Demonstration
of
Retrieval Methods
for
Westinghouse Hanford Corporation
by
MPW Industrial Services, Inc.

Trial No. 2
April 30, 1996

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DEMONSTRATION REPORT #2
MPW INDUSTRIAL SERVICES, INC.

FOR WESTINGHOUSE HANFORD COMPANY

1. BACKGROUND -

Westinghouse Hanford Company has been pursuing strategies to break up and retrieve the radioactive waste material in single shell storage tanks at the Hanford Nuclear Reservation, by working with non-radioactive "saltcake" and sludge material that simulate the actual waste.

Previous trials run by MPW for Westinghouse Hanford Company (report dated October 20, 1995) resulted in difficulty breaking up the simulant using three approaches, with pressures to 10,000 psi and flow rates to 56 gpm. The saltcake simulant was extremely hard, with a tensile strength similar to concrete.

Westinghouse Hanford proposed a second set of trials utilizing a range of four simulants to attempt to bracket the capability of the 10,000 psi waterblast stream. This set of trials had one simulant similar to the soft sludge previously trialed, two similar to the hard saltcake but with a lower strength, and one with a coarse rock-salt in a saltcake matrix, which is quite low in strength.

II. TRIAL PLAN -

Under this proposal, MPW would attempt to dislodge the four different simulants using two methods, for a total of eight pans. Each pan would be 4-foot square x 1-1/2-foot deep. The approaches would be as follows:

A. Rotary tooling approaching straight down, with two triangle nozzles, each at a nominal 12.5 gpm at 10,000 psi, at a 45-degree angle.

B. Straight in to the exposed edge of the material with an articulated "water cannon" - with a triangle nozzle rated at approximately 25 gpm.

III. SAMPLE PREPARATION -

Simulant samples were mixed from the following components:

Potassium/magnesium sulfate "langebeinite", trade name "Dynamate", obtained from Ingredient Resources Corp., Louisville, KY. - 2000 lb.

EPK pulverized Kaolin clay, obtained from Feldspar, Spruce Pine, NC. - 2000 lb.

Extra Coarse White Rock Salt, obtained from Western Ohio Salt, Dayton, OH. - 2500 lb.

Durabond Plaster of Paris, obtained from DAP, Dayton, OH. - 2000 lb.

Samples were mixed according to the following ratios:

Sample Designation	Ingredient	Percent	Mix Ratio
Saltcake Composition #2	Dynamate	88% wt.	300 lb.
	Water	12% wt.	5 gallons
Saltcake Composition #3	Dynamate	75% wt.	300 lb.
	Water	25% wt.	12 gallons
Saltcake Composition #4	Rock Salt	86% wt.	460 lb.
	Plaster of Paris	9.33% wt.	50 lb.
	Water	4.67% wt.	3 gallons
Hardpan Composition #1	Kaolin Clay	25.5% wt.	100 lb.
	Plaster of Paris	30% wt.	59 lb.
	Water	42.5% wt.	18.5 gallons

Samples were blended in a cement mixer for minimum times to achieve reasonable homogeneity, and poured immediately into the pans. Samples were prepared exactly 14 days prior to the trial, and were stored indoors.

IV. TRIAL SET-UP -

The 20-cubic yard roll-off box with 12 feet of the center cut out and the sides extended up 8 feet, used in the original WHC trial, was used for this trial. The overhead track system for the hose, originally from which hung a rotary tool, was used only to connect the pump to the fixed movable rotary tool - the earlier trial proved the hanging tool to be of insufficient stability to make repetitive cuts into the material. A framework was erected over the pan to hold the tool at the proper height for each trial point.

The nozzle configuration for the rotary trials consisted of two Rankin Shapejets, each at a nominal 12.5 gpm at 10,000 psi. The cannon used a single Rankin Shapejet, with a nominal 25 gpm. All of the nozzles had triangular openings.

A 350 HP waterblast truck was gravity fed from a tank adjacent to it, due to the lack of availability of a sufficient water supply close to the trial site.

A pair of trials added to the end of the demonstration consisted of aiming the cannon at a plate covered with a pressure-sensitive film, and again at a plate configured with a pattern of strain gages with internal recording devices. The results are not covered in this report, as they were external to the scope of this demonstration. They are, however, included in the photo section as Photos 59 and 60.

A high-volume foot pedal was used as the primary pressure relief device.

V. TRIAL EXECUTION -

The "rotary" portion of the trials, as listed in the "Method" column of the following tables and explained in the "Trial Set-Up" section, was executed by clamping the feed pipe of the tool in a vertical axis, near the center of the pan, with varying "Y" distances as noted in the appropriate column. This distance was measured from the lower nozzle to the surface of the sample. The "X" distance would not apply, as the tool is centered.

The tool rpm was estimated to be approximately 40 in all cases; an exact rotational speed would be difficult to determine, as optical devices that could view the tool while running would encounter interference from the intense spray.

Flow rate of the rotary assembly totaled approximately 24 gpm.

The "water cannon" consisted of a straight stream of water directed by an operator through a near-horizontal rigid lance. The distance from the nozzle to the sample is the "X" distance listed in the appropriate column under the "water cannon" trials. Note that the term "water cannon" is not used in its' strictest sense - the trial used a **continuous stream** as opposed to a sudden high-energy **burst** of short duration.

Total flow was approximately 24 gpm.

It should also be noted that the impact point of the water cannon stream on the surface was stable only as far as the ability of the operator to hold the lance in a

fixed position. While the pivot point of the lance was fixed in an x-y plane, the operator had - and initially used - the ability to probe for weak points in the

sample structure by moving the lance in a slight angular motion around the impact point. As the trial progressed, the decision was made to clamp the lance in a fixed position, to intensify the impact at a given point.

VI. RESULTS -

Both the rotary method and the water cannon "devastated" the hardpan composition #1 (Trials No. 7 and 8, pans 4-A and 4-B) as noted in the table, as expected.

Both methods also cut easily through the Saltcake #4 (pans 3-A and 3-B, Trials #3 and #6,) with debris flying in all directions.

Neither tool was effective on Saltcake samples #2 and #3, which were stated to be weaker versions of the material tested earlier and reported in our report dated October 20, 1996. The results on these two samples, using both methods, were similar to each other.

While the limited effect of the tooling on these two materials was disappointing, the purpose of gathering data was met.

Trial results are summarized in the following table:

TRIAL EXECUTION AND RESULTS

Trial	Pan #	Composition	Method	"X" Dist.	"Y" Dist.	Pressure	Time	Results	Photo #
1	1-A	Saltcake #2	Rotary						1
			Est. 40 rpm	-	24"	10,000 psi	60"	No effect	
			Total 24 gpm		18"			"	
					12"			19" circle, slight penetration	
					6"			6" circle, 2-3 fist-sized chips, 2" depth	
					3"			2-3" cone-shaped circle, 4" depth, 2" deep to cone	2
2	2-A	Saltcake #3	Rotary						
			Est. 40 rpm		24"	8,000 psi	60"	Pressure low - repeat	
			Total 24 gpm		24"	10,000 psi	45"	Slight depression, large diameter, 2-3" wide; some craters	3,4
					18"		60"	26" I. d. circle, 1/8" deep, 2-3" wide band, some craters	5,6,7
					12"			13" I. d. circle, 2-4" wide, 1/4" deep, craters	8,9
					6"			4" i.d., cone-shaped crater, stress cracks appearing	10
					3"			4" deep, 4-1/2" coneshaped crater; 1" path, 1-1/2" i.d. cone	11,12,13,14

