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INACTIVE TAILING PILE MOISTURE CONDITIONS

FOR:
HOMESTAKE MINING COMPANY

BY:
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1.0 INTRODUCTION

Homestake Mining Company drilled five test holes in the inactive tailing pile at their Milan, New Mexico site on August 3, 1989. Figure 1-1 presents the locations of the five sites. Continuous samples with an acrylic tube were taken at these five sites to define the lithology of the tailings. Samples were selected from this material to be tested to define the moisture content-pressure head curves of the inactive tailings. These curves were used to define the specific retention of the tailing material. A comparison of specific retention values and existing moisture content was made.

2.0 LITHOLOGY AND PIEZOMETER CONSTRUCTION FOR THE INACTIVE TAILINGS

The tailings within the inactive pile were discharged from the northern end of the pile and, therefore, the lithology would be expected to be controlled by the points of discharge. The southern hole IP1, contained only slimes in the tailings, which exist between the cover material and the original ground surface at eleven feet. Table 2-1 presents the lithology of the test hole IP1.

Drill site IP2, which is farther north of the site IP1, contains mainly tailing slimes but does contain a couple lenses of tailing sands. Site IP3, which is east of site IP2, contains more sands than slimes. The lithology at site IP4 is similar to site IP3, but may contain more fine grain material. The lithology at site IP5 is essentially all tailing sand, as would be expected for this site.

The lithology of these five test holes is very similar to the expected lithology due to area of discharge. Site IP4 contains slightly more fines than expected and site IP3 contains more sand than expected (see attached Appendix 1).

Two inch diameter piezometers were installed in the test holes for monitoring water levels. Table 2-6 presents the piezometer basic data. This table also presents the water level measurements for the piezometers. Only piezometer IP4 contains water and it contains only 4.5 feet of water above the base of the tailing pile.

TABLE 2-1 LITHOLOGIC LOG FOR PIEZOMETER IP-1

LITHOLOGIC LOG FOR: HOMESTAKE MINING WELL IP-1
AUGUST 3, 1989

DEPTH FT-LSD	DESCRIPTION
0-4	Compacted into 2.5' sample tube - sample seems to be all fill material
4-6.5	Fill material to 5.5' then dark gray silt clay saturated mill slime ml (some compaction)
5.8-6.0	Lab sample IP1-1
6-0.6.5	Lab sample IP1-2
6.5-9	All dark gray silt, clay saturated mill slime - unstratified
7.6-7.8	Lab sample IP1-3
7.8-8.3	Lab sample IP1-4
8.3-8.5	Lab sample IP1-5
8.5-9.0	Lab sample IP1-6
9-11.5	Dark gray silt, clay saturated mill slime to ~ 11' then soil below pile
11.5-14	Tube 4 & 5 compacted or pushed away from sampler: recovery was 2.5' ~ 2' sand and the rest slime, sand from 11-14' SP fine-med. grain below base of pile, some silt
14-16.5	SP sand to 15.0' fn. red brown damp then clay soil or lense to 16.5' (CL)
16.5-19	Clay soil or lense to 18' (CL) then red-brown sand to 19' fn. and med. grain SP
19'	TD

TABLE 2-2 LITHOLOGIC LOG FOR PIEZOMETER IP-2
LITHOLOGIC LOG FOR: HOMESTAKE MINING WELL IP-2
AUGUST 3, 1989

DEPTH FT-LSD	DESCRIPTION
0-1.5	Was discarded, mixture soil, sand, mill tailings
1.5-4	SP brown some root and organic matter, damp
4-9	5' sample run produced 2' of sample. Seems that soft material pushes away from auger in side walls. Sample is SP sand as above, 2' of saturated slime between 4 and 6.5' - lost?, sample remaining beleived to be from 6.5 to 9'
10.1-10.5	Lab sample IP2-1
10.8-11.5	Lab sample IP2-2
12.2-12.4	Lab sample IP2-3
13.0-13.7	Lab sample IP2-4
13.7-14.0	Lab sample IP2-5
11.5-14.0	Lab sample IP2-6
9-14	mills slime, dark gray - saturated silt, clay (ML) there is a sand split from 10' to 10.5' mostly unstratified
14-16.5	Mill slimes from 14 to 16.5' pressed into side wall
16.5-19	Old soil surface roots clay, silt, dary gray brown damp (ML). Fine sand (SP) tan to brown fine grained

TABLE 2-3 LITHOLOGIC LOG FOR PIEZOMENTER IP-3

LITHOLOGIC LOG FOR: HOMESTAKE MINING WELL IP-3
AUGUST 3, 1989

DEPTH FT-LSD	DESCRIPTION
1-4	Light gray - tan sand - fill material SP. Lost 6" sample (compaction ?), mill tailings sand gray-brown damp fine - grain
4-6.5	Mill sand tailings SP gray to brown fine some clay unstratified
5.9-6.1	Lab sample IP3-1
6.5-9	SP Mill sand tailings but clay breaks from 7' to 7.5' and 8' to 8.5' all are gray to gray brown sand are damp and clays are wet
7.7-7.9	Lab sample IP3-2
9-11	Lost 1.5' sample
11-14	Mill tailings sand, SP gray to gray brown some clay no clay splits
12.8-13.6	Lab sample IP3-3
14-17	Same as above, damp
17-19	Old soil surface gray brown sand SP fine and medium grain damp
19-21.5	Lost 2.5' sample
21.5-22.5	As in tube 7
22.5-24	CH red-maroon weathered clay shale

