

Information Circular 8691

Updated Cost Evaluation of a Metal and Mineral Recovery Process for Treating Municipal Incinerator Residues

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UPDATED COST EVALUATION OF A METAL AND MINERAL RECOVERY PROCESS FOR TREATING MUNICIPAL INCINERATOR RESIDUES

by

John J. Henn¹

ABSTRACT

An economic evaluation was made of the Bureau of Mines incinerator residue separation process to update the one published in 1971 to a mid-1974 cost basis. This evaluation includes a modification of the glass-recovery operation used in the original plant design as well as a unit to bale the ferrous scrap product before shipment. Products from the plant are ferrous metal, aluminum and copper-zinc scrap, and a mixed-color glass cullet.

The estimated capital and operating costs for four plant sizes are as follows:

Separation plant size (dry feed basis)	Fixed capital cost (mid-1974 basis)	Operating cost per ton of incinerator residue (dry basis)
250 tpd, 8-hour day.....	\$2,337,500	\$7.41
400 tpd, 8-hour day.....	2,792,500	5.40
670 tpd, 24-hour day.....	2,280,700	4.71
1,000 tpd, 24-hour day....	2,630,900	3.46

The operating costs do not include credits for recovered metals and glass.

INTRODUCTION

Every day large quantities of metal and mineral values are discarded in the form of municipal incinerator residues. These residues contain iron, non-ferrous metals, and glass that can be recovered and recycled. The Bureau of Mines, in its research on methods of handling solid waste, first established methods for sampling and characterizing incinerator residues from urban refuse (3).² Later, a pilot plant was designed to process 1,000 pounds per hour of municipal incinerator residues from which ferrous metals, nonferrous metals, and two grades of glass product were obtained (5). An economic evaluation of the initial process design was published in 1971 (2).

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²Underlined numbers in parentheses refer to items in the list of references preceding the appendix.

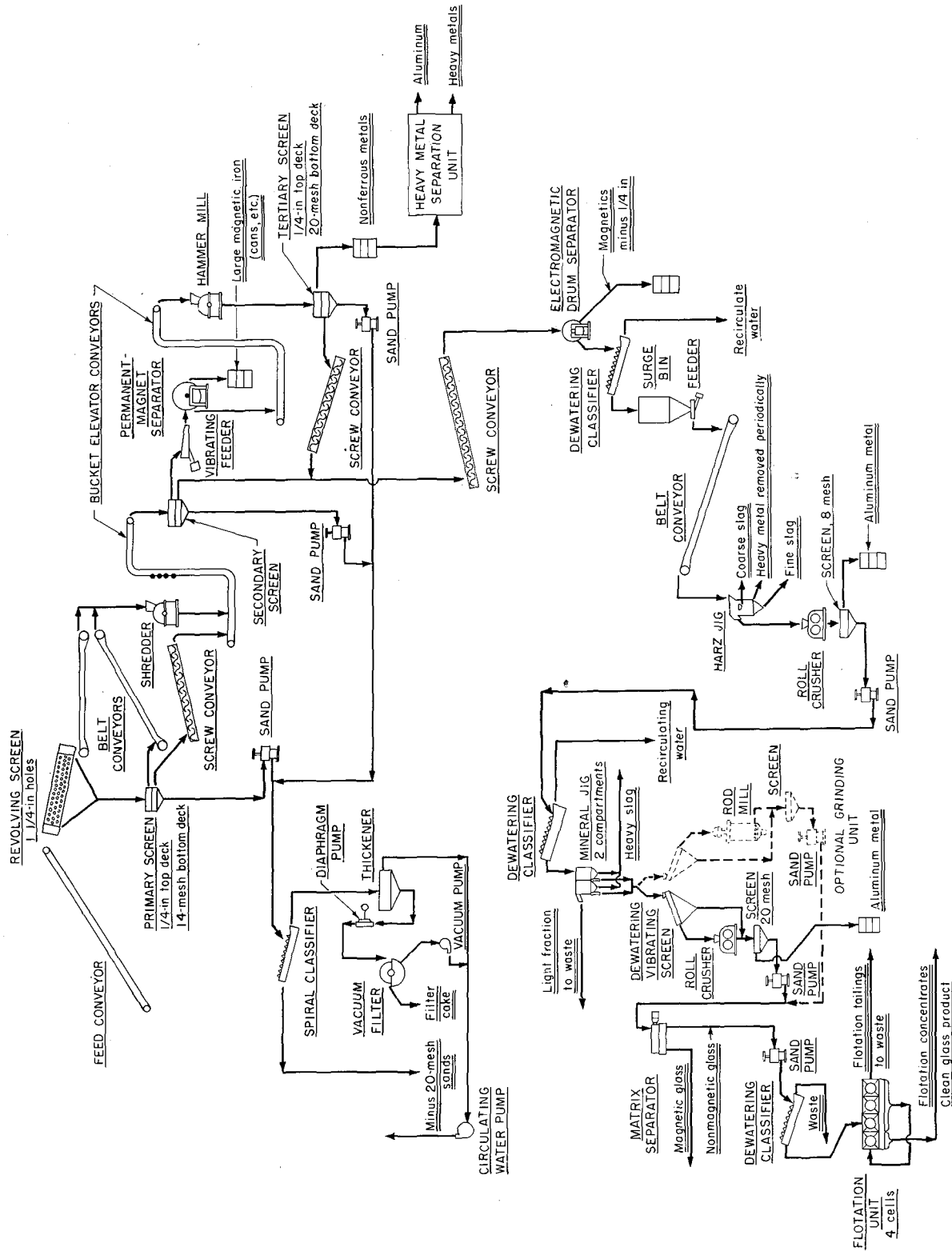


FIGURE 1. - Pilot plant flow diagram.

Since publication of the original economic evaluation of the incinerator residue process, the process has been modified to obtain an improved grade of glass product. The process modification consists primarily of substituting roll crushing for rod milling and adding two separate jigging operations and flotation. In addition, the two-stage high-intensity magnetic separation step has been reduced to a single-stage operation. The single glass product from the present plant is of a higher quality than either of the glass fractions recovered in the original process design. The economic evaluation presented in this report is for the current incinerator residue plant design and is based on mid-1974 costs.

