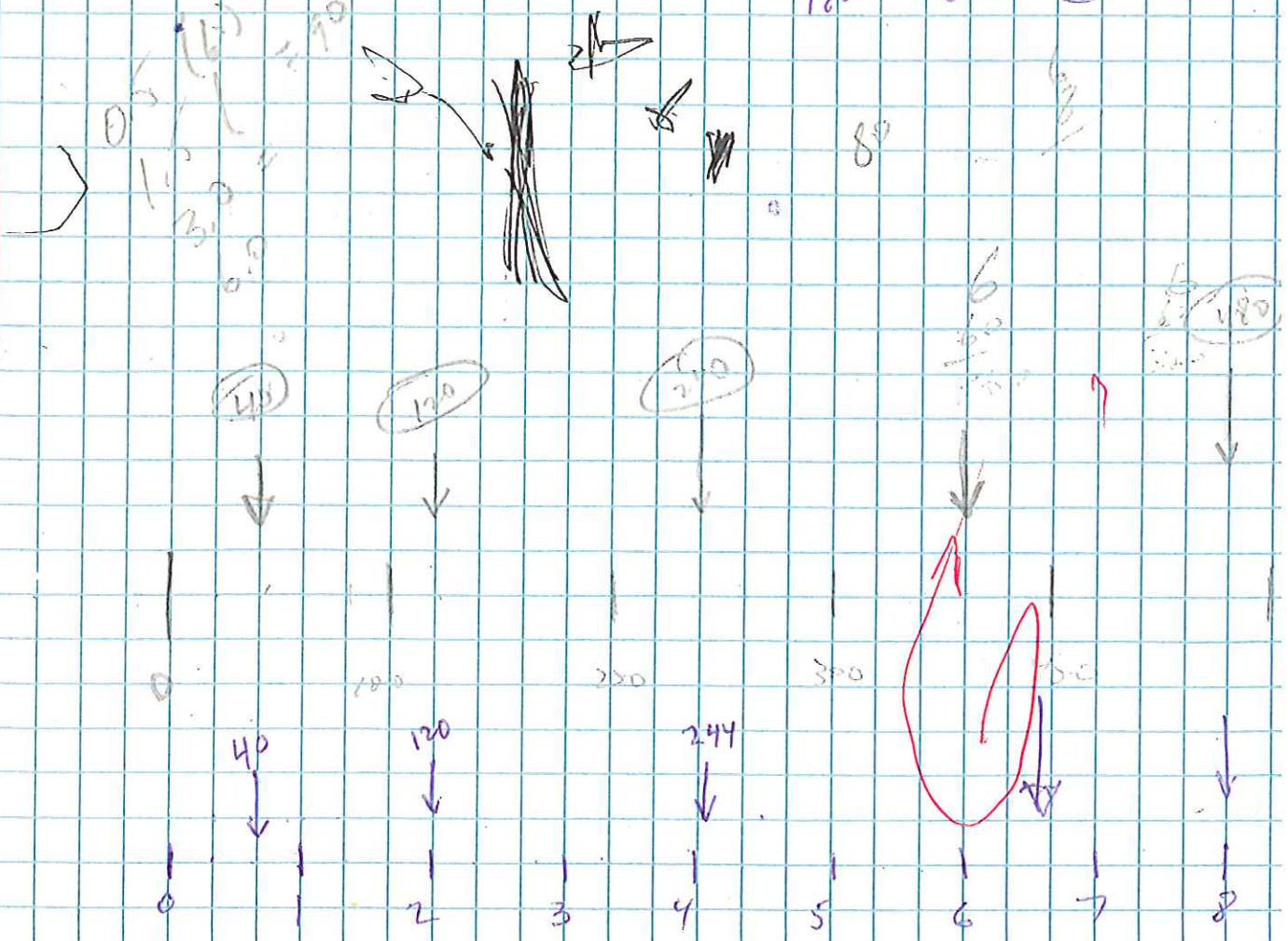
Maximum loss calc.

e.g. .0844 J in hot spike

460.37 cps / .0844 = 5455 cps·J⁻¹

4077.33 cps / 5455 = 0.747 J

4.8822 J



22 Sept.

Blending

start 0950

stop 1030 ← Sample HI-05
after 40 min total

restart 1042 80 min

Stop 1202 ← Sample HI2-05
after 120 min total

restart 1207 (need 120 min next)
1411 > 124
. . . .
Sample HI3-05
~~244~~ m
after 244 min total.

23 Sept.

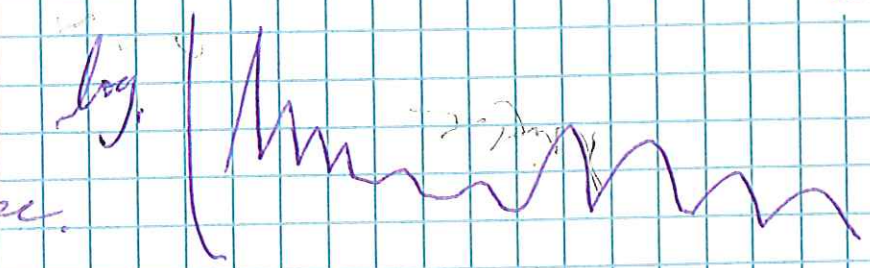
restart 0900 need ≥240 min
1136 > 120 3 to 4 hours.
~~36~~ ~~150~~ min
244
165
504

Stop
after 400 min
Sample HI4-05

244
156
400

spectra

log



[S] 46,037 / 100 sec.

[F] 407,783 / 100 sec

30 µg/g
× 6
180 µg/g

2×

GAMMA's

^{241}Am	59.537	
^{109}Cd	88.03 ←	
^{57}Co	[122.1]	140
^{139}Ce	165.9	182
[^{203}Hg	279.2]	230
^{113}Sn	391.7	310
^{85}Sr	514.0	396
^{137}Cs	661.7 ←	448
^{88}Y	898.0	
^{60}Co	1173 ←	
^{60}Co	1333 ←	
^{88}Y	1836	

3.4 keV

1333 − 392 / 448 − 140 = 308

3.06 keV/ch.

E = a + 3.06(ch)

a = 662 −

= −42 keV

Energy Conversion

^{137}Cs	661.7 kev	ch ~ 610
^{60}Co	above 1024	
^{22}Na	511	480
	1274	924
^{57}Co	122.1	123
		23
^{241}Am		63

below ^{60}Co

$\frac{1}{2}$ height of 884

Fri 23 Sept. 1994

$N_a I(Tl)$ meas.

[chs 19 to 948] (11 peaks) int 88 y

	100 sec counts	cps
FS	400719 (dt = 103/100) 401720	?? 4002.3
LS	44615 dt = 100/100 44321	434.82
BS	1016 957 > 986 ÷ 100 =	9.86 cps
C2	1423 1423	4,395 cps
H1	39829 39219	385.38 cps
H2	40292 40425	393.73
H3	40391 40185	392.57

1466

FRI 23 SEPT 1994

empty blender

T = 21.5
T = 29.46
RH = 42.5

Morinelli
Beaker tare = 148.10041
= 1863.14348
30

1715.9006 g

if density = 1.72
vol. = 0.998 L

OSI

used 1846.4848

23 mg lost.
0.00068 g/grain
34 grains lost.

recovered
30.9877
33.3162
32.5688
33.6888
130.5615
1715.90084
1846.4619

transfered w/ funnel + bag.

some grains lost at sealing mtl. on shaft + electrostatic adhesion to plastic bag.

perhaps 1-2 grains

Tues. 27 sept. 1994

salt for GSZ

in 1000 mL flask

$T = 20.8, 20.9$
$\rho = 29.35$
$RH = 44.5$

see p. 45

tare = 266.21500

1649.22739

$\rho = 1.384$

Mass = 1383.7039

27 sept.

Not rough. used.

195328

FS 196579 / 100 = 1965.79

LS 39355 = 393.55

HI 35591

HI $\frac{355.91 - 7.7}{393.55 - 7.7} = \frac{348.21}{385.85} = .90245$

corresponds to 0.07616 g sol in 33.688 g soil

= 0.002261

FS = 392439 / 200 = 1962.2 cps − = 1954.5

C2 = 2041 / 200 = 10,205 − 2.5

S = 78661 / 200 = 393.31 cps − 385.6

~~F~~ = 1539 / 200 = ~~7.695~~

BS = / 200

$[S] = \frac{385.6 \text{ cps}}{.084398 \text{ g}} = 4568.8 \text{ cps} \cdot \text{g}^{-1}$

$\therefore L = \frac{(1954.5 - 2.5)}{4568.8 \text{ cps} \cdot \text{g}^{-1}} = 0.4283$