TABLE 2-4 LITHOLOGIC LOG FOR PIEZOMENTER IP-4
LITHOLOGIC LOG FOR: HOMESTAKE MINING WELL IP-4
AUGUST 3, 1989

DEPTH FT-LSD	DESCRIPTION
1-6.5	Sand silt clay, mill tailings SP damp brown some organic material, roots, etc.
7.9-8.3	Lab sample IP4-1
6.5-9	Damp sand silt, clay, organic material to 8' then mostly sand dark gray very damp
8.5-9.0	Lab sample IP4-5
9-11.5	Lost 2.5' of sample (pushed into sides?)
12.2-12.5	Lab sample IP4-2
11.5-14	Dark gray and brown sand silt and clay saturated to 12.3' then damp brown and gray sand to 14' seems to be part fill and part mill slimes
14-16.5	Saturated dark gray mill slimes SP-SM
15.0-15.4	Lab sample IP4-6
15.4-15.8	Lab sample IP4-3
16.5-18	SP-SM saturated dark gray mill slimes
16.9-17.3	Lab sample IP4-4
18-19	Old soil, damp gray-brown some organic matter

TABLE 2-5 LITHOLOGIC LOG FOR PIEZOMETER IP-5
LITHOLOGIC LOG FOR: HOMESTAKE MINING WELL IP-5
AUGUST 3, 1989

DEPTH FT-LSD	DESCRIPTION
1-4	SP mill tailings - sand very fine grain gray tan damp some organic matter
4-6.5	Lost 2.5' sample
6.5-9	Mill tailings sand wet dark gray SP some stratification mostly color change in sand but one clay silt zone
7.5-7.8	Lab sample IP5-1
9-11.5	Lost 2.5' of sample
11.5-14	Dark gray mill tailings sand (SP) some clay, wet unstratified
12.9-13.2	Lab sample IP5-2
14-16.5	Lost 2.5' of sample
16.5-19	Uniform mill tailings sand SP dark gray no stratification wet, some clay
19-21.5	SP dark gray mill tailings sand damp, some clay very little composition change some lightening of color
21.5-24	Lost about 1'
22.1-22.4	Lab sample IP5-3
24-27	Believe slimes flowed into well in drilling, lost 1.5 sample, mill tailings sand and slime tailings wet, slime saturated
25.8-26.5	Lab sample IP5-4
27-29	Old soil @ 27.0' fine and medium sand some silt and clay damp
29-34	Lost 1.8' of sample SP fine medium grain sand Some silt and clay
32.5-33	Clay seam 6" thick (CH)
34	TD

TABLE 2-6 BASIC WELL DATA FOR THE INACTIVE TAILING PIEZOMETERS

WELL NO.	TOTAL DEPTH (FT-MP)	MEASURING POINT ABOVE LSD (FT)	MEASURING POINT ELEV. (FT-MSL)	WATER LEVEL DATE	WATER LEVEL DEPTH (FT-MP)	WATER LEVEL ELEV. (FT-MSL)	PERFORATE INTERVA (FT-LSD)
IP-1	15.0	3.3	6582.74	8/14/89	DRY	<6567.7	6-11
	15.2			9/12/89	DRY	<6563.5	
	15.0			10/4/89	DRY	<6567.7	
IP-2	18.0	4.0	6588.79	8/14/89	DRY	<6570.8	5-10
	18.3			9/12/89	DRY	<6570.5	
	18.0			10/4/89	DRY	<6570.8	
IP-3	19.2	4.0	6588.43	8/14/89	DRY	<6569.2	7-17
	19.6			9/12/89	DRY	<6568.8	
	19.9			10/4/89	DRY	<6568.5	
IP-4	20.1	1.3	6591.30	8/14/89	14.90	6576.4	5-15
	19.4			9/12/89	14.53	6576.8	
	19.8			10/4/89	14.84	6576.5	
IP-5	29.2	3.0	6599.04	8/14/89	DRY	<6569.8	11.5-26.
	29.7			9/12/89	DRY	<6569.3	
	30.2			10/4/89	DRY	<6568.8	

3.0 MOISTURE CONTENT

Numerous samples were selected to determine the moisture-pressure head curves for the different lithologies in the different holes. The slimes at site IP1 were tested from six different intervals. The laboratory samples were labeled IP1-1 through IP1-6 and their depths are presented on the lithologic table, Table 2-1. The moisture content was measured at saturation, -15 bars and either -0.3 or -0.48 bars. A pressure head of -.033 bars is generally accepted to be equal to the specific retention of the material. Figure 3-1 presents a plot of the moisture content versus pressure head. The initial moisture content for each sample was placed on the curve to show the initial moisture level compared to the other moisture contents. The six moisture curves for the sample IP1 site are very similar, except in the lower levels at the IP1-5 sample. Samples IP1-2, IP1-4 and IP1-6 were loaded to simulate the cover material after reclamation. The loaded curves are shifted upward; that is they contain more moisture for the same pressure. The initial moisture contents plot above the saturated level for all of the samples except IP1-2 and IP1-6 which were equal to their saturation level. The initial moisture concentrations being greater than the saturation value is probably due to some consolidation of the sample during installation of it into the pressure cell. Each of these slime samples still contains drainable water, but the amount of drainable water is small compared to their specific retention.. Table 3-1 presents a tabulation of the laboratory results and also presents an estimate

of specific retention of these materials. Two of the loaded sample moisture contents are very close to their specific retention values. A large percentage of the water in these slimes will not drain and the portion that does will likely move at a very slow rate.

Five samples were taken from the IP2 site to define the moisture-pressure head curves for this material (see Figure 3-2). All of these samples were tailing slimes except for IP2-1, which was a one-half foot sand split in the slimes interval. This sand sample produced a curve similar to the slimes material which was probably caused by the loading of this material. This sample must have enough fines to act similar to the slimes after being loaded. The initial moisture content from samples IP2-1 and IP2-4, even though at saturation, are also near their specific retention values for these two curves. This data shows that both the slimes and sands sample will not have a significant amount of drainable water after loading. These two curves indicate that essentially all water will be retained in these materials after loading. The initial moisture content placed on the moisture curve for the IP2-2 slime sample indicates that the moisture content in this material is below saturation with approximately six percent above the specific retention value. The moisture content in the slimes from sample IP2-3 is approaching the specific retention value and, therefore, probably contains very little drainable water. Both samples IP2-2 and IP2-3 have relatively small specific retention values for the slimes.

Figure 3-3 presents the moisture content versus pressure head for three tailing sands samples taken from site IP3. The initial moisture contents of each of these samples are very near the specific retention values from the moisture curves and should be considered drained. These sand samples have smaller specific retention than most of the slimes samples, as expected.

Four samples were tested for their moisture content from the IP4 site. This material varied from a sand (IP4-1), to a silty sand (IP4-2), to slime (IP4-3 and IP4-4). Each of these materials are close to being saturated.

Test hole IP5 contained mainly sand, as expected, because the site is located near the discharge area of the tailing facility. Figure 3-5 presents the moisture versus pressure head curves for the IP5 site. Samples IP5-1, IP5-2 and IP5-3 had initial moisture contents fairly close to their specific retention values. The initial moisture content from the sand and slimes samples (IP5-4) is essentially at saturation, but is not very much different than the specific retention value for this material.