Data used in publication of the earlier report on process economics were obtained during pilot plant operations utilizing incinerator residues primarily from the metropolitan Washington, D.C., area. The present evaluation is based on data from many more days of operations on incinerator residues from other cities in addition to Washington, D.C., such as New Orleans, La.; Chicago, Ill.; Dayton, Ohio; Stamford, Conn.; North Hempstead and Roslyn, N.Y.; and Lowell and Newton, Mass. A schematic representation of the pilot plant is shown in figure 1.

DESCRIPTION OF PROCESS

The separation process is designed to recover ferrous metals, nonferrous metals, and glass from incinerator residues. It is assumed that the incinerator burns urban refuse that would normally be collected from a city or town and not industrial refuse from a particular plant. The plant separates the residue into various metal and mineral products, and greatly reduces the volume of waste sent to landfills.

It is assumed that incinerator residues fed to the plant are properly incinerated; that is, they contain a minimum of unburned paper, rags, and other combustibles, and that the conventional incinerator practice of residue quenching is followed. The wet residue is assumed to be fed to the separation plant directly from the incinerator; however, provision is made for receiving residue by truck so that one large separation plant can serve a number of incinerators. The entire separation process is operated wet, using water sprays to wash materials in the trommel and on screens and magnetic separators. The water used in washing is recovered and recycled so that no pollution will occur from discarding it.

A process flow diagram is shown in figure 2, and the incinerator residue analysis is shown in table 1. Table 2 shows the estimated quantities of the various fractions recovered for each of the four plant sizes. A material balance for the 1,000-ton-per-day plant (dry residue basis) is shown in figures D-1 through D-4 in appendix D. Flow rates for the other plants may be calculated by using factors from this balance, such as 0.25 for the 250-ton-per-day plant.

TABLE 1. - Analysis of the incinerator residue,
dry basis

<u>Residue</u>	<u>Percent</u>
Wire and large iron.....	3.0
Tin cans.....	13.6
Small ferrous metal.....	13.9
Nonferrous metal.....	2.8
Glass, slag, and ceramics.....	53.1
Ash, grit, and dirt.....	13.6
Total.....	100.0

TABLE 2. - Quantity of the various fractions recovered, tons per day

	<u>Plant capacity</u>			
	<u>250 tpd</u>	<u>400 tpd</u>	<u>670 tpd</u>	<u>1,000 tpd</u>
Plus 4-mesh ferrous metal.....	41	66	111	166
Minus 4- plus 20-mesh ferrous metal.....	35	56	93	139
Aluminum.....	4	6	11	16
Copper-zinc.....	3	5	8	12
Glass.....	59	94	158	235
Waste solids.....	108	173	289	432

Primary Separation and Water Recovery Section

Wet incinerator residue is conveyed to a trommel to remove the plus 1-1/4-inch material for shredding in a hammer mill shredder. Large pieces of metal that may damage the shredder are removed by hand from the conveyor following the trommel and are conveyed to the shipping area.

Minus 1-1/4-inch material from the trommel is fed to a double-deck screen, referred to as the primary screen, from which three size fractions are obtained. The largest size fraction, plus 1/4 inch, is conveyed to the shredder where it is combined with the plus 1-1/4 inch oversize from the trommel. The minus 1/4-inch plus 14-mesh middle fraction from the primary screen is conveyed to an electromagnetic drum separator. The undersize, containing the minus 14-mesh solids and the screen wash water, is pumped to a spiral classifier for dewatering.

The material leaving the shredder feeds a second double-deck screen. Oversize, plus 1/4 inch, from this secondary screen is conveyed to a permanent-magnet drum separator. The middle fraction, minus 1/4-inch plus 20-mesh material from the secondary screen is conveyed to the same electromagnetic drum separator as the middle fraction from the primary screen. The wash water and the minus 20-mesh solids are pumped to the dewatering spiral classifier.

The waste solids from the primary and secondary screens as well as from other operations in the plant are dewatered by treatment in a spiral classifier, followed by thickening and filtration. The waste material is composed