MI = 4.88217 − .4283 = 4.45387 g soln in 1846.4878 g soil

0.002412 g/g

NIST(TR) on OS samples — 27 Sept 1993

mass				
33.6887	H1	355993 / 1000	346.66	.90250
32.5688	H2	359820	351.48	.91605
	S	392457	384.112	
33.31620	H3	360655	352.31	.91721
30.9877	H4	331779	323.43	.84202
	BS	8345		
	H1	355506	347.22	0.89157
	H2	358915	350.57	0.90017
	S	392792	384.45	
	H3	361060	352.72	0.90569
	H4	330995	322.65	0.82848
	BS			

$$\text{gff } M_1/g_{soil} = 0.027195\,(0.084398) = 0.0022952$$

$$\frac{4.882169 - L}{1715.901} = 0.0022952$$

$$1846.48478$$

$$L = -(1715.901)(.0022952) + 4.882169$$

$$= 0.94383 \;/\; 0.644112$$

$$\therefore \text{Spike} = 3.938057 \;/\; 4.238052$$

ck

$$\frac{4.238052}{1846.48478} = 0.0022952$$

.026789	FS	392439 /200	1953.71	5.0770
.028046	C2	(2041)	2.51	0.00652
	S	78661	384.815	
.027530	F	1539		
.27173	BS	1698 = 8.49		
		393144	1957.345	5.06088
.026465		(2029)	2.085	0.005391
.027639		79027	386.76	
		1612		
.027185		1675		
.026736				
		393853		
		(2040)		
		78898		
		1654		
		1675		
		393265		
		(2019)		
		78397		
		1528		
		1693		

0.0126

0.36

< 0.001%

fraction of total spike

Sample FS

F bkgd

(C2)

2041 − 1698	2.535	1.715	
2029 − 1675	2.035	1.77	
2040 − 1695	1.93	1.825	
2019 − 1693	2.455	1.63	

(1.735 cps)

2.25125

Swab C2

0.0843989 MI ~~(1.735)~~ 2.25125 / 385.3025 (S)

= 0.00049312

out of 4.2380529 MI

0.0116%

384.815
386.76
386.115
383.52
385.3025

0.001

60% + 88%

		23-699	362-699	124-699
H2	1000/1003	357218	67087	206127
S	1000	391649	73796	224725
FS	100/102	195843	~~112299~~ 39590	112299 ✓
B	1000	8366	1083	4172
	100	788	102	393

ratios

$\frac{H2}{S} = \frac{348.85}{383.28}$ $\frac{66.004}{72.713}$ $\frac{201.955}{220.553}$

$= 0.9102$ 0.9077 0.9157

$\frac{FS}{S} = \frac{195.06}{383.28}$ $\frac{394.817}{72.713}$ $\frac{111.882}{220.553}$

$= 5.0878$ 5.4298 5.0728

cps/g

Hg	Sn	Sr	Cs	Y	Co
0.8095	1.068	0.7798	1.376	0.8350	1.261
0.8250	1.1076	0.8285	1.438	0.8814	1.333
0.8168	1.090	0.8140	1.413	0.8642	1.294
0.7599	1.089	0.8049	1.418	0.8510	1.295

	1	1	2	1	1	1
2/1	1.019	1.037	1.062	1.045	1.056	1.057
3/1	1.009	1.021	1.040	1.027	1.035	1.030
4/1	0.939	1.020	1.032	1.031	1.019	1.027
4/3	0.930	0.999	0.992	1.004	0.985	0.997

Mon. 2 oct. 1994

from spectra of Fri 30 sept. 1994

2000 sec.

QUAD	[0-1024]	(y)	[cps/g]
1/4	744563	33.68816	11.051
2/4	754260	32.56388	11.580
3/4	756211	33.31620	11.349
4/4	696570	30.98777	11.240

mean = 11.305

corresponds to
- −2.3%
- +2.4%
- +0.4%
- −0.6%

Δ from mean

	(Hg) [91-124]	(Sn) [123-166]	(Sr) [166-210]	(Cs) [211-273]	(Y) [273-361]	Co [369-513]
1/4	54545	71960	52541	92722	56260	84955
2/4	53736	72147	53967	93683	57412	86845
3/4	54426	72625	54037	94162	57584	86574
4/4	47093	67477	49889	87870	52739	80286

(normalize to 4/4)

	1.066	1.053	1.055
	1.069	1.082	1.066
	1.076	1.083	1.072
	1	1	1