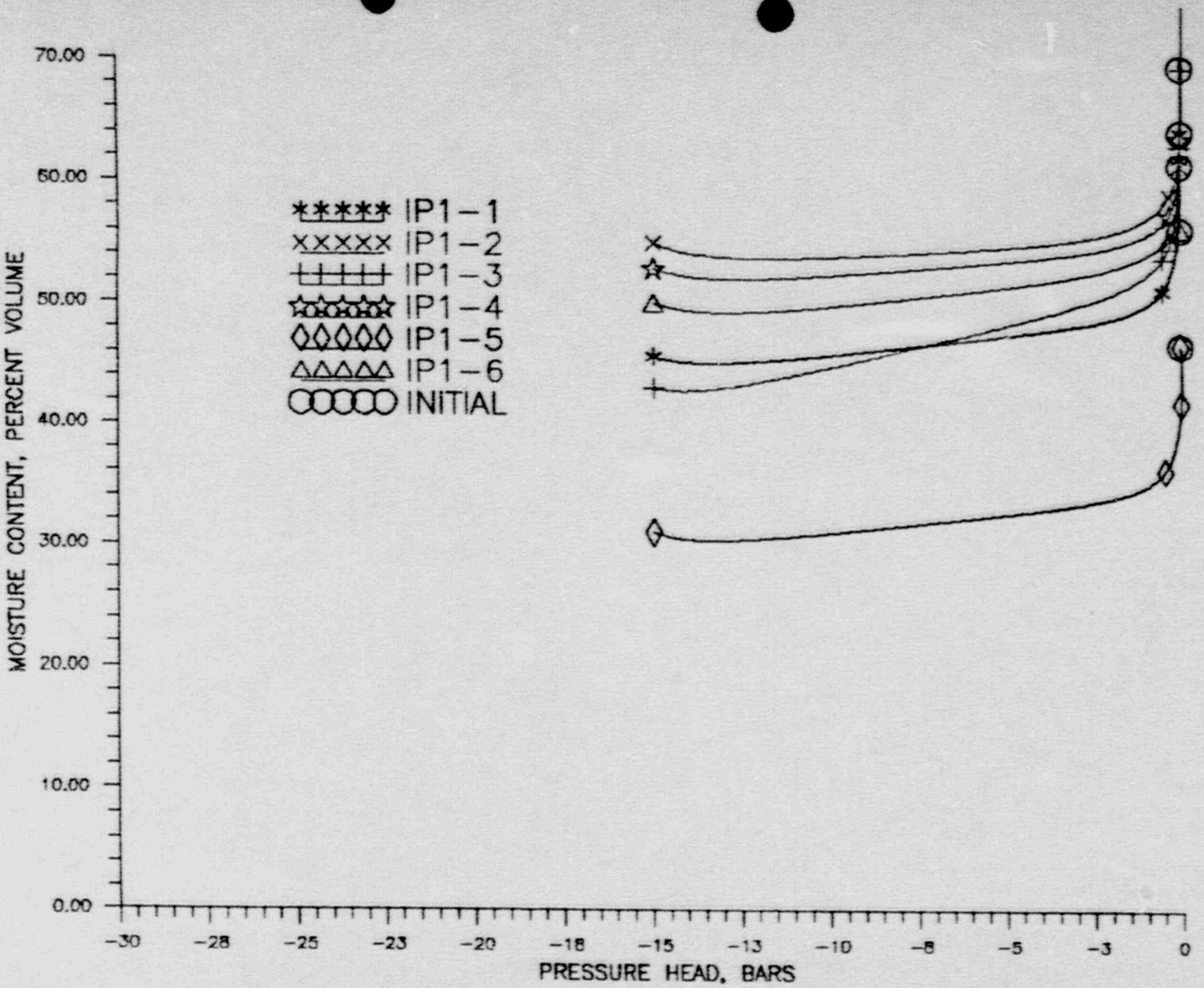

FIGURE 3-1. MOISTURE CONTENT VERSUS PRESSURE HEAD FOR IP1 SAMPLES

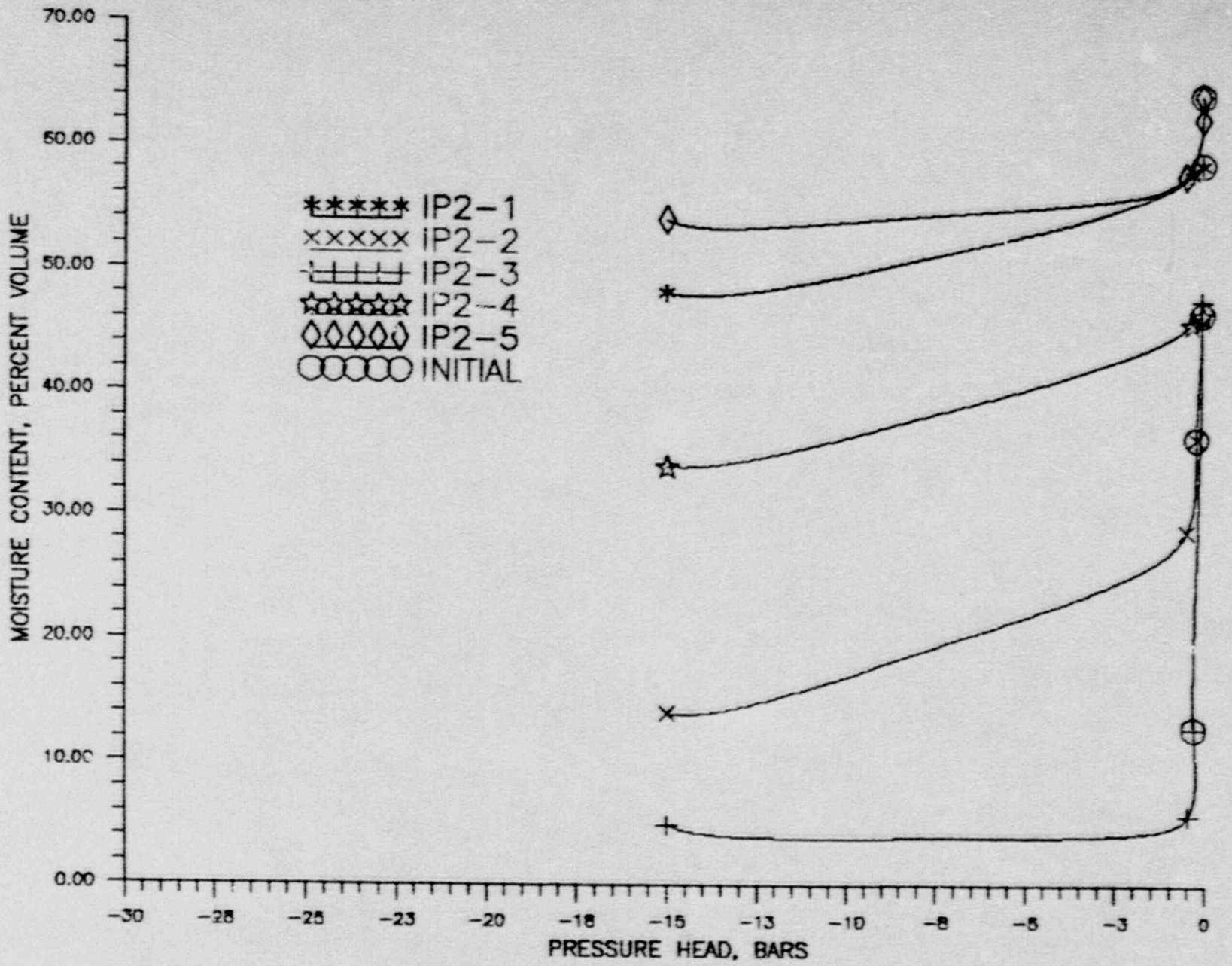

FIGURE 3-2. MOISTURE CONTENT VERSUS PRESSURE HEAD FOR IP2 SAMPLES

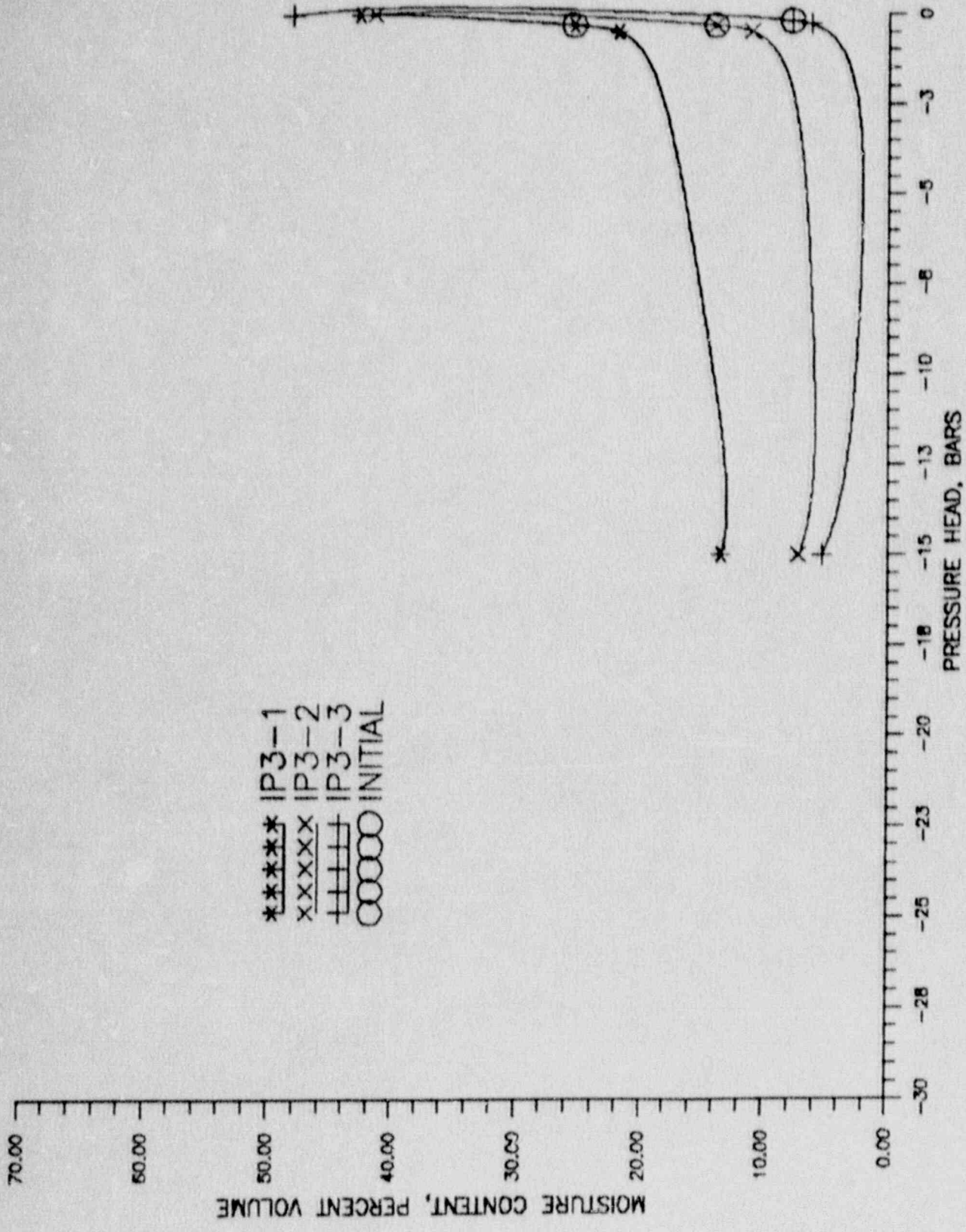

FIGURE 3-3. MOISTURE CONTENT VERSUS PRESSURE HEAD FOR IP3 SAMPLES

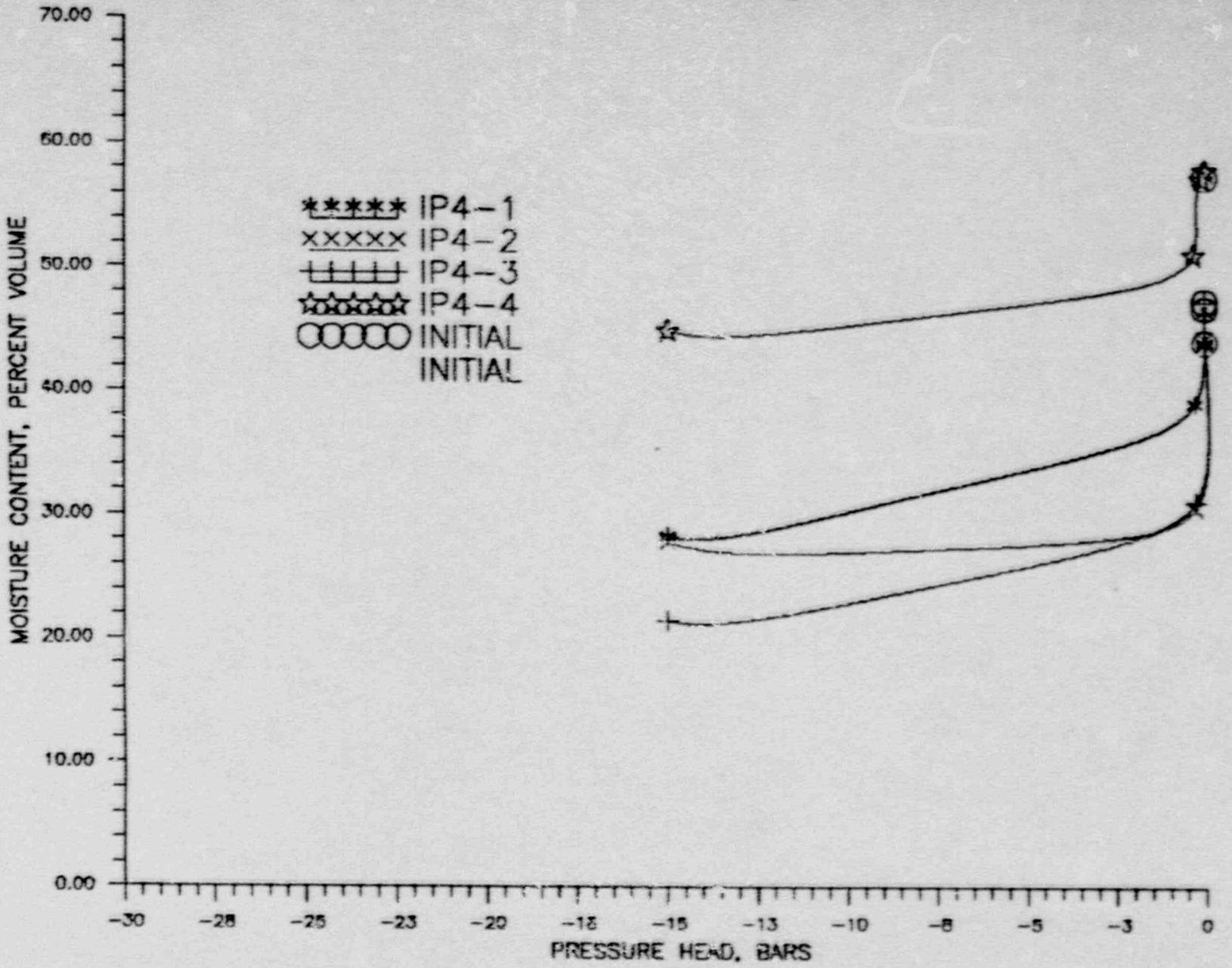

FIGURE 3-4. MOISTURE CONTENT VERSUS PRESSURE HEAD FOR IP4 SAMPLES

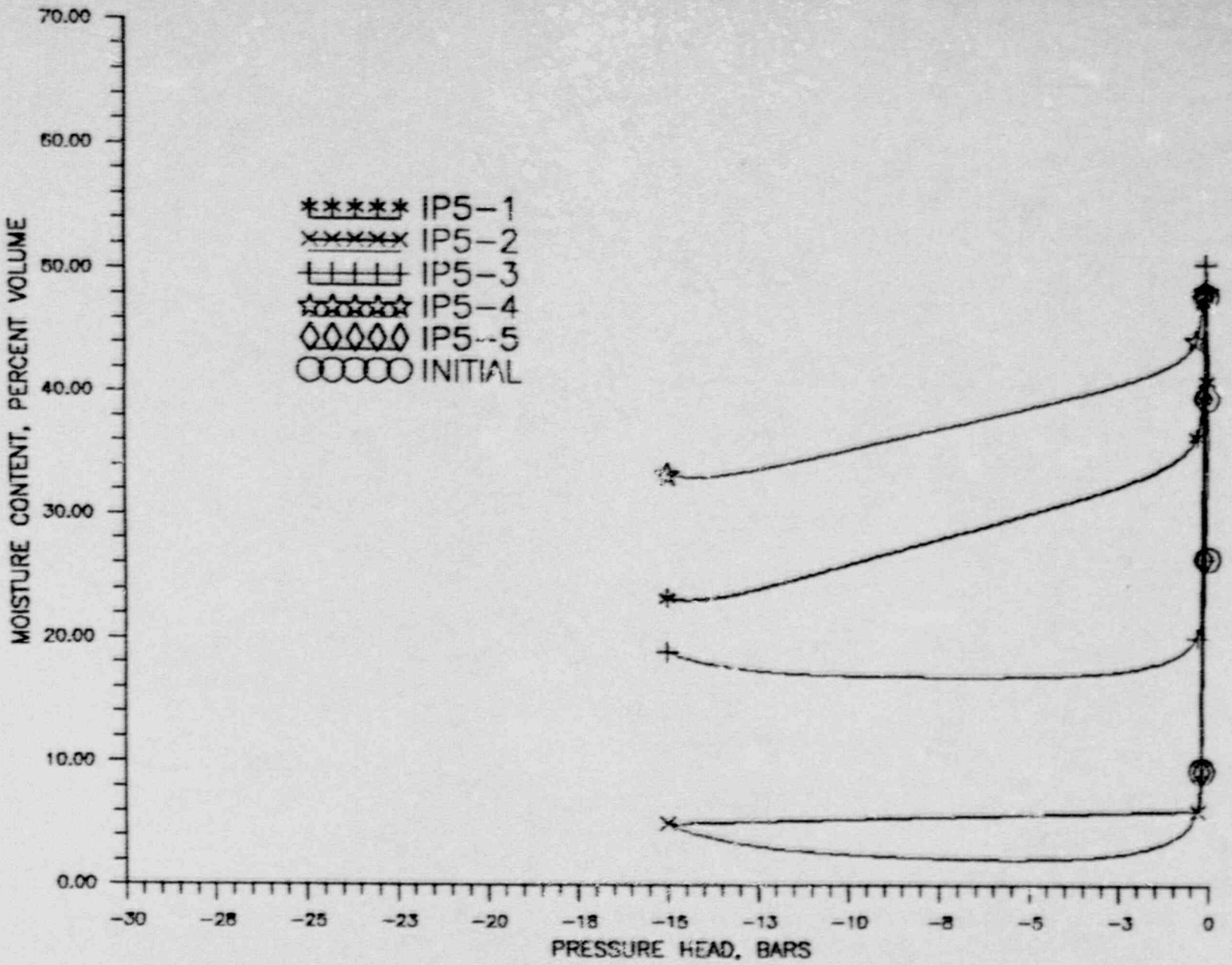

FIGURE 3-5. MOISTURE CONTENT VERSUS PRESSURE HEAD FOR IP5 SAMPLES

TABLE 3-1. OBSERVED MOISTURE CONTENTS AND ESTIMATED SPECIFIC RETENTION

	MOISTURE CONTENT FOR PRESSURE HEAD (BARS)				INITIAL MOISTURE CONTENT	SPECIFIC RETENTION
	0.0	-0.3	-0.48	-15	(%VOL)	(%)
IP1-1	62.09	--	51.14	45.67	64.21	52
IP1-2*	61.47	58.97	--	54.98	61.47	58
IP1-3	63.11	--	53.80	48.03	68.56	54
IP1-4*	63.73	57.46	--	52.87	77.72	55
IP1-5	41.86	--	36.27	31.08	46.65	37
IP1-6*	56.25	55.37	--	50.06	56.25	55
IP2-1*	58.58	57.78	--	48.10	58.58	57
IP2-2	45.84	--	28.83	14.01	36.35	30
IP2-3	47.64	--	5.73	4.93	12.84	8
IP2-4*	46.52	45.77	--	33.99	46.52	45
IP2-5	62.32	--	57.65	53.95	64.21	58
IP2-6*	53.345	52.55	--	47.22	53.45	52
IP3-1	42.91	--	21.97	13.52	25.53	25
IP3-2	41.67	--	11.12	7.31	14.02	14
IP3-3	48.32	6.31	--	5.40	7.90	7

IP4-1	43.90	39.18	--	28.34	44.07	39
IP4-2	44.39	30.61	--	27.93	46.82	30
IP4-3	46.06	31.14	--	21.50	47.41	31
IP4-4	58.05	51.26	--	44.95	57.43	51
IP4-5*	9.43	9.65	--	6.27	9.43	9
IP4-6*	41.44	31.74	--	24.13	41.44	30
IP5-1	41.08	36.44	--	23.26	39.60	36
IP5-2	48.09	6.11	--	5.00	9.37	6
IP5-3	50.43	20.21	--	18.95	26.47	20
IP5-4	48.39	44.33	--	33.36	47.86	44

NOTE: * Sample loaded to simulate reclamation cover.

4.0 CONCLUSION

The majority of the slimes in the inactive tailing pile are at or near saturation. The specific retention values from this material is very high and, therefore, very little of the moisture in this material will drain. The samples loaded to simulate the reclamation covers increase in specific retention and essentially will retain all existing moisture. The existing moisture content of the sand tailings is generally close to the specific retention of this material and, therefore, most of the drainable water has left the tailing material. The sand at site IP4 is an exception with moisture contents essentially at saturation.

The only piezometer that has collected water in the two months since installation has been IP4. This piezometer has only a very few feet of water (about 4.5 ft.) in the tailing sands which would not be feasible to be pumped for removal. The inactive tailing facility has a very small amount of drainable water which will drain at a very gradual rate over a very long period of time.

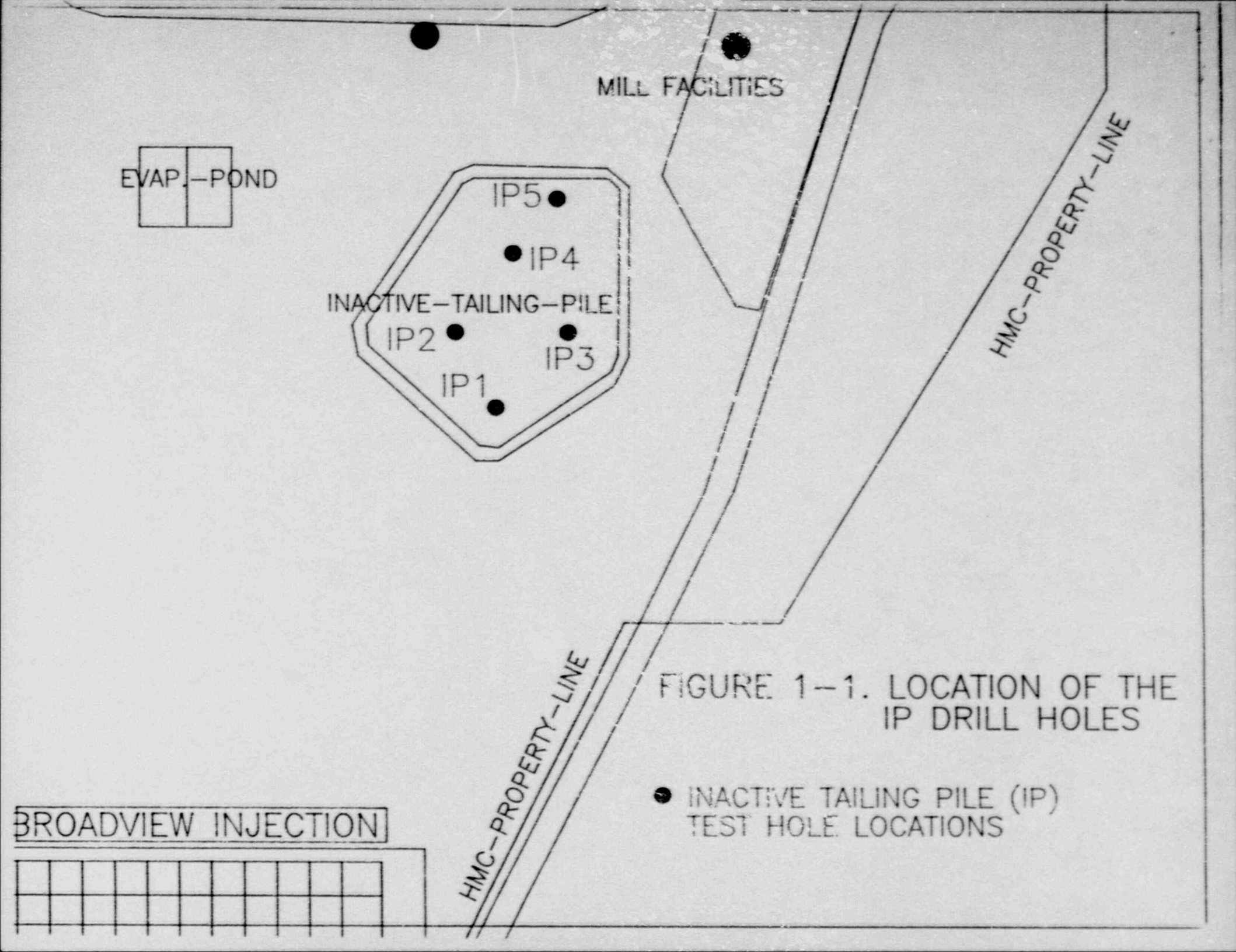

FIGURE 1-1. LOCATION OF THE IP DRILL HOLES