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BENEFICIATION STUDIES ON THE HASAN ÇELEBI MAGNETITE DEPOSIT, TURKEY

by

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ABSTRACT

Bench-scale and semicontinuous tests were performed on surface, trench, and diamond drill core samples from the Hasan Çelebi low-grade magnetite deposit to determine the optimum beneficiation procedures utilizing wet magnetic separation techniques. Composite core samples typically contain about 27 percent recoverable magnetite and require crushing and grinding through 1 mm in size to insure satisfactory separation of the gangue from the magnetite Regrinding and cleaning the magnetite concentrate to 80 percent minus 150-mesh is necessary to obtain an optimum of 66 percent iron.

Semicontinuous pilot-plant testing with the wet magnetic drum using the recycled middling technique indicates that as much as 83 percent of the acid-soluble iron can be recovered into a concentrate containing 66 percent iron, with minimum deleterious elements. This represents 27 weight percent of the original ore. Further tests will continue when the Maden Tetkik ve Arama Enstitüsü (MTA) receives 25 tons of bulk sample from an exploratory drift and cross-cut now being driven through a section of the major reserve area.

INTRODUCTION

Purpose of project

Iron ore beneficiation studies which were part (subproject 6) of a broad cooperative mineral investigation program, were conducted by the Maden Tetkik ve Arama Enstitüsü (MTA) of Turkey and the U. S. Geological Survey (USGS). The project was under the auspices of the Government of Turkey and the Agency for International Development (AID), U. S. Department of State.

The objective of the project was to test the value of modern beneficiation techniques in making usable the low grade iron ores of Turkey. Components of the project were procurement, installation and operation of laboratory and pilot plant equipment and training of MTA personnel in specialized fields of beneficiation.

Scope of investigation

The Hasan Çelebi magnetite deposit is 96 km by road northwest of Malatya in east-central Turkey (fig. 1), and is served by both a highway and the Divriği-Malatya railroad. The exploration area, approximately 500 m wide and two km long, has an east-west trend and crosses the highway, the railroad, and a small stream. During the 1970 season, 3459.15 m of diamond drilling was completed, and 10,000 m was programmed for the 1971 season.

The ores investigated during this project have come from the Hasan Çelebi deposit; the beneficiation program and exploration work were conducted concurrently for the past 1½ years. Additional diamond drilling is in progress, and further pilot plant beneficiation studies are planned on bulk samples from exploration drifts and crosscuts now being driven.

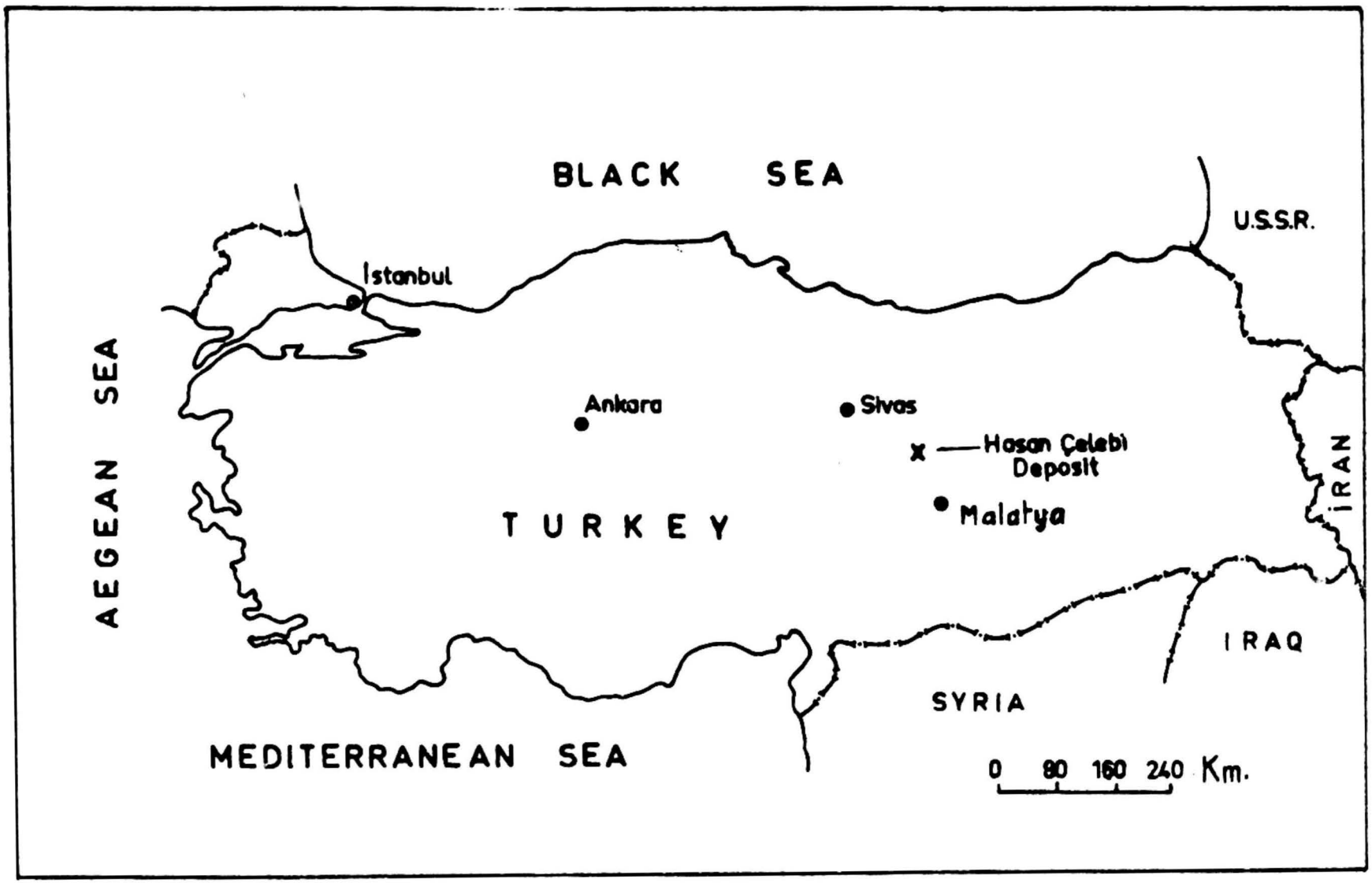

Figure 1 : INDEX MAP OF TURKEY SHOWING LOCATION OF HASAN ÇELEBİ AREA

The geology of the iron deposit and the surrounding area has been described by Jacobson and others (1972). A First Feasibility Report by MTA was made in 1971 for project planning.

Acknowledgments

The authors are grateful for the guidance and cooperation received from Dr. S. Alpan, General Director of MTA, Mr. Nahit Kiragli, Chief of the Technological Department, and Dr. Avni Yazan, Chief of the Ore Dressing Division.

SURFACE SAMPLE INVESTIGATIONS

Late in 1969 the Metallic Minerals Department (Maden Etüd) of MTA took four surface samples of about one ton each from the major anomalous areas of Hasan Çelebi (fig. 2) and requested the Technological Department to conduct ore dressing tests. At that time the Ore Dressing Laboratory had no beneficiation equipment for magnetite ores, thus no work was performed on the samples until June 1970, when the Davis tube and the Eriez 12" x 7½" single drum wet magnetic separator arrived as part of the AID Development Loan. This equipment was immediately set up and work on the samples was initiated. Two hundred kilograms of each sample were prepared by roll-crushing and screening through minus 1-mm size, and representative portions were chemically (table follows) and mineralogically (see below) analyzed.

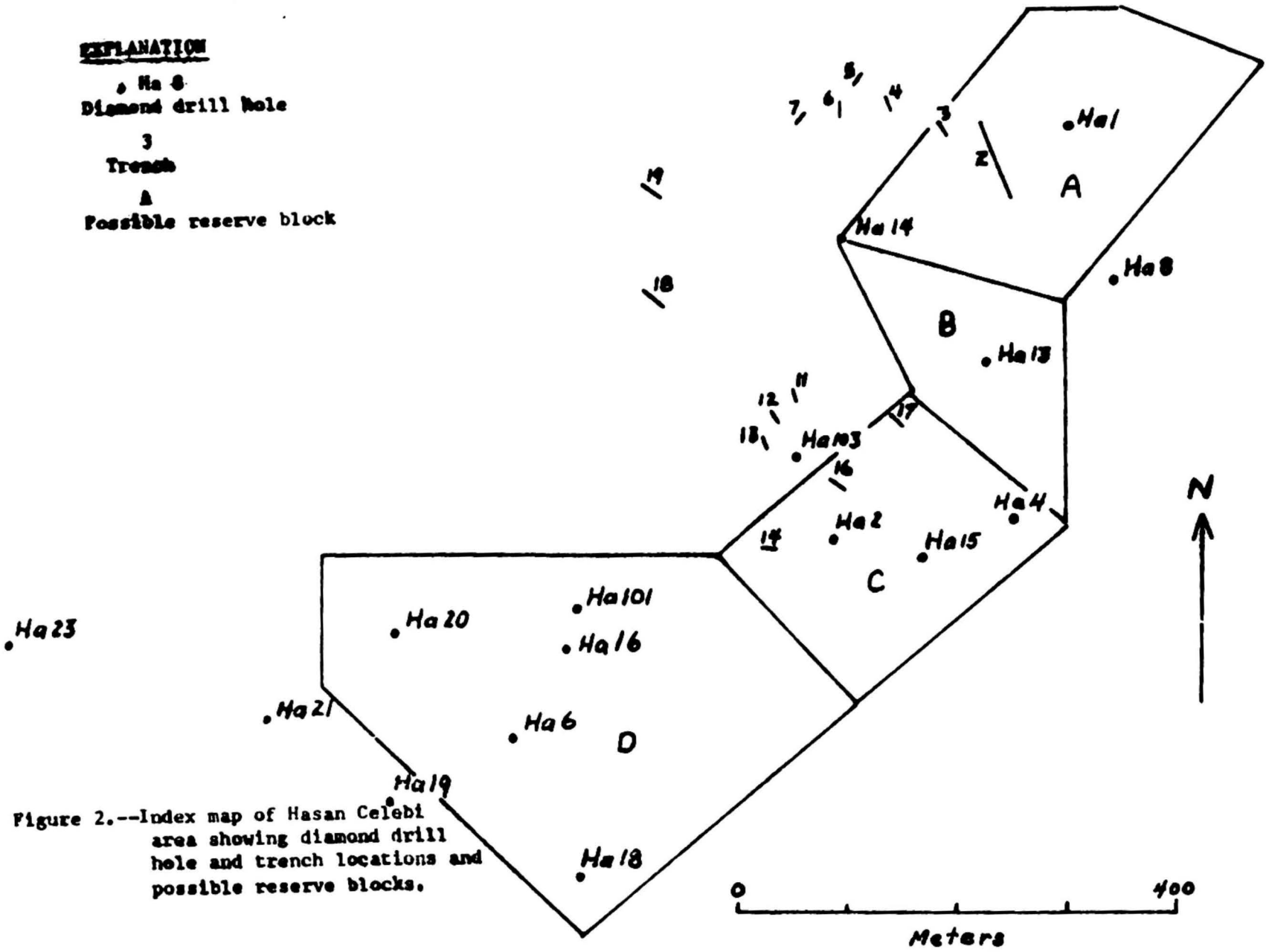

Figure 2.--Index map of Hasan Celebi area showing diamond drill hole and trench locations and possible reserve blocks.

Chemical analyses of surface samples

Sample Designation	Analysis Fe (percent)	Analytical Laboratory Number
Hasan Çelebi no. 1	10.38	91751
Hasan Çelebi no. 2	60.94 1/	92184
Hasan Çelebi no. 3	37.07	91750
Hasan Çelebi no. 4	42.71	91752

1/ Also contains: SiO_2, 10.95 percent; As, 0.06 percent; S, Trace; P, 0.18 percent.

Mineralogical analyses of surface samples

Hasan Çelebi no. 1

This sample is from a magnetite-bearing metasomatized rock that is completely zeolitized and partly carbonitized, and sericitized. The original rock is obscure, but it probably was an alkali syenite.

It contains considerable zeolite, lesser amounts of carbonates, magnetite, chlorite, and sericite, small amounts of hematite, albite, and limonite, and the accessory minerals pyrite, titanite, zircon, and apatite.

The feldspars of the original rock have been altered to zeolites and some exhibit relict structure. Zeolites are in fibrous, columnar, and tabular form, with some radial crystals. Natrolite was identified, and another zeolite of laumontite structure was observed. Calcite is the principal carbonate mineral.

The magnetite has a grain size between 0.2-3.0 mm and usually occurs as individual crystals between zeolite crystals. In some places magnetite forms intergrowths with chlorite, calcite, and zeolite crystals. The magnetite has been subjected to martitization at some places parallel to the crystallographic axes.

The chlorite is a fibrous and micaceous form of leptochlorite that was formed by alteration of biotite from the original rock. Sericite occurs as flakes between zeolite crystals. Hematite has been formed by martitization. Albite microcrystals occur with the zeolites. Some pyrite has been altered to limonite, exhibiting pseudomorphic character.

Hasan Çelebi no. 2

This sample contains much magnetite, lesser hematite and limonite, and gangue minerals of mostly quartz and lesser calcite. Magnetite formed in xenomorphic crystals; grain sizes vary from 0.05 to 4.0 mm. Martitization was observed, and the hematite thus formed is in the form of acicular crystals and veinlets. Widths vary from a few microns to 30 microns, and lengths from 5 to 50 microns.

Limonite is associated with the magnetite, either in microcrystals or as a gel structure. Locally a radial structure and/or small veinlets were observed.

Quartz crystals range from 0.02 to 0.3 mm, and form aggregates among the magnetite crystals. They show anomalous extinction due to pressure, and have a granoblastic texture.

Calcite microcrystals present range from 0.01 to 0.05 mm, and form veinlets in the magnetite.

Hasan Çelebi no. 3

This sample was surface dirt and highly altered rock fragments, containing considerable magnetite. No petrographic or mineralogic determination was requested.

Hasan Çelebi no. 4

This sample is a magnetite-bearing actinolite-wollastonite hornfels, of coarse-grained and felsitic texture. It contains much actinolite, lesser amounts of magnetite, calcite, and wollastonite, small amounts of quartz, chlorite, and nematite, and the accessory minerals pyrite and limonite. Actinolite is in the form of lamellae, columnar and acicular crystals and is similar to grammatite.

Magnetite is associated with actinolite as small crystals or in crystalline lenses locally forming stringers and aggregates in the rock. The grain size of the magnetite is between 0.1 to 0.5 mm wide and between 0.5 to 2.0 mm long. Magnetite crystals formed in cracks are 1.0 to 20.0 mm wide and of variable lengths. Such aggregates have a cataclastic texture. Fragmentation cracks, which are between 0.02 to 0.04 mm wide, are filled with calcite, chlorite and quartz crystals. Magnetite in these cracks has also been martitized, in some places parallel to the crystallographic axes.

Calcite is crypto- and microcrystalline and is associated with actinolite, magnetite, and especially wollastonite. Wollastonite forms bundles of crystals or fibrous intergrowths with calcite crystals.

Quartz crystals are granoblastic and micrograined, and show anomalous extinction, forming in veinlets or groups in the sample. Chalcedony also forms in radial crystals associated with granoblastic quartz crystals. Chlorite is iron-deficient, usually orthochlorite.

Hematite is in the magnetite as long, thin crystals; grain size is between 0.05 to 0.25 mm. Some hematite has been formed by martitization. Pyrite is observed in trace amounts only in magnetite crystals and grains.

Screen analyses and Davis tube evaluation

Hasan Çelebi no. 1

Screen analyses of the -1 mm crushed feed (fig. 3 and table 1[1/]) indicate that no significant concentration of iron is in any of the fractions, and that there is no possibility of discarding either low-grade fine or coarse material. Davis tube evaluation of each screen fraction (fig. 4) indicates that maximum recovery will be obtained by grinding with a minimum of plus 48-mesh material, and optimum grade will not be attained without regrinding the concentrate substantially to or through minus 150 mesh. Additionally, recovery will be low because of the low-grade ore and the partial alteration of magnetite to hematite and limonite (table 1).

Hasan Çelebi no. 2

Screen analyses of the -1 mm crushed feed (fig. 5 and table 2) indicate that no significant concentration of iron is in any of the fractions, and that there is no possibility of discarding either a fine or coarse low-grade product. Davis tube evaluation of each screen fraction as shown in figure 6 indicates a gradual decrease in recovery in all size fractions finer than 1 mm. This decrease is probably due to the increased separation of hematite in the finer sizes, which is intimately associated with the magnetite. Optimum grade and recovery can be attained without further grinding finer than minus 1-mm (table 2).

1/ Tables listed in the appendix.

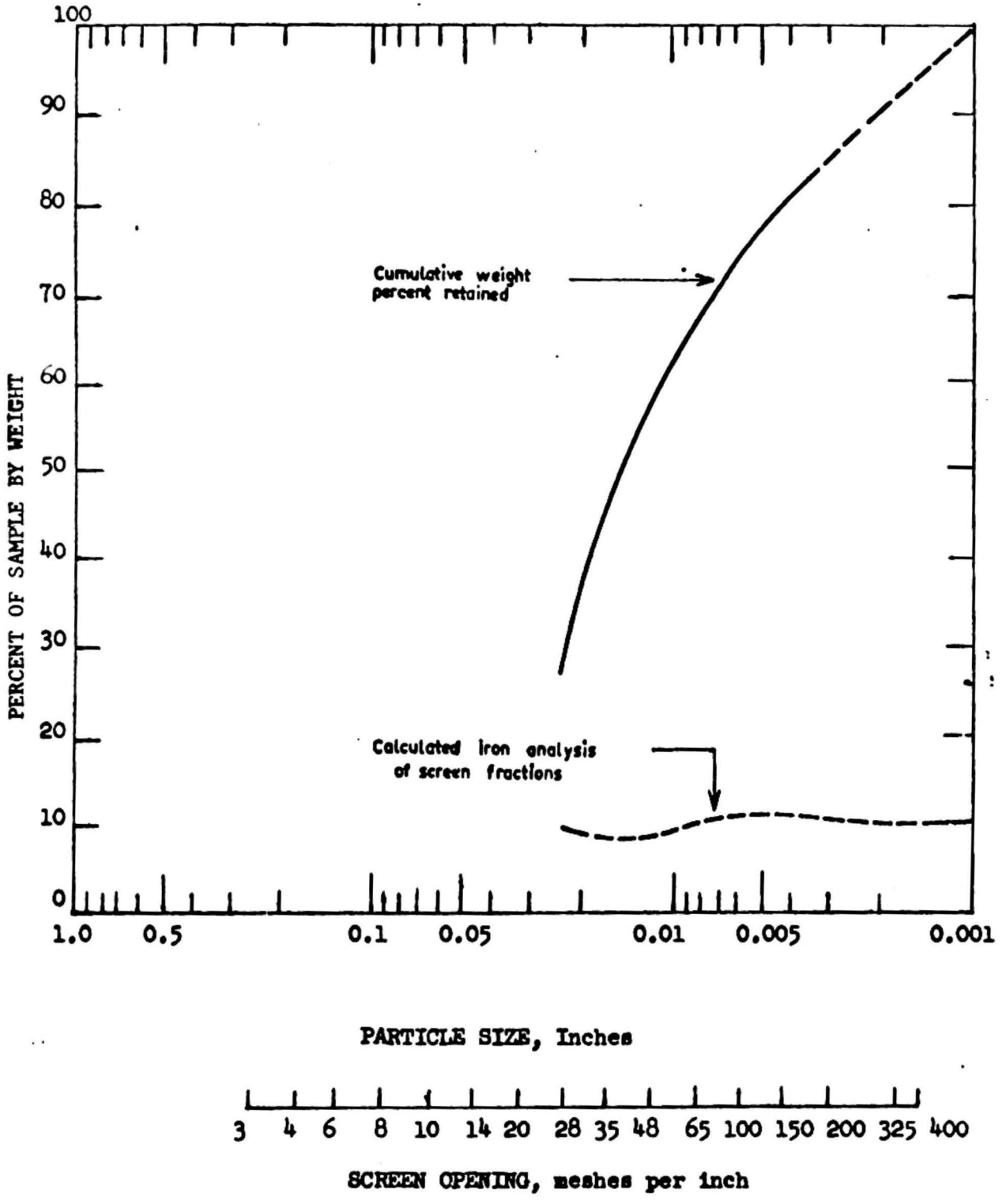

Figure 3. Screen analysis of Hasan Çelebi no. 1 crushed ore.

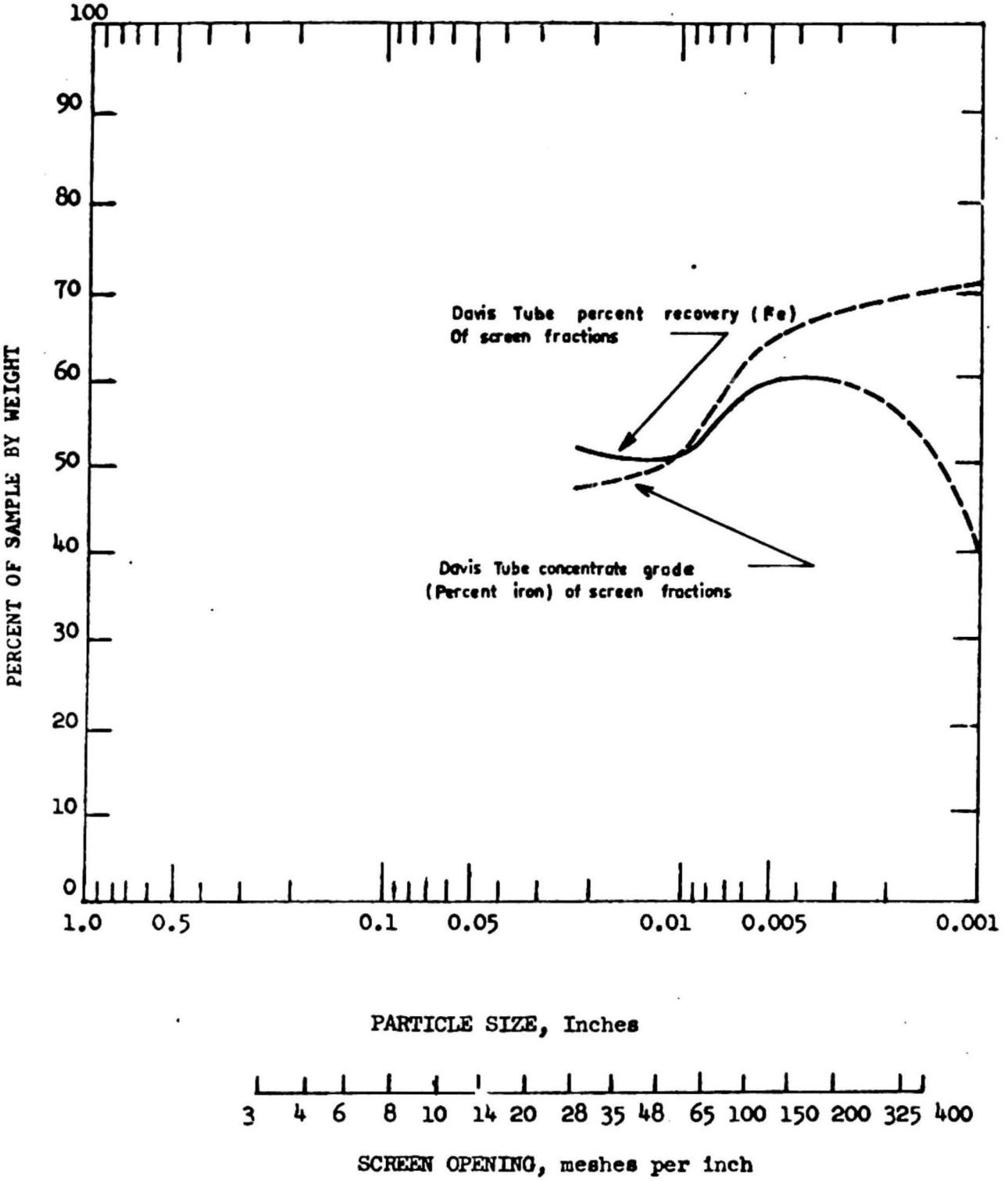

Figure 4. Davis tube evaluation of Hasan Çelebi no. 1, minus 1-mm crushed ore screen fractions.

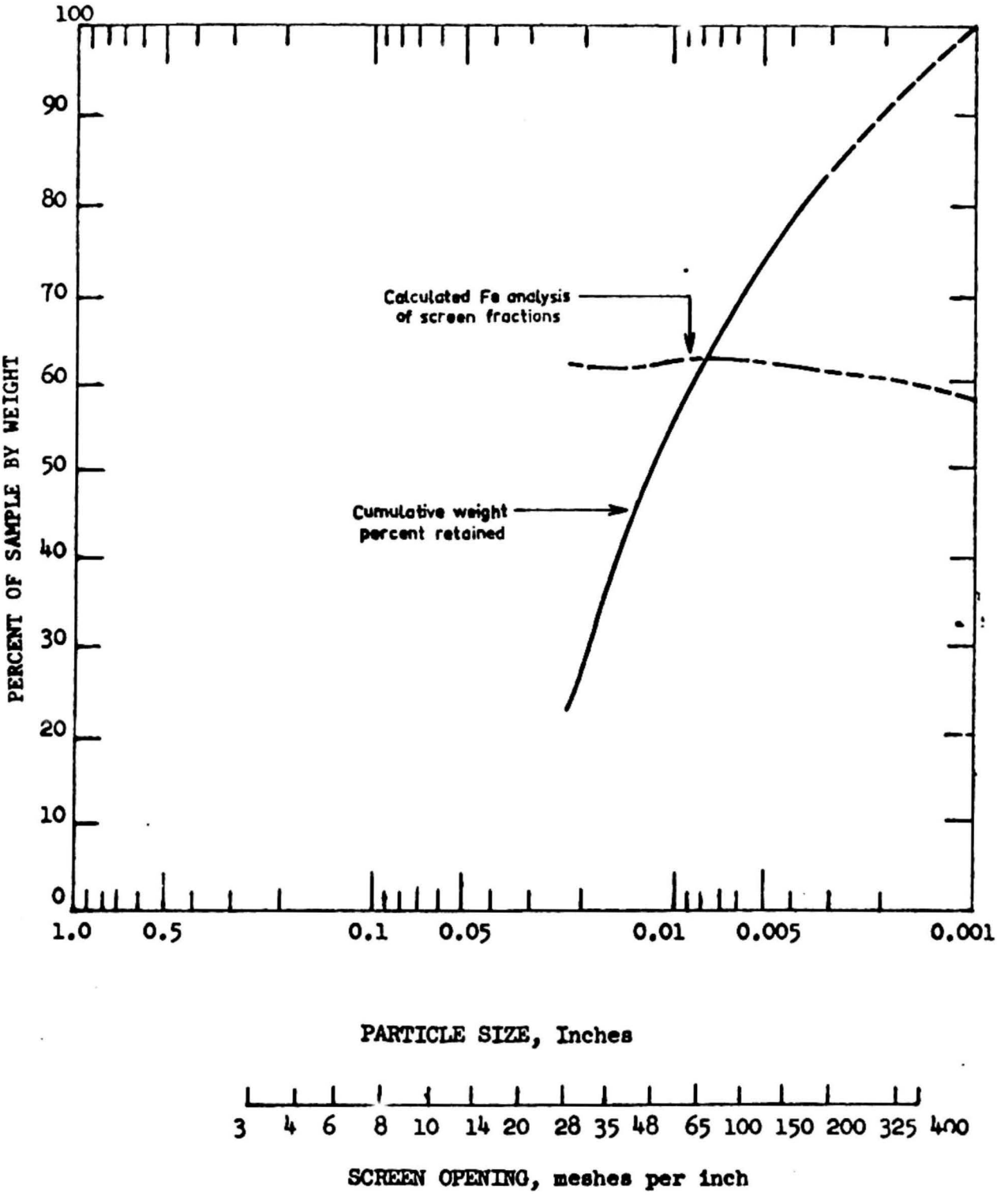

Figure 5. Screen analysis of Hasan Çelebi no. 2 crushed ore.

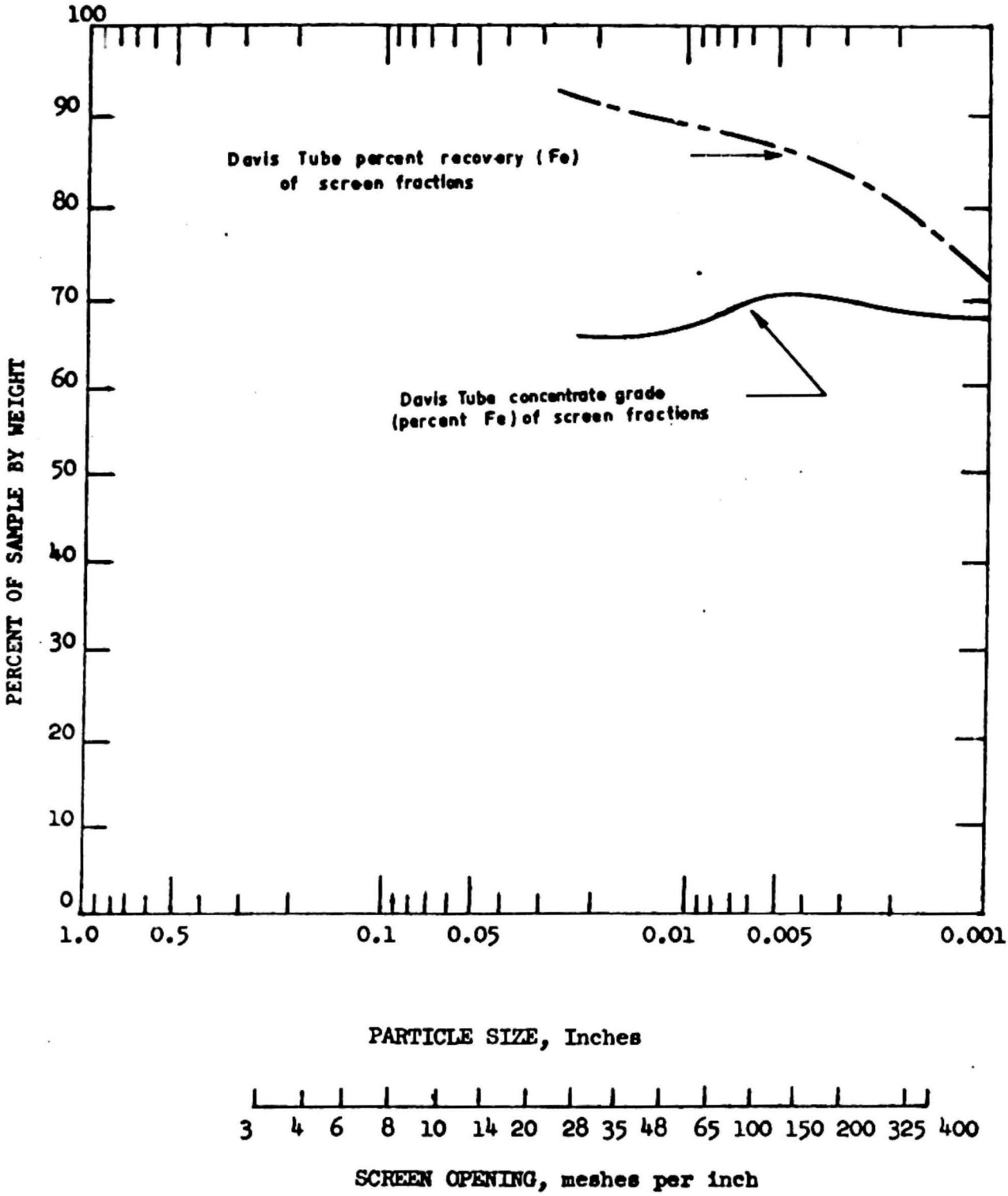

Figure 6. Davis tube evaluation of Hasan Çelebi no. 2, minus 1-mm crushed ore screen fractions.

Hasan Çelebi no. 3

This is a surface dirt sample. Screen analysis of the prepared minus 1-mm feed (fig. 7 and table 3) indicates a slight concentration of iron in the intermediate screen sizes, but no possibility of discarding either a fine or coarse low-grade product. Davis tube evaluation of each screen fraction as shown in figure 8 indicates a gradual decrease in recovery in the sample fractions finer than 1 mm. Concentrate grade will not approach optimum until the concentrate has been reground substantially to 65-mesh (table 3).

Hasan Çelebi no. 4

A screen analysis of prepared minus 1-mm feed (fig. 9 and table 4) indicates a slight concentration of iron in intermediate screen sizes, but no possibility of discarding either a fine or coarse low-grade product. Davis tube evaluation of each screen fraction as shown in figure 10, indicates a recovery approximating 91.5 percent with sample preparation to minus 1-mm. However, recovery does drop off gradually in the finer sizes. The concentrate will also require minimum regrinding to attain optimum grade (table 4).

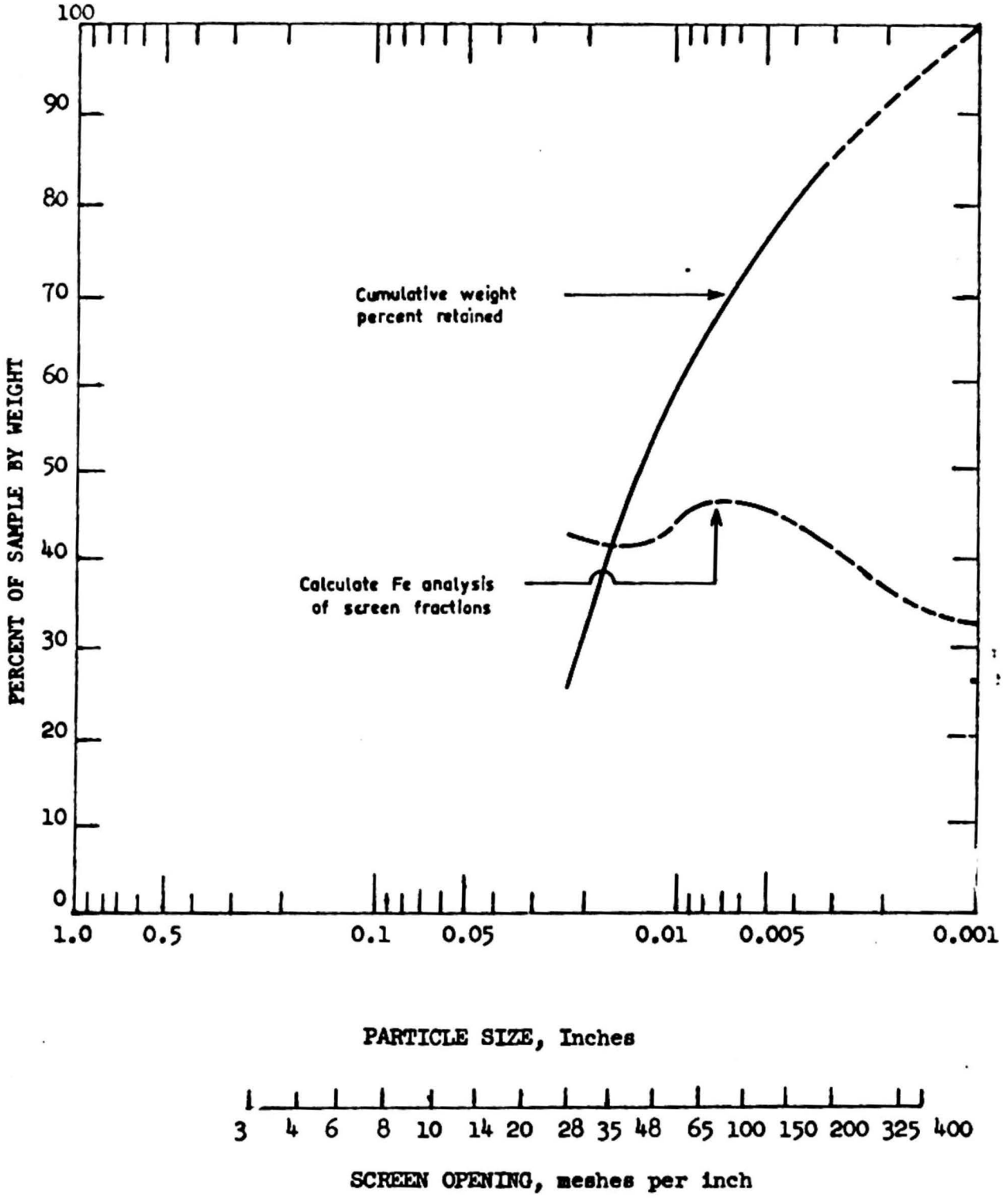

Figure 7. Screen analysis of Hasan Çelebi no. 3 crushed ore.

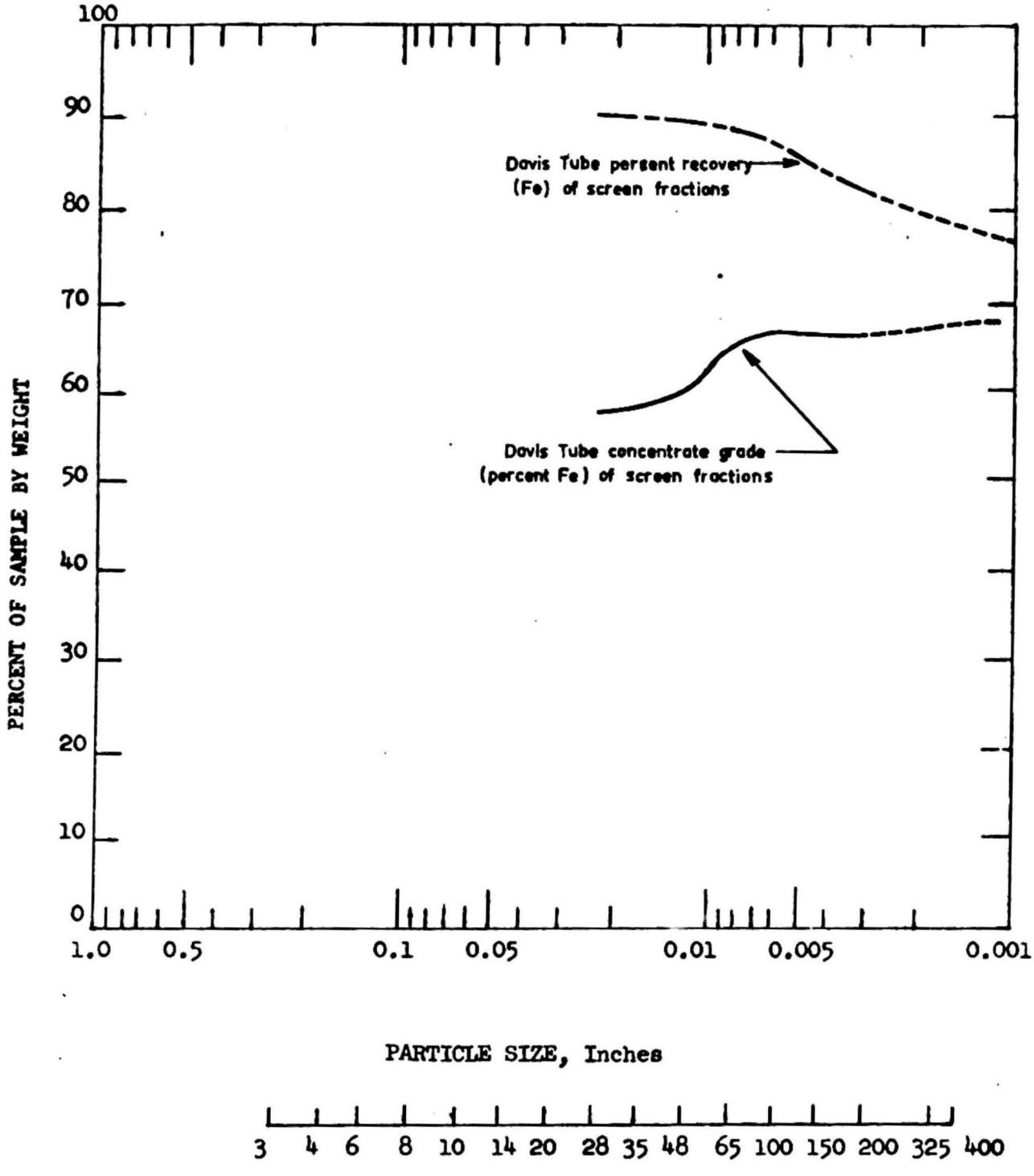

Figure 8. Davis tube evaluation of Hasan Çelebi no. 3, minus 1-mm crushed ore screen fractions.

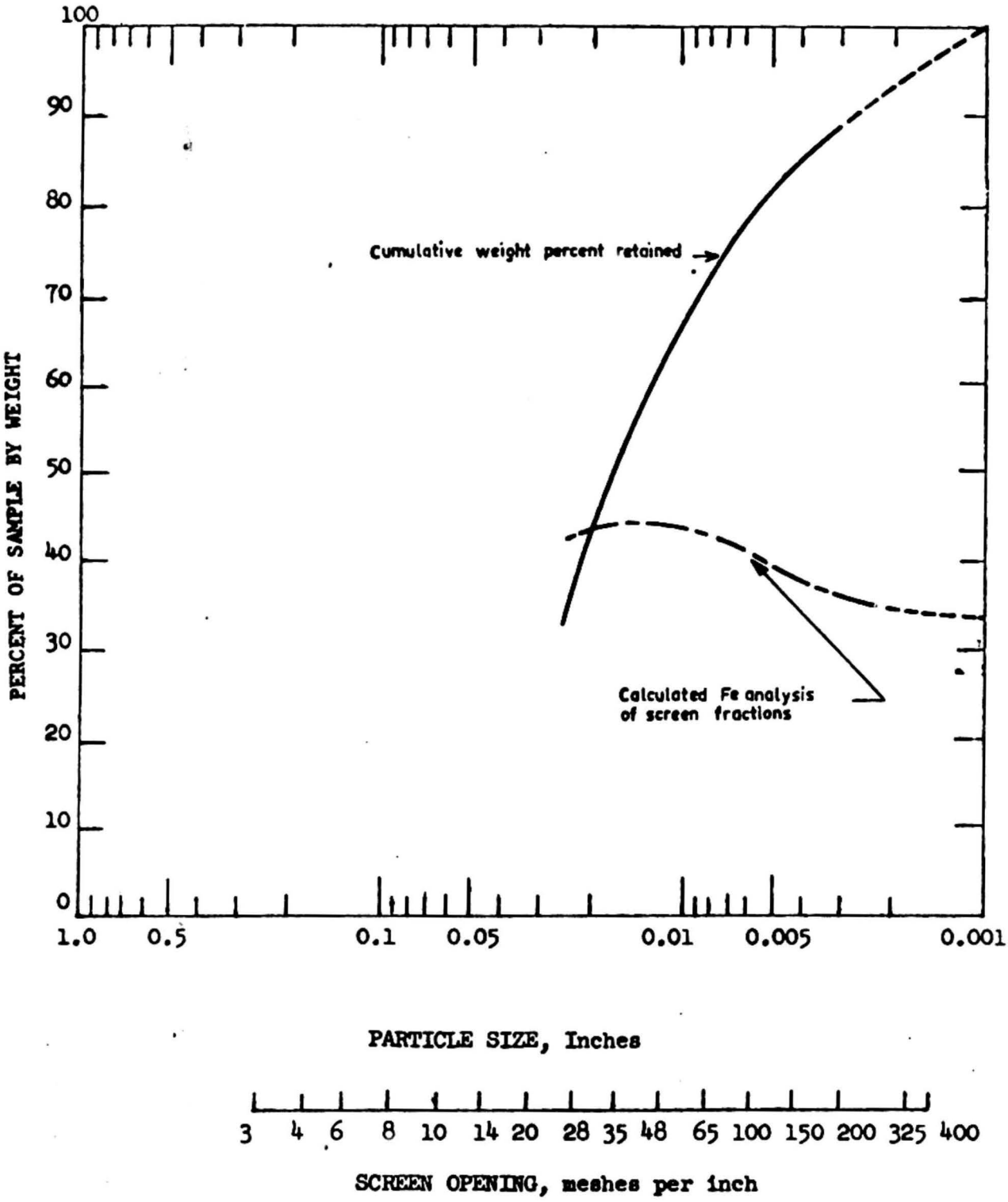

Figure 9. Screen analysis of Hasan Çelebi no. 4 crushed ore.

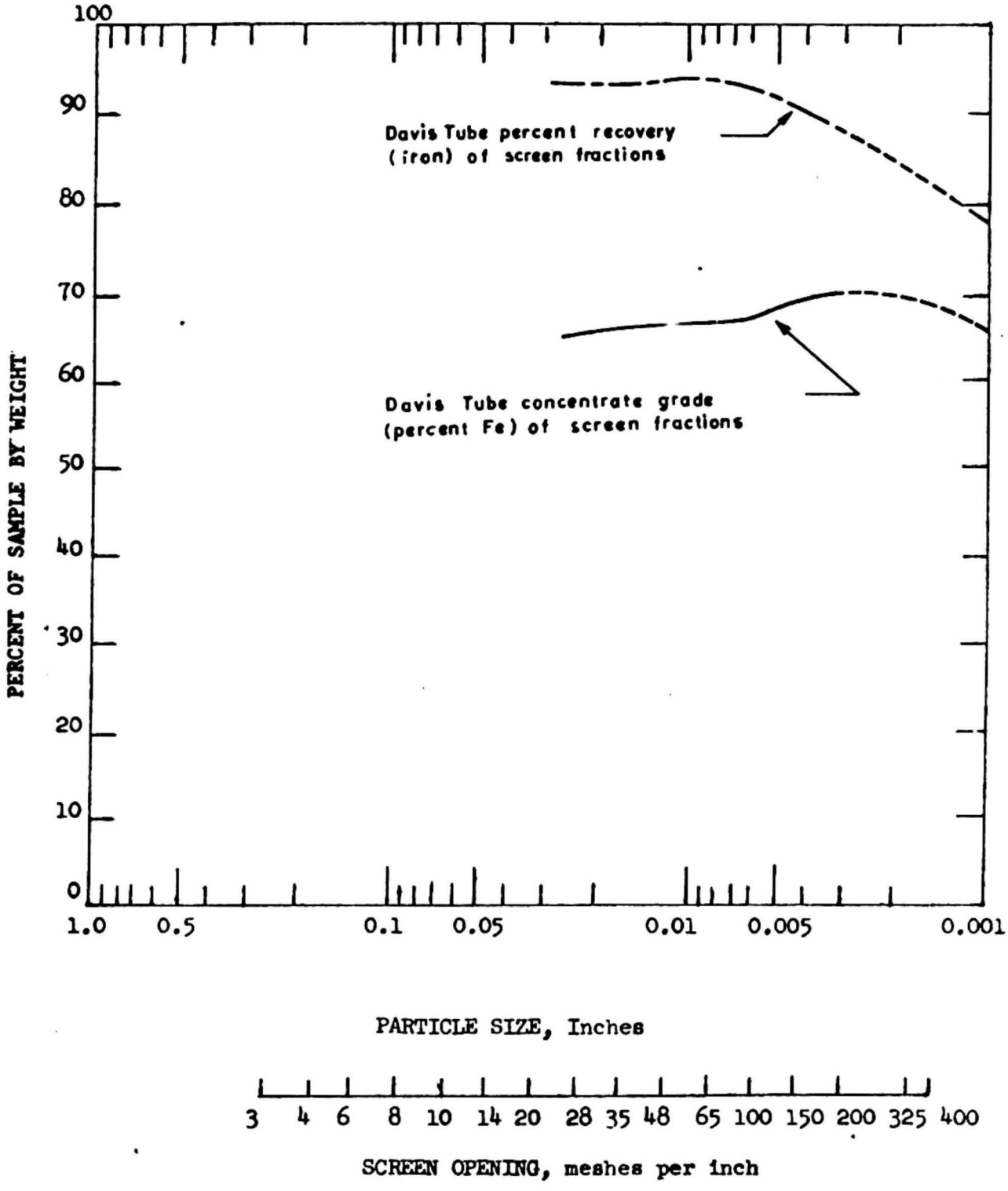

Figure 10. Davis tube evaluation of Hasan Çelebi no. 4, minus 1-mm crushed ore screen fractions.

Semicontinuous wet magnetic drum tests

Hasan Çelebi no. 1

Three hundred kilograms of this sample was prepared by roll-crushing and screening through 1-mm size. One hundred fifty-five kilograms of the screened material was then passed over the Eriez 12" x 7½" wet magnetic single-drum separator to produce a rough concentrate and a tailing. The rough concentrate was dried and pulverized to minus 100-mesh size, and then repassed over the drum to produce a final concentrate and a middling. About 50 percent of the iron was recovered in a concentrate containing 66.13 percent iron. The metallurgical balance and a detailed chemical analysis of the concentrate are presented in table 5. Confirming the Davis tube evaluation, optimum concentrate grade was attained with a minus 100-mesh regrind of the concentrates.

Hasan Çelebi no. 2

One hundred kilograms of the sample was prepared by roll-crushing and screening through 1-mm size and 68 kg of the screened material was then passed over the Eriez 12" x 7½" single drum wet magnetic separator to produce a rough concentrate and a tailing. The rough concentrate was further cleaned twice to produce a final concentrate. The metallurgical balance is presented in table 6. Confirming the Davis tube evaluation, over 87 percent of the iron was recovered in a concentrate containing 66.43 percent iron without any regrinding of the concentrate. A detailed analysis of the concentrate is also presented in table 6.

Hasan Çelebi no. 3

Two hundred kilograms of this sample was prepared by roll-crushing and screening through 1-mm size and 160 kg of the product was passed over the Eriez 12" x 7½" single drum wet magnetic separator to produce a rough concentrate and a tailing. The rough concentrate was cleaned once by repassing over the drum. This concentrate was then dried, roll-crushed and screened through a 35-mesh screen, and re-cleaned three times with the wet drum. The metallurgical balance is presented in table 7. Confirming the Davis tube evaluation, over 80 percent of the iron was recovered in a concentrate containing 63.32 percent iron. A detailed analysis of the concentrate is also presented in table 7. Recycling of the reground middlings in a simulated continuous circuit could increase the recovery to as much as 88.38 percent, and further regrinding of the concentrate might attain an optimum grade of 66 to 67 percent iron. However, no further work was done on this sample to confirm this.

Hasan Çelebi no. 4

Two hundred kilograms of the sample was prepared by roll-crushing and screening through 1-mm size, and 100 kg of the product was passed over the Eriez single drum magnetic separator to produce a rough concentrate

and a tailing. This rough concentrate was then cleaned twice by repassing over the drum to produce a final concentrate and two middling products. The metallurgical balance is presented in table 8. Over 87 percent of the iron was recovered in a concentrate containing 65.04 percent iron, without regrinding the concentrate, confirming the evaluation of the Davis tube test.

It is concluded from the tests performed on these four surface samples that differential alteration of magnetite to hematite and limonite affects the iron content of the samples. Lower recovery of iron can be expected from samples which have undergone greater alteration. However, the finer the grind, the more associated hematite is separated from the magnetite, and it is found in the nonmagnetic tailing. It is also hypothesized that the higher TiO_2 (average 2.28 percent) content of these surface concentrates, compared with the 0.75 percent level in concentrates from unaltered ore such as drill core samples, is explained by the fact that more of the fine-grained titanite in the surface samples is separated, and because the extremely fine-grained magnetite attached to the titanite particles, will impart enough magnetic susceptibility to allow it to be found in the magnetic concentrate.

TRENCH SAMPLE INVESTIGATIONS

Fifteen trench samples were evaluated by Davis tube tests during the 1970 season. Magnetite contents are indicated in table 9. In addition

samples from three of the more important trenches, with significant magnetite contents, were further evaluated by complete analysis of the Davis tube concentrate product and by HCl-soluble iron analysis of the tailing product in order to determine efficiency of iron recovery. Magnetite concentrate analyses are given in table 10 and the metallurgical balances in table 11.

A special study of a 250 kg sample from trench no. 2 was made because of its location in the area of the principal iron reserves. Davis tube evaluation indicated a 27.53 percent magnetite content, which was very near the average ore grade anticipated at this point, although the metallurgical recovery, based on HCl-soluble iron tailing analysis, was only 61.2 percent. Accordingly, a 100 kg fraction was prepared by roll-crushing and screening through 1.0-mm size. A representative portion of the product was then analyzed by a wet screen test and each screen fraction was evaluated by the Davis tube. Results of this work (table 12), indicate that as much as 75.18 percent of the HCl-soluble iron can be magnetically recovered in a concentrate containing 64.94 percent iron if the material has been crushed or ground to at least 80 percent -28 mesh. Figures 11 and 12 show this information graphically.

The 100 kg sample was treated by the Eriez 12" x 7½" single drum wet magnetic separator. After cleaning twice the concentrate was prepared by roll-crushing to minus 35-mesh, and again recleaned twice. Microscopic examination of the concentrate indicated some remaining locking of the gangue with magnetite. The concentrate was further treated by roll-crushing and screening through 65-mesh and cleaned once on the

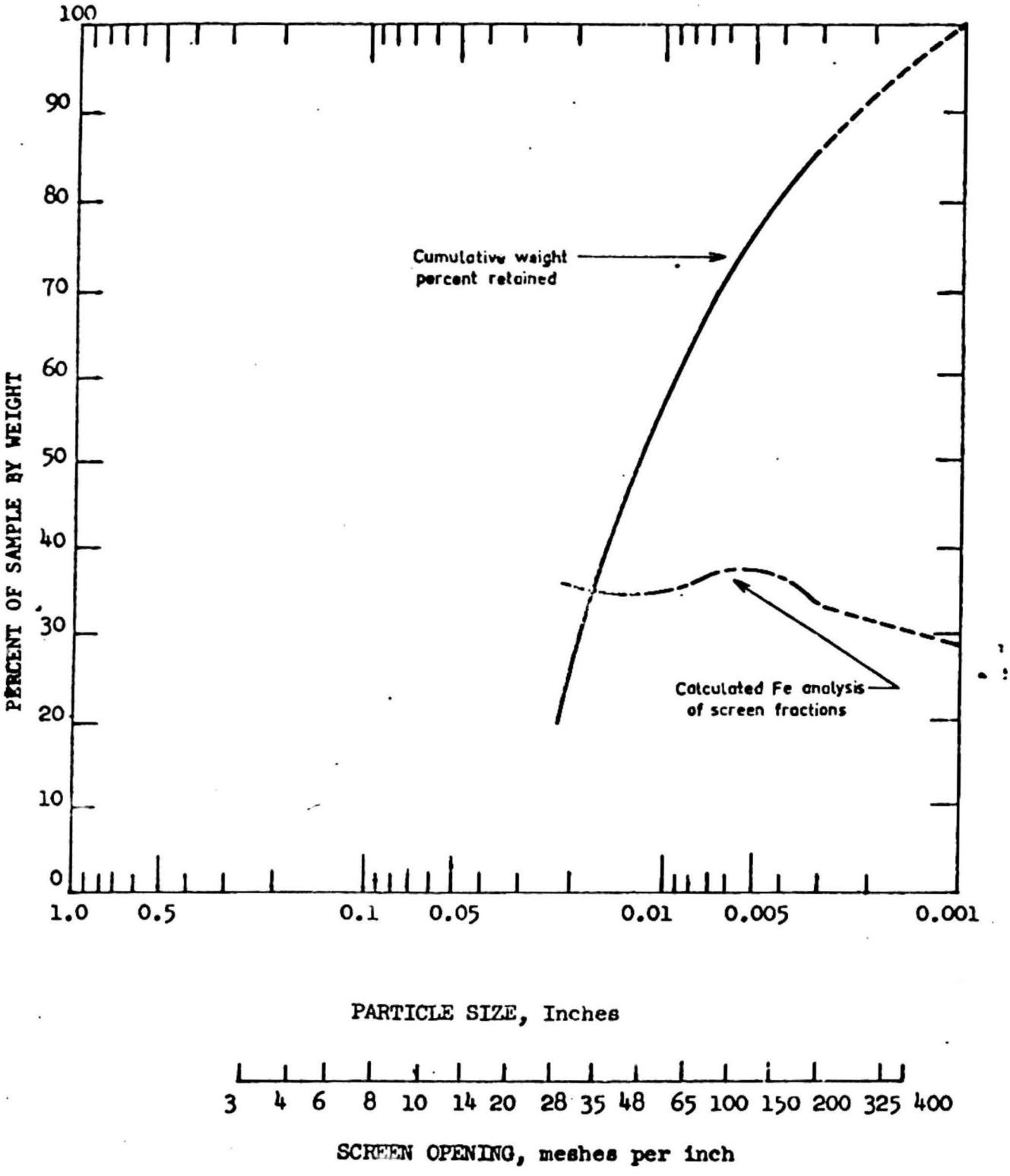

Figure 11. Screen analysis of Hasan Çelebi trench no. 2, crushed ore.

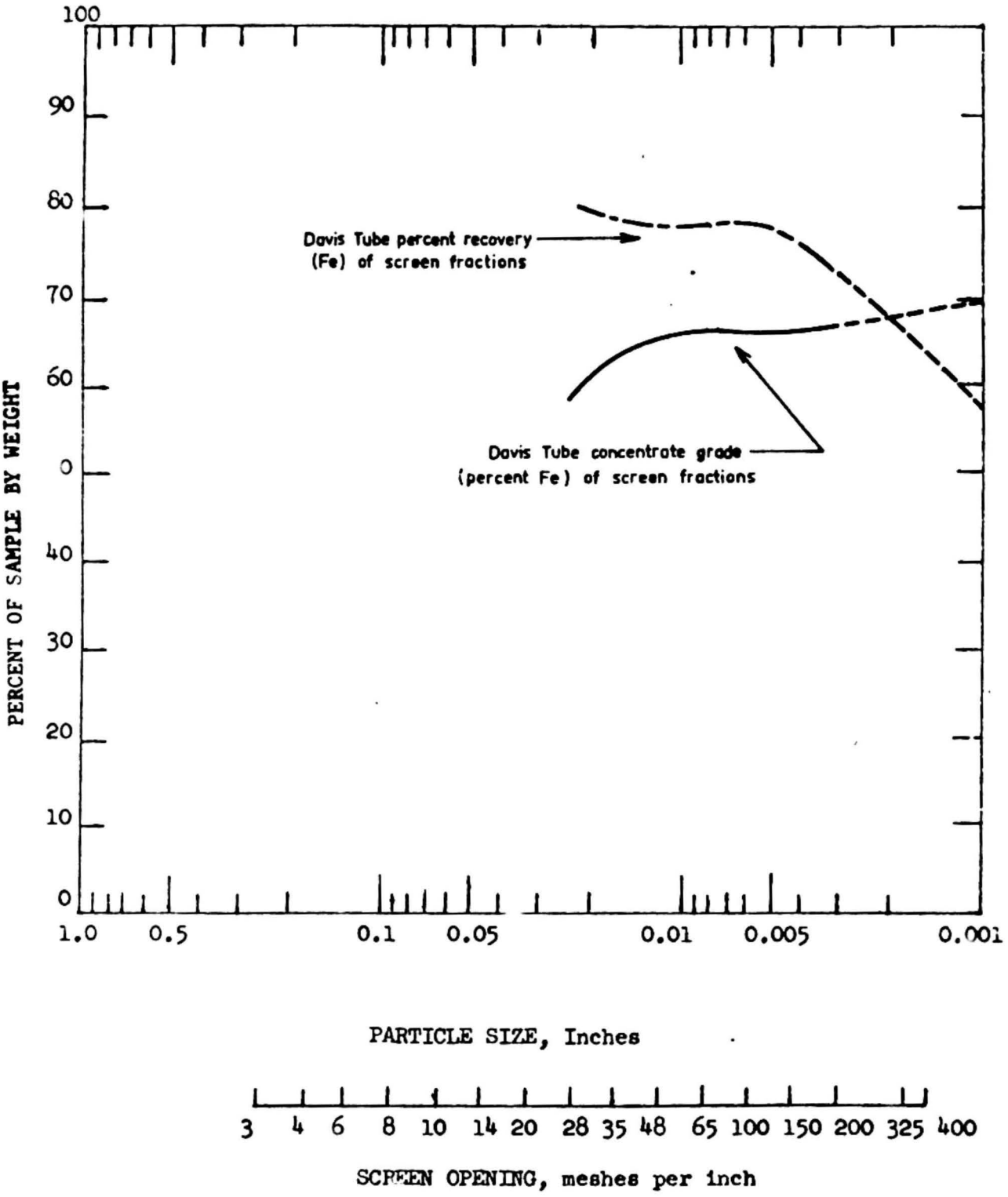

Figure 12. Davis tube evaluation of Hasan Çelebi trench no. 2, minus 1-mm crushed ore screen fractions.

wet drum. The final product after further chemical analysis showed that as much as 74.73 percent of the HCl-soluble iron can be magnetically recovered in a concentrate containing 66.30 percent iron. A complete analysis of the concentrate is given in table 10, and the metallurgical balance in table 13.

The drum test confirmed the previous conclusions on surface samples (p.11) that 1) iron is recovered from altered magnetite by conventional magnetic separation methods; 2) grinding must be finer; and 3) the 2.13 percent TiO_2 content in the concentrate is several times higher than expected in a concentrate from unaltered ore.

EVALUATION OF DIAMOND DRILL CORE

Evaluation and beneficiation studies were made on the core from 3459.15 m of diamond drilling completed during the 1970 season. Included is core from the first diamond drill hole, Ha-1, completed in November 1969 at a depth of 110.35 m. At that time, MTA nad no equipment capable of beneficiating magnetite ores, thus split core samples taken from hole Ha-1, were submitted to the analytical laboratory for chemical analysis. In June 1970, when a Davis tube was received and put into operation by the Ore Dressing Division, these samples were evaluated for actual magnetite content and recovery by the Davis tube. Split core samples from exploratory holes at Hasan Çelebi were delivered for magnetite evaluation at about the same time the Davis tube and the Eriez 12" x 7½" separator arrived at the Laboratory.

Davis tube evaluation

Split core samples taken at 1 m intervals from each drill hole were composited for evaluation. Like materials were composited on the basis of geological profiles of drill holes which classfied magnetite mineralization as heavy, medium, light, very light and without ore. The composited samples were jaw-crushed and roll-crushed through minus 8-mesh size. A 500-g split from each composite sample was pulverized with the disc pulverizer until 95 percent was minus 100-mesh. After careful rolling and blending, two 10-g splits were taken and weighed witnin 1-mg accuracy with the Sartorius electric balance. They were then treated in the Davis tube for magnetite content measurement. The average result of two duplicate tests was reported as the final result. The Davis tube operation and work were based upon the standard procedure recommended by the U. S. Bureau of Mines (Frommer, no date). The procedure follows:

1. Split out approximately 100 g of minus 10-mesh material.
2. Carefully reduce the 100 g sample to particle size specified. Method of reduction may vary, but should be described.
3. Blend the pulverized sample, and remove 10 g for the test.
4. With the Davis tube slightly inclined, and current set at 1.8 amperes, or enough to energize the magnetic field, but not enough to reciprocate the tube, slowly introduce the slurried sample to the tube.
5. Return the tube to 45°, set the water flow at 100 cc per minute, and speed at 45 strokes per minute. Operate for 5 minutes.
6. Reset the water flow to 250 cc per minute and speed to 85 strokes per minute. Operate for an additional 15 minutes, for completion of the test.

The electric Sartorius balance was used for weighing all samples and products.

Results from the Davis tube evaluation of the samples from each diamond drill hole were reported in the same format as illustrated in tables 14 through 29; additional compositing of group results into continuous mineralized sections indicates the optimum section which could be the initial basis for open-pit planning.

Over 100 different specific gravity tests were performed on the composite samples, using 25 g of minus 8-mesh sample and 50-ml pycnometers. This work relates the variation or specific gravity to the magnetite mineralization, and provided the Geological Department and the Plans and Projects Department with information required for calculation of ore reserves.

The following table summarizes the results of Davis tube evaluation of the split cores from the 19 diamond drill holes drilled in the 1970 season:

Davis tube evaluation of diamond drill split cores, 1970

Split cores in immediate area of the deposit				Split cores for prospecting and geological information		
Diamond drill hole no.	Depth (Meters)	Sample Interval (meters)	Recoverable magnetite, (percent)	Diamond drill hole no.	Depth (meters)	Recoverable magnetite (percent)
Ha-1	110.35	88.35	47.99	Ha-10	122.7	4.84
Ha-2	224	0-135	37.06	Ha-102a	39.6	4.47
Ha-4	230	41-213	23.47	Ha-104	107.6	3.82
Ha-6	237	0-237	26.51			
Ha-8	140	0-140	12.00			
Ha-13	239	0-239	22.11			
Ha-14	225	0-146	21.25			
Ha-15	315	0-199	28.93			
Ha-16	385	15-211	32.49			
Ha-18	218	37-158	25.84			
Ha-19	242	177-224	21.37			
Ha-20	176	0-176	25.37			
Ha-21	157.5	0-157.5	13.32			
Ha-23	195	30-84	19.07			
Ha-101	86.6	0-86.6	34.00			
Ha-103	66	0-66	15.07			

For detailed group and mineralized section analyses refer to tables 14 through 29.

Additional Davis tube evaluation of the core samples involved compositing all contiguous groups within each hole which could represent an optimum mineralized section. Several Davis tube tests were performed on these composites to produce enough magnetite concentrate for a total chemical analysis. The Davis tube tailing was then analyzed for total and HCl-soluble iron. With this information, a metallurgical balance and recovery could then be calculated, which would be a guide for further tests.

In an exploration program, mineral-dressing evaluation should be current with the drilling, so that any changes in quality of the magnetite concentrate, or character of the ore, can be immediately pinpointed.

The complete chemical analyses of the magnetite concentrates from the optimum mineralized sections of each diamond drill hole are tabulated in table 10. This data indicates the probability of attaining an excellent pellet-grade concentrate containing approximately 67 percent Fe, and low contents of SiO_2, phosphorous, sulfur, arsenic, and titania. The metallurgical balances tabulated in table 30 indicate that, by selecting samples of an average ore grade of 27 percent recoverable magnetite, about 78 percent of the iron would be recovered. Most of the iron not recovered is in the form of hematite, principally specularite. If this project continues, flotation tests should be performed on the non-magnetic tailings to recover the hematite. Gravity concentration by Humphrey spirals also might be useful and should be investigated.

BENEFICIATION STUDIES ON THE COMPOSITE DRILL CORE SAMPLE

Composite samples of the optimum mineralized sections of each drill hole were prepared for the purpose of obtaining a large enough sample (+500 kg) for larger scale beneficiation tests. Preliminary calculations of reserves had indicated 114 million tons of ore with a recoverable magnetite content of 28 percent. Based on this estimate, compositing calculations were made on the profile information of each individual hole comprising a reserve block. About 30 percent of the 1-m split core samples weighed less than 500 g. In the remainder, it was estimated that, by taking 1 kg from each of the 1-m samples comprising an optimum mineralized section, about 946 kg of sample could be obtained, with an estimated recoverable magnetite content of 27.39 percent. The sample was then composited and prepared, and Davis tube evaluation of a representative fraction confirmed the calculated content by yielding 26.94 percent recoverable magnetite.

Bench-scale tests

The sample was prepared and representative fractions split out according to the flowsheet in table 31. Head samples were appropriately prepared and analyzed. The results of analyses follow:

Chemical analysis (percent) of core composites

Sample	Total Fe	HCl-soluble Fe	Analytical lab. no.
Hasan-Çelebi core composite	24.81	23.36	99295

Davis tube evalutaion of core composite head sample

Product	Weight (percent)	Analysis Fe (percent)	Fe units	Distribution (percent)	Analytic lab. no.
Concentrate	26.94	67.57 1/	1820.34	77.80	99298
Tailing	73.06	7.11 2/	519.46	22.20	99299
Calculated	100.00	23.40	2339.80	100.00	

1/ Total Fe analysis. Also contains 1.56 percent SiO_2; 0.06 percent As; 0.07 percent S; trace TiO_2 and P; 0.92 percent Al_2O_3; 0.20 percent CaO; 0.12 percent MgO; 0.18 percent Mn; and 0.14 percent V.

2/ HCl-soluble Fe analysis. Also contains 8.47 percent total Fe; 0.84 percent S; and trace Zn and Cu.

Samples of the above Davis tube concentrate and tailing were sent to the spectrographic laboratory for trace element analysis with the following results:

Spectrographic analyses (percent)
of Davis tube concentrate and tailing

Element	Davis tube concentrate (lab. no. 99296)	Davis tube tailing (lab. no. 99297)
Zn		0.4
Ca	0.3	
Ti	.2	.3
V	.15	.02
Mg	.1	
Cr	.03	
Ni	.02	.01
Mn	.01	.03
Co	.002	.003
Cu	.001	.007
Na,K,Li	Not detected	- - -
Al	Not made	- - -
W,Pb	- - -	Not detected
Mo	- - -	.001

Although the Zn was indicated as 0.4 percent in the spectrograph analysis, a chemical analysis showed only a trace.

Further laboratory work consisted of roll-crushing and pulverizing representative portions of the sample to minus 1-mm size, minus 0.5-mm size, minus 48-mesh, and to minus 100-mesh, followed by wet screen analyses and Davis tube evaluation of each screen fraction for recoverable magnetite content.

Screen analyses of these preparations are shown in figures 13, 15, and 17, and indicate that concentrations of iron are in the intermediately fine fractions, and that there is no possibility of discarding either a fine or coarse low-grade product. Davis tube evaluation of each screen fraction is shown graphically in figures 14, 16, and 18. The data indicate that maximum recovery of 90 percent and optimum concentrate grade of 67 percent iron are not attained in any coarse fraction until the 150-mesh range is approached. Examination of the four progressively finer prepared feeds indicates that maximum recovery of 83 percent is attained in the range of minus 0.5 to 1-mm, but optimum concentrate grade of 67 percent iron cannot be attained without regrinding to minus 150-mesh and including the commensurate recleaning steps. The following tabulation gives the details, and figure 19 graphically portrays the data.

Analyses of finer prepared feeds

Feed	Davis tube concentrate		Davis tube recovery	Analytical lab no.
	Weight (percent)	Analysis percent Fe		
Minus 1 mm.....Calculated 1/	41.70	47.58	82.68	
.....Actual	41.33	44.43	83.31	93320
Minus 0.5 mm.....Calculated 1/	37.44	54.16	85.25	
.....Actual	36.50	54.23	83.75	99322
Minus 48 mesh....Calculated 1/	32.00	61.39	81.82	
....Actual	31.43	60.55	82.20	99324
Minus 100 mesh...Actual	26.94	67.57	77.80	99298

1/ Calculated from Davis tube evaluation of screen fractions.

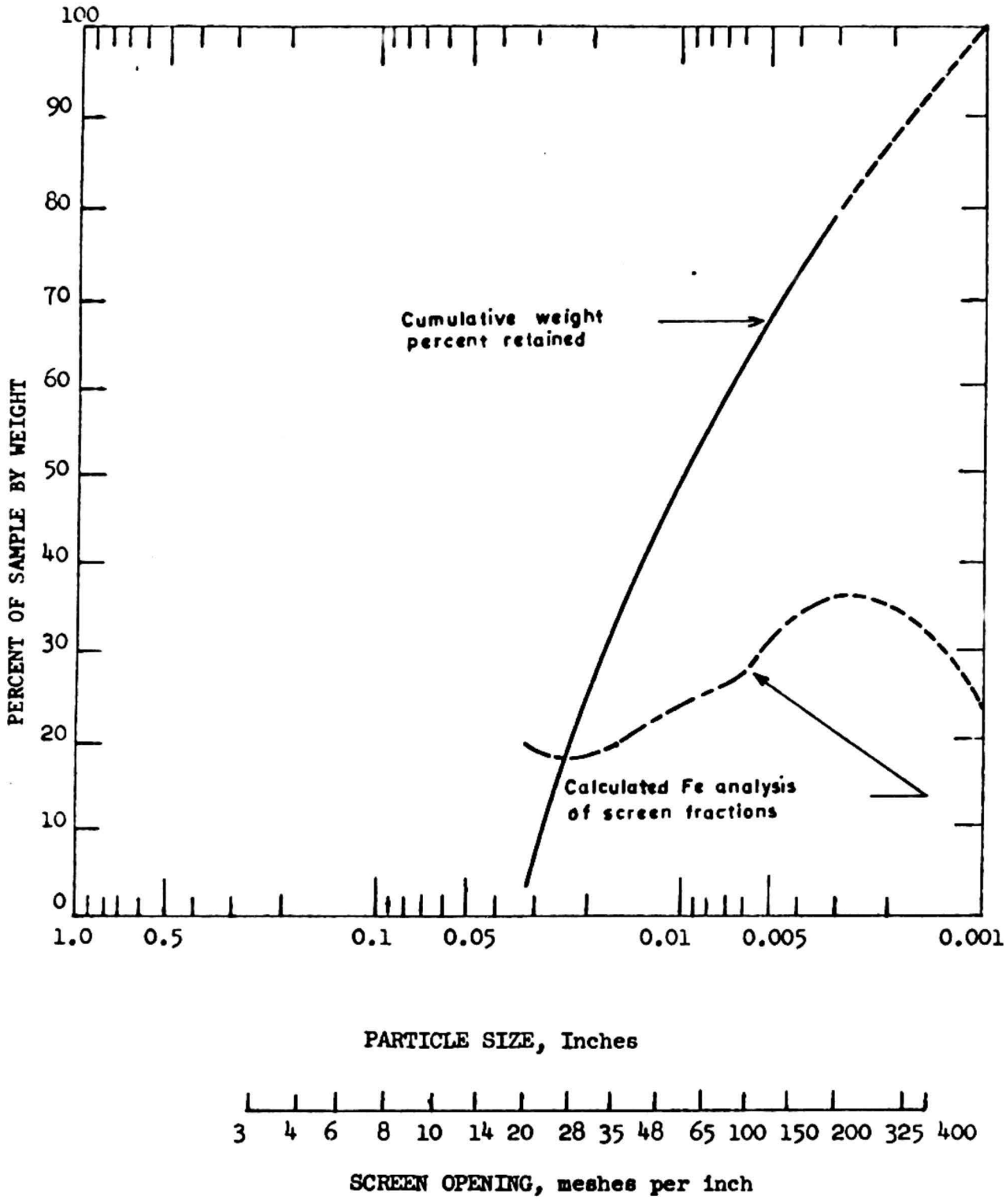

Figure 13. Screen analysis of Hasan Çelebi composite core, minus 1-mm crushed ore.

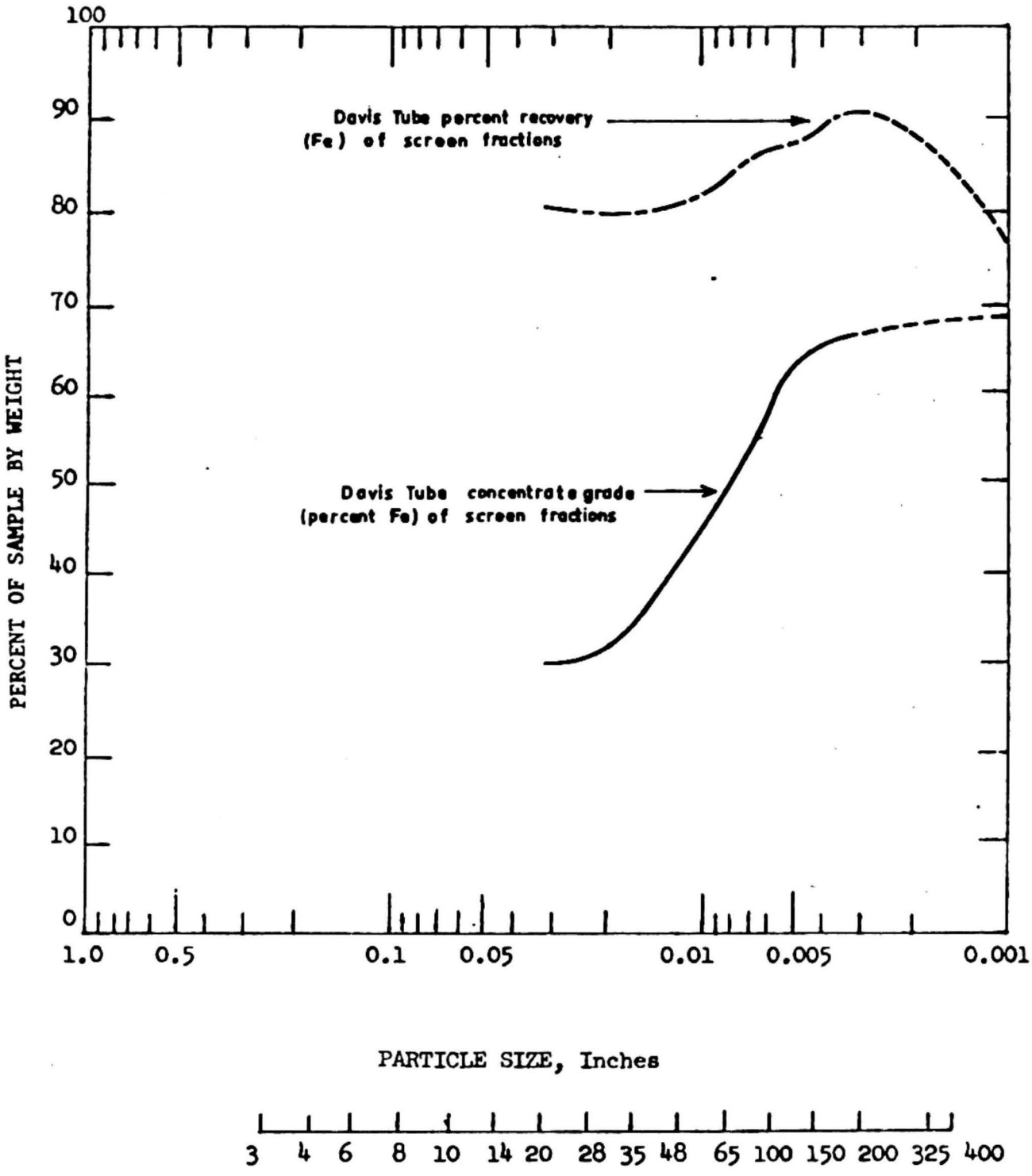

Figure 14. Davis tube evaluation of Hasan Çelebi composite core, minus 1-mm crushed ore screen fractions.

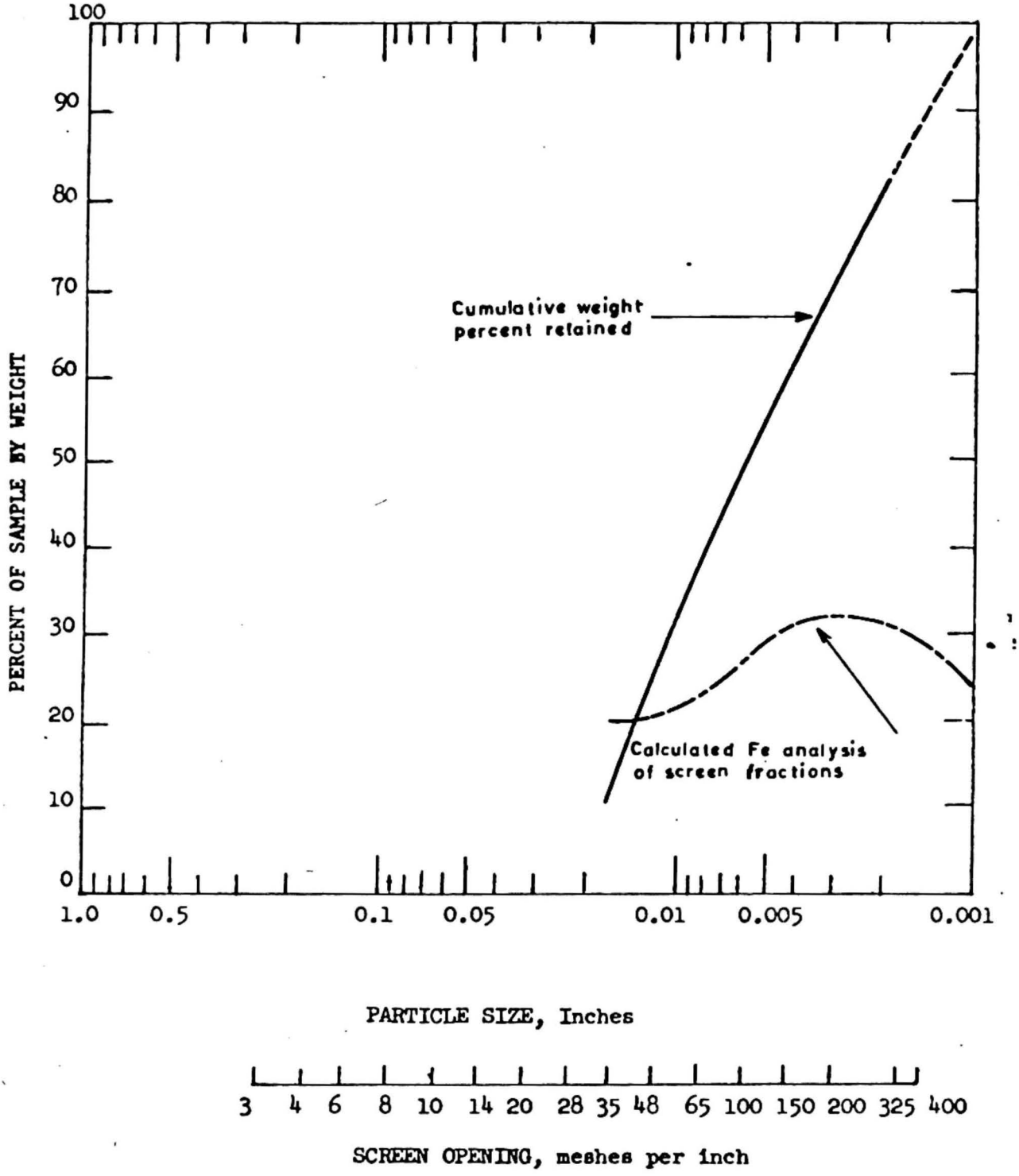

Figure 15. Screen analysis of Hasan Çelebi composite core, minus 0.5-mm crushed ore.

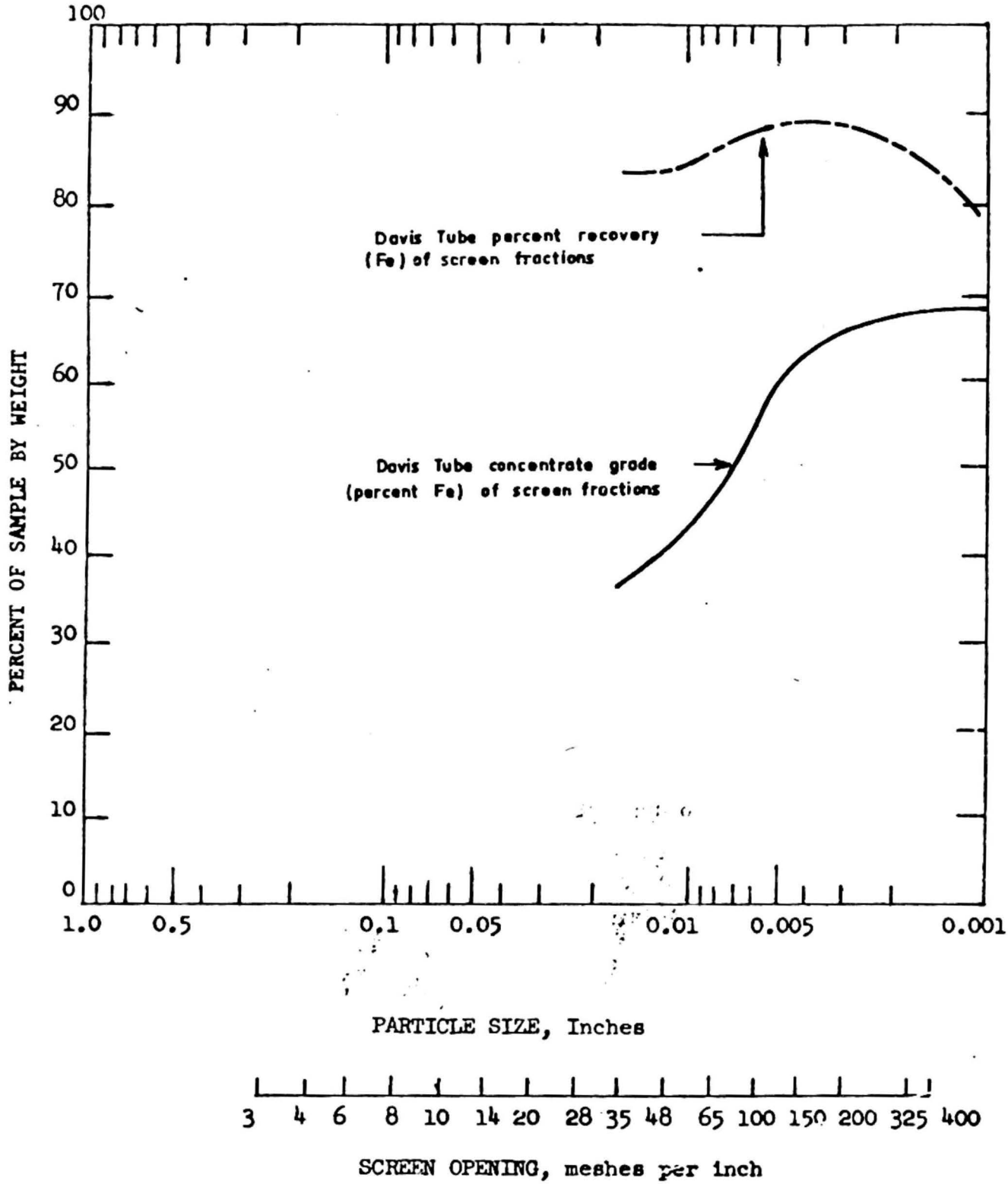

Figure 16. Davis tube evaluation of Hasan Çelebi composite core, minus 0.5-mm crushed ore screen fractions.

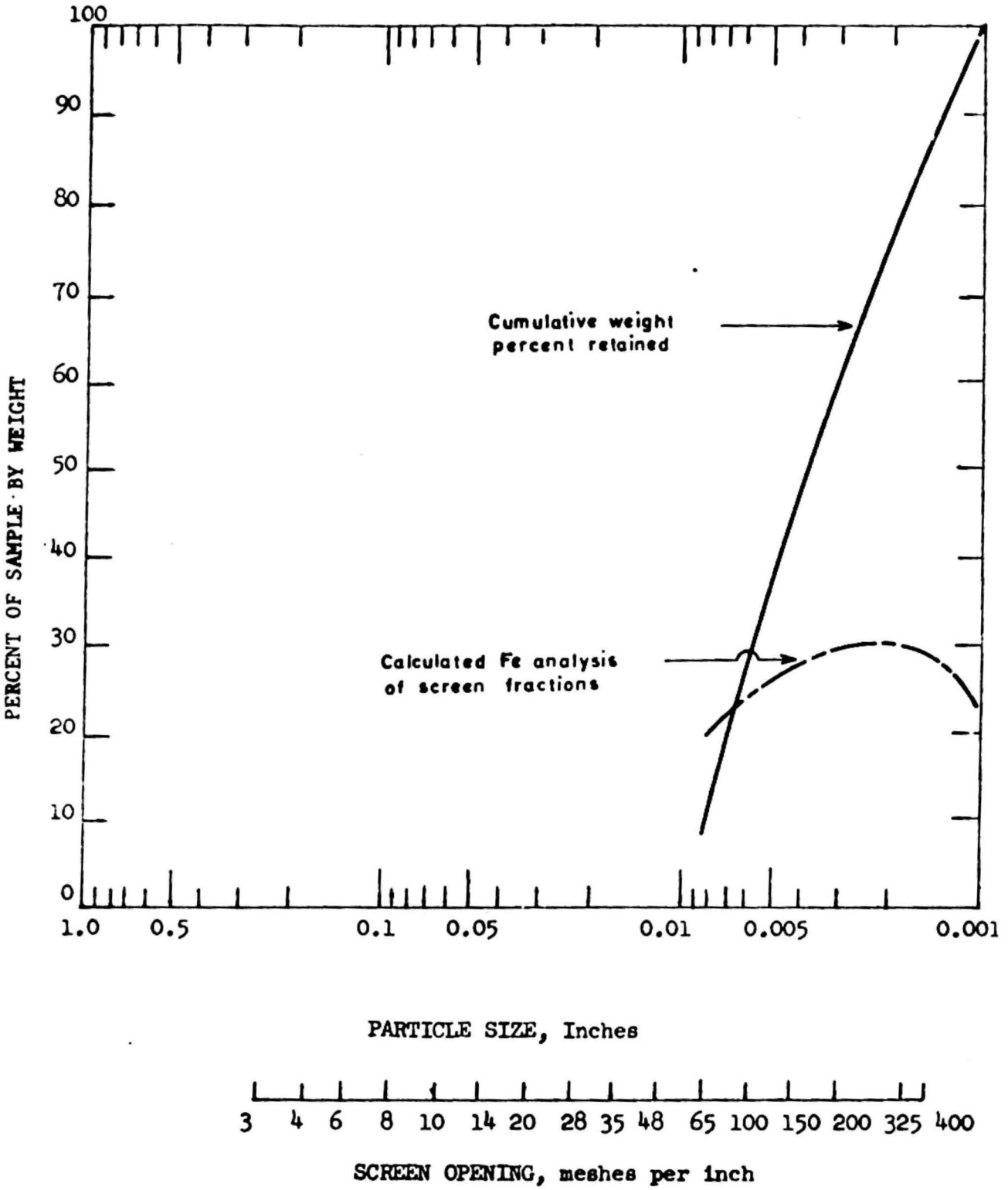

Figure 17. Screen analysis of Hasan Çelebi composite core, minus 48-mesh crushed ore.

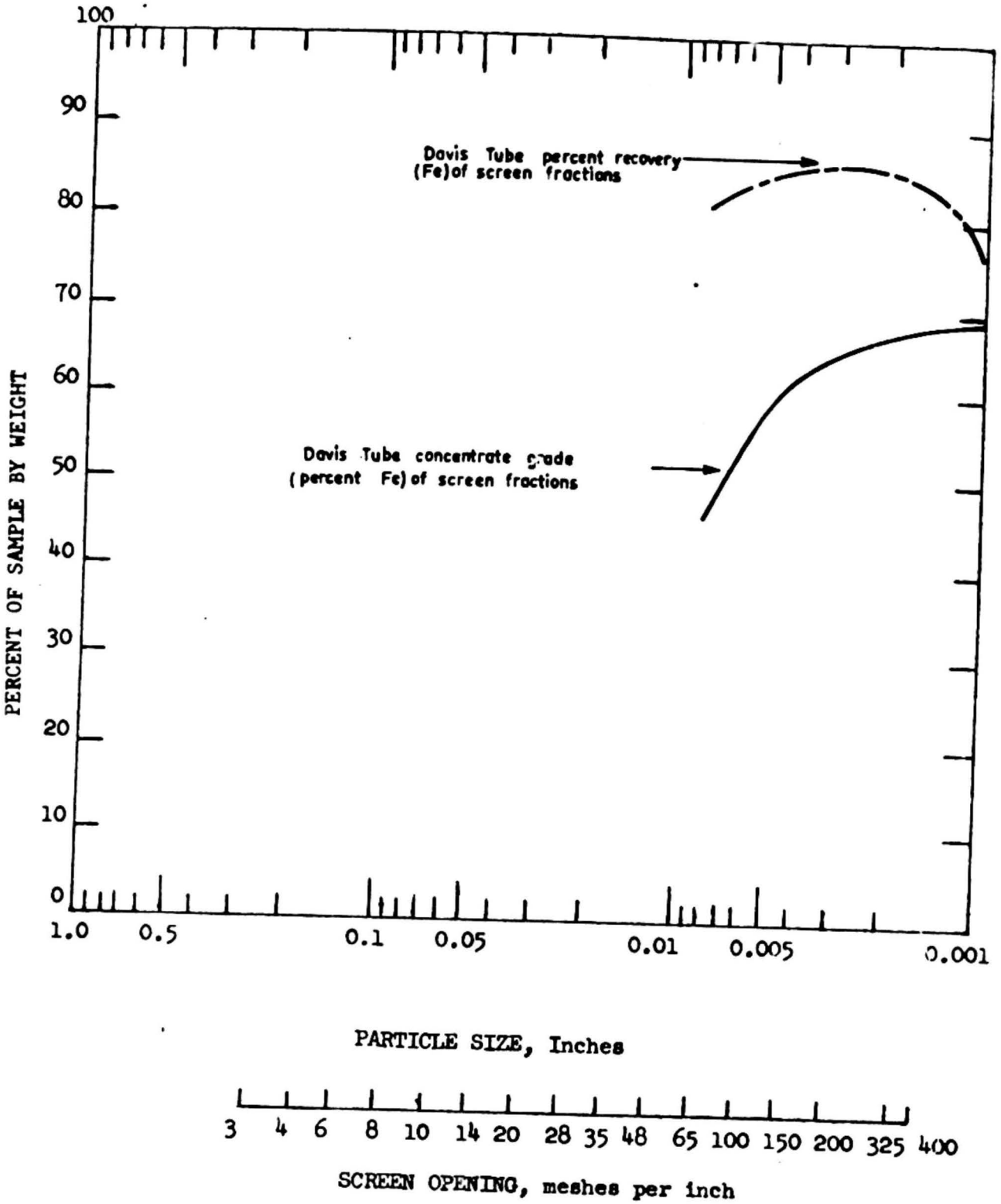

Figure 18. Davis tube evaluation of Hasan Çelebi composite core, minus 48-mesh crushed ore.

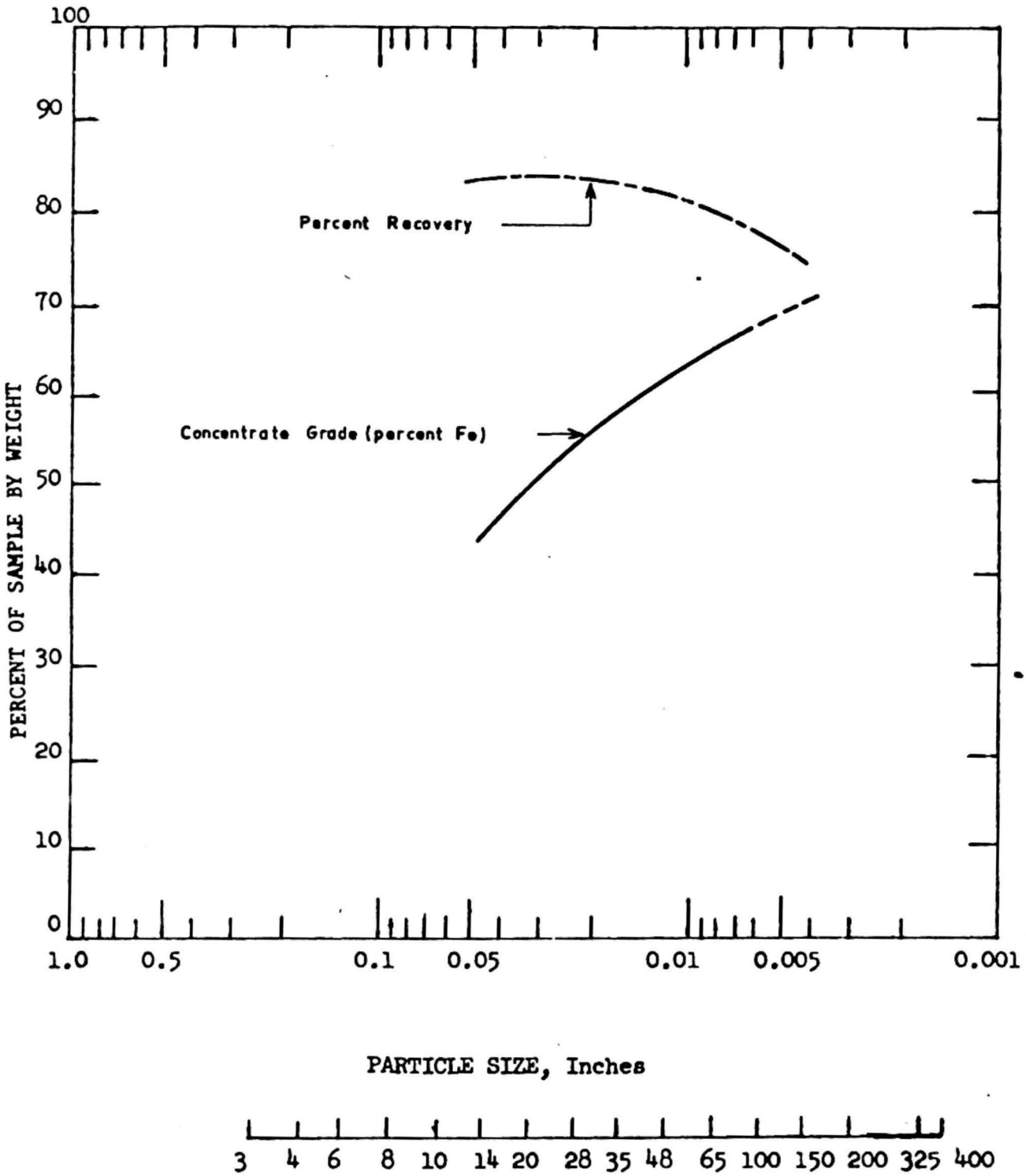

Figure 19. Davis tube evaluation of Hasan Çelebi composite core, minus 1-mm, minus 0.5-mm, minus 48-mesh, and minus 100-mesh crushed ore samples.

To assist the Plans and Project Department of MTA to calculate ore reserves, several specific gravity tests were performed on this composite sample, with only variations in particle size of material. Within the size limits of the sample available--8-mm size to 100-mesh--no variation in rock porosity was observed. The average specific gravity of the composite sample was determined to be 3.127.

Because of limited availability of composite sample material, very little work could be done to test the application of coarse-cobbing to this ore. One test only, using the dry ring-type magnetic separator on minus 8-mesh ore, was performed. It indicated that 31.62 weight percentof the ore could be rejected at that size and that 99.52 percent of the magnetite could be recovered. The data from the test follow:

Product	Weight percent	Davis tube magnetite(percent)	Davis tube, percent recovery	Ring-type magnetic separator conditions
Concentrate 1	59.27	31.05	96.71	0.2 amps, 6 mm gap
Concentrate 2	9.11	5.86	2.81	.5 amps, 6 mm gap
Tailing	31.62	.29	.48	
Calculated	100.00	19.03	100.00	

It is recommended that, when bulk samples are obtained from the drift and cross-cut tunnels, comprehensive cobbing studies be performed to test their applicability. The Eriez 12"x12" cobbing drum and 12"x8' conveyor belt is expected to arrive about September 1971, and the 25-ton bulk sample from Hasan Çelebi should also arrive at that time.

Grindability tests were performed on representative portions of the composite sample. Four 50-g samples of the wet-screened minus 14-mesh plus 28-mesh ore were individually tested with the Hargrove Grindability Machine manufactured by Wallace of Croydon, England. An average of 8.2 g

of minus 200-mesh material was obtained after 60 revolutions. The Hargrove Index was calculated as follows:

$$13 + 6.93 \text{ (weight of } -200 \text{ mesh in grams)} = 13 + 6.93(8.2) = 69.83$$

Converting this to the Bond Index was done as follows:

$$\frac{435}{(H_1)^{0.91}}, \text{ where } H_1 = \text{Hargrove Index}$$

Then $$\frac{435}{(69.83)^{0.91}} = 9.129$$

The Bond Index of 9.129 corresponds to a less-than-average work index, and compares to an average chrome ore.

Semicontinuous pilot plant tests

Based upon the recovery, liberation, and concentrate-grade information obtained from the Davis tube evaluation of the four roll-crushing and grinding tests, three 100 kg representative portions of the composite sample were prepared by roll-crushing through 1-mm size; each 100-kg sample was separately submitted to the Eriez single-drum 12" x 7½" wet magnetic separator according to the flowsheet in table 38. Stage-grinding of the concentrate through 35-mesh, 65-mesh, and 150-mesh followed. The individual middlings were dried and sampled, and then were mixed, roll-crushed twice, and locked in to the following test by recycling.

It is emphasized that this work was done using only a single-drum magnetic separator and without using a demagnetizing coil for magnetically deflocculating the concentrates. However, the Eriez 3-drum separator and degaussing coil were put into operation in September 1971, therefore considerable time should be saved, cleaning procedures should be improved, and concentrate grade should be higher, by using the new equipment.

Results of the tests of the 100-kg samples, using a recycled middling technique, substantiate information of the Davis tube evaluation, and indicate that as much as 83.0 percent of the HCl-soluble iron can be recovered into a concentrate.

The weight of these concentrates is 26 percent of the weight of the original feed. This corresponds closely to the initial estimates of average grade of 28.25 percent, and also to the Davis tube evaluation of the composite drill core 26.94 percent recoverable magnetite.

Final results are not back from the analytical laboratory as of June 30, 1971.

RESERVE AND GRADE DETERMINATIONS

During the 1970 drilling season, 19 holes were drilled in the Hasan Çelebi area for a total of 3459.15 m. Sixteen holes (3137.00 m) were in the immediate area and data from them have been used in calculating reserves. The other three holes (296.05 m) were not in the immediate area, and were drilled for the purpose of prospecting and for obtaining geological information.

Beneficiation tests were made on split core samples from the 16 drill cores, and the results have been tabulated (tables 14 through 29). These tables also indicate the optimum commercially mineralized horizon in each hole.

RECOMMENDATIONS FOR FURTHER BENEFICIATION WORK

The Ore Dressing Laboratory has completed semicontinuous pilot plant testing of the composite core sample. For an average ore containing 27 percent recoverable magnetite, testing has indicated the mesh required for screening samples, regrinding requirements for optimum concentrate grade, grindability indices, and in a very limited way the potential for rejection by coarse cobbing.

MTA is driving a 250-m drift across the strike of the mineralization on the line of diamond drill holes nos. 2, 15, and 4, for the purpose of obtaining a large representative sample for comprehensive beneficiation tests. Two 100-m crosscuts north and south from the midpoint of the drift are also being driven. A bulk sample from these workings probably arrived at the Laboratory in September 1971. A Eriez 3-drum wet magnetic separator and Eriez cobbing drum were scheduled to arrive about the same time. Thus the next step in beneficiation tests will be to process approximately 15 tons of bulk sample in this pilot plant equipment. Better figures on recoveries, concentrate grade, screening and grinding requirements will result. In addition, it is necessary that sufficient magnetite concentrate be obtained to run fine grinding and pelletizing tests. Because of the coarse-cobbing potential indicated by the limited test discussed in this report, it is recommended that pilot-plant scale work be done with the Eriez cobbing drum to develop more information about coarse barren rock rejection.

The non-magnetic tailings from the magnetic separation still cont about 6 percent HCl-soluble iron, most of which is specularite. It is recommended that flotation tests be made on the non-magnetic tailings of the bulk sample to attempt to recover a specularite concentrate at low cost. This would be an important addition to the profitability of any venture.

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Jacobson, H. S., Kendiroglu, Zeki, Ozdemir, Celil, Bogaz, Resat, Onder, Osman and Gurel Nafis, 1972, Geology and mineral deposits of the Hekimhan-Hasan Çelebi Iron District, Turkey: U. S. Geol. Survey open-file rept. (IR) TU-16, 35 p., 1 fig., 4 pls., 6 tables.

APPENDIX

APPENDIX (cont'd.)

APPENDIX (cont'd.)

Table 1.--Hasan Çelebi surface sample no. 1, Davis tube evaluation and wet screen analysis.

DAVIS TUBE EVALUATION

Mesh Fraction	Product	Weight Percent	Analysis, % Fe	Fe Units	Feed Percent Fe	Davis Tube Recovery	Analytical Lab. No.
+28	Concentrate	10.71	47.03	503.69	9.57	52.62	92008
	Tailing	89.29	5.18	453.59			92009
-28+48	Concentrate	8.86	49.55	439.01	8.54	51.42	92007
	Tailing	91.14	4.55	414.69			92003
-48+100	Concentrate	9.84	63.43	624.15	10.61	58.85	92010
	Tailing	90.16	4.84	436.37			92004
-100+200	Concentrate	9.36	67.63	633.02	10.65	59.42	92011
	Tailing	90.63	4.77	432.35			92005
-200	Concentrate	5.72	70.56	403.60	9.92	40.67	92006
	Tailing	94.28	6.24	588.31	----	----	92012
Calculated 1/							
	Concentrate	9.12	55.29	2603.47	9.61	52.45	
	Tailing	90.88	5.03	2325.31			
Analytical					10.38		91751

WET SCREEN ANALYSIS

Mesh Fraction	Grams	Weight Percent	Cumulative Weight %	Calculated % Fe 2/	Fe Units	Fe Distribution %
+28	55.0	27.5	27.5	9.57	263.18	27.38
-28+48	59.0	29.5	57.0	8.54	251.93	26.20
-48+100	35.0	17.5	74.5	10.61	185.68	19.31
-100+200	21.0	10.5	85.0	10.65	111.83	11.63
-200	30.0	15.0	100.0	9.92	148.80	15.48
Calculated	200.0	100.0		9.61	961.43	100.00

1/ Calculated weighted average, wet screen analysis
2/ From Davis Tube Evaluation

Table 2.--Hasan Çelebi surface sample no. 2, Davis tube evaluation and wet screen analysis.

DAVIS TUBE EVALUATION

Mesh Fraction	Product	Weight Percent	Analysis, % Fe	Fe Units	Feed Percent Fe	Davis Tube Recovery	Analytical Lab. No.
+28	Concentrate	86.31	65.87	5685.24	61.50	82.45	92190
	Tailing	13.69	33.92	464.36			92185
-28+48	Concentrate	82.09	66.13	5428.61	60.56	89.64	92191
	Tailing	17.91	35.04	627.57			92186
-48+100	Concentrate	77.44	70.37	5449.45	62.04	87.84	92192
	Tailing	22.56	33.43	754.18			92187
-100+200	Concentrate	73.34	70.09	5140.40	60.94	84.36	92193
	Tailing	26.66	35.75	953.10			92188
-200	Concentrate	60.83	67.98	4135.22	57.45	71.98	92194
	Tailing	39.17	41.10	1609.89	----	----	92189
Calculated 1/							
	Concentrate	77.39	67.65	25838.92	60.60	86.40	
	Tailing	22.61	36.36	4409.10			
Analytical					60.94		92184

WET SCREEN ANALYSIS

Mesh Fraction	Grams	Weight Percent	Cumulative Weight %	Calculated % Fe 2/	Fe Units	Fe Distribution %
+28	46.0	23.0	23.0	61.50	1414.5	23.34
-28+48	54.0	27.0	50.0	60.56	1635.1	26.99
-48+100	40.4	20.2	70.2	62.04	1253.2	20.68
-100+200	25.6	12.8	83.0	60.94	780.0	12.87
-200	34.0	17.0	100.0	57.45	976.7	16.12
Calculated	200.0	100.0		60.60	6059.5	100.00

1/ Calculated weighted average, wet screen analysis
2/ From Davis Tube Evaluation

Table 3.--Hasan Çelebi surface sample no. 3, Davis tube evaluation and wet screen analysis.

DAVIS TUBE EVALUATION

Mesh Fraction	Product	Weight Percent	Analysis, % Fe	Fe Units	Feed Percent Fe	Davis Tube Recovery	Analytical Lab. No.
+28	Concentrate	67.08	58.12	3898.69	42.76	91.19	92019
	Tailing	32.92	11.47	377.59			92020
-28+48	Concentrate	61.38	60.06	3686.48	41.05	89.80	92452
	Tailing	38.62	10.84	418.64			92018
-48+100	Concentrate	57.24	67.24	3848.82	43.59	88.30	92016
	Tailing	42.76	11.93	510.13			92014
-100+200	Concentrate	51.17	66.30	3392.57	41.44	81.87	92013
	Tailing	48.83	15.39	751.49			92015
-200	Concentrate	36.07	68.05	2454.56	31.79	77.21	92021
	Tailing	63.93	11.33	724.33	———	———	92022
Calculated 1/							
	Concentrate	56.85	62.36	17281.12	40.58	87.35	
	Tailing	43.15	11.90	2782.18			
Analytical					37.07		91750

WET SCREEN ANALYSIS

Mesh Fraction	Grams	Weight Percent	Cumulative Weight %	Calculated % Fe 2/	Fe Units	Fe Distribution %
+28	50.0	25.0	25.0	42.76	1068.8	26.34
-28+48	56.0	28.0	53.0	41.05	1149.4	28.32
-48+100	39.0	19.5	72.5	43.59	850.0	20.95
-100+200	24.0	12.0	84.5	41.44	497.3	12.25
-200	31.0	15.5	100.0	31.79	492.7	12.14
Calculated	200.0	100.0		40.58	4058.2	100.00

1/ Calculated weighted average, wet screen analysis
2/ From Davis Tube Evaluation

Table 4.--Hasan Çelebi surface sample no. 4, Davis tube evaluation and wet screen analysis.

DAVIS TUBE EVALUATION

Mesh Fraction	Product	Weight Percent	Analysis, % Fe	Fe Units	Feed Percent Fe	Davis Tube Recovery	Analytical Lab. No.
+28	Concentrate	61.59	65.16	4013.20	42.97	93.39	92023
	Tailing	38.41	7.39	283.8[illegible]			92024
-28+48	Concentrate	62.42	66.43	4146.56	44.22	93.78	92025
	Tailing	37.58	7.32	275.08			92026
-48+100	Concentrate	57.58	66.85	3849.22	41.39	93.01	92028
	Tailing	42.42	6.82	289.30			92027
-100+200	Concentrate	47.44	67.06	3181.33	36.03	88.30	92030
	Tailing	52.56	8.02	421.53			92029
-200	Concentrate	36.72	69.95	2568.56	33.08	77.67	92031
	Tailing	63.28	11.68	739.11	———	———	92032
Calculated 1/							
	Concentrate	56.78	66.34	17758.87	41.17	91.50	
	Tailing	43.22	8.10	2008.87			
Analytical					42.71		91752

WET SCREEN ANALYSIS

Mesh Fraction	Grams	Weight Percent	Cumulative Weight %	Calculated % Fe 2/	Fe Units	Fe Distribution %
+28	70.0	35.0	35.0	42.97	1504.0	36.54
-28+48	52.0	26.0	61.0	44.22	1149.7	27.92
-48+100	35.0	17.5	78.5	41.39	724.3	17.59
-100+200	19.0	9.5	88.0	36.03	342.3	8.31
-200	24.0	12.0	100.0	33.08	397.0	9.64
Calculated	200.0	100.0		41.17	4117.3	100.00

1/ Calculated weighted average, wet screen analysis
2/ From Davis Tube Evaluation

Table 5.--Hasan Çelebi surface sample no. 1, pilot plant metallurgical tests.

TREATMENT: 300 kg of this sample was prepared by roll-crushing and screening through 1 mm; 155 kg of the prepared sample was passed over the Eriez 12" x 7½" single-drum wet magnetic separator to produce a rough concentrate and tailing, the magnetic controller rheostat setting was 75. The rough concentrate was dried and pulverized through 100-mesh, and repassed over the drum to produce a final concentrate and a middling; magnetic controller was set at 45.

METALLURGICAL BALANCE

Product	Weight, Kgs.	Weight %	Analysis, % Fe	Fe Units	Fe Distribution %	Analytical Lab. No.
Concentrate	12.937	8.74	66.13 1/	577.98	50.58	92814
Middling	4.063	2.75	12.54	34.49	3.02	92816
Tailing	131.000	88.51	5.99	530.17	46.40	92817
Calculated	148.00	100.00	11.43	1142.64	100.00	
Analytical			10.38			91751

1/ Also analyses 2.56% SiO_2, Trace P, 0.12% Ti, Trace S, 0.10% Mn, 0.01% As, and 2.66% Al_2O_3+TiO_2.

Table 6.--Hasan Çelebi surface sample no. 2, pilot plant metallurgical tests.

TREATMENT: 100 kg of this sample was prepared by roll-crushing and screening through 1-mm; 68 kg of the prepared sample passed over the Eriez 12" x 7½" single-drum wet magnetic separator to produce a rough concentrate and tailing; magnetic controller rheostat setting was 75. Test time was one hour and water flow was 18 liters per minute. The rough concentrate was further cleaned twice to produce a final concentrate and two middling products. Magnetic controller rheostat setting was 70.

METALLURGICAL BALANCE

Product	Weight, Kgs.	Weight Percent	Analysis, % Fe	Fe Units	Fe Distribution %	Analytical Lab. No.
Concentrate	52.400	77.19	66.43 1/	5127.7	86.95	92771
Middling #1	0.615	0.91	44.97	40.9	0.69	92772
Middling #2	0.475	0.69	50.06	34.5	0.58	92773
Tailing	14.400	21.21	32.77	695.1	11.78	92774
Calc.	67.890	100.00	58.98	5898.2	100.00	
Analytical			60.94			92184

1/ Also analyses 3.77% SiO_2; Trace P; 0.12% Ti; Trace S; 0.09% Mn; 0.01% As; and 1.08% $Al_2O_3+TiO_2$.

Table 7.--Hasan Çelebi surface sample no. 3, pilot plant metallurgical tests.

TREATMENT: 200 kg of this sample was prepared by roll-crushing and screening through 1-mm; 160 kg of the prepared sample was passed over the Eriez 12" x 7½" single-drum wet magnetic separator to produce a rough concentrate and tailing. Test time was two hours, and water flow was 18 liters per minute. The magnetic controller rheostat setting was 70. The rough concentrate was cleaned once by repassing over the drum; magnetic controller rheostat setting was 30. The concentrate was then dried, roll-crushed and screened through 35-mesh, and re-passed over the wet drum and cleaned twice; magnetic controller rheostat setting was 25.

METALLURGICAL BALANCE

Product	Weight, Kgs.	Weight Percent	Analysis, % Fe	Fe Units	Fe, Distribution %	Analytical, Lab. No.
Concentrate	75.86	48.12	63.32 1/	3046.96	80.48	95923
Middling #1	8.00	5.08	28.96	147.12	3.89	95915
Middling #2	2.31	1.47	29.12	42.81	1.13	95921
Middling #3	1.66	1.05	32.41	34.03	0.90	95922
Middling #4	7.19	4.56	16.45	75.01	1.98	95.920
Tailing	62.60	39.72	11.08	440.10	11.62	95913
Calculated	157.62	100.00	37.86	3786.03	100.00	
Analytical			37.07			91750

1/ Also analyses 4.06% SiO_2, Trace P, 0.08% S, 2.17% TiO_2, 2.07% Al_2O_3, and 0.0074% As.

Table 8.--Hasan Çelebi surface sample no. 4, pilot plant metallurgical tests.

TREATMENT: 200 kg of the sample was prepared by roll-crushing and screening through 1-mm, and 100 kg was passed over the Eriez single-drum wet magnetic separator to produce a rough concentrate and tailing. Test time was 70 minutes, and the magnetic controller rheostat setting was 75. Water flow was 18 liters per minute during the test. The rough concentrate was then cleaned twice by repassing over the drum to produce a final concentrate and two middling products. The magnetic controller rheostat setting was 45 during the recleaning step.

METALLURGICAL BALANCE

Product	Weight, Kgs.	Weight Percent	Analysis, % Fe	Fe Units	Fe, Distribution %	Analytical, Lab. No.
Concentrate	57.00	58.29	65.04 1/	3791.2	87.28	92775
Middling #1	1.05	1.07	26.89	28.8	0.66	92776
Middling #2	0.45	0.46	32.21	14.8	0.34	92777
Tailing	39.3	40.18	12.67	509.1	11.72	92778
Calculated	97.8	100.00	43.44	4343.9	100.00	
Analytical			42.71			91752

1/ Also analyses 3.52% SiO_2, Trace P, 0.22% Ti, Trace S, 0.11% Mn, 0.01% As, and 3.37% $Al_2O_3+TiO_2$.

Table 9.--Hasan Çelebi trench samples, Davis tube evaluation.

DAVIS TUBE EVALUATION

Trench Number	Samples Composited	Sample Numbers	Magnetite Percent
2	60	1-60	27.27
3	7	1-7	23.02
4	1	2	0.26
5	1	1	0.40
6	1	1	0.38
7	1	2 each #8	0.82
11	2	1-2	20.37
12	1	1	8.34
13	2	1-2	17.73
14	9	1-9	43.58
16	14	1,4-6,8-15,21,22 (16 missing)	46.18
17	4	1-4	22.28
18	4	1-3,7	37.04
19	4	1-4	20.55
A	2	8,9	9.40

Table 10.--Magnetite concentrate analyses, all tests.

I. DAVIS TUBE EVALUATION

A. Diamond Drill Core

DD Core Number	Chemical Analysis, Percent											Analytical Lab. No.
	Fe	SiO_2	P	S	As	TiO_2	Al_2O_2	CaO	MgO	V	Mn	
Ha-1 Comp.	68.33	1.46	Tr	0.02	Tr	1.53	0.04					93470
Ha-2 Comp. I	65.29	4.40	Tr	0.01	Tr	0.67	0.02					93472
" " II	65.04	3.52	Tr	0.11	Tr	0.87	0.52					93474
" " III	64.90	4.27	Tr	0.12	Tr	0.71	1.13					93476
Ha-4 "	67.27	2.71	Tr	Tr	0.006	0.63	0.17					93609
Ha-6 "	68.82	1.73	Tr	0.58	0.021	0.55	0.82					97273
Ha-8 "	67.70	1.94	Tr	0.08	0.032	0.44	1.56					97251
Ha-13 " I	67.20	2.18	0.01	0.10	Tr	0.50	0.80					94187
" " II	67.60	1.82	0.01	0.10	Tr	0.40	0.76					94189
" Flot Test	66.34	3.84	0.02	0.05	None							94786
Ha-14 Comp.	68.25	1.50	Tr	0.52	0.007	0.84	1.16					96949
Ha-15 " I	67.41	2.44	Tr	0.42	0.015	0.57	1.32					96858
" " II	67.94	1.54	Tr	0.34	0.012	0.65	1.26					96890
Ha-16 "	68.14	1.27	Tr	0.04	Tr	Tr	0.64	0.26	0.14			98681
Ha-18 "	68.70	Tr	Tr	None	Tr	1.15	2.55					97322
Ha-19 "	67.12	2.30	Tr	0.04	Tr	0.70	1.07			0.11		98641
Ha-20 "	69.40	Tr	Tr	None	Tr	1.00	3.00					98203
Ha-21 "	68.40	1.96	Tr	Tr	Tr	0.90	0.60	0.50	0.10			98681
Ha-23 "	68.40	1.66	Tr	Tr	Tr	0.68	1.46			0.04		98666
Ha101 "	70.70	Tr	Tr	Tr	Tr	0.80	3.00					98025
Ha-103 "	68.52	1.38	Tr	Tr	Tr	0.35	0.76					97253

B. Trench Samples

No.2(1-60)	67.16	3.14	Tr	0.08	Tr	1.64	5.28					93998
No.14(1-9)	66.01	3.02	Tr	0.06	Tr	Tr	4.02					94000
No.16(1-15)	69.10	2.00	Tr	0.05	0.007	Tr	1.15					94003
Bulk No.2												

II. 12" X 7½" Eriez Single-Drum Magnetic Separator Test

H-C No. 1	66.13	2.56	Tr	Tr	0.01	0.20	2.46				0.10	92814
H-C No. 2	66.43	3.77	Tr	Tr	0.01	0.20	0.88				0.09	92771
H-C No. 3	63.32	4.06	Tr	0.08	0.007	2.17	2.07					95293
H-C No. 4	65.04	3.52	Tr	Tr	0.01	0.37	3.00				0.11	92775
Bulk Trench#2	66.80	1.00	Tr	0.04	0.022	2.13	0.72	0.32	0.56	0.15	0.16	280

Table 11.--Trench samples - Davis tube metallurgical balances.

Trench Samples

1. Trench No. 2 (Composite 1-60 samples).

Product	Weight Percent	Analysis, % Fe Total	Analysis, % Fe HCl-Sol	Fe, % Recovery Total Fe	Fe, % Recovery HCl-Sol Fe	T.T.L. No.
Concentrate	27.53	67.16 1/		60.31	61.21	97255
Tailing	72.47	16.79	16.17	39.69	38.79	93999
Calculated	100.00	30.66	30.21	100.00	100.00	

2. Trench No. 14 (Composite 1-9 samples).

Product	Weight Percent	Analysis, % Fe Total	Analysis, % Fe HCl-Sol	Fe, % Recovery Total Fe	Fe, % Recovery HCl-Sol Fe	T.T.L. No.
Concentrate	44.56	66.01 1/		89.07	89.90	94000
Tailing	55.44	6.51	5.96	10.93	10.10	94001
Calculated	100.00	33.02		100.00	100.00	

3. Trench No. 16 (Composite 1-15 samples).

Product	Weight Percent	Analysis, % Fe Total	Analysis, % Fe HCl-Sol	Fe, % Recovery Total Fe	Fe, % Recovery HCl-Sol Fe	T.T.L. No.
Concentrate	45.95	69.10 1/		87.[illegible]	88.34	94002
Tailing	54.05	8.48	7.75	12.6[illegible]	11.66	94003
Calculated	100.00	36.33		100.00	100.00	

1/ See Table 10 for complete analysis.

Table 12.--Hasan Çelebi trench sample no. 2, Davis tube evaluation and wet screen analysis

DAVIS TUBE EVALUATION

Mesh Fraction	Product	Weight Percent	Analysis, % Fe	Fe Units	Feed, Percent Fe	Davis Tube Recovery %	Analytical Lab. No.
+28	Concentrate	48.07	59.69	2859.30	36.04	79.62	92901
	Tailing	51.93	14.14	734.29			92902
-28+48	Concentrate	40.26	66.00	2657.16	34.24	77.61	92903
	Tailing	59.74	12.83	766.46			92904
-48+100	Concentrate	44.47	66.10	2934.47	37.46	78.47	92905
	Tailing	55.53	14.52	806.30			92906
-100+200	Concentrate	35.59	67.22	2392.36	33.22	72.02	92907
	Tailing	64.41	14.43	929.44			92908
-200	Concentrate	23.87	69.05	1648.22	28.91	57.02	92909
	Tailing	76.13	16.32	1242.44	----	----	92910
Calculated 1/							
	Concentrate	39.91	64.94	12506.40	34.48	75.18	
	Tailing	60.09	14.24	4478.66			
Analytical					30.92		92900

WET SCREEN ANALYSIS

Mesh Fraction	Grams	Weight Percent	Cumulative Weight %	Calculated % Fe 2/	Fe Units	Fe Distribution %
+28	31.5	19.44	19.44	36.04	700.6	20.32
-28+48	50.0	30.86	50.30	34.24	1056.6	30.64
-48+100	38.0	23.46	73.76	37.46	878.8	25.49
-100+200	20.0	12.35	86.11	33.22	410.3	11.90
-200	22.5	13.89	100.00	28.91	401.6	11.65
Calculated	162.0	100.00		34.48	3447.9	100.00

1/ Calculated weighted average, wet screen analysis
2/ From Davis Tube Evaluation

Table 13.--Hasan Çelebi trench sample no. 2, pilot plant metallurgical tests.

TREATMENT: 200 kg of the sample was prepared by roll-crushing and screening through 1-mm, and 105 kg was passed through the Eriez single-drum wet magnetic separator to produce a rough concentrate and tailing. Test time was 50 minutes, and water flow was 18 liters per minute; and a magnetic controller rheostat setting was 70. The rough concentrate was re-cleaned twice by repassing over the drum; magnetic controller rheostat setting was 25 and 20, respectively. The concentrate was dried, roll-crushed and screened through 35-mesh, passed over the Eriez drum, re-cleaned twice to produce a concentrate and two middling products; magnetic controller rheostat setting was 20. Again the concentrate was dried, roll-crushed and screened through minus 65-mesh, and passed over the Eriez drum once at a magnetic controller rheostat setting of 25 to produce a final concentrate and a middling product.

METALLURGICAL BALANCE

Product	Weight Kgs.	Weight, Percent	Analysis, % Fe	Fe Units	Fe, Distribution %	Analytical, Lab. No.
Concentrate	25.805	24.74	66.80 1/	1652.6	56.44	280
Middling #1	10.600	10.16	24.96	253.6	8.66	282
Middling #2	3.095	2.97	40.24	119.5	4.08	283
Middling #3	2.113	2.03	22.87	46.4	1.58	284
Middling #4	0.826	0.79	31.66	25.0	0.85	285
Middling #5	2.356	2.26	40.46	91.4	3.12	286
Tailing	59.500	57.05	12.97 2/	739.9	25.27	281
Calculated	104.295	100.00	29.28	2928.4	100.00	
Analytical			30.92			92900

1/ Also analyses 1.00% SiO, 0.022% As, Trace P, 0.04% S, 2113% TiO_2, 0.72% Al_2O_3, 0.56% MgO, 0.32% CaO, 0.16% Mn, and 0.15% V.
2/ Also analyses 13.09% Total Fe.

Table 14.--Davis tube evaluation of core from diamond drill hole no. Ha-1.

Meter Intervals Composited	Meters	Group	Magnetite		
			Percent	Units	Distribution
0 - 2.00	2.0	I	55.50	111.00	2.62
17.0 - 30.0	13.0	II	42.68	554.84	3.09
35.0 - 37.0	2.0	III	61.58	123.16	2.90
37.0 - 44.6	7.6	IV	49.57	376.73	8.89
44.6 - 47.65	3.05	V	61.99	189.07	4.46
47.65- 61.65	14.0	VI	48.41	677.74	15.99
63.65- 78.65	15.0	VII	48.18	722.70	17.04
78.65- 80.65	2.0	VIII	47.07	94.14	2.22
80.65-90.30	9.65	IX	55.95	539.92	12.73
90.30- 97.50	7.2	X	51.56	371.23	8.76
97.50-110.35	12.85	XI	37.29	479.18	11.30
TOTAL	88.35		47.99	4239.71	100.00

Table 15.--Davis tube evaluation of core from diamond drill hole no. Ha-2.

Meter Intervals Composited	Meters	Magnetite			
		Percent	Units	0-135 meters	0-224 meters
0-26	26	35.56	924.56	18.48	14.32
26-30	4	44.65	178.60	3.57	2.77
30-32	2	38.34	76.68	1.53	1.19
32-41	9	42.13	379.17	7.58	5.87
41-59	18	33.32	599.76	11.99	9.29
59-86	27	37.60	1015.20	20.29	15.73
86-101	15	47.26	708.90	14.17	10.98
101-111	10	39.50	395.00	7.90	6.12
111-120	9	37.25	335.25	6.70	5.19
120-135	15	25.97	389.55	7.79	6.03
135-155	20	14.30	286.00		4.43
155-165	10	31.28	312.80		4.85
165-173	8	22.02	176.16		2.73
173-183	10	16.70	167.00		2.59
183-191	8	8.10	64.80		1.00
191-208	17	13.32	226.44		3.51
208-212, 215-218, 221-224	10	13.06	130.60		2.02
212-215, 218-221	6	14.80	88.80		1.38
Calculated	224	28.82	6455.27	100.00	100.00
0-135	135	37.06	5002.67		
135-224	89	10.32	1452.60		

Table 16.--Davis tube evaluation of core from diamond drill hole no. Ha-4

Group	Meter Intervals Composited	Meters	MAGNETITE		
			Percent	Units	Percent Distribution
I	1-25	25	24.67	616.75	13.93
II	25-41	16	5.67	90.72	2.05
III	41-54	13	22.16	288.08	6.51
IV	54-82	28	20.16	564.48	12.75
V	82-116	34	24.88	845.92	19.11
VI	116-130	14	7.99	111.86	2.53
VII	130-162	32	22.66	725.12	16.38
VIII	162-176	14	21.19	296.66	6.70
IX	176-190	14	4.20	58.80	1.33
X	190-213	23	27.39	629.97	14.23
XI	213-230	17	11.65	198.39	4.48
		230	19.25	4426.75	100.00
Composite	Groups				
1	I, III, I, V, VII, VIII, X	169	23.47	3966.98	89.61
2	II, VI, IX, XI	61	7.54	459.77	10.39
		230			

Table 17.--Davis tube evaluation of core from diamond drill hole no. Ha-6.

Group	Meter Intervals Composited	Meters	MAGNETITE		
			Percent	Units	Percent Distributic
1	0-100	100	23.94	2394.00	38.09
2	100-104	4	23.04	92.16	1.47
3	104-107	3	27.15	81.45	1.30
4	107-118	11	36.21	398.31	6.34
5	118-149	31	25.80	799.80	12.73
6	149-167	18	25.06	451.08	7.18
7	167-173	6	24.98	149.88	2.39
8	173-177	4	24.25	97.00	1.54
9	177-184	7	21.41	149.87	2.39
10	184-214	30	35.44	1063.20	16.93
11	214-223	9	29.24	263.16	4.19
12	223-231	8	27.43	219.44	3.49
13	231-233	2	15.35	30.70	0.49
14	233-237	4	23.03	92.12	1.47
		237	26.51	6282.17	100.00

Table 18.--Davis tube evaluation of core from diamond drill hole no. Ha-8.

Group	Meter Intervals Composited	Meters	MAGNETITE		
			Percent	Units	Percent Distribution
1	0-14	14	25.41	355.74	21.06
2	14-63	49	5.21	255.29	15.12
3	63-65	2	14.80	29.60	1.75
4	65-77	12	7.61	91.32	5.41
5	77-80	3	24.04	72.12	4.27
6	80-81	1	8.68	8.68	0.51
7	81-84	3	28.78	86.28	5.11
8	84-88	4	1.56	6.24	0.37
9	88-93	5	20.59	102.95	6.10
10	93-97	4	12.07	48.24	2.86
11	97-99	2	17.90	35.80	2.12
12	99-100	1	13.21	13.21	0.78
13	100-113	13	17.25	224.25	13.28
14	113-114	1	2.27	2.27	0.13
15	114-119	5	13.22	66.10	3.91
16	119-125	6	11.49	68.94	4.08
17	125-130	5	15.89	79.45	4.70
18	130-140	10	14.25	142.50	8.44
		140	12.06	1688.98	100.00
Section	(77-113)	(36)	(16.56)	(597.77)	(35.40)

Table 19.--Davis tube evaluation of core from diamond drill hole no. Ha-10, 102A, 104

Group	Meter Intervals Composited	Meters	MAGNETITE Percent	MAGNETITE Units	MAGNETITE Percent Distribution	Specific Gravity
1	0-39	39	2.73	106.47	17.92	2.53
2	39-42	3	34.36	103.08	17.35	2.94
3	42-44	2	13.48	26.96	4.54	2.60
4	44-47	3	4.31	12.93	2.18	2.73
5	47-70	23	4.19	96.37	16.22	2.75
6	70-80	10	11.20	112.00	18.84	2.70
7	80-116	36	3.72	133.92	22.52	2.78
8	116-122.70	6.70	0.38	2.55	0.43	2.68
Total		122.70	4.84	594.28	100.00	2.68
		DIAMOND DRILL HOLE NO. HA-102A				
1	0-39.60	39.60	4.47	---	100.00	2.77
		DIAMOND DRILL HOLE NO. HA-104				
1	0-107.60	107.60	3.82	---	100.00	2.88

Table 20.--Davis tube evaluation of core from diamond drill hole no. Ha-13.

Group	Meter Intervals Composited	Meters	MAGNETITE		
			Percent	Units	Percent Distribution
I	0-8	8	6.92	55.36	1.05
II	8-19	11	29.47	324.17	6.13
III	19-25	6	31.32	187.92	3.56
IV	25-36	11	29.40	323.40	6.12
V	36-76	40	27.18	1114.38	21.09
VI	76-97	21	14.35	301.35	5.70
VII	97-111	14	17.63	246.82	4.67
VIII	111-116	5	6.51	32.55	0.62
IX	116-120	4	9.38	37.52	0.71
X	120-126	6	6.31	37.86	0.72
XI	126-167	41	23.55	965.55	18.27
XII	167-169, 172-175	5	16.83	84.15	1.59
XIII	169-172, 175-188	16	25.29	404.64	7.66
XIV	188-200	12	15.96	191.52	3.62
XV	200-214	14	30.93	433.02	8.20
XVI	214-239	25	21.75	543.75	10.29
		239	22.11	5283.95	100.00

Table 21.--Davis tube evaluation of core from diamond drill hole no. Ha-14.

Group	Meter Intervals Composited	Meters	Magnetite Percent	Units	Percent Distribution 0-146 meters	146-225 meters
1	0-5	5	26.46	132.25	4.26	
2	5-8	3	17.96	53.88	1.74	
3	8-11	3	22.93	68.79	2.22	
4	11-12	1	17.93	17.93	0.58	
5	12-21	9	23.04	207.36	6.68	
6	21-31	10	13.00	130.00	4.19	
7	31-41	10	21.22	212.20	6.84	
8	41-49	8	15.49	123.92	3.99	
9	49-54	5	12.39	61.95	2.00	
10	54-70	16	21.23	339.68	10.95	
11	70-77	7	24.91	174.37	5.62	
12	77-79	2	3.64	7.28	0.23	
13	79-81	2	24.62	49.24	1.59	
14	81-82	1	12.47	12.47	0.40	
15	82-89	7	26.90	188.30	6.07	
16	89-93	4	10.39	41.56	1.34	
17	93-95	2	33.20	66.40	2.14	
18	95-105	10	11.44	114.40	3.69	
19	105-146	41	26.84	1100.44	35.47	
	COMPOSITE	146	21.25	3102.42	100.00	
20	146-149	3	11.22	33.66		4.84
21	149-158	9	13.09	117.81		16.93
22	158-165	7	5.52	38.64		5.55
23	165-168	3	10.13	30.39		4.37
24	168-171	3	3.89	11.67		1.68
25	171-193	22	11.66	256.52		36.86
26	193-202	9	4.40	39.60		5.69
27	202-205	3	9.93	29.79		4.28
28	205-221	16	3.48	55.68		8.00
29	221-225	4	20.53	82.12		11.80
		79	8.81	695.88		100.00

Table 22.--Davis tube evaluation of core from diamond drill hole no. Ha-15.

Group	Meter Intervals Composited	Meters	MAGNETITE Percent	Units	Percent Distribution 0-199 meters	199-315 meters
1	0-8,26-29, 45-48	14	27.25	381.50	6.63	
2	8-17	9	19.39	178.51	3.05	
3	17-18	1	40.80	40.80	0.71	
4	18-23	5	14.83	74.15	1.29	
5	23-26	3	28.64	85.92	1.49	
6	29-33	4	30.35	121.40	2.11	
7	33-35	2	31.96	63.92	1.11	
8	35-45	10	40.38	403.80	7.01	
9	48-74	26	35.72	928.72	16.12	
	74-77	3	0	0	0	
10	77-89 1/	12	24.42	293.04	5.09	
11	89-90	1	6.09	6.09	0.11	
12	90-117	27	28.86	779.22	13.53	
13	117-124	7	30.75	215.25	3.74	
14	124-130	6	32.74	196.44	3.41	
15	130-131	1	5.32	5.32	0.09	
16	131-138	7	36.57	255.99	4.45	
17	138-143	5	29.28	146.40	2.54	
18	143-156	13	34.52	448.76	7.80	
19	156-159	3	26.99	80.97	1.41	
20	159-180	21	31.89	669.69	11.62	
21	180-189	9	13.60	122.40	2.13	
22	189-199	10	26.29	262.29	4.56	
	COMPOSITE	199	28.93	5756.58	100.00	
23	199-201	2	4.97	9.94		0.51
24	201-215	14	9.33	130.62		6.70
25	215-237	22	26.37	580.14		29.77
26	237-239	2	13.38	26.76		1.37
27	239-246	7	18.54	129.78		6.66
28	246-249	3	2.59	7.77		0.40
29	249-256	7	18.95	132.65		6.81
30	256-260	4	7.75	31.00		1.59
31	260-266	6	24.47	146.82		7.53
35 2/	266-279	13	17.16	223.08		11.45
32	279-281	2	9.83	19.66		1.01
35 2/	281-287	6	17.16	102.96		5.28
33	287-296	9	12.93	116.37		5.97
35 2/	296-309	13	17.16	223.08		11.45
34	309-312	3	5.56	16.68		0.86
35 2/	312-315	3	17.16	51.48		2.64
		116	16.70	1948.79		100.00

1/ Core samples missing.

2/ Group 35 is a 35-m composite of sediments of the 4 indicated intervals.

Table 23.--Davis tube evaluation of core from diamond drill hole no. Ha-16.

Group	Meter Intervals Composited	Meters	MAGNETITE			
			Percent	Units	Distribution	Specific Gravity
1	0-15	15	30.54	458.10	4.82	3.09
2	15-162	147	35.07	5155.29	54.19	3.27
3	162-164	2	12.97	25.94	0.27	2.91
4	164-169	5	28.94	144.70	1.52	3.21
5	169-171	2	5.71	11.42	0.12	2.81
6	171-175	4	21.59	86.36	0.91	3.12
7	175-177	2	7.43	14.86	0.16	2.97
8	177-179	2	22.48	44.96	0.47	3.13
9	179-180	1	32.98	32.98	0.35	3.30
10	180-190	10	31.23	312.30	3.28	3.19
11	190-192	2	9.34	18.68	0.20	2.94
12	192-196	4	14.99	59.96	0.63	3.02
13	196-198	2	3.71	7.42	0.08	2.94
14	198-211	13	34.80	452.40	4.76	3.18
Section	(15-211)	(196)	(32.49)	(6367.27)	(66.94)	(3.23)
15	211-219	8	6.94	55.52	0.58	2.88
16	219-232	13	17.15	222.95	2.34	2.81
17	232-237	5	9.25	46.25	0.49	2.80
18	237-246	9	15.05	135.45	1.42	2.84
19	246-256	10	14.75	147.50	1.55	2.99
20	256-260	4	23.03	92.12	0.97	3.01
21	260-287	27	8.62	232.74	2.45	2.81
22	287-290	3	29.80	89.40	0.94	3.13
23	290-298	8	8.04	64.32	0.68	2.77
24	298-302	4	19.40	77.60	0.82	2.87
25	302-337	35	12.15	425.25	4.47	2.86
Section	(211-337)	(126)	(12.61)	(1589.10)	(16.71)	(2.86)
26	337-348	11	26.31	289.41	3.04	3.04
27	348-385	37	21.83	807.71	8.49	2.91
Section	(337-385)	(48)	(22.86)	(1097.12)	(11.53)	(2.94)
Total		385	24.71	9511.59	100.00	3.07

Table 24.--Davis tube evaluation of core from diamond drill hole no. Ha-18.

Group	Meter intervals Composited	Meters	MAGNETITE		
			Percent	Units	Percent Distribution
1	0-37	37	7.50	277.50	7.02
2	37-65	28	24.97	699.16	17.69
3	65-70	5	13.01	65.05	1.65
4	70-119	49	26.39	1293.11	32.70
5	119-121	2	13.60	27.20	0.69
6	121-149	28	31.04	869.12	21.98
7	149-154	5	14.06	70.30	1.78
8	154-158	4	25.88	103.52	2.62
9	158-200	42	6.67	280.14	7.09
10	200-201	1	41.71	41.71	1.06
11	201-218	17	13.30	226.10	5.72
		218	18.13	3952.91	100.00
2-8	37-158	121	25.84	3127.46	79.12
1,9-11	0-37 158-218	97	8.51	825.45	20.88
		218	18.13	3952.91	100.00

Table 25.--Davis tube evaluation of core from diamond drill hole no. Ha-20.

Group	Meter Intervals Composited	Meters	MAGNETITE			
			Percent	Units	Percent Distribution	Specific Gravity
1	0-13	13	52.09	677.17	15.16	3.58
2	13-14	1	21.16	21.16	0.47	3.10
3	14-16	2	16.07	32.14	0.72	3.11
4	16-36	20	6.38	127.60	2.96	2.82
5	36-64	28	33.01	924.28	20.70	3.22
6	64-66	2	10.74	21.48	0.48	2.91
7	66-69	3	5.08	15.24	0.34	2.82
8	69-70	1	11.14	11.14	0.25	2.87
9	70-81	11	24.18	265.98	5.96	3.01
10	81-90	9	3.76	33.84	0.76	2.86
11	90-98	8	22.19	177.52	3.98	3.00
12	98-99 104-107	4	21.06	84.24	1.89	2.84
13	99-104 107-115	13	10.56	137.28	3.07	2.80
14	115-120 125-129 132-135 138-142 144-145 147-153 154-156	25	36.64	916.00	20.50	3.20
15	120-125 129-132 135-138 142-144 145-147 153-154 156-158	18	25.48	458.64	10.27	3.08
16	158-160	2	42.82	85.64	1.92	3.11
17	160-176	16	29.78	476.48	10.67	3.06
		176	25.37	4465.83	100.00	3.07

Table 26.--Davis tube evaluation of core from diamond drill hole no. Ha-21.

Group	Meter Intervals Composited	Meters	MAGNETITE			
			Percent	Units	Percent Distribution	Specific Gravity
1	0-3	3	22.17	66.51	3.17	2.88
2	3-11	8	13.94	111.52	5.32	2.79
3	11-14	3	7.56	22.68	1.08	2.75
4	14-18	4	19.28	77.12	3.68	2.88
5	18-23	5	6.21	31.05	1.48	2.82
6	23-29	6	13.59	81.54	3.89	2.67
7	29-58	29	19.28	559.12	26.65	2.90
8	58-64	6	9.49	56.94	2.71	2.87
9	64-69	5	23.20	116.00	5.53	2.90
10	69-107	38	11.05	419.90	20.02	2.84
11	107-111	4	16.74	66.96	3.19	2.88
12	111-157.5	46.5	10.50	488.25	23.28	2.81
Total		157.5	13.32	2097.59	100.00	2.84

Table 27.--Davis tube evaluation of core from diamond drill hole no. Ha-23.

Group	Meter Intervals Composited	Meters	MAGNETITE			
			Percent	Units	Percent Distribution	Specific Gravity
1	0-2	2	4.50	9.00	0.37	2.96
2	2-14	12	7.25	87.00	3.59	2.78
3	14-28	14	12.91	180.74	7.47	2.95
4	28-30	2	6.77	13.54	0.55	2.84
Section	(0-30)	(30)	(9.67)	(290.28)	(11.99)	(2.86)
5	30-56	26	24.35	633.10	26.14	3.07
6	56-71	15	8.47	127.05	5.25	2.89
7	71-74	3	23.37	70.11	2.90	3.11
8	74-77	3	19.71	59.13	2.44	2.95
9	77-84	7	20.08	140.56	5.81	2.96
Section	(30-84)	(54)	(19.07)	(1029.95)	(42.54)	(3.00)
10	85-185	101	8.76	884.76	36.55	2.72
11	185-189	4	19.93	79.72	3.29	2.84
12	189-195	6	22.70	136.20	5.63	2.84
Section	(185-195)	(10)	(21.59)	(215.92)	(8.92)	(2.84)
Total		195	12.41	2420.91	100.00	2.97

Table 28.--Davis tube test evaluation of core from diamond drill hole no. Ha-101, 19.

Group	Meter Intervals Composited	Meters	MAGNETITE			
			Percent	Units	Percent Distribution	Specific Gravity
1	0-19	19	19.12	363.28	12.34	2.92
2	19-86.6	67.6	38.18	2580.97	87.66	3.30
		86.6	34.00	2944.25	100.00	3.22

DIAMOND DRILL HOLE NO. Ha-19

Group	Meter Intervals Composited	Meters	MAGNETITE			
			Percent	Units	Percent Distribution	Specific Gravity
1	0-10	10	9.40	94.00	3.97	2.82
2	10-51	41	5.22	214.02	9.04	2.86
3	51-58	7	6.47	45.29	1.91	2.88
4	58-117	59	2.89	170.51	7.20	2.81
Section	(0-117)	(117)	(4.48)	(523.82)	(22.12)	(2.84)
5	117-122	5	23.83	119.15	5.03	3.21
6	122-232	10	14.17	141.70	5.99	2.97
7	132-134	2	22.16	44.32	1.87	3.13
8	134-141	7	7.38	51.66	2.18	2.91
9	141-146	5	19.94	99.70	4.21	3.10
Section	(117-146)	(29)	(15.74)	(456.53)	(19.28)	(3.03)
10	146-157	11	2.67	29.37	1.24	2.93
11	157-169	12	4.68	56.16	2.37	3.00
12	169-177	8	6.74	53.92	2.28	3.03
Section	(146-177)	(31)	(4.50)	(139.45)	(5.89)	(2.98)
13	177-189	12	22.17	266.04	11.24	3.14
14	189-191	2	16.80	33.60	1.42	3.00
15	191-206	15	24.25	363.75	15.38	3.13
16	206-211	5	9.01	45.05	1.90	2.94
17	211-215	4	19.95	79.80	3.37	3.08
18	215-216	1	11.07	11.07	0.47	2.91
19	216-224	8	25.62	204.96	8.66	3.02
Section	(177-224)	(47)	(21.37)	(1004.27)	(42.44)	(3.08)
20	224-227	3	10.07	30.21	1.28	2.83
21	227-242	15	14.18	212.70	8.99	2.93
Section	(224-242)	(18)	(13.50)	(242.91)	(10.27)	(2.91)
Total		242	9.78	2366.98	100.00	2.93

Table 29.--Davis tube evaluationoof core from diamond drill hole no. Ha-103.

Group	Meter Intervals Composited	Meters	MAGNETITE		
			Percent	Units	Percent Distribution
1	0-2	2	17.23	34.46	3.46
2	2-4	2	7.71	15.42	1.55
3	4-6	2	2.04	4.08	0.41
4	6-11	5	14.47	72.35	7.27
5	11-12	1	2.44	2.44	0.25
6	12-22	10	13.80	138.00	13.87
7	22-23	1	5.07	5.07	0.51
8	23-25	2	15.13	30.26	3.04
9	25-37	12	10.17	122.04	12.27
10	37-38	1	25.57	25.57	2.57
11	38-43	5	20.36	101.80	10.23
12	43-59	16	15.77	252.32	25.37
13	59-60	1	21.71	21.71	2.18
14	60-66	6	28.23	169.38	17.02
		66	15.07	994.90	100.00
Section	(37-66)	(29)	(20.39)	(570.78)	(57.35)

Table 30.--Davis tube test evaluation of diamond drill core and sulfur and copper analyses of Davis tube tailings.

Hole #	Interval, Meters	Magnetite Con. Wt %	Magnetite Con. % Fe 1/	Tailing, % Fe Total	Tailing, % Fe HCl-Sol	% Recovery, Fe Total	% Recovery, Fe HCl-Sol	Analytical Lab. No.
Ha-1	88.35	47.97	69.33	11.28	9.71	84.81	86.65	93470
Ha-2	0-135	36.64	65.29	8.07	6.56	82.38	85.20	93472
"	135-224	16.32	65.04	9.82	8.69	56.34	59.34	93474
"	0-224	28.72	64.90	8.86	7.52	74.69	77.67	93476
Ha-4	169/230	23.34	67.27	10.33	9.21	66.47	68.98	93609
Ha-6	0-237	26.51	68.82	7.04	6.56	77.91	79.01	97273
Ha-8	0-140	12.00	67.70	10.59	9.12	46.57	50.30	97251
Ha-13	8-76	28.67	67.20	8.06	7.50	77.02	78.27	94187
"	126-239	23.21	67.60	8.84	7.10	69.80	74.21	94189
Ha-14	0-146	21.25	68.27	7.39	7.13	71.36	72.09	96949
Ha-15	0-199	28.93	67.41	9.74	9.36	73.80	74.57	96888
"	199-315	16.70	67.97	8.43	8.09	61.78	62.75	96890
Ha-16	15-211	32.49	68.14	6.99	6.12	82.43	84.27	99293
Ha-18	37-158	25.84	68.70	8.35	7.20	74.14	76.88	97322
Ha-19	177-224	20.94	67.12	8.09	7.32	68.73	70.83	98641
Ha-20	0-176	25.37	69.40	7.80	6.45	75.15	78.53	98023
Ha-21	0-157.5	13.32	68.40	5.68	5.25	64.92	66.69	98681
Ha-23	30-84	19.07	68.40	4.18	3.05	79.41	84.09	98666
Ha-101	177-224	21.37	70.70	7.95	6.85	70.73	73.72	98025
Ha-103	0-66	15.07	68.52	7.39	7.13	62.20	63.03	97253
Average		24.19	67.81	8.24	7.30	70.99	73.35	

SULFUR AND COPPER ANALYSES OF DAVIS TUBE TAILINGS

Hole No.	Chemical Analysis, percent Sulfur	Copper
Ha-6(0-237 M)	0.25	0.06
Ha-8(0-140 M)	3.78	0.22
Ha-14(0-146 M)	2.74	None
Ha-15(0-199 M)	0.59	0.06
" (199-315M)	0.82	0.18
Ha-16(15-211 M)	0.17	Trace
Ha-18(37-158 M)	0.20	None
Ha-19(177-224M)	0.48	Trace
Ha-20(0-176 M)	0.30	None
Ha-21(0-157.5)	0.27	Trace
Ha-23(30-84 M)	0.11	Trace
Ha-101(177-224M)	0.16	None
Ha-103(0-66 M)	2.73	None

1/ For complete analysis, see Table 10.

Table 31.--Davis tube test evaluation of composite core samples from drill holes.

A. Diamond Drill Hole No. 1

1. Composite (88.35/110.35 meters)

Product	Weight Percent	Analysis, % Fe Total	HCl-Sol	Fe, % Recovery Total Fe	HCl-Sol Fe	T.T.L. No.
Concentrate	47.97	68.33*		84.81	86.65	93470
Tailing	52.03	11.28	9.71	15.19	13.35	93471
Calculated	100.00	38.65		100.00	100.00	

B. Diamond Drill Hole No. 2

2. Composite 1 (0-135 meters)

Product	Weight Percent	Analysis, % Fe Total	HCl-Sol	Fe, % Recovery Total Fe	HCl-Sol Fe	T.T.L. No.
Concentrate	36.64	65.29*		82.38	85.20	93472
Tailing	63.36	8.07	6.56	17.62	14.80	93473
Calculated	100.00	29.04		100.00	100.00	

3. Composite 2 (135-224 meters)

Product	Weight Percent	Analysis, % Fe Total	HCl-Sol	Fe, % Recovery Total Fe	HCl-Sol Fe	T.T.L. No.
Concentrate	16.32	65.04*		56.36	59.34	93474
Tailing	83.68	9.82	8.69	43.64	40.66	93475
Calculated	100.00	18.83		100.00	100.00	

4. Composite 3 (0-224 meters)

Product	Weight Percent	Analysis, % Fe Total	HCl-Sol	Fe, % Recovery Total Fe	HCl-Sol Fe	T.T.L. No.
Concentrate	28.72	64.90*		74.69	77.67	93476
Tailing	71.28	8.86	7.52	25.31	22.33	93477
Calculated	100.00	24.95		100.00	100.00	

*See Table 10 for complete analysis.

C. Diamond Drill Hole No. Ha-4.

1. Composite (169/230 meters).

Product	Weight Percent	Analysis, % Fe Total	HCl-Sol	Fe, % Recovery Total Fe	HCl-Sol Fe	T.T.L. No.
Concentrate	23.34	67.27*		66.47	68.98	93609
Tailing	76.66	10.33	9.21	33.53	31.02	93610
Calculatod	100.00	23.62		100.00	100.00	

D. Diamond Drill Hole No. Ha-13.

1. Composite 1 (8-76 meters).

Product	Weight Percent	Analysis, % Fe Total	HCl-Sol	Fe, % Recovery Total Fe	HCl-Sol Fe	T.T.L. No.
Concentrate	28.67	67.20*		77.02	78.27	94187
Tailing	71.33	8.06	7.50	22.98	21.73	94188
Calculated	100.00	25.02		100.00	100.00	

2. Composite 2 (126-239 meters).

Product	Weight Percent	Analysis, % Fe Total	HCl-Sol	Fe, % Recovery Total Fe	HCl-Sol Fe	T.T.L. No.
Concentrate	23.21	67.60*		69.80	74.21	94189
Tailing	76.79	8.84	7.10	30.20	25.79	94190
Calculated	100.00	22.48		100.00	100.00	

3. Combined Magnetic Separation & Pyrite Flotation (Denver Flot. Cell)

Product	Grams	Weight Percent	Chem. Analysis, % Fe	S	Recovery, % Fe	S	T.T.L. No.
Magnetite Conc.	118.3	23.15	66.34*	0.05	67.76	0.97	94786
Pyrite Conc.	16.8	3.29	41.22 2/	27.00	5.98	74.49	94788
Magn. Mids	4.0	0.78	22.34	1.51	0.77	0.99	94787
Pyrite Mids	15.0	2.93	24.02	2.43	3.11	5.97	94789
Tailing	357.0	69.85	7.26 1/	0.30	22.38	17.58	94790
Calculated	511.1	100.00	22.16	1.19	100.	100.00	

1/ Also analyses 7.03% HCl-soluble Fe.
2/ Also analyses 0.40% Cu, no gold, no silver.

* See Table 10 for complete analysis.

(Continued)

E. Diamond Drill Hole No. Ha-6

1. Composite (0-237 meters)

Product	Weight Percent	Analysis, % Fe Total	HCl-Sol	Fe, % Recovery Total Fe	HCl-Sol Fe	T.T.L. Lab. No.
Concentrate	26.51	68.82 1/		77.91	79.01	97273
Tailing	73.49	7.04 2/	6.56	22.09	20.99	97274
Calculated	100.00	23.42	23.07	100.00	100.00	

2/ Also analyses 0.25% S and 0.06% Cu.

F. Diamond Drill Hole No. Ha-8

1. Composite (0-140 meters)

Product	Weight Percent	Analysis, % Fe Total	HCl-Sol	Fe, % Recovery Total Fe	HCl-Sol Fe	Analytical Lab. No.
Concentrate	12.00	67.70 1/		46.57	50.30	97251
Tailing	88.00	10.59 3/	9.12	53.43	49.70	97252
Calculated	100.00	17.44	16.15	100.00	100.00	

3/ Also analyses 3.78% S and 0.22% Cu.

G. Diamond Drill Hole No. Ha-14

1. Composite (0-146 meters)

Product	Weight Percent	Analysis, % Fe Total	HCl-Sol	Fe, % Recovery Total Fe	HCl-Sol Fe	Analytical Lab. No.
Concentrate	21.25	68.25 1/		71.36	72.09	96949
Tailing	78.75	7.39 4/	7.13	28.64	27.91	96950
Calculated	100.00	20.32	20.12	100.00	100.00	

4/ Also analyses 2.74% S and No Cu.

H. Diamond Drill Hole No. Ha-15

1. Composite (0-199 meters)

Product	Weight Percent	Analysis, % Fe Total	HCl-Sol	Fe, % Recovery Total Fe	HCl-Sol Fe	Analytical Lab. No.
Concentrate	28.93	67.41 1/		73.80	74.57	96888
Tailing	71.07	9.74 5/	9.36	26.20	25.43	96889
Calculated	100.00	26.42	26.15	100.00	100.00	

1/ See Table 10 for complete analysis.
5/ Also analyses 0.59% S and 0.06% Cu.

TABLE 31 (cont'd.)

H. Diamond Drill Hole No. Ha-15 (continued)

2. Composite (199-315 meters)

Product	Weight Percent	Analysis, % Fe Total	HCl-Sol	Fe, % Recovery Total Fe	HCl-Sol Fe	Analytical Lab. No.
Concentrate	16.70	67.97 1/		61.78	62.75	96890
Tailing	83.30	8.43 2/	8.09	38.22	37.25	96891
Calculated	100.00	18.37	18.09	100.00	100.00	

2/ Also analyses 0.82% S and 0.18% Cu.

I. Diamond Drill Hole No. Ha-16

1. Composite (15-211 meters)

Product	Weight Percent	Analysis, % Fe Total	HCl-Sol	Fe, % Recovery Total	HCl-Sol	Analytical Lab No.
Concentrate	32.49	68.14 1/		82.43	84.27	99293
Tailing	67.51	6.99 3/	6.12	17.57	15.73	99294
Calculated	100.00	26.86	26.27	100.00	100.00	

3/ Also analyses 0.17% S and Trace Cu.

J. Diamond Drill Hole No. Ha-18

1. Composite (37-158 meters)

Product	Weight Percent	Analysis, % Fe Total	HCl-Sol	Fe, % Recovery Total	HCl-Sol	Analytical Lab. No.
Concentrate	25.84	68.70 1/		74.14	76.88	97322
Tailing	74.16	8.35 4/	7.20	25.86	23.12	97323
Calculated	100.00	23.94	23.09	100.00	100.00	

4// Also analyses 0.20% S and No Cu.

K. Diamond Drill Hole No. Ha-19

1. Composite (177-224 meters)

Product	Weight Percent	Analysis, % Fe Total	HCl-Sol	Fe, % Recovery Total	HCl-Sol	Analytical Lab. No.
Concentrate	20.94	67.12 1/		68.73	70.83	98641
Tailing	79.06	8.09 2/	7.32	31.27	29.17	98642
Calculated	100.00	20.45	19.84	100.00	100.00	

1/ Also analyses 0.48% S and Trace Cu.

L. Diamond Drill Hole No. Ha-20

1. Composite (0-176 meters)

Product	Weight Percent	Analysis, % Fe Total	HCl-Sol	Fe, % Recovery Total	HCl-Sol	Analytical Lab. No.
Concentrate	25.37	69.40 1/		75.15	78.53	98023
Tailing	74.63	7.80 3/	6.45	24.85	21.47	98024
Calculated	100.00	23.43	22.42	100.00	100.00	

3/ Also analyses 0.30% S and No Cu.

M. Diamond Drill Hole No. Ha-21

1. Composite (0-157.5 meters)

Product	Weight Percent	Analysis, % Fe Total	HCl-Sol	Fe, % Recovery Total	HCl-Sol	Analytical Lab. No.
Concentrate	13.32	68.40 1/		64.92	66.69	98681
Tailing	86.68	5.68 4/	5.25	35.08	33.31	98682
Calculated	100.00	14.03	13.66	100.00	100.00	

4/ Also analyses 0.27% S and Trace Cu.

N. Diamond Drill Hole No. Ha-23.

1. Composite (30-84 meters)

Product	Weight Percent	Analysis, % Fe Total	HCl-Sol	Fe, % Recovery Total	HCl-Sol	Analytical Lab. No.
Concentrate	19.07	68.40 1/		79.41	84.09	98666
Tailing	80.93	4.18 5/	3.05	20.59	15.91	98667
Calculated	100.00	16.43	15.51	100.00	100.00	

1/ See Table 10 for complete analysis.
5/ Also analyses 0.11% S and Trace Cu.

TABLE 31 (cont'd.)

O. Diamond Drill Hole No. Ha-101.

1. Composite (177-224 meters)

Product	Weight Percent	Analysis, % Fe Total	HCl-Sol	Fe, % Recovery Total	HCl-Sol	Analytical Lab. No.
Concentrate	21.37	70.70 1/		70.73	73.72	98025
Tailing	78.63	7.95 2/	6.85	29.27	26.28	98026
Calculated	100.00	21.36	20.49	100.00	100.00	

2/ Also analyses 0.16% S and No Cu.

P. Diamond Drill Hole No. Ha-103).

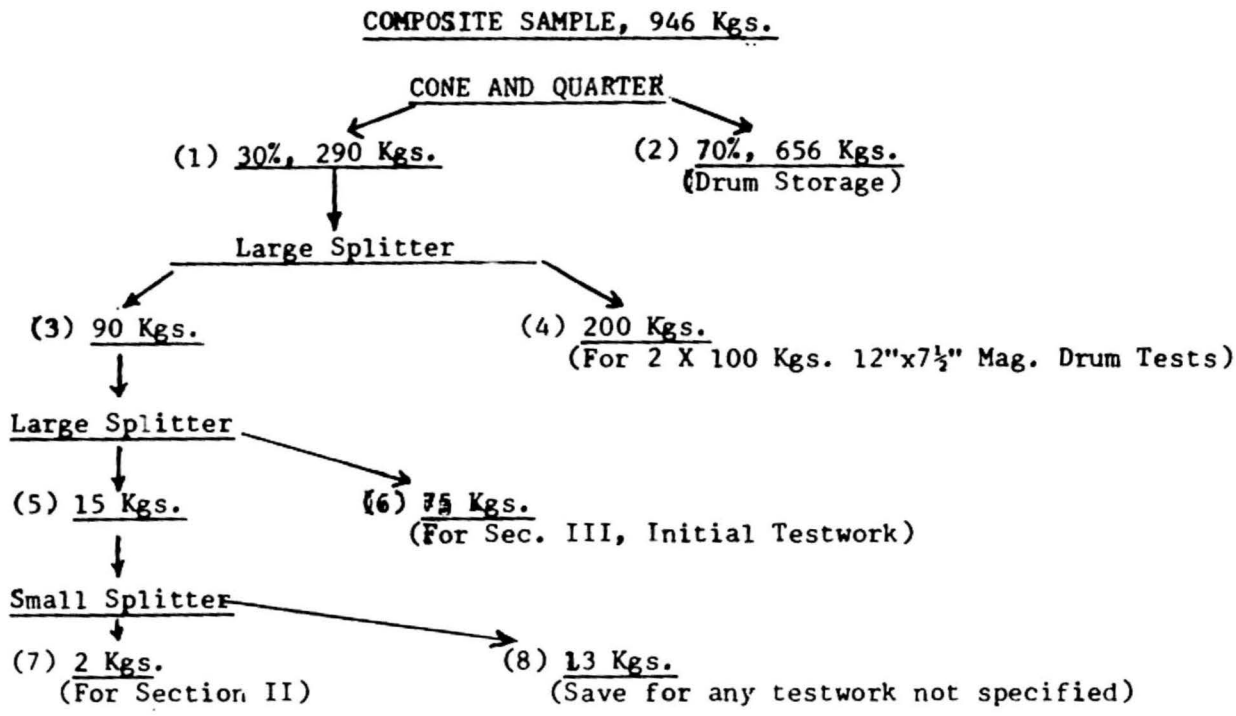
1. Composite (0-66 meters)

Product	Weight Percent	Analysis, % Fe Total	HCl-Sol	Fe, % Recovery Total	HCl-Sol	Analytical Lab. No.
Concentrate	15.07	68.52 1/		62.20	63.03	97253
Tailing	84.93	7.39 3/	7.13	37.80	36.97	97254
Calculated	100.00	16.60	16.38	100.00	100.00	

1/ See Table 10 for Complete analysis
3// Also analyses 2.73% S and No Cu.

Table 32.--Sample preparation and proposed flowsheet for treatment of composite core samples.

I. Preparation and Initial Splitting



II. Head Sampling

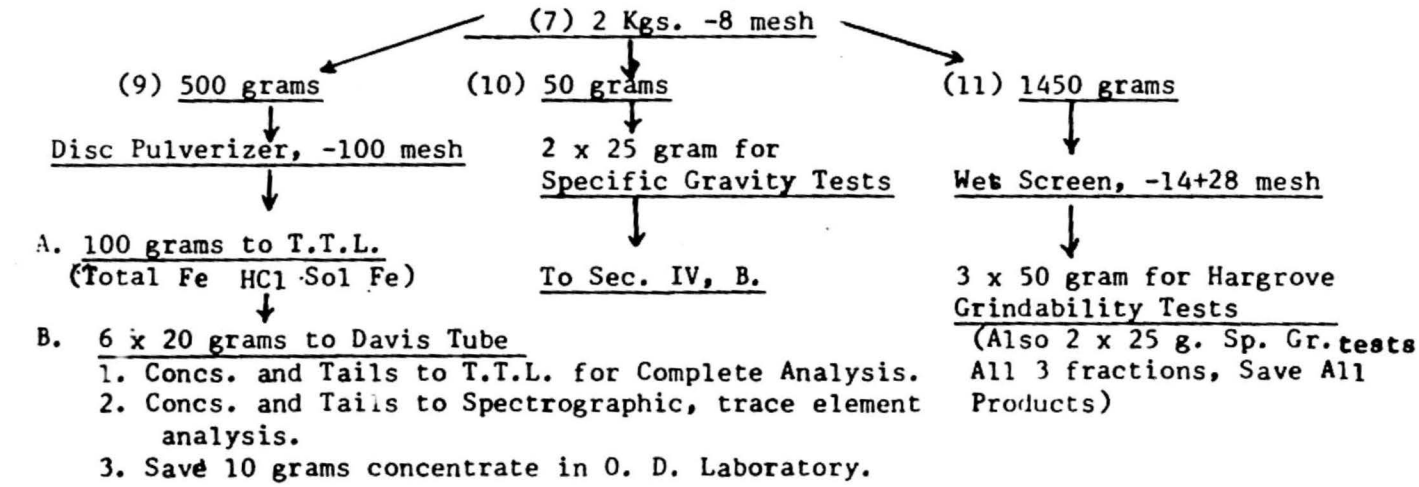


TABLE 32 (cont'd.)

III. Initial Testwork

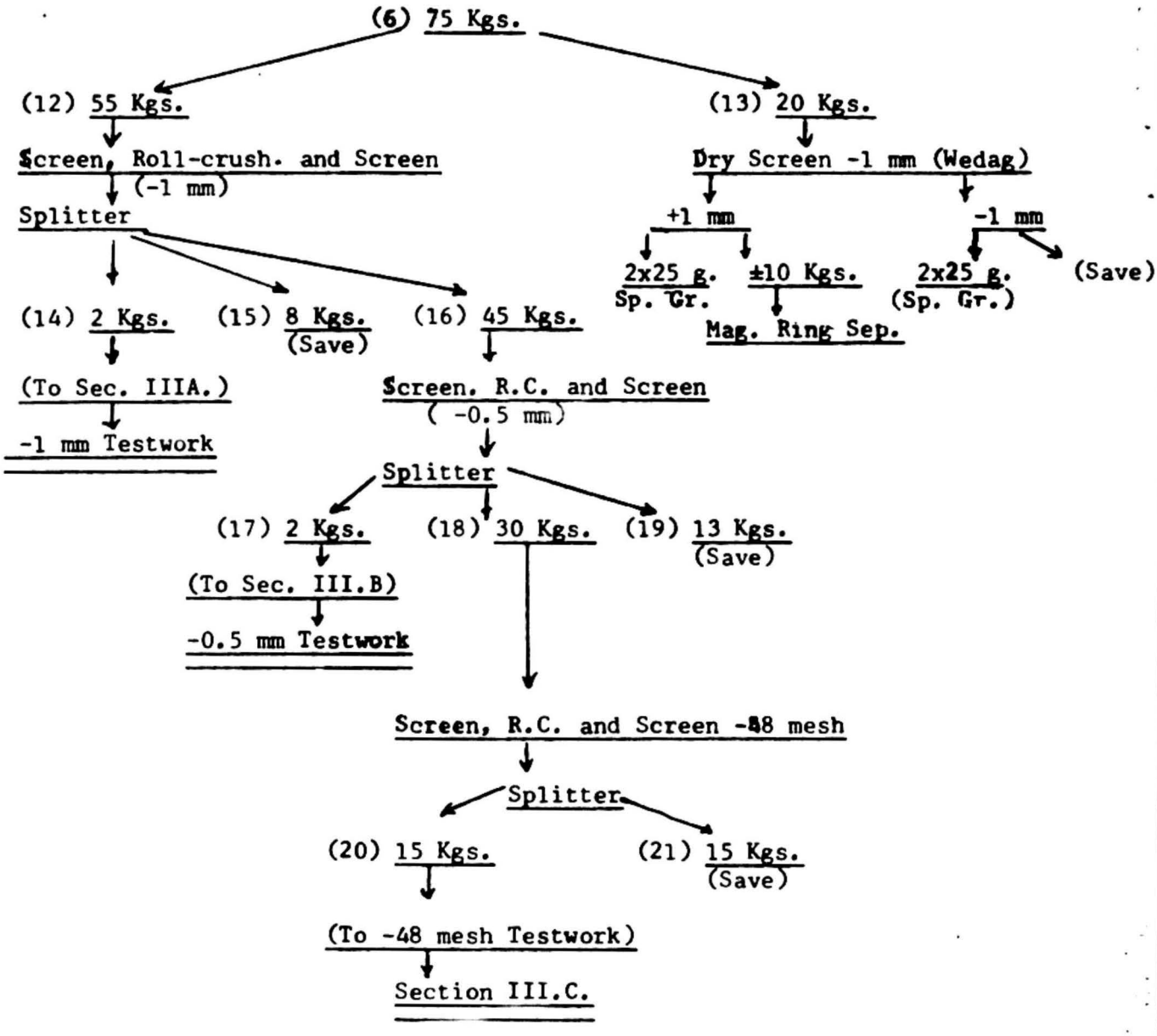
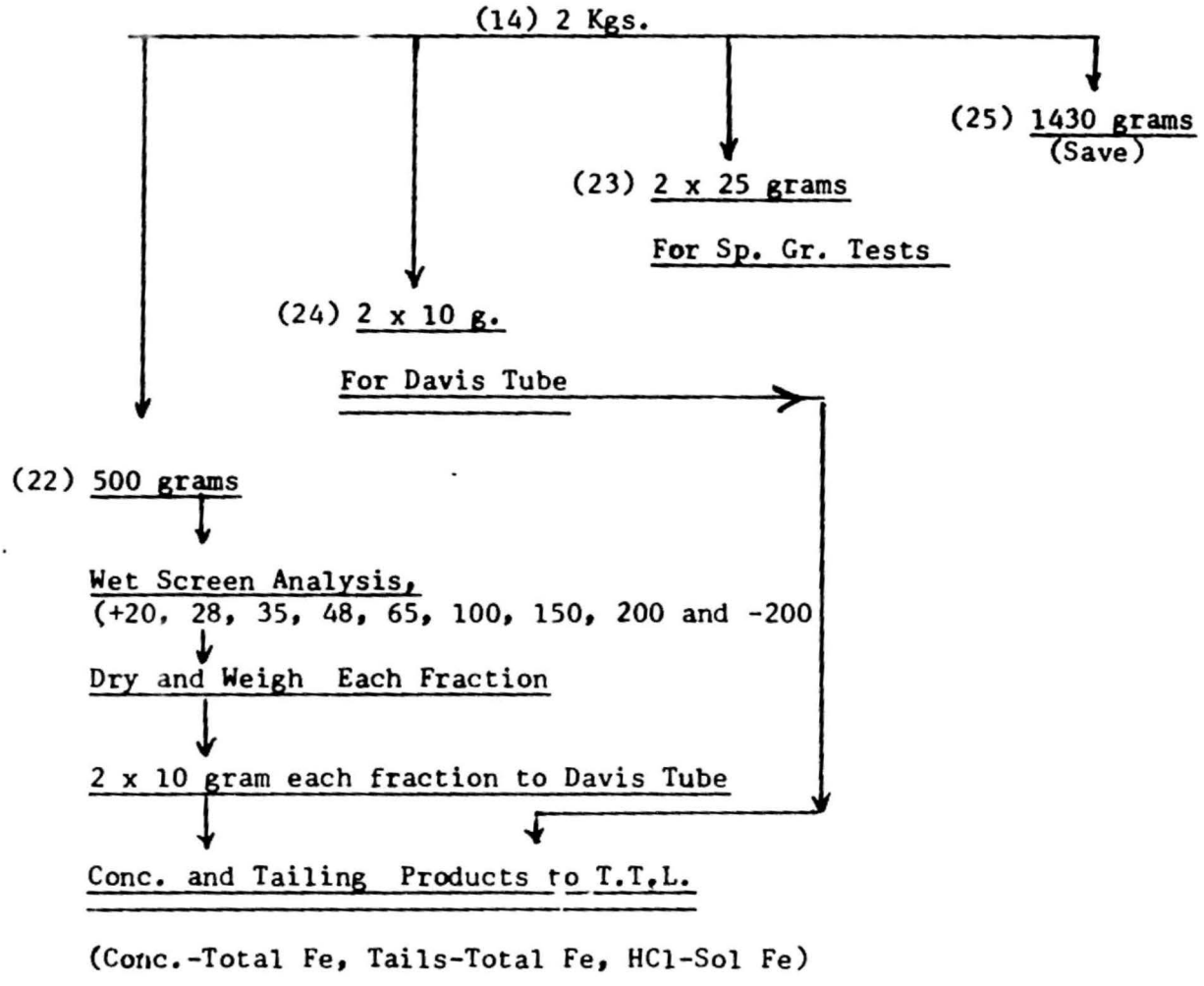


TABLE 32 (cont'd.)

III. Initial Testwork (Continued)

A. -1 mm Testwork

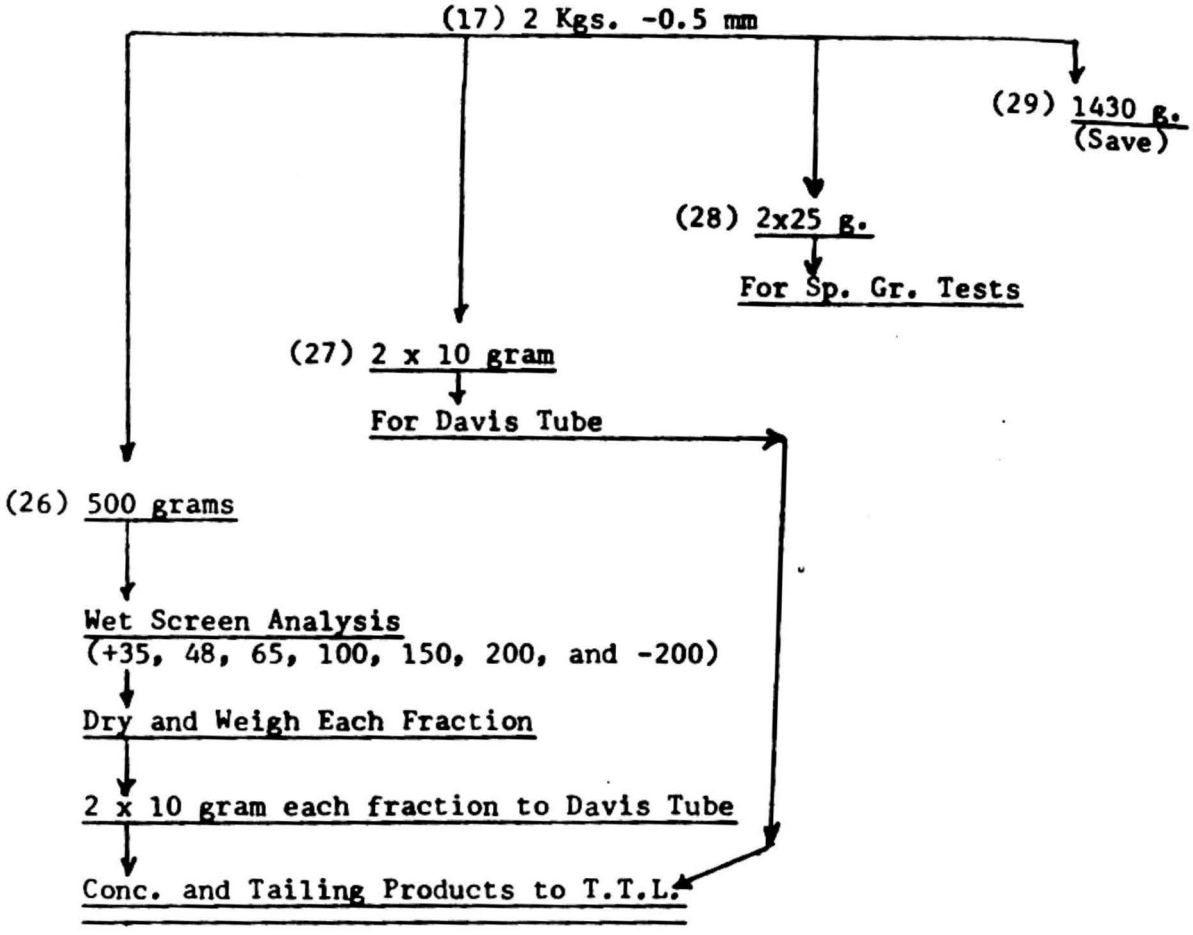


(Conc.-Total Fe, Tails-Total Fe, HCl-Sol Fe)

TABLE 32 (cont'd.)

III. Initial Testwork (Continued)

B. -0.5 mm Testwork

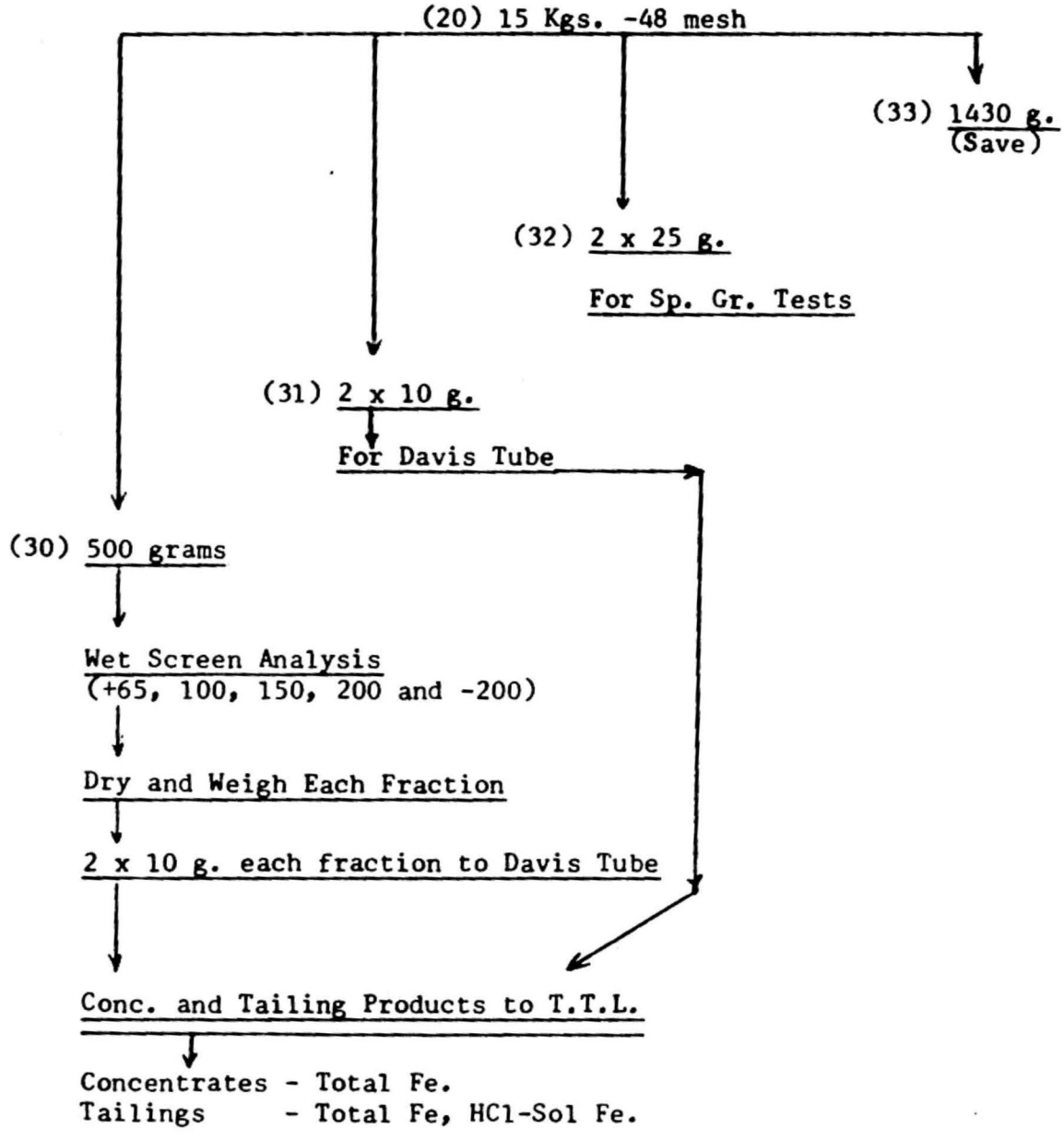


(Conc.-Total Fe, Tails-Total Fe, HCl-Sol Fe)

TABLE 32 (cont'd.)

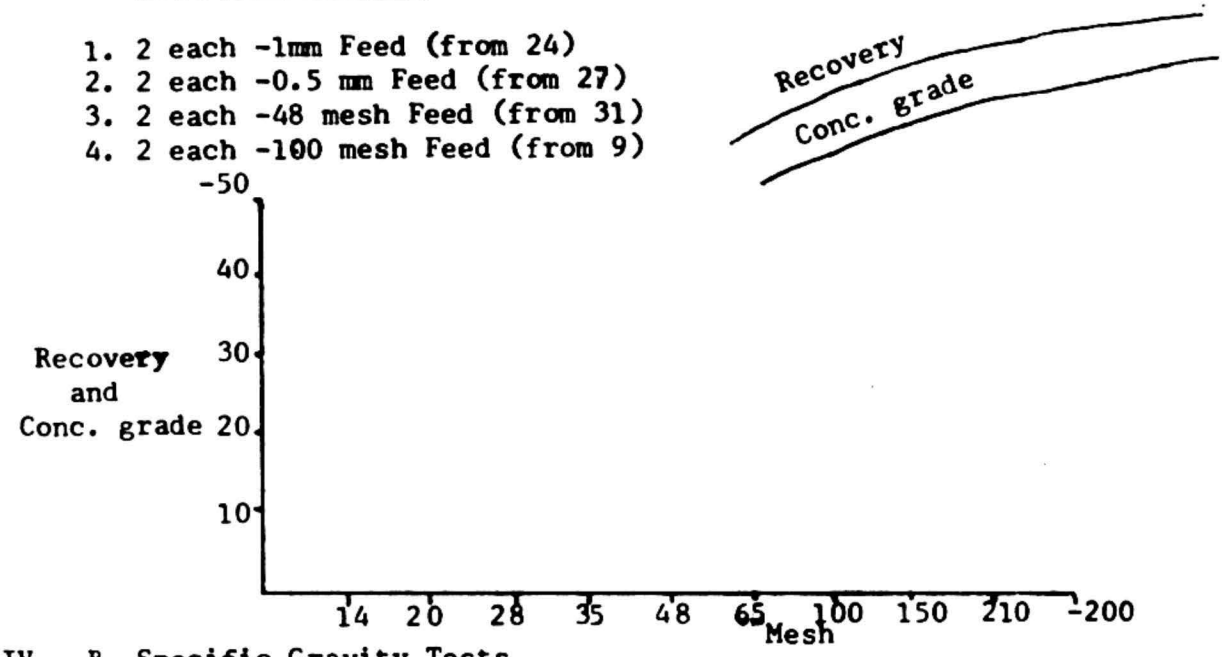
III. Initial Testwork (Continued)

C. -48 mesh Testwork



IV. A. Davis Tube Tests:

1. 2 each -1mm Feed (from 24)
2. 2 each -0.5 mm Feed (from 27)
3. 2 each -48 mesh Feed (from 31)
4. 2 each -100 mesh Feed (from 9)



IV. B. Specific Gravity Tests

1. 2 each -8 mesh Feed (from 10)
2. 2 each (-8 mesh + 1 mm) (from 13)
3. 2 each (- 1mm) (from 13)
4. 2 each (-1 mm) (from 23)
5. 2 each (-0.5 mm) (from 28)
6. 2 each (-48 mesh) (from 32)
7. 2 each (+14 mesh) (from 11)
8. 2 each (-14 mesh and 28 mesh) (from 11)
9. 2 each (-28 mesh) (from 11)

Table 33.-- Davis tube evaluation of composite core sample, minus 1-mm-crushed ore.

Mesh Fraction	Product	Weight Percent	Analysis, % Fe	Fe Units	Feed, Percent Fe	Davis Tube Recovery	Analytical Lab. No.
+20	Concentrate	52.40	29.83	1563.09	19.39	80.63	99355
	Tailing	47.60	7.89	375.56			99356
-20+28	Concentrate	47.54	30.46	1448.07	18.20	79.56	99357
	Tailing	52.46	7.09	371.94			99358
-28+35	Concentrate	45.36	33.83	1534.53	19.28	79.59	99359
	Tailing	54.64	7.20	393.41			99360
-35+48	Concentrate	43.42	42.05	1825.81	22.52	81.06	99361
	Tailing	56.58	7.54	426.61			99362
-48+65	Concentrate	42.34	50.28	2128.86	25.24	84.33	99363
	Tailing	57.66	6.86	395.55			99364
-65+100	Concentrate	42.79	57.60	2464.70	28.44	86.66	99365
	Tailing	57.21	6.63	379.30			99366
-100+150	Concentrate	45.38	65.71	2981.92	33.56	88.87	99367
	Tailing	54.62	6.84	373.60			99368
-150+200	Concentrate	49.68	66.40	3298.75	36.38	90.68	99369
	Tailing	50.32	6.74	339.16			99370
-200	Concentrate	26.93	68.57	1846.59	23.85	77.42	99371
	Tailing	73.07	7.37	538.53	____	____	99372
Calculated 1/							
	Concentrate	41.70	47.58		24.00	82.68	
	Tailing	58.30	7.13				
Analytical					23.36		99295

1/ Calculated weighted average, using wet screen analysis.

Table 34.--Wet screen analysis of composite core sample, minus 1-mm cursched ore.

Mesh Fraction	Grams	Weight Percent	Cumulative Weight %	Calculated % Fe 2/	Fe Units	Fe Distribution %
+20	12.8	2.61	2.61	19.39	50.61	2.11
-20+28	87.5	17.86	20.47	18.20	325.05	13.54
-28+35	74.0	15.11	35.58	19.28	291.32	12.14
-35+48	52.0	10.61	46.19	22.52	238.94	9.96
-48+65	44.5	9.09	55.28	25.24	229.43	9.56
-65+100	55.5	11.33	66.61	28.44	322.23	13.43
-100+150	21.5	4.39	71.00	33.56	147.33	6.14
-150+200	40.5	8.27	79.27	36.38	300.86	12.53
-200	101.5	20.73	100.00	23.85	494.41	20.59
Calculated	489.8	100.00		24.00	2400.18	100.00
Analytical				23.36		

2/ From Davis Tube Evaluation of Screen Fractions

Table 35.--Davis tube evaluation of composite core sample, minus 0.5-mm crushed ore.

Mesh Fraction	Product	Weight Percent	Analysis, % Fe	Fe Units	Feed, Percent Fe	Davis Tube Recovery	Analytical Lab. No.
+35	Concentrate	45.35	36.11	1637.23	19.74	82.94	99377
	Tailing	54.66	6.16	336.71			99378
-35+48	Concentrate	41.66	39.71	1654.32	19.97	82.83	99379
	Tailing	58.34	5.88	343.04			99380
-48+65	Concentrate	39.12	46.67	1825.73	21.82	83.68	99381
	Tailing	60.88	5.85	356.15			99382
-65+100	Concentrate	40.89	55.25	2220.50	25.81	86.03	99383
	Tailing	59.81	6.03	360.65			99384
-100+150	Concentrate	44.13	62.89	2775.34	31.02	89.48	99385
	Tailing	55.87	5.84	326.28			99386
-150+200	Concentrate	43.12	65.74	2834.71	31.70	89.41	99387
	Tailing	56.88	5.90	335.59			99388
-200	Concentrate	26.22	67.89	1780.08	22.69	78.44	99389
	Tailing	73.78	6.63	489.16	----	----	99390
Calculated 1/							
	Concentrate	37.44	54.16		24.14	85.25	
	Tailing	62.56	6.17				
		100.00					
Analytical					24.81 2/		99295
					23.36 3/		

1/ Calculated weight average, wet screen analysis
2/ Total iron analysis
3/ HCl-soluble iron analysis

Table 36.--Wet screen analysis of composite core sample, minus 0.5-mm crushed ore.

Mesh Fraction	Grams	Weight Percent	Cumulative Weight %	Calculated % Fe 1/	Fe Units	Fe Distribution %
+35	51.2	10.31	10.31	19.74	203.52	8.43
-35+48	65.6	13.21	23.52	19.97	263.80	10.93
-48+65	79.4	15.99	39.51	21.82	348.90	14.46
-65+100	37.4	7.53	47.04	25.81	194.35	8.05
-100+150	67.9	13.68	60.72	31.02	426.35	17.58
-150+200	48.2	9.71	70.43	31.70	307.81	12.75
-200	146.8	29.57	100.00	22.69	670.94	27.80
Calculated	496.5	100.00		24.14	2413.67	100.00
Analytical				24.81 2/ 23.36 3/		

1/ From Davis Tube Evaluation
2/ Total Iron Analysis
3/ Hcl-soluble Iron Analysis

Table 37.--Davis tube evaluation and wet screen analysis of composite core sample, minus 48-mesh crushed ore.

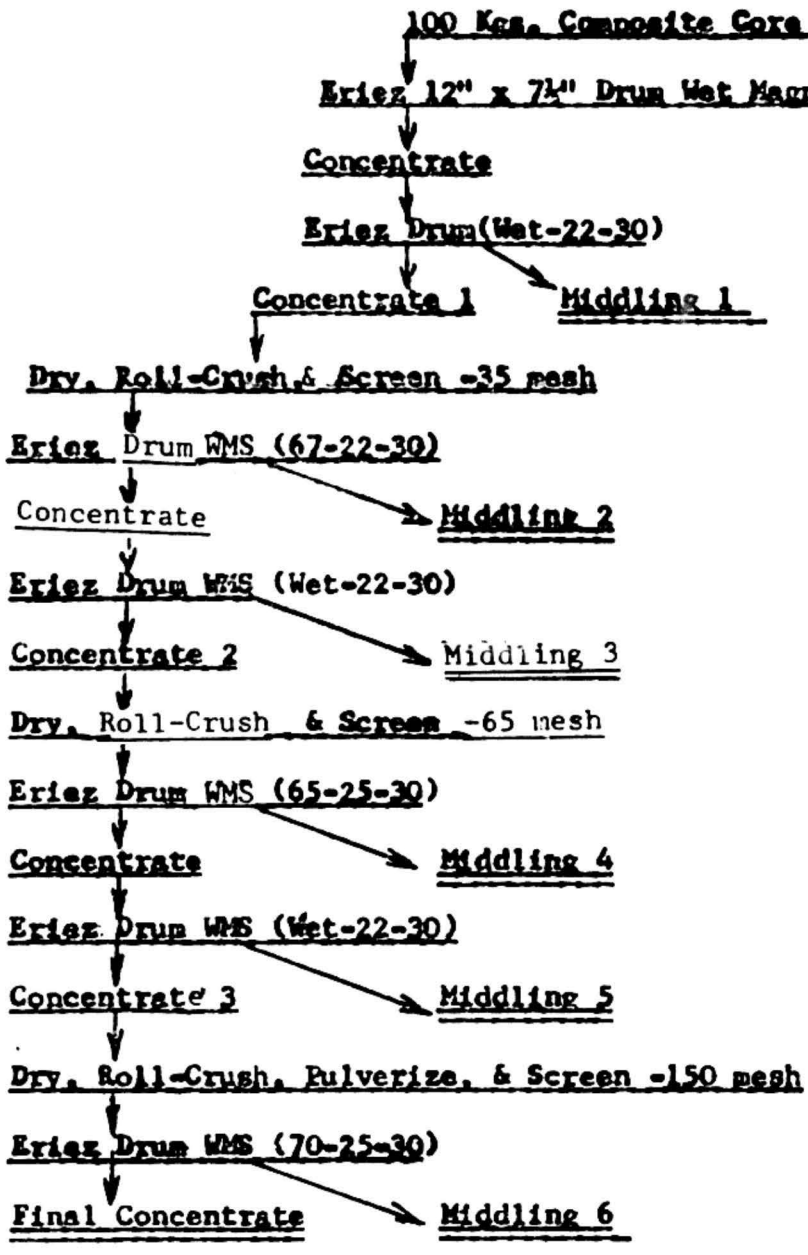
Mesh Fraction	Product	Weight Percent	Analysis, % Fe	Fe Units	Feed, Percent Fe	Davis Tube Recovery	Analytical Lab. No.
+65	Concentrate	34.24	46.57	1594.56	19.62	81.29	99391
	Tailing	65.76	5.58	366.94			99392
-65+100	Concentrate	36.08	55.89	2016.51	24.01	84.00	99393
	Tailing	63.92	6.01	384.16			99394
-100+150	Concentrate	37.81	61.69	2332.50	27.08	86.13	99395
	Tailing	62.19	6.04	375.63			99396
-150+200	Concentrate	38.80	65.15	2527.82	29.12	86.82	99397
	Tailing	61.20	6.27	383.72			99398
-200	Concentrate	24.47	68.54	1677.17	22.02	76.16	99399
	Tailing	75.53	6.95	524.93	----	----	99400
Calculated 1/							
	Concentrate	32.00	61.39		24.01	81.82	
	Tailing	68.00	6.42				
Analytical					24.81 2/		99295
					23.36 3/		99295

WET SCREEN ANALYSIS

Mesh Fraction	Grams	Weight Percent	Cumulative Weight %	Calculated % Fe 4/	Fe Units	Fe Distribution %
+65	41.0	8.25	8.25	19.62	161.87	6.74
-65+100	125.0	25.16	33.41	24.01	604.09	25.15
-100+150	60.5	12.18	45.59	27.08	329.83	13.73
-150+200	75.4	15.17	60.76	29.12	441.75	18.39
-200	195.0	39.24	100.00	22.02	864.06	35.99
Calculated	496.9	100.00		24.02	2401.60	100.00

1/ Calculated weighted average, wet screen analysis
2/ Total Iron analysis
3/ HCl-soluble iron analysis
4/ From Davis Tube evaluation

Table 38.--Flowsheet for semicontinuous Eriez single-drum wet magnetic separator.



1/ Parenthesis figures, resp.
1. Vibrating Feeder Rheostat Setting
2. Magnetic Drum Controller Rheostat Setting
3. Minutes of Test Operation

Table 39. Metallurgical balance in semicontinuous Eriez single-drum wet magnetic separator tests.

		First Test		Second Test		Third Test	
	Product	Weight Kgs.	Weight, Percent	Weight, Kgs.	Weight Percent	Weight, Kgs.	Weight, Percent
Step 1, minus 1-mm	Concentrate	36.80	38.16	38.30	35.34	42.45	38.01
	Middling 1	6.93	7.19	8.22	7.59	7.72	6.91
	Tailings	52.70	54.65	61.85	57.07	61.50	55.08
		96.43	100.00	108.37	100.00	111.67	100.00
Step 2, minus 35-mesh	Concentrate	28.90	82.03	30.03	82.26	31.80	77.48
	Middling 2	5.71	16.21	5.00	13.69	7.57	18.45
	Middling 3	0.62	1.76	1.48	4.05	1.67	4.07
		35.23	100.00	36.51	100.00	41.04	100.00
	Factor: 36.80/35.23 = 1.0446			38.30/36.51 = 1.049		42.45/41.04 = 1.0344	
Step 3, minus 65-mesh	Concentrate	24.24	88.95	25.27	88.64	24.60	86.43
	Middling 4	2.16	7.93	2.62	9.19	3.03	10.65
	Middling 5	0.85	3.12	0.62	2.17	0.83	2.92
		27.25	100.00	28.51	100.00	28.46	100.00
	Factor: 28.90/27.25 = 1.0606			30.03/28.51 = 1.0533		31.80/28.46 = 1.117	
[illegible]	Concentrate	22.40	95.20	21.90	89.61	21.50	91.69
[illegible]	Middling 6	1.13	4.80	2.54	10.39	1.95	8.31
[illegible]		23.53	100.00	24.44	100.00	23.45	100.00
	Factor: 24.24/23.53 = 1.0302			25.27/24.44 = 1.0340		24.60/23.45 = 1.049	

First Test,
Recapitulated Metallurgical Balance

Product	Weight, Kgs.	Weight Percent	Davis Tube, % Recov. Magnetite	Magnetite Units	Distr. Percent
Concentrate: 36.80x.8203x.8895x.9520	25.57	26.52	100.00	2652.0	89.00
Middling 1	6.93	7.19	15.79	113.5	3.80
Middling 2: 5.71 x 1.0446	5.96	6.18	10.87	67.2	2.26
Middling 3: 0.62 x 1.0446	0.65	0.67	30.99	20.8	0.70
Middling 4: 2.16 x 1.0446 x 1.0606	2.39	2.48	8.04	19.9	0.67
Middling 5: 0.85 x 1.0446 X 1.0606	0.94	0.97	42.94	41.7	1.40
Middling 6: 1.13x1.0446x1.0606x1.0302	1.29	1.34	16.48	22.1	0.74
Tailing	52.70	54.65	0.78	42.6	1.43
Calculated	96.43	100.00	29.80	2979.8	100.00

TABLE 39 (cont'd.)
HASAN ÇELEBI PROJECT

Metallurgical Balance
Semi-Continuous Eriez Single-Drum Wet Magnetic Separator Testwork

RECAPITULATED METALLURGICAL BALANCE
Combined First and Second Tests

Product	Weight Kgs.	Weight Percent	Davis Tube,% Recov.Magnetite	Magnetite Distr. Units	Magnetite Distr. Percent
1st Conc:36.80x.8203x.8895x.952=25.57 2nd Conc:38.30x.8226x.8864x.8961=25.02	50.59	27.11	100.00	2711.0	92.46
2nd Middling 1	8.22	4.40	10.91	48.0	1.64
2nd Middling 2: 5.00 x 1.0490	5.25	2.81	9.04	25.4	0.87
2nd Middling 3: 1.48 x 1.0490	1.55	0.83	41.40	34.4	1.17
2nd Middling 4: 2.62 x 1.0533 x 1.0490	2.89	1.55	11.90	18.4	0.63
2nd Middling 5: 0.62 x 1.0533 x 1.0490	0.69	0.37	41.23	15.3	0.52
2nd Mid 6:2.54x1.0340x1.0533x1.0490	2.90	1.55	22.69	35.2	1.20
Tails: 1st 52.70 x 0.78 = 41.11 2nd 61.85 x 0.66 = 40.82 114.55 0.72 81.93	114.55	61.38	0.72	44.2	1.51
Calculated	186.64	100.00	29.32	2931.9	100.00

RECAPITULATED METALLURGICAL BALANCE
Combined First, Second, & Third Tests

Product	Weight, Kgs.	Weight Percent	Davis Tube, % Recov.Magnetite	Magnetite Distr. Units	Magnetite Distr. Percent
1st Conc:36.80x.8203x.8895x.952=25.57 2nd Conc:38.30x.8226x.8864x.8961=25.02 3rd Conc:42.45x.7748x.8643x.9169=26.06	76.65	27.69	100.00	2769.0	93.54
3rd Middling 1	7.72	2.79	13.50	37.7	1.27
3rd Middling 2: 7.57 x 1.0344	7.83	2.83	7.14	20.2	0.68
3rd Middling 3: 1.67 x 1.0344	1.73	0.62	34.37	21.3	0.72
3rd Middling 4: 3.03 x 1.0344 x 1.117	3.50	1.26	12.05	15.2	0.51
3rd Middling 5: 0.83 x 1.0344 x 1.117	0.96	0.35	39.78	13.9	0.47
3rd Mid 6: 1.95 x 1.0344 x 1.117 x 1.049	2.36	0.85	35.13	29.9	1.01
Tails: 1st 52.70 x 0.78 = 41.11 2nd 61.85 x 0.66 = 40.82 3rd 61.50 x 1.07 = 65.81 176.05 0.84 147.74	176.05	63.61	0.84	53.4	1.80
Calculated	276.80	100.00	29.61	2960.6	100.00