Trial	Pan #	Composition	Method	"X" Dist.	"Y" Dist.	Pressure	Time	Results	Photo #
3	3-A	Saltcake #4	Rotary						
			Est. 40 rpm	-	24"	10,000 psi	30"	36" diameter, heavy cutting, salt flying; 5-6" wide, deep on back side	15,16
			Total 24 gpm		18"		30"	25" diameter, 2-1/2" path, 4-6" deep; some areas blown out	17,18
					12"		15"	Obliterated, 8-9" left in front	19
4	1-B	Saltcake #2	Cannon						
			24 gpm	5'	-	9,500 psi	30"	No effect	20,21
				4'			30"	Right side, some erosion	22
				3'			30"	Right center, more erosion	23
				2'			30"	Left of center, less erosion	24
				1'			30"	Slight erosion	25
				6"			30"	Knocked out large chunk, left side	26,27, 28
				3"			30"	Right of center, cutting slots	29,30, 31
5	2-B	Saltcake #3	Cannon						
			24 gpm	5'	-	9,500 psi	30"	Right side, one cut	32,33
				4'			30"	Right-center, 2" wide	34
				3'			30"	Center, 3" wide	35
				2'			30"	1-1/4" deep, 2" wide	36
				1'			30"	2" wide, 2" deep	37,38
				6"			30"	Large fracture, left side	39,40, 41
				3"			30"	Right side, major fracture	42

Trial	Pan#	Composition	Method	"X" Dist.	"Y" Dist.	Pressure	Time	Results	Photo
6	3-B	Saltcake #4	Cannon						
		(Pan tilted)	24 gpm	5'	-	10,000 psi	30"	Right upper - large hole	43,44, 45
		Pan level		4'	-	10,000 psi	30"	Left upper - 5" deep, 2-3 large chunks	46
				3'			30"	Left - removed to bottom of pan 7"-wide hole	47,48
				3'			30"	Into edge - 18" wide, 5-1/2" deep, right side	49,50
				2'			30"	Into edge, center-right; 11" deep	51
				1'			30"	Into left corner	52,53
7	4-A	Hardpan #1	Cannon						
			24 gpm	5'	-	10,000 psi	15"	Went through in seconds, cut all the way; some chunks; 6-7" groove	54,55, 56
8	4-A	Hardpan #1	Rotary						
			Total 24 gpm	-	2'	10,000 psi	10"	Completely sliced through; easy penetration	57
	4-B			-	1'		10"	Ditto (last pan)	58

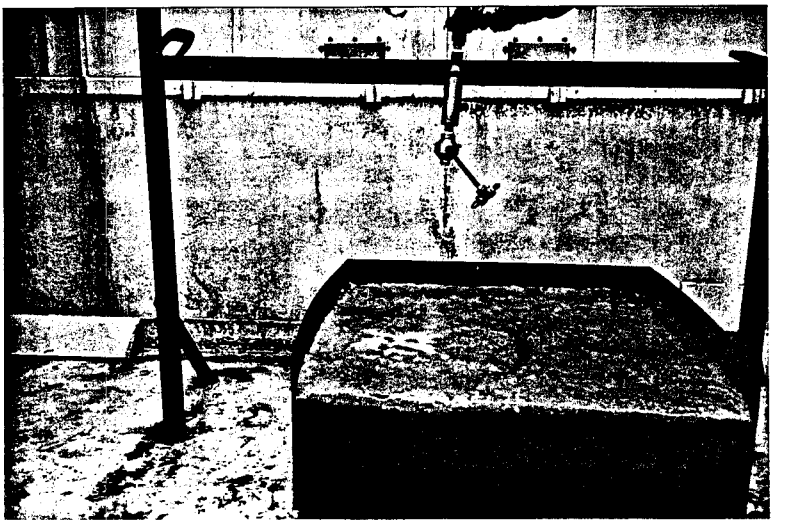

Photo 1 - Saltcake #2, Rotary, @ 24"

Photo 2 - Saltcake #2, Rotary, @ 3"

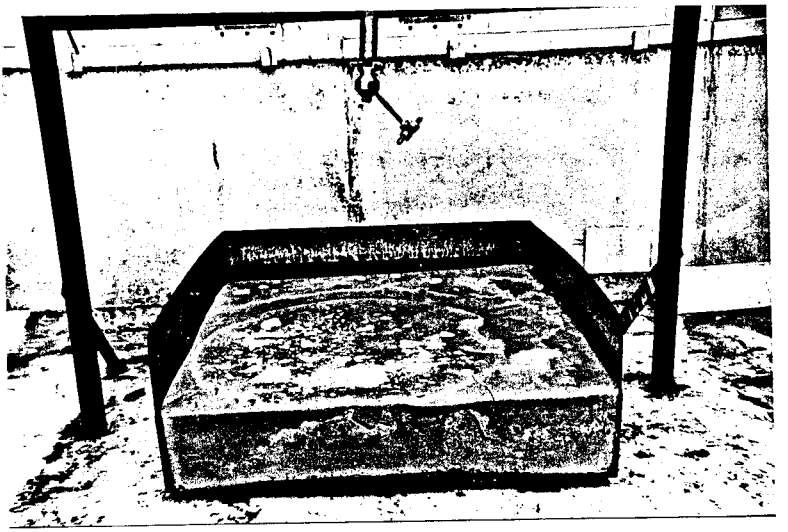

Photo 3 - Saltcake #3, Rotary, @ 24"

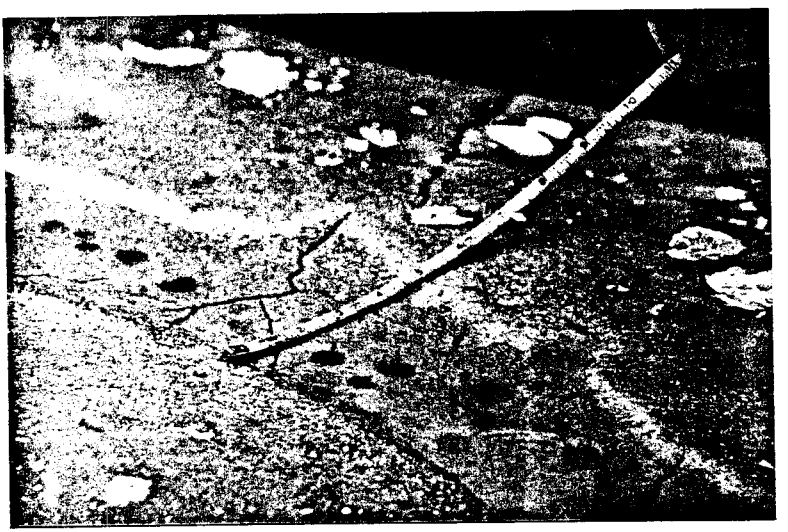

Photo 4 - Saltcake #3, Rotary, @ 24"

Phot o 5 - Saltcake #3, Rotary, @ 18"

Photo 6 - Saltcake #3, Rotary, @ 18"

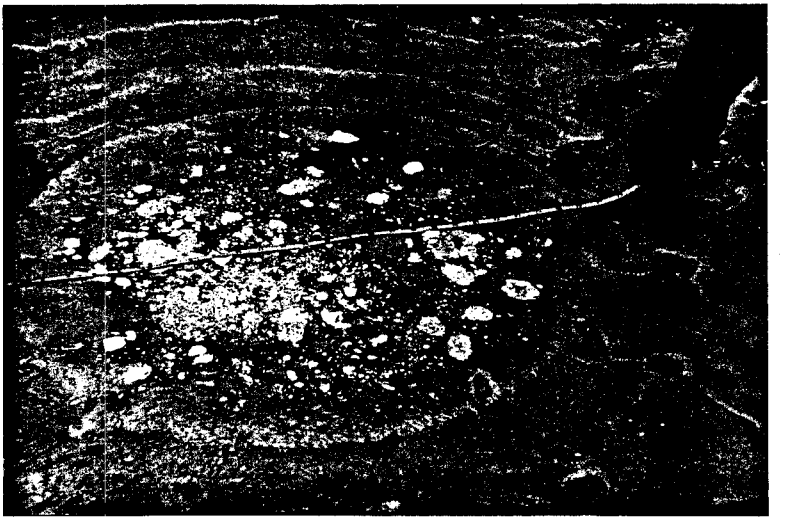

Photo 7 - Saltcake #3, Rotary, @ 18"

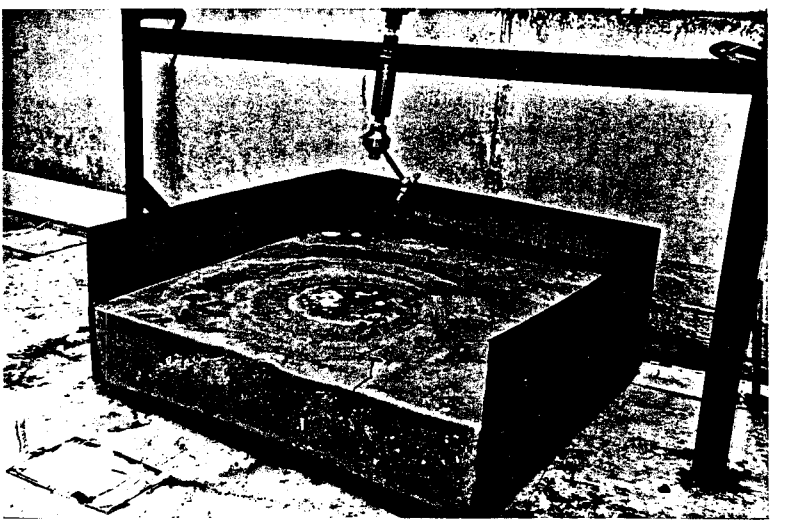

Photo 8 - Saltcake #3, Rotary, @ 12"

Photo 9 - Saltcake #3, Rotary, @ 12"

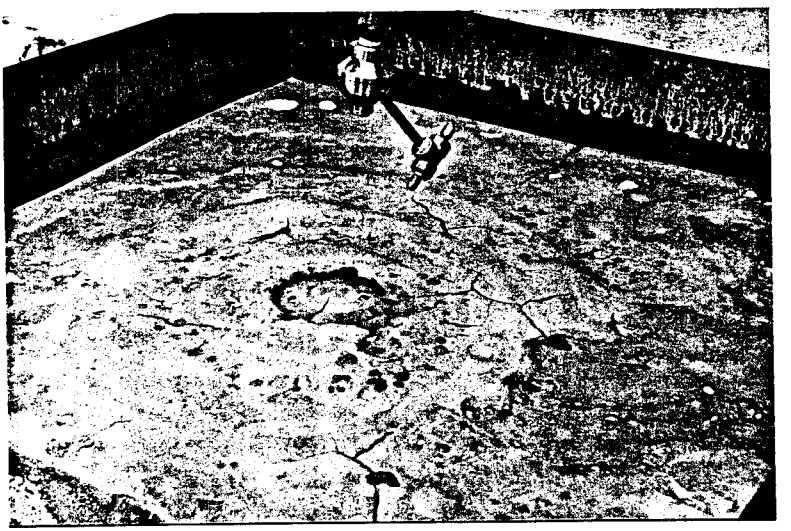

Photo 10 - Saltcake #3, Rotary, @ 6"

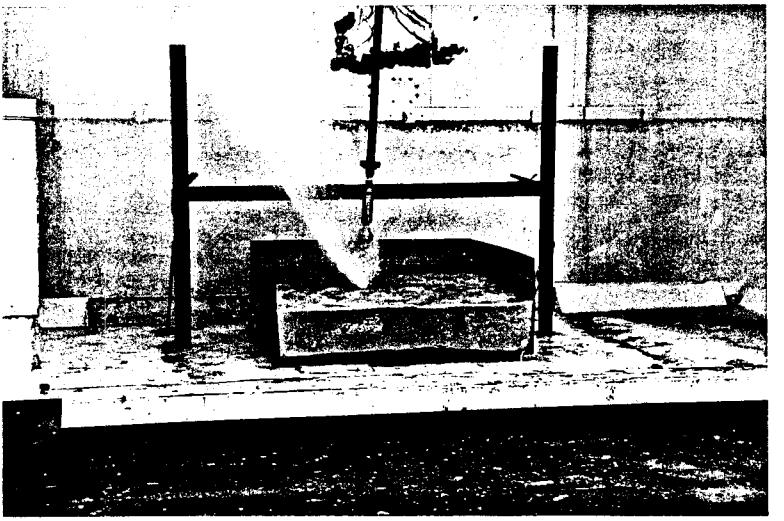

Photo 11 - Saltcake #3, Rotary, @ 3"

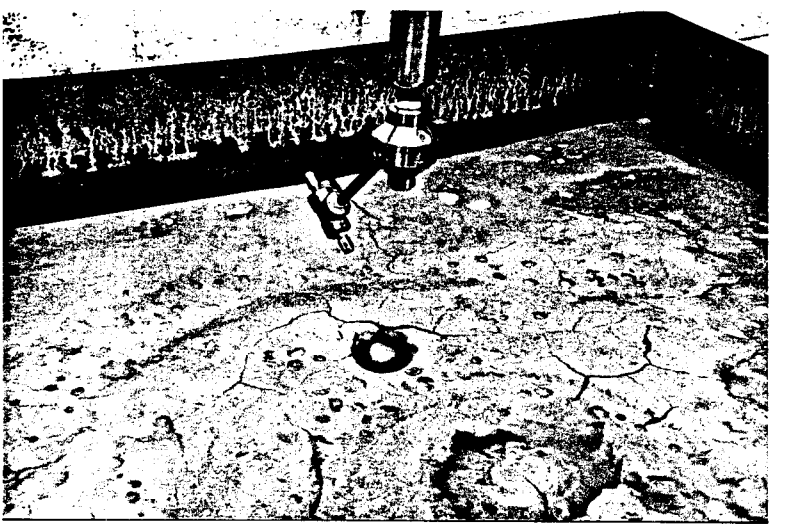

Photo 12 - Saltcake #3, Rotary, @3"

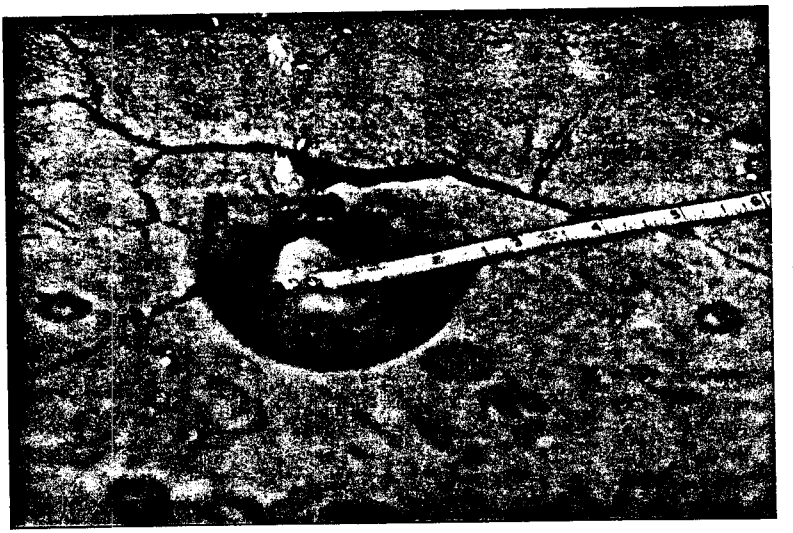

Photo 13 - Saltcake #3, Rotary, @ 3"

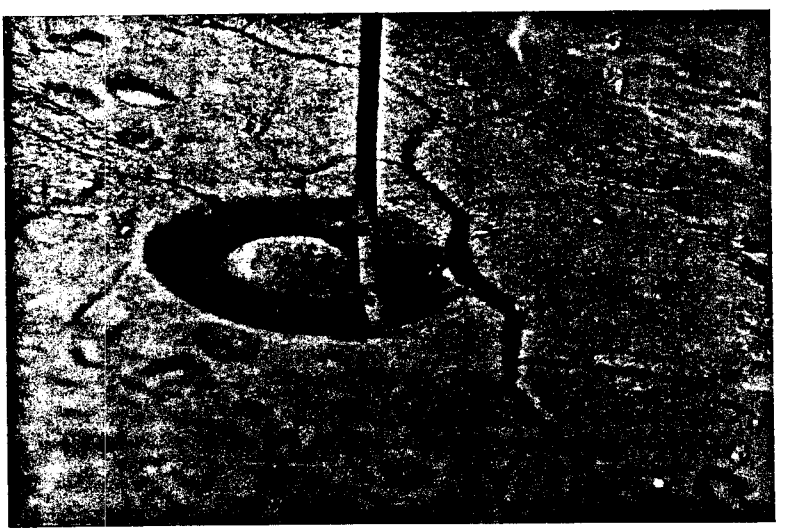

Photo 14 - Saltcake #3, Rotary, @ 3"

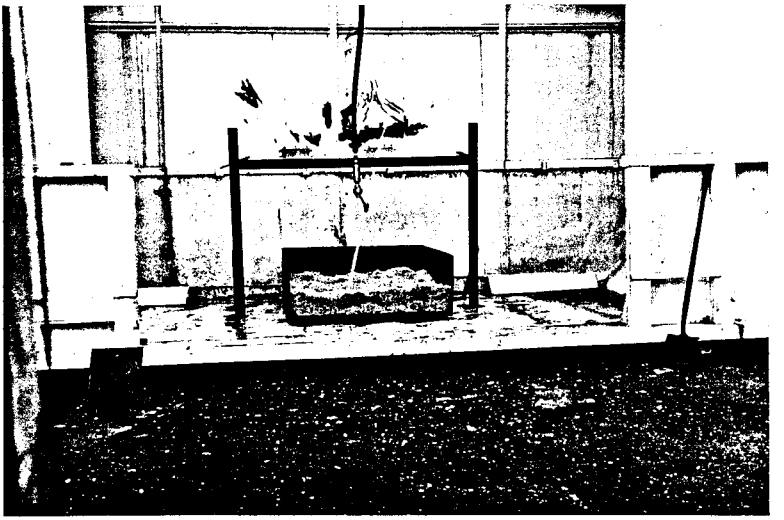

Photo 15 - Saltcake #4, Rotary, @ 24"

Photo 16 - Saltcake #4, Rotary, @ 24"

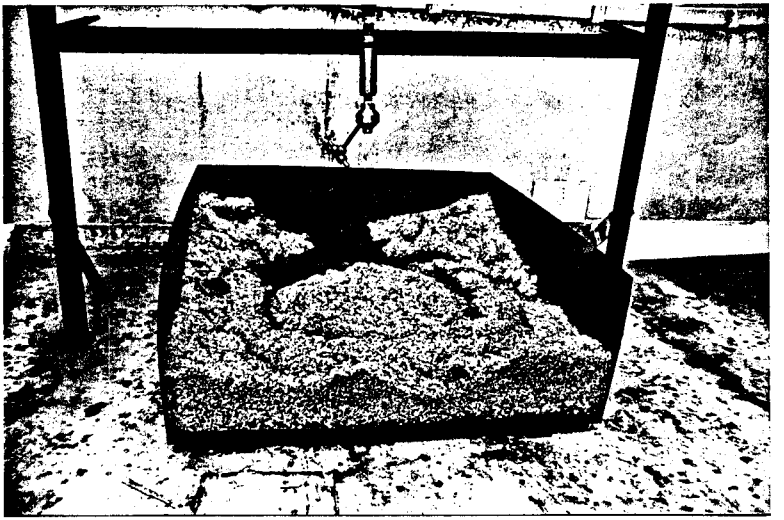

Photo 17 - Saltcake #4, Rotary, @ 18"

Photo 18 - Saltcake #4, Rotary, @ 18"

Photo 19 - Saltcake #4, Rotary, @ 12"

Photo 20 - Saltcake #2 Cannon, @ 5'

Photo 21 - Saltcake #2, Cannon, @ 5'

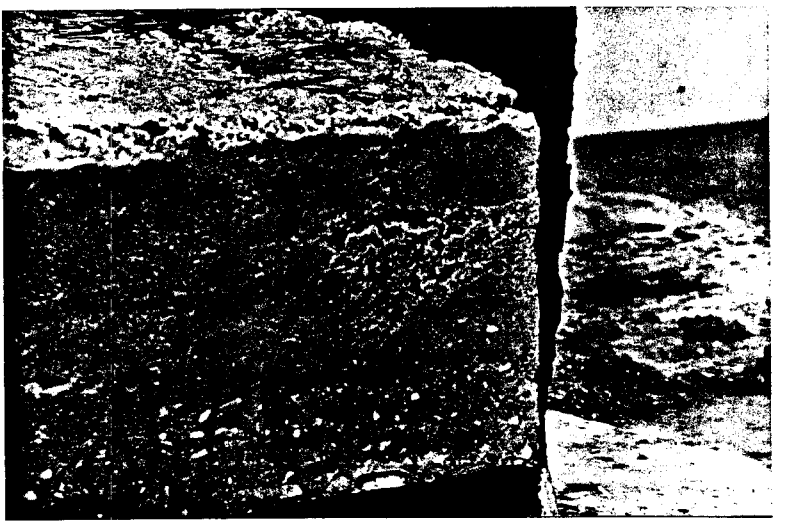

Photo 22 - Saltcake #2, Cannon, @ 4'

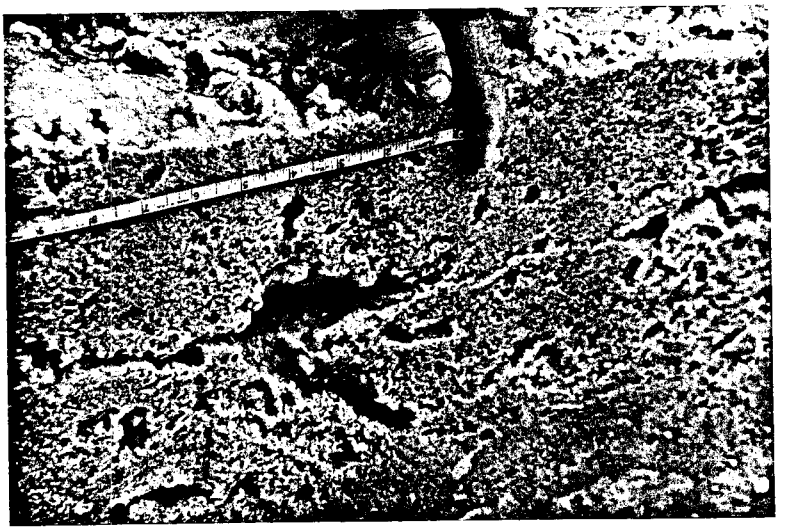

Photo 23 - Saltcake #2, Cannon, @ 3'

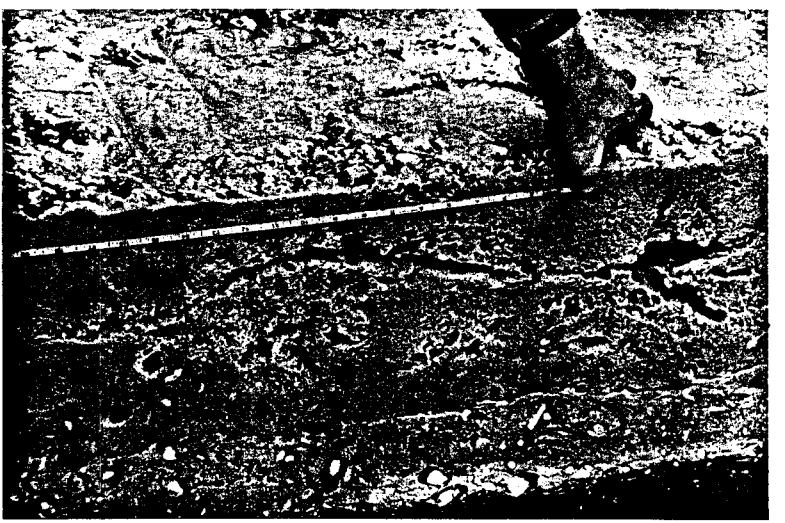

Photo 24 - Saltcake #2, Cannon, @ 2'

Photo 25 - Saltcake #2, Cannon, @ 1'

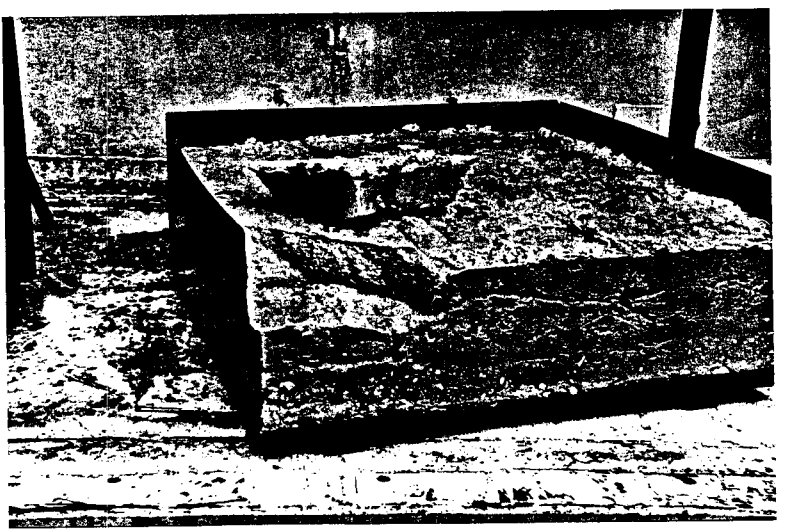

Photo 26 - Saltccake #2, Cannon, @ 6"

Photo 27 - Saltcake #2, Cannon, @ 6"

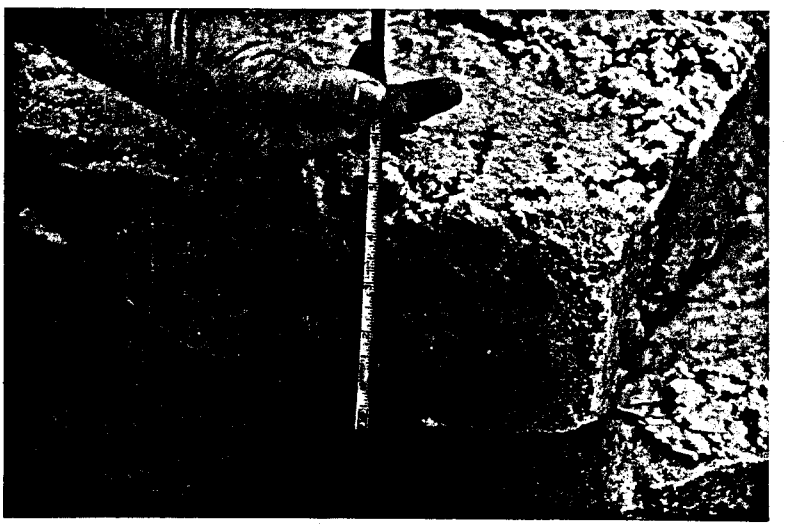

Photo 28 - Saltcake #2, Cannon, @ 6"

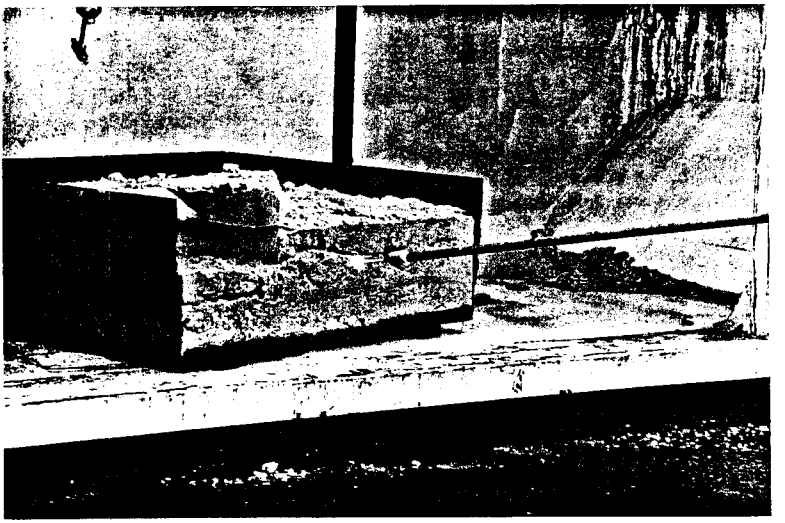

Photo 29 - Saltcake # 2, Cannon, @ 3"

Photo 30 - Saltcake #2, Cannon, @ 3"

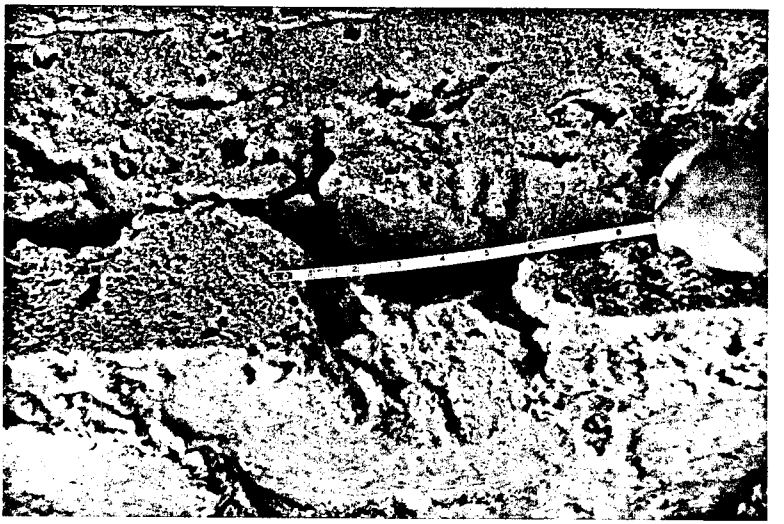

Photo 31 - Saltcake #2, Cannon, @ 3"

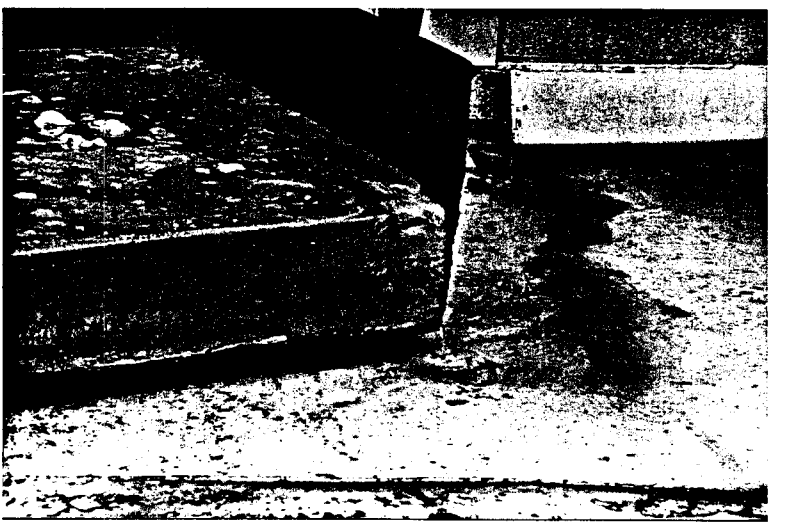

Photo 32 - Saltcake #3, Cannon, @ 5'

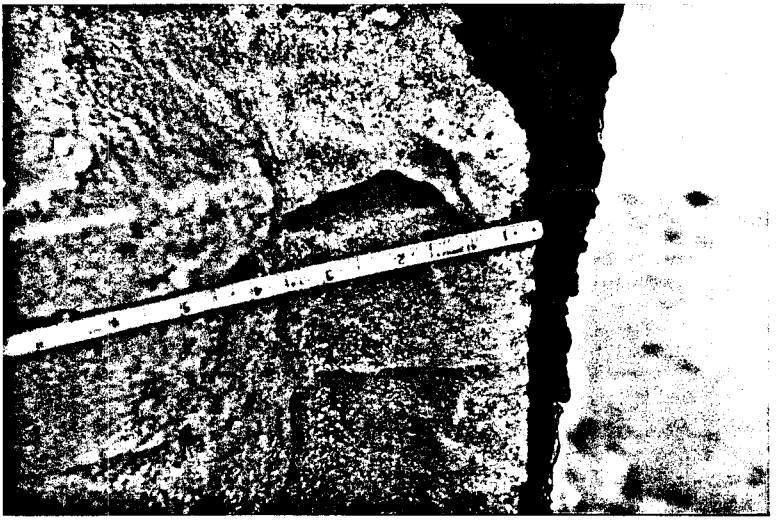

Photo 33 - Saltcake #3, Cannon, @ 5'

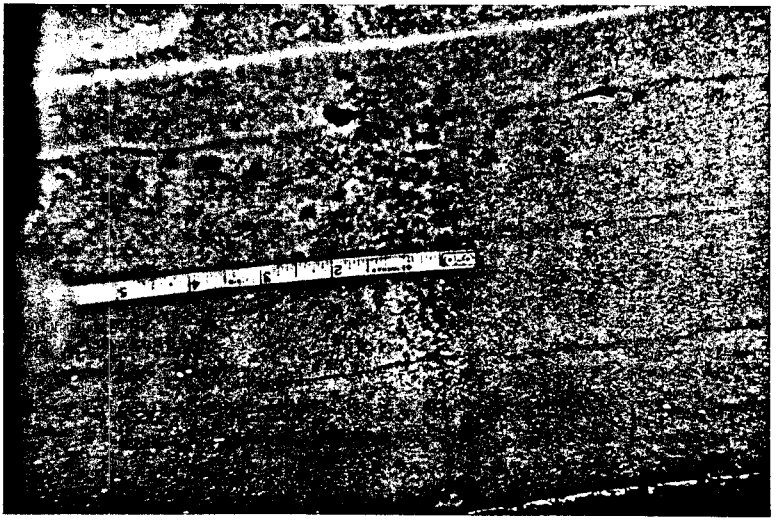

Photo 34 - Saltcake #3, Cannon, @ 4'

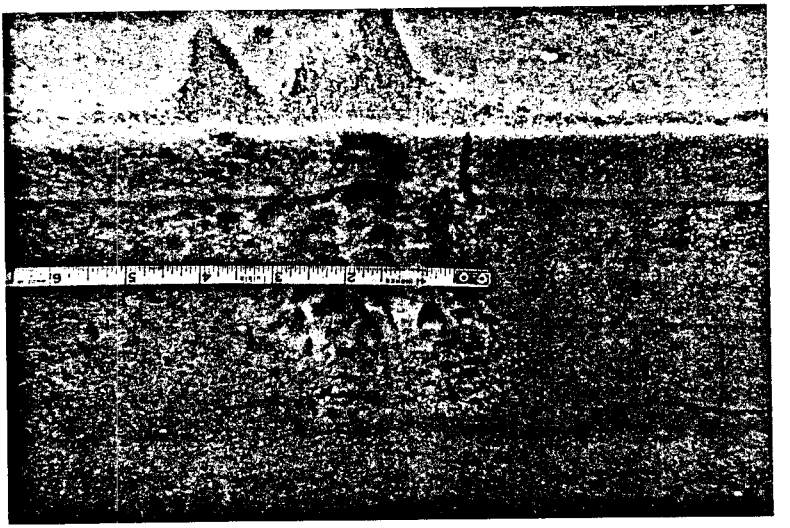

Photo 35 - Saltcake #3, Cannon, @ 3'

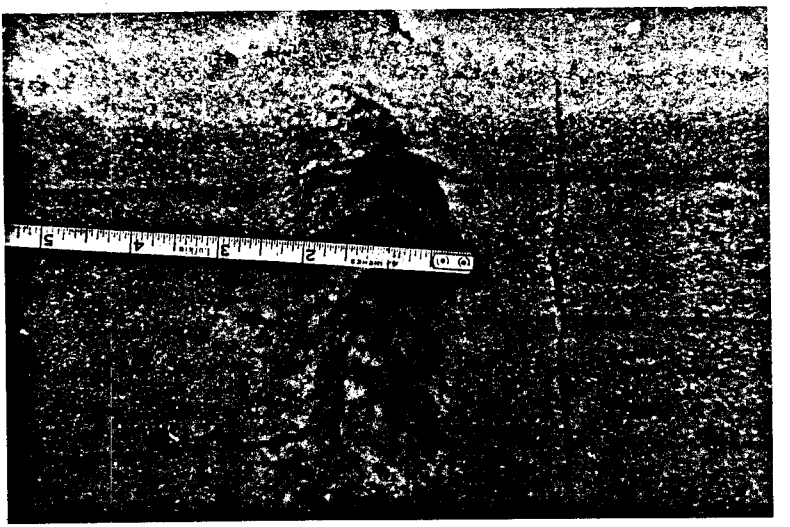

Photo 36 - Saltcake #3, @ 2'

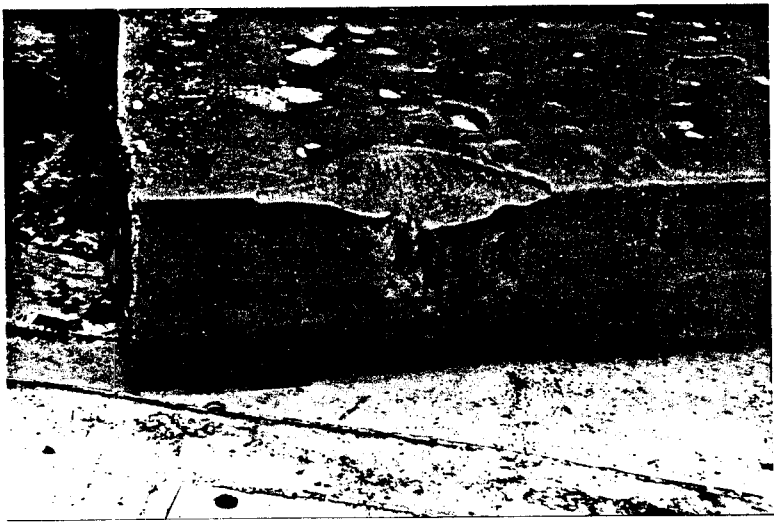

Photo 37 - Saltcake #3, Cannon, @ 1'

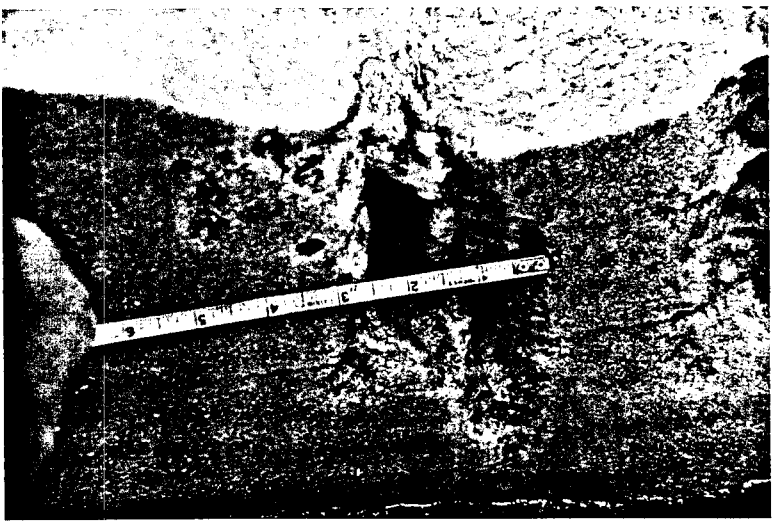

Photo 38 - Saltcake #3, Cannon @ 1'

Photo 39 - Saltcake #3, Cannon, @ 6"

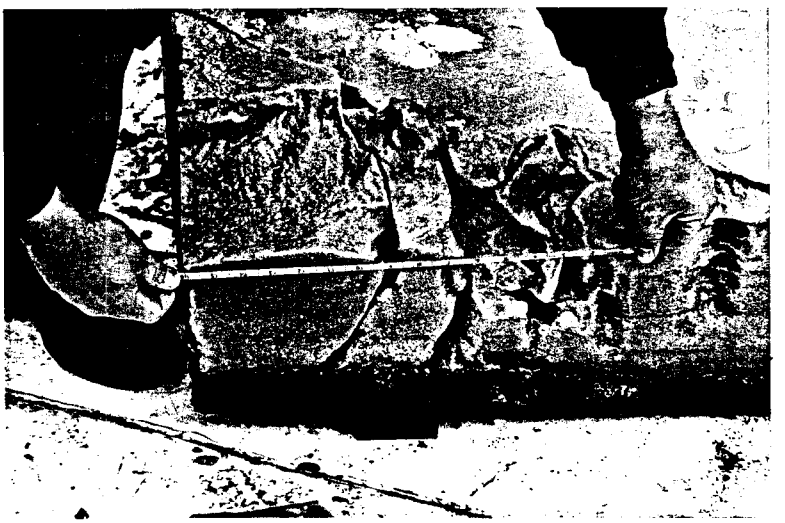

Photo 40 - Saltcake #3, Cannon, @ 6"

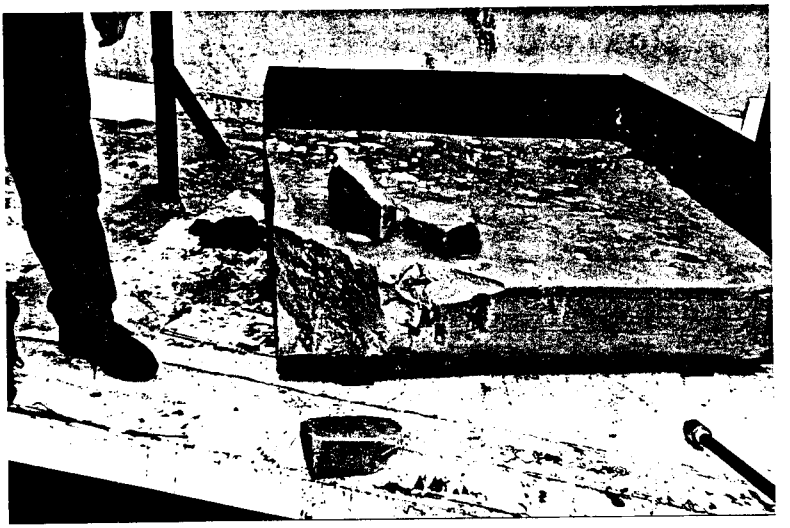

Photo 41 - Saltcake #3, Cannon, @ 6"

Photo 42 - Saltcake #3, Cannon, @ 3"

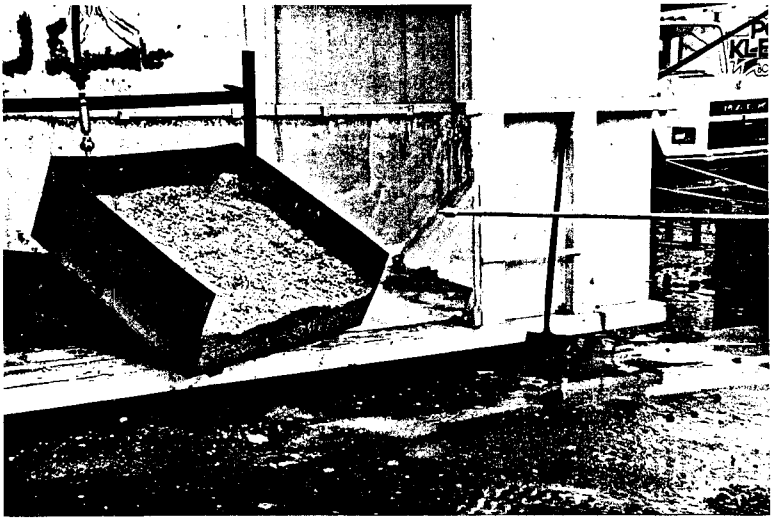

Photo 43 - Saltcake #4, Cannon, @ 5'

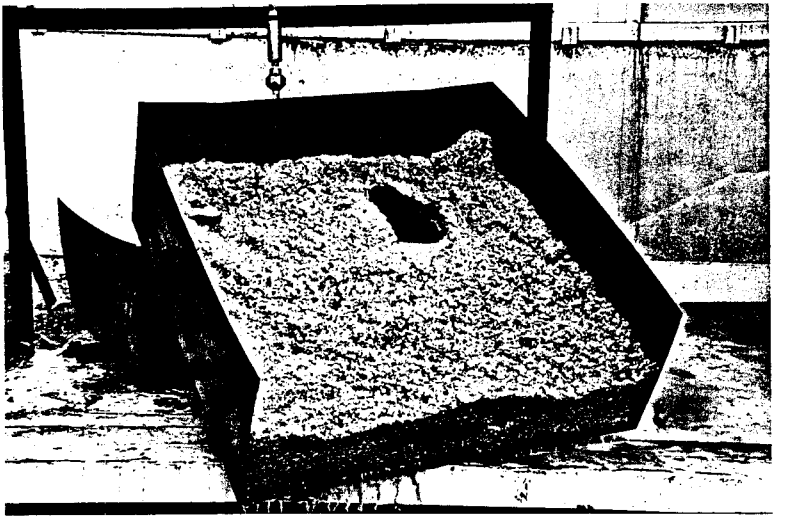

Photo 44 - Saltcake #4, Cannon, @ 5'

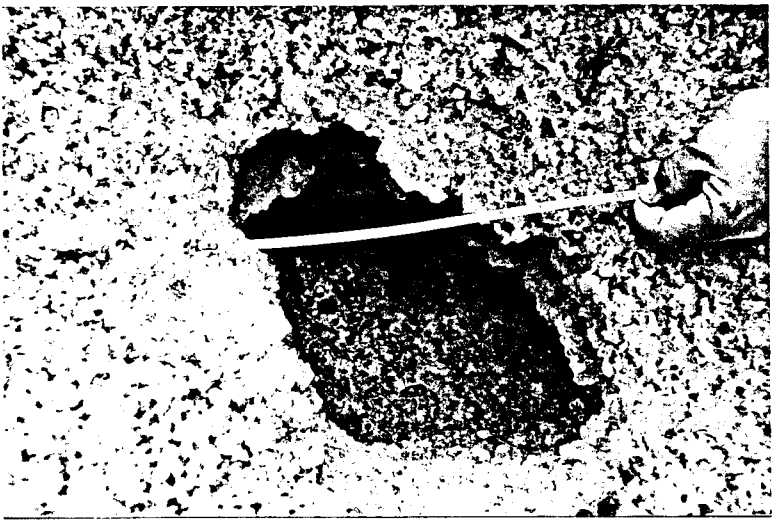

Photo 45 - Saltcake #4, Cannon, @ 5'

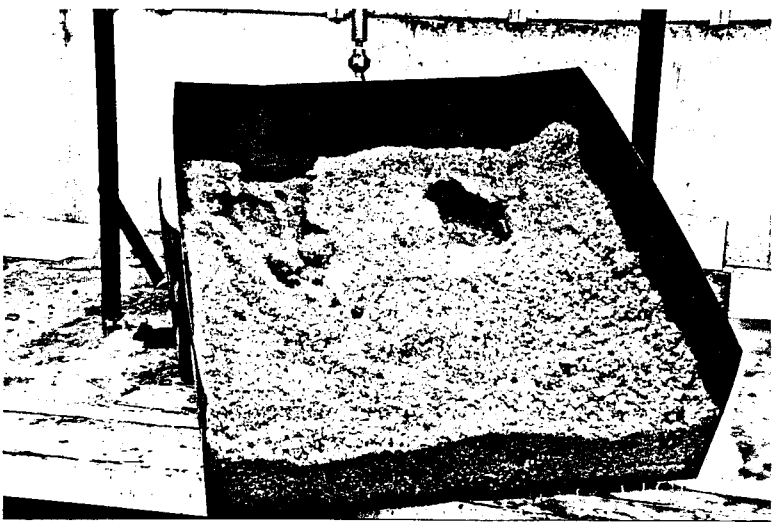

Photo 46 - Saltcake #4, Cannon, @ 4'

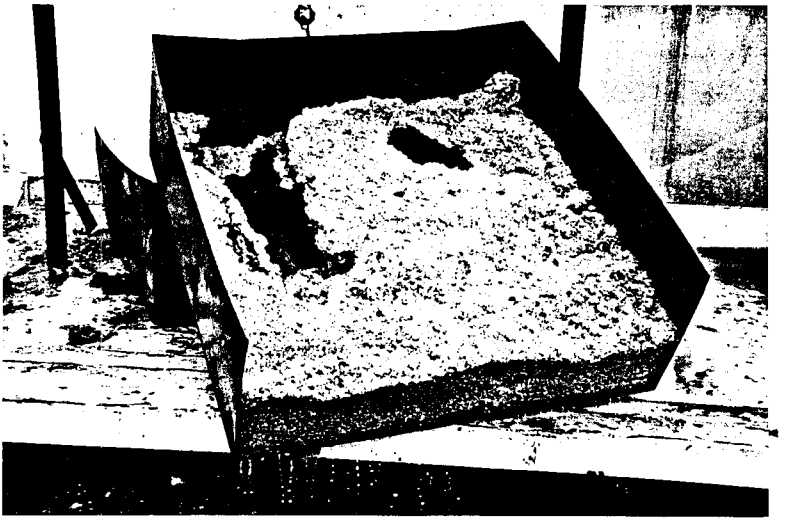

Photo 47 - Saltcake #4, Cannon, @ 3'

Photo 48 - Saltcake #4, Cannon, @ 3'

Photo 49 - Saltcake #4, Cannon, @ 3'

Photo 50 - Saltcake #4, Cannon, @ 3'

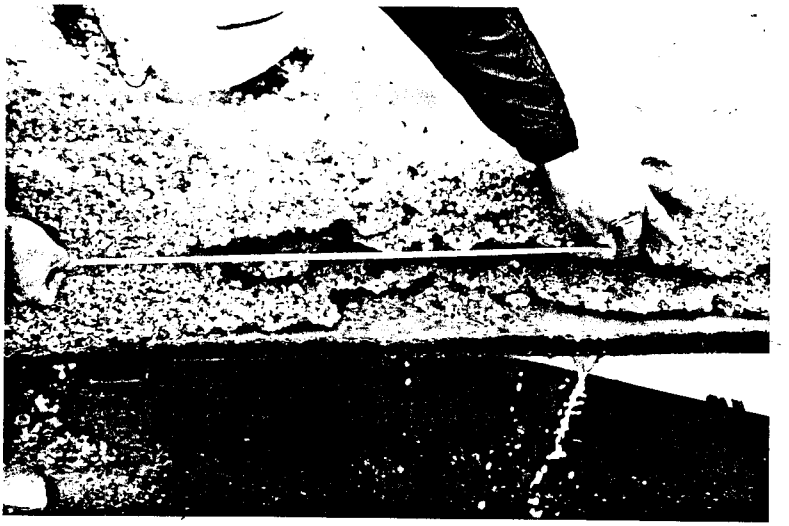

Photo 51 - Saltcake #4, Cannon, @ 2'

Photo 52 - Saltcake #4, Cannon, @ 1'

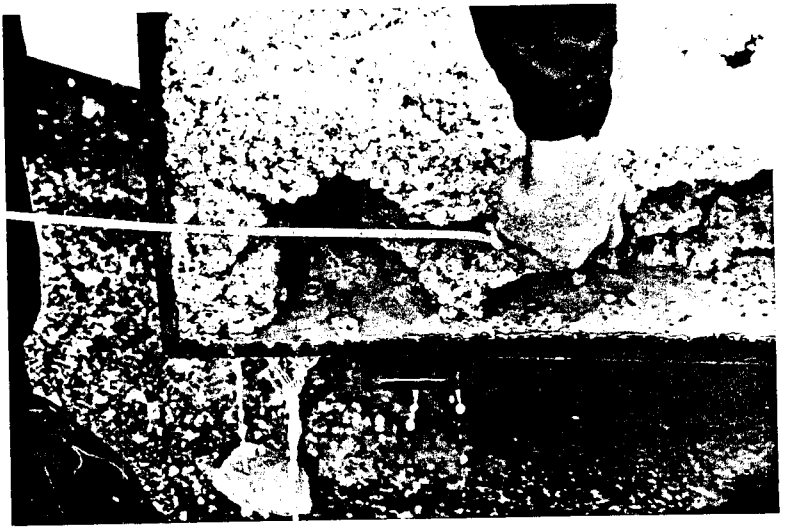

Photo 53 - Saltcake #4, Cannon, @ 1'

Photo 54 - Hardpan #1, Cannon, @ 5'

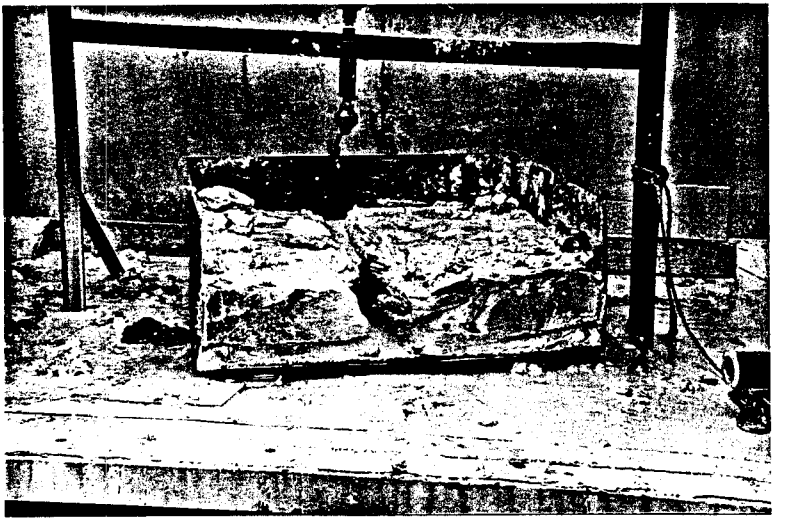

Photo 55 - Hardpan #1 - Cannon, @ 5'

Photo 56 - Hardpan #1, Cannon, @ 5'

Photo 57 - Hardpan #1, Rotary, @ 2'

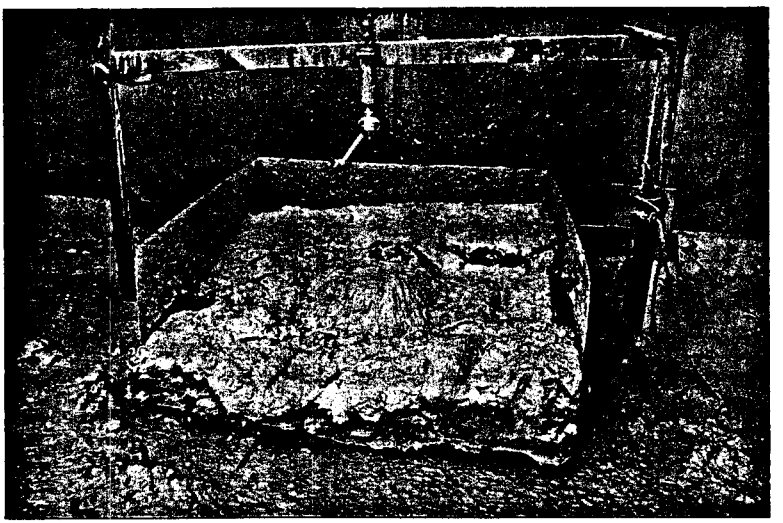

Photo 58 - Saltcake #4, Rotary, @ 1'

Photo 59 - Pressure-sensitive film trial

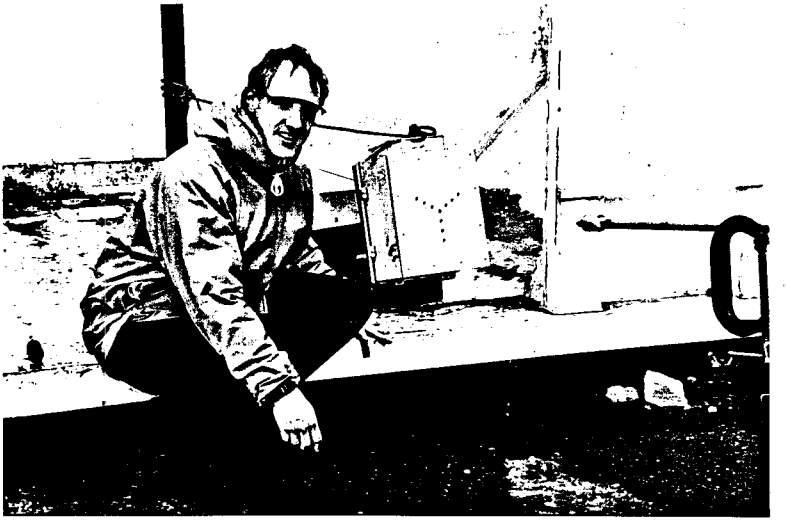

Photo 60 - Strain gage force measurement trial