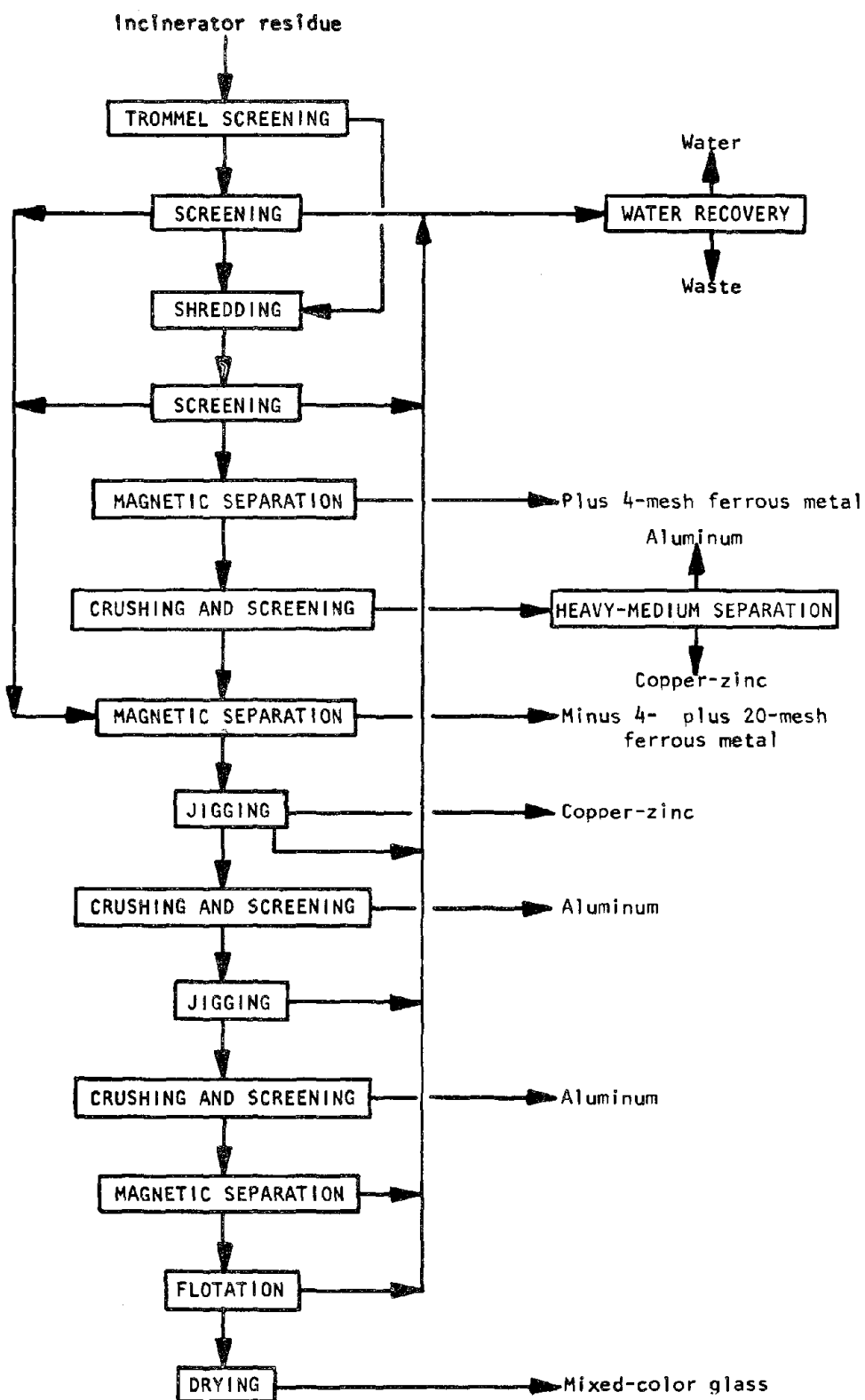


FIGURE 2. - Incinerator residue separation process.

principally of fine ash, carbon, dirt, fine glass, ceramics, other nonmetals, and metal oxides. A flocculant is added to the overflow from the dewatering spiral classifier as it is pumped to a thickener. With the flocculant, the solids entering the thickener settle at a rate of 11 feet per hour and, after removal from the thickener, are dewatered on a rotary vacuum filter. The solids removed from the dewatering spiral classifier and the filter are trucked to a landfill site. The water recovered from the thickener and filter is reused in the plant.

Metal Recovery Section

In this section, two ferrous metal fractions and one nonferrous metal fraction are separated from the incinerator residue. One of the ferrous fractions is a plus 1/4-inch material consisting primarily of tin cans; the other is a minus 1/4-inch plus 20-mesh material composed of mill scale, small screws, nuts, bolts, pins, and the like. The nonferrous fraction is a plus 1/4-inch material composed primarily of aluminum, copper, and zinc.

To recover the plus 1/4-inch ferrous metal and the nonferrous metal, the oversize from the secondary screen is fed to a permanent-magnet drum separator. The magnetic concentrate from the separator is the plus 1/4-inch ferrous metal product that is collected and conveyed to a baling unit where it is compressed into bales that are then loaded into a railroad car. The nonmagnetic tailings from the magnetic separator are fed to a hammer mill for further size reduction. The material leaving the hammer mill is fed to a tertiary, double-deck screen. Plus 1/4-inch material from the screen consists of nonferrous metal that is conveyed to the nonferrous metals upgrading section. The minus 1/4-inch plus 20-mesh middle fraction is conveyed to an electromagnetic drum separator; the minus 20-mesh fines are conveyed to the dewatering spiral classifier in the primary separation and water recovery section.

The second ferrous metal fraction is recovered, using an electromagnetic drum separator, from the minus 1/4-inch plus 20-mesh middle fractions from the primary, secondary, and tertiary screens. The ferrous product, magnetic concentrate recovered from the separator, is conveyed to the baling unit and baled with the plus 1/4-inch ferrous metal. The nonmagnetic tailings from the electromagnet drum separator is partially dewatered with a spiral classifier before it is sent to the glass recovery section.

Glass Recovery Section

The solids leaving the spiral classifier in the metal recovery section are fed to Harz jigs where most of the heavy slag is removed from the glass. Fine slag passes into the hutch and coarse slag is discharged from the cup. The two slag products are combined and sent to the primary separation and water recovery section. Heavy nonferrous metal accumulates in the jig bed and is removed periodically as a copper-zinc product. Glass and aluminum with lighter contaminants overflow the end of the jig.

The overflow material is crushed in a roll crusher and passed through an 8-mesh screen to remove aluminum. The minus 8-mesh material is fed to a

spiral classifier to remove unwanted fines. The overflow from the spiral classifier is sent to the thickener in the primary separation and water recovery section, and the solids are fed to modified mineral jigs.

In the mineral jigs, additional fine slag collects in the hutch. Glass, aluminum, and ceramics discharge from the cup and light contaminants overflow the end of the jig. The glass recovered from the mineral jigs goes to another stage of roll crushing followed by screening on 20 mesh to reclaim a small amount of fine aluminum.

The minus 20-mesh material is fed to a high-intensity, matrix-type magnetic separator to remove any magnetic material that was liberated during crushing, including feebly magnetic particles. The nonmagnetics are pumped to a spiral classifier and deslimed to approximately 150 mesh. The slime overflow is sent to the thickener in the primary separation and water recovery section. The solids leaving the spiral classifier are fed to flotation cells for final cleanup. The tailings from flotation consist of ceramics, bricks, stones, etc., and are sent to the dewatering spiral classifier in the primary separation and water recovery section.

After dewatering, the flotation concentrate is fed to a rotary dryer to remove the remaining water and yield a high-grade mixed-color glass product.

Nonferrous Metals Upgrading Section

Nonferrous metals recovered in the metal recovery section are fed to a heavy-medium separator containing a ferrosilicon-water slurry having a specific gravity of 2.95. In this separator, the light aluminum fraction of the nonferrous metals floats while the heavier copper-zinc fraction sinks. Two separate streams exit from the separator--one containing the sink fraction and the other, the float fraction.

The sink and float fractions go to separate screens where most of the fine ferrosilicon material is removed from the larger nonferrous metal and collected in a tank. The nonferrous metals are then transferred to screens equipped with water sprays to wash the remaining ferrosilicon from the metals. The float product, containing about 96 percent aluminum, and the sink product, containing about 50 percent copper and 40 percent zinc, are each conveyed to the product shipping area.

The diluted ferrosilicon recovered from the washing screens is fed to a magnetic separator to eliminate nonmagnetic fines that might build up in the operation. From the magnetic separator, the ferrosilicon is sent to a densifier that dewateres the ferrosilicon to a point where it can be reused in the heavy-medium separator. The dewatered ferrosilicon is then mixed with the undiluted ferrosilicon removed from the nonferrous metals before washing, and is recycled to the heavy-medium separator vessel.

PROCESS ECONOMICS

The costs shown in this report are for the present plant design. All costs are given on a mid-1974 basis.

Four plant sizes are considered in this evaluation. Two plants, operating on a 24-hour-per-day, 5-day-per-week basis, have capacities of 1,280 and 858 tons per day of wet incinerator residues, equivalent to 1,000 and 670 tons per day on a dry basis, respectively. The other two plants operate 8 hours per day, 5 days per week, and treat 512 and 320 tons per day of wet incinerator residues, equivalent to 400 and 250 tons per day on a dry basis, respectively. The nonferrous metals upgrading section is operated 8 hours per day, 5 days per week in all four plants. For this evaluation, it is considered that the separation plant is operating in conjunction with an incinerator and that the same maintenance crew will be used for both the incinerator and the separation plant.

Capital Costs

The capital cost estimates are of the general type called "study estimates" by Weaver and Bauman (6) and are expected to be within 30 percent of the actual cost. The fixed capital costs on a mid-1974 basis for the four plants are shown in table 3.

TABLE 3. - Estimated capital costs¹

	Plant capacity, tons per day			
	250	400	670	1,000
Fixed capital:				
Primary separation and water recovery section.....	\$681,200	\$820,200	\$642,500	\$756,900
Metal recovery section.....	414,900	434,200	415,400	429,000
Glass recovery section.....	822,400	1,056,400	803,900	975,300
Nonferrous metals upgrading section	96,600	96,600	104,300	106,800
Subtotal.....	2,015,100	2,407,400	1,966,100	2,268,000
Plant facilities, 10 percent of subtotal.....	201,500	240,700	196,600	226,800
Plant utilities, 6 percent of subtotal.....	120,900	144,400	118,000	136,100
Fixed capital cost.....	2,337,500	2,792,500	2,280,700	2,630,900
Working capital:				
Raw material and supplies.....	2,100	2,800	2,900	3,800
Product and in-process inventory...	40,100	46,700	68,400	74,700
Accounts receivable.....	40,100	46,700	68,400	74,700
Available cash.....	24,900	28,800	50,000	54,300
Working capital cost.....	107,200	125,000	189,700	207,500
Total capital cost.....	2,444,700	2,917,500	2,470,400	2,838,400

¹Basis: M and S index = 386.1.

Cost-capacity data of the type shown by Bauman (1) and Mills (4) are used as the principal sources of equipment costs. The costs of the major items of equipment and their accessories are tabulated for each section in the appendixes at the end of this report. Factors for piping, instruments, and the like are assigned to each section, depending on whether fluids, a combination of fluids and solids, or solids are handled. These factors are shown for each section in the appendixes. A factor of 10 percent, referred to as miscellaneous, is added to each section to cover minor equipment and construction costs that are not shown with the equipment listed for the section.

For each section, the "field indirect," which covers field supervision, inspection, temporary construction, equipment rental, and payroll overhead, is estimated at 10 percent of the direct cost. Both the cost of engineering and that of administration and overhead are estimated at 5 percent of the construction cost. A contingency of 10 percent and a contractor's fee of 5 percent are included in the section cost.

The costs of plant facilities are estimated as 10 percent of the total process section costs. Plant utility costs are estimated at only 6 percent of the process section costs because it is assumed that the plant is located at an existing incinerator and major utilities would be available. The costs for plant facilities and utilities include the same field indirect, engineering, administration and overhead, contingency, and contractor's fee as are included in the section costs. Included under plant facilities are the costs of laboratories, shops, roads, and fences. The costs of water and power distribution systems are included under plant utilities. Because the plant location has not been selected, the cost of land is not included. Also, startup costs are not included in the estimates.

Working capital is defined as "the funds in addition to fixed capital, land investment, and startup costs that must be provided to operate a plant." Working capital is estimated from the following items: (1) raw materials and supplies inventory (cost of raw materials and operating supplies for 1 month), (2) product and in-process inventory (total operating cost for 1 month), (3) accounts receivable (total operating cost for 1 month), and (4) available cash (direct expenses for 1 month). The estimated working capital for each plant is included in table 3.

Operating Costs

The estimated operating costs, divided into direct, indirect, and fixed costs, are based on a 260-day operating year. Included in the direct operating costs are raw materials, utilities, labor, maintenance, payroll overhead, and operating supplies.

Direct labor cost is estimated on the basis of manning the plant with three men for each position that operates 24 hours per day, 5 days per week, and with one man for each position that operates 8 hours per day, 5 days per week. This process requires both skilled and unskilled workers, so a wage rate of \$5 per hour was used in estimating the operating cost. The wage is an average of wages for laborers and for several skilled operators. The

direct labor assignments are shown by section in the appendixes. The cost of supervision is estimated as 25 percent of the labor cost.

Electricity, water, and natural gas are purchased utilities. Plant maintenance is separately estimated for each piece of equipment and for the buildings, electrical system, piping, plant utility distribution system, plant facilities, etc. Operating supplies are 20 percent of the cost of plant maintenance. Payroll overhead includes vacations, social security, and fringe benefits.

Because this is a municipal government operation and not a corporation with a large overhead, indirect costs are estimated at 20 percent of the direct labor and maintenance costs. The indirect costs include the expenses of control laboratories, accounting, plant protection and safety, plant administration, and marketing.

Fixed costs include the cost of insurance and depreciation. The annual cost of insurance is estimated as 1 percent of the plant cost. Depreciation is based on a straight-line, 20-year period. No local taxes are included in the fixed costs because it is assumed that the plants will be operated by a city or State government.

Operating costs of all four plants are shown in dollars per ton of dry incinerator residue fed to the plant. These costs represent the expense of separating the incinerator residue into ferrous metal, aluminum scrap, copper-zinc scrap, and a glass fraction. The estimated costs do not include the costs of incineration and trucking to the plant or the costs of additional upgrading and waste-solid disposal. The estimated operating costs, itemized in tables A-8, B-8, C-8, and D-8, are summarized in table 4.

TABLE 4. - Summary of estimated operating costs

Capacity, tons per day incinerator residue (dry basis)	Operating time, hours per day	Estimated operating cost per ton of dry incinerator residue
250.....	8	\$7.41
400.....	8	5.40
670.....	24	4.71
1,000.....	24	3.46

Products and Profitability

The products recovered from the incinerator residues are ferrous metal scrap, aluminum scrap, a mixed copper-zinc scrap, and a mixed-color glass cullet. For this evaluation, it was assumed that all the ferrous metals recovered in the plant could be baled together. However, it is quite likely that only the large ferrous metal fraction can be baled causing the small ferrous metal fraction to be shipped as a loose material. Should this be the case, the effect of collecting two separate ferrous metal products, one baled and the other loose, will have little effect on the estimated operating costs. The two nonferrous metal products will be shipped loose as will the glass

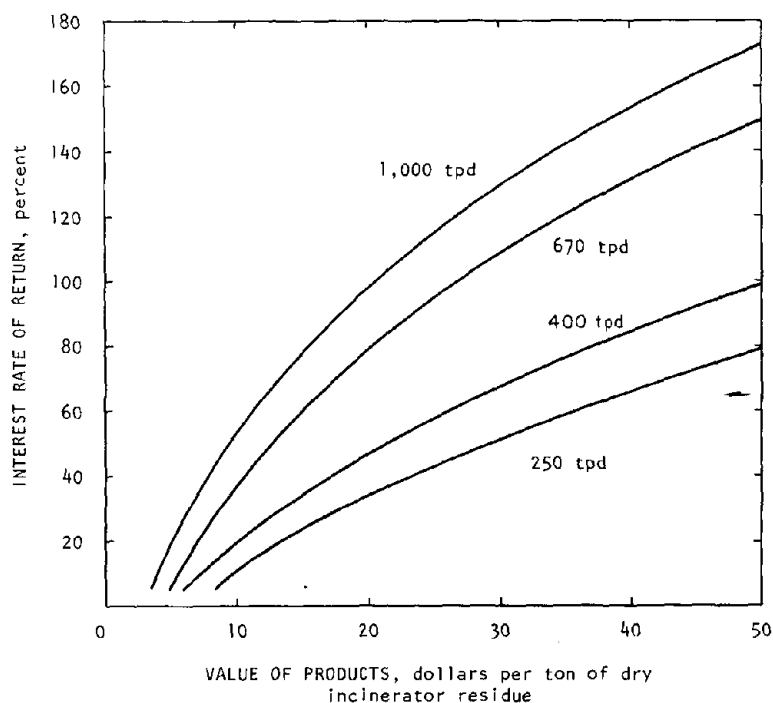


FIGURE 3. - Variation in interest rate of return with value of combined products.

separation plant for the various products, figure 3 is included to gage the profitability of the process. With this figure, the interest rate of return on investment can be determined for values of combined products up to \$50 per ton of incinerator residues. To estimate the profitability of a plant in a given location, the market value of all the products should be determined at the plant site, then the interest rate of return can be determined for each of the four plant sizes evaluated in this report.

cullet. The glass cullet recovered in this plant is of good quality, being relatively free of undesirable contaminants such as ceramics.

No attempt was made to tabulate the expected values of the various products recovered from the separation plant, primarily because of the increasing values of scrap materials. The product values, however, will also vary with plant location, product quality, and market conditions. For this evaluation, no plant location was selected, so the locations of scrap markets are unknown.

Because no specific credit is allowed in the economic evaluation of the

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APPENDIX A.--250-TON-PER-DAY INCINERATOR RESIDUE
PLANT--8-HOUR DAY

TABLE A-1. - Raw material, utility, and labor requirements
250-tpd incinerator residue plant--8-hour day

	Quantity per ton of dry incinerator residue
Flocculant.....pound..	0.02
Ferrosilicon.....do....	0.01
Flotation reagent.....do....	0.08
Electric power.....kilowatt-hours..	13.30
Process water.....thousand gallons..	0.07
Natural gas.....million Btu..	0.13
Direct operating labor.....man-hour..	0.29

TABLE A-2. - Major items of equipment, 250-tpd incinerator
residue plant--8-hour day

Section and item	Quantity	Unit size
Primary separation and water recovery:		
Trommel.....	1	6 feet in diameter by 12 feet long.
Shredder.....	1	500 horsepower.
Thickener.....	1	43 feet in diameter.
Rotary vacuum filter.....	1	250 square feet.
Metal recovery:		
Permanent-magnet drum separator	1	30 inches in diameter by 18 inches wide.
Baler.....	1	100 horsepower.
Hammer mill.....	1	7.5 horsepower.
Electromagnet drum separator...	1	30 inches in diameter by 18 inches wide.
Glass recovery:		
Harz jig.....	4	24 by 36 inches, 4 compartments.
Roll crusher.....	1	15 horsepower.
Mineral jig.....	2	16 by 24 inches, duplex.
Roll crusher.....	1	15 horsepower.
Matrix-type, high-intensity magnetic separator.....	1	10 tons per hour.
	1	5 tons per hour.
Flotation unit.....	1	38 by 38 inches, 6 cells.
Dryer.....	1	4.5 feet in diameter by 45 feet long.
Nonferrous metals upgrading:		
Heavy-medium separator.....	1	1.5 feet in diameter by 4 feet long.
Permanent-magnet drum separator	1	30 inches in diameter by 12 inches wide.

TABLE A-3.-EQUIPMENT COST SUMMARY,
PRIMARY SEPARATION AND WATER RECOVERY SECTION
250 TPD INCINERATOR RESIDUE PLANT--8 HOUR DAY

ITEM	COST(1)		
	EQUIPMENT	LABOR	TOTAL
HOPPER.....	\$ 1700	\$ 100	\$ 1800
APRON FEEDER.....	5500	800	6300
BELT CONVEYOR.....	23300	4200	27500
TROMMEL.....	13600	1600	15200
BELT CONVEYOR.....	16000	2900	18900
BELT CONVEYOR.....	10000	1800	11800
PRIMARY SCREEN.....	3000	400	3400
BELT CONVEYOR.....	6900	1200	8100
BELT CONVEYOR.....	7500	1300	8800
PUMP.....	1700	100	1800
SURGE BIN.....	5400	300	5700
APRON FEEDER.....	5500	800	6300
SHREDDER.....	55800	7800	63600
SECONDARY SCREEN.....	2400	300	2700
BUCKET ELEVATOR.....	4200	600	4800
BELT CONVEYOR.....	5800	1000	6800
PUMP.....	1100	100	1200
SPIRAL CLASSIFIER.....	4500	400	4900
PUMP.....	900	100	1000
BELT CONVEYOR.....	5200	900	6100
SURGE HOPPER.....	400	100	500
MIXING TANK.....	3000	300	3300
METERING PUMPS.....	900	100	1000
SCALE.....	200	100	300
THICKENER.....	19800	2000	21800
PUMP.....	1500	100	1600
PUMPS.....	3900	100	4000
ROTARY VACUUM DRUM FILTER.....	30700	3100	33800
BELT CONVEYOR.....	2900	500	3400
STORAGE TANK.....	10700	1100	11800
PUMP.....	3200	200	3400
TOTAL.....	257200	34400	291600
FRONT END LOADER.....			8100
TOTAL EQUIPMENT COST X FACTOR INDICATED			
FOUNDATIONS, X .070.....			18000
BUILDINGS, X .250.....			64300
STRUCTURES, X .050.....			12900
INSTRUMENTATION, X .010.....			2600
ELECTRICAL, X .140.....			36000
PIPING, X .100.....			25700
PAINTING, X .010.....			2600
MISCELLANEOUS, X .100.....			25700
TOTAL.....			187800
TOTAL DIRECT COST.....			487500
FIELD INDIRECT, 10.0 PERCENT OF TOTAL DIRECT COST.....			48700
TOTAL CONSTRUCTION COST.....			536200
ENGINEERING, 5.0 PERCENT OF TOTAL CONSTRUCTION COST...			26800
ADMINISTRATION AND OVERHEAD, 5.0 PERCENT OF TOTAL CONSTRUCTION COST.....			26800
SUBTOTAL.....			589800
CONTINGENCY, 10.0 PERCENT OF ABOVE SUBTOTAL.....			59000
SUBTOTAL.....			648800
CONTRACTOR'S FEE, 5.0 PERCENT OF ABOVE SUBTOTAL.....			32400
SECTION COST.....			681200

(1) EQUIPMENT COSTS ARE BASED ON THE M AND S INDEX OF 386.1.

TABLE A-4.-EQUIPMENT COST SUMMARY, METAL RECOVERY SECTION
250 TPD INCINERATOR RESIDUE PLANT--8 HOUR DAY

ITEM	COST(1)		
	EQUIPMENT	LABOR	TOTAL
MAGNETIC SEPARATOR.....	\$ 6200	\$ 600	\$ 6800
BELT CONVEYOR.....	9900	1800	11700
SURGE HOPPER.....	200	100	300
APRON FEEDER.....	3700	600	4300
BALER.....	79800	20000	99800
ROLLER CONVEYOR.....	2100	300	2400
CAR PULLER.....	2500	200	2700
HAMMERMILL.....	2600	400	3000
TERTIARY SCREEN.....	2100	300	2400
BELT CONVEYOR.....	5700	1000	6700
BELT CONVEYOR.....	7400	1300	8700
SURGE HOPPER.....	800	100	900
PUMP.....	1500	100	1600
MAGNETIC SEPARATOR.....	8500	800	9300
BELT CONVEYOR.....	7400	1300	8700
SURGE HOPPER.....	300	100	400
SPIRAL CLASSIFIER.....	5000	500	5500
PUMP.....	800	100	900
TOTAL.....	146500	29600	176100
CRANE.....			(2) 6600
TOTAL EQUIPMENT COST X FACTOR INDICATED			
FOUNDATIONS, X .070.....			10300
BUILDINGS, X .250.....			36600
STRUCTURES, X .100.....			14600
INSTRUMENTATION, X .010.....			1500
ELECTRICAL, X .140.....			20500
PIPING, X .100.....			14600
PAINTING, X .010.....			1500
MISCELLANEOUS, X .100.....			14600
TOTAL.....			114200
TOTAL DIRECT COST.....			296900
FIELD INDIRECT, 10.0 PERCENT OF TOTAL DIRECT COST.....			29700
TOTAL CONSTRUCTION COST.....			326600
ENGINEERING, 5.0 PERCENT OF TOTAL CONSTRUCTION COST...			16300
ADMINISTRATION AND OVERHEAD, 5.0 PERCENT OF TOTAL CONSTRUCTION COST.....			16300
SUBTOTAL.....			359200
CONTINGENCY, 10.0 PERCENT OF ABOVE SUBTOTAL.....			35900
SUBTOTAL.....			395100
CONTRACTOR'S FEE, 5.0 PERCENT OF ABOVE SUBTOTAL.....			19800
SECTION COST.....			414900

(1) EQUIPMENT COSTS ARE BASED ON THE M AND S INDEX OF 386.1.

(2) INSTALLED COST.

TABLE A-5.-EQUIPMENT COST SUMMARY, GLASS RECOVERY SECTION
250 TPD INCINERATOR RESIDUE PLANT--8 HOUR DAY

ITEM	COST(1)		
	EQUIPMENT	LABOR	TOTAL
HARZ JIG.....	\$ 36500	\$ 3600	\$ 40100
PUMP.....	1700	100	1800
BELT CONVEYOR.....	6700	1200	7900
ROLL CRUSHER.....	8800	900	9700
VIBRATING SCREEN.....	2200	300	2500
BELT CONVEYOR.....	7400	1300	8700
PUMP.....	2600	100	2700
SPIRAL CLASSIFIER.....	5000	500	5500
PUMP.....	3100	100	3200
MINERAL JIG.....	9800	1000	10800
PUMP.....	1500	100	1600
PUMP.....	1800	100	1900
VIBRATING SCREEN.....	2700	300	3000
PUMP.....	1600	100	1700
ROLL CRUSHER.....	8800	900	9700
VIBRATING SCREEN.....	3300	400	3700
PUMP.....	2200	100	2300
MATRIX SEPARATOR.....	56100	5600	61700
MATRIX SEPARATOR.....	37500	3700	41200
PUMP.....	1500	100	1600
PUMP.....	2200	100	2300
SPIRAL CLASSIFIER.....	5000	500	5500
PUMP.....	2500	100	2600
FLOTATION UNIT.....	11300	1100	12400
PUMP.....	1500	100	1600
VIBRATING SCREEN.....	1900	200	2100
PUMP.....	500	100	600
BELT CONVEYOR.....	7000	1300	8300
GLASS DRYER.....	59400	9500	68900
HOPPER.....	200	100	300
SCREW FEEDER.....	1100	200	1300
CYCLONE DUST COLLECTOR.....	3000	300	3300
BELT CONVEYOR.....	10400	1900	12300
STORAGE BIN.....	3500	200	3700
TOTAL.....	310300	36200	346500
TOTAL EQUIPMENT COST X FACTOR INDICATED			
FOUNDATIONS, X .07C.....			21700
BUILDINGS, X .250.....			77600
STRUCTURES, X .100.....			31000
INSTRUMENTATION, X .010.....			3100
ELECTRICAL, X .140.....			43400
PIPING, X .100.....			31000
PAINTING, X .010.....			3100
MISCELLANEOUS, X .100.....			31000
TOTAL.....			241900
TOTAL DIRECT COST.....			588400
FIELD INDIRECT, 10.0 PERCENT OF TOTAL DIRECT COST.....			58800
TOTAL CONSTRUCTION COST.....			647200
ENGINEERING, 5.0 PERCENT OF TOTAL CONSTRUCTION COST...			32400
ADMINISTRATION AND OVERHEAD, 5.0 PERCENT OF TOTAL CONSTRUCTION COST.....			32400
SUBTOTAL.....			712000
CONTINGENCY, 10.0 PERCENT OF ABOVE SUBTOTAL.....			71200
SUBTOTAL.....			783200
CONTRACTOR'S FEE, 5.0 PERCENT OF ABOVE SUBTOTAL.....			39200
SECTION COST.....			822400

(1) EQUIPMENT COSTS ARE BASED ON THE M AND S INDEX OF 386.1.

**TABLE A-6.--EQUIPMENT COST SUMMARY,
NONFERROUS METALS UPGRADING SECTION
250 TPD INCINERATOR RESIDUE PLANT--8 HOUR DAY**

ITEM	COST(1)		
	EQUIPMENT	LABOR	TOTAL
HEAVY-MEDIUM SEPARATOR.....	\$ 4400	\$ 900	\$ 5300
SINK DRAINAGE SCREEN.....	1400	200	1600
SINK WASHING SCREEN.....	1600	200	1800
FLOAT DRAINAGE SCREEN.....	1400	200	1600
FLOAT WASHING SCREEN.....	1600	200	1800
DILUTE MEDIUM SUMP.....	600	100	700
MAGNETIC FLOCCULATOR.....	200	100	300
MAGNETIC SEPARATOR.....	5400	500	5900
PUMP.....	500	100	600
DENSIFIER.....	3700	400	4100
STORAGE TANK.....	1000	100	1100
PUMP.....	500	100	600
DENSE MEDIUM SUMP.....	2700	100	2800
PUMP.....	1500	100	1600
BELT CONVEYOR.....	5100	900	6000
BELT CONVEYOR.....	5100	900	6000
DEMAGNETIZING COIL.....	200	100	300
TOTAL.....	36900	5200	42100
TOTAL EQUIPMENT COST X FACTOR INDICATED			
FOUNDATIONS, X .070.....			2600
BUILDINGS, X .250.....			9200
STRUCTURES, X .050.....			1800
INSTRUMENTATION, X .010.....			400
ELECTRICAL, X .140.....			5200
PIPING, X .100.....			3700
PAINTING, X .010.....			400
MISCELLANEOUS, X .100.....			3700
TOTAL.....			27000
TOTAL DIRECT COST.....			69100
FIELD INDIRECT, 10.0 PERCENT OF TOTAL DIRECT COST.....			6900
TOTAL CONSTRUCTION COST.....			76000
ENGINEERING, 5.0 PERCENT OF TOTAL CONSTRUCTION COST...			3800
ADMINISTRATION AND OVERHEAD, 5.0 PERCENT OF TOTAL CONSTRUCTION COST.....			3800
SUBTOTAL.....			83600
CONTINGENCY, 10.0 PERCENT OF ABOVE SUBTOTAL.....			8400
SUBTOTAL.....			92000
CONTRACTOR'S FEE, 5.0 PERCENT OF ABOVE SUBTOTAL.....			4600
SECTION COST.....			96600

(1) EQUIPMENT COSTS ARE BASED ON THE M AND S INDEX OF 386.1.

TABLE A-7.-DIRECT LABOR REQUIREMENTS,
250 TPD INCINERATOR RESIDUE PLANT--8 HOUR DAY

SECTION AND ITEM	DIRECT LABOR ASSIGNMENT			
	NUMBER OF MEN	SHIFTS PER DAY	DAYS PER WEEK	TOTAL MEN REQUIRED
PRIMARY SEPARATION AND WATER RECOVERY SECTION				
FRONT END LOADER.....	1.0	1	5	1.0
TROMMEL.....	2.0	1	5	2.0
SHREDDER.....	1.0	1	5	1.0
SUBTOTAL.....				4.0
METAL RECOVERY SECTION				
BALER.....	1.0	1	5	1.0
CRANE.....	1.0	1	5	1.0
HAMMERMILL.....	1.0	1	5	1.0
SUBTOTAL.....				3.0
GLASS RECOVERY SECTION				
HARZ JIG.....	1.0	1	5	1.0
SUBTOTAL.....				1.0
NONFERROUS METALS UPGRADING SECTION				
HEAVY-MEDIUM SEPARATOR.....	1.0	1	5	1.0
SUBTOTAL.....				1.0
TOTAL.....				9.0

TABLE A-8.-ESTIMATED ANNUAL OPERATING COST,
250 TPD INCINERATOR RESIDUE PLANT--8 HOUR DAY

	ANNUAL COST	COST PER TON INCINERATOR RESIDUE
DIRECT COST		
RAW MATERIALS		
INCINERATOR RESIDUE		
AT \$.00 PER TON.....	\$ 0	\$.00
FLOCCULANT AT \$1.70 PER POUND.....	2000	.03
FLOTATION REAGENT		
AT \$.67 PER POUND.....	3700	.06
FERROSILICON AT \$.16 PER POUND.....	100	.01
TOTAL	5800	.10
UTILITIES		
ELECTRIC POWER AT 1 CENT PER KWHR...	8600	.13
WATER, PROCESS AT 50 CENTS PER MGAL.	2200	.03
NATURAL GAS AT 80 CENTS PER MMBTU...	6800	.10
TOTAL	17600	.26
DIRECT LABOR		
LABOR AT \$5.00 PER HOUR.....	93600	1.44
SUPERVISION, 25 PERCENT OF LABOR....	23400	.36
TOTAL	117000	1.80
PLANT MAINTENANCE		
LABOR.....	45900	.71
SUPERVISION, 25 PERCENT OF		
MAINTENANCE LABOR.....	11500	.18
MATERIALS.....	38200	.59
TOTAL	95600	1.48
PAYROLL OVERHEAD, 25 PERCENT OF		
ABOVE PAYROLL.....	43600	.67
OPERATING SUPPLIES, 20 PERCENT OF		
PLANT MAINTENANCE.....	19100	.29
TOTAL DIRECT COST.....	298700	4.60
INDIRECT COST, 20 PERCENT OF		
DIRECT LABOR AND MAINTENANCE.....	42500	.65
FIXED COST		
INSURANCE, 1.0 PERCENT OF TOTAL		
PLANT COST.....	23400	.36
DEPRECIATION, 20 YEAR LIFE.....	116900	1.80
TOTAL OPERATING COST.....	481500	7.41

APPENDIX B.--400-TON-PER-DAY INCINERATOR RESIDUE
PLANT--8-HOUR DAY

TABLE B-1. - Raw material, utility, and labor requirements,
400-tpd incinerator residue plant--8-hour day

	Quantity per ton of dry incinerator residue
Flocculant.....pound..	0.02
Ferrosilicon.....do....	0.01
Flotation reagent.....do....	0.08
Electric power.....kilowatt-hours..	12.46
Process water.....thousand gallons..	0.07
Natural gas.....million Btu..	0.16
Direct operating labor.....man-hour..	0.18

TABLE B-2. - Major items of equipment, 400-tpd incinerator
residue plant--8-hour day

Section and item	Quantity	Unit size
Primary separation and water recovery:		
Trommel.....	1	8 feet in diameter by 15 feet long.
Shredder.....	1	800 horsepower.
Thickener.....	1	54 feet in diameter.
Rotary vacuum filter.....	1	350 square feet.
Metal recovery:		
Permanent-magnet drum separator	1	30 inches in diameter by 24 inches wide.
Baler.....	1	100 horsepower.
Hammer mill.....	1	15 horsepower.
Electromagnet drum separator...	1	30 inches in diameter by 30 inches wide.
Glass recovery:		
Harz jig.....	6	24 by 36 inches, 4 compartments.
Roll crusher.....	1	30 horsepower.
Mineral jig.....	3	16 by 24 inches, duplex.
Roll crusher.....	1	15 horsepower.
Matrix-type, high-intensity magnetic separator.....	2	10 tons per hour.
Flotation unit.....	2	38 by 38 inches, 6 cells.
Dryer.....	1	6.25 feet in diameter by 52 feet long.
Nonferrous metals upgrading:		
Heavy-medium separator.....	1	1.5 feet in diameter by 4 feet long.
Permanent-magnet drum separator	1	30 inches in diameter by 12 inches wide.

TABLE B-3.-EQUIPMENT COST SUMMARY,
PRIMARY SEPARATION AND WATER RECOVERY SECTION
400 TPD INCINERATOR RESIDUE PLANT--8 HOUR DAY

ITEM	COST(1)		
	EQUIPMENT	LABOR	TOTAL
HOPPER.....	\$ 2500	\$ 100	\$ 2600
APRON FEEDER.....	5500	800	6300
BELT CONVEYOR.....	23300	4200	27500
TROMMEL.....	18000	2200	20200
BELT CONVEYOR.....	16000	2900	18900
BELT CONVEYOR.....	10000	1800	11800
PRIMARY SCREEN.....	3700	400	4100
BELT CONVEYOR.....	6900	1200	8100
BELT CONVEYOR.....	7500	1300	8800
PUMP.....	2000	100	2100
SURGE BIN.....	7900	400	8300
APRON FEEDER.....	5500	800	6300
SHREDDER.....	77600	10900	88500
SECONDARY SCREEN.....	2800	300	3100
BUCKET ELEVATOR.....	4200	600	4800
BELT CONVEYOR.....	5800	1000	6800
PUMP.....	1300	100	1400
SPIRAL CLASSIFIER.....	4500	400	4900
PUMP.....	1200	100	1300
BELT CONVEYOR.....	5200	900	6100
SURGE HOPPER.....	500	100	600
MIXING TANK.....	3000	300	3300
METERING PUMPS.....	1100	100	1200
SCALE.....	200	100	300
THICKENER.....	27000	2700	29700
PUMP.....	1900	100	2000
PUMPS.....	4600	100	4700
ROTARY VACUUM DRUM FILTER.....	35900	3600	39500
BELT CONVEYOR.....	2900	500	3400
STORAGE TANK.....	18800	1900	20700
PUMP.....	4000	200	4200
TOTAL.....	311300	40200	351500
FRONT END LOADER.....			8100
TOTAL EQUIPMENT COST X FACTOR INDICATED			
FOUNDATIONS, X .070.....			21800
BUILDINGS, X .250.....			77800
STRUCTURES, X .050.....			15600
INSTRUMENTATION, X .010.....			3100
ELECTRICAL, X .140.....			43600
PIPING, X .100.....			31100
PAINTING, X .010.....			3100
MISCELLANEOUS, X .100.....			31100
TOTAL.....			227200
TOTAL DIRECT COST.....			586800
FIELD INDIRECT, 10.0 PERCENT OF TOTAL DIRECT COST.....			58700
TOTAL CONSTRUCTION COST.....			645500
ENGINEERING, 5.0 PERCENT OF TOTAL CONSTRUCTION COST...			32300
ADMINISTRATION AND OVERHEAD, 5.0 PERCENT OF TOTAL			
CONSTRUCTION COST.....			32300
SUBTOTAL.....			710100
CONTINGENCY, 10.0 PERCENT OF ABOVE SUBTOTAL.....			71000
SUBTOTAL.....			781100
CONTRACTOR'S FEE, 5.0 PERCENT OF ABOVE SUBTOTAL.....			39100
SECTION COST.....			820200

(1) EQUIPMENT COSTS ARE BASED ON THE M AND S INDEX OF 386.1.

TABLE B-4.-EQUIPMENT COST SUMMARY, METAL RECOVERY SECTION
400 TPD INCINERATOR RESIDUE PLANT--8 HOUR DAY

ITEM	COST(1)		
	EQUIPMENT	LABOR	TOTAL
MAGNETIC SEPARATOR.....	\$ 8200	\$ 800	\$ 9000
BELT CONVEYOR.....	9900	1800	11700
SURGE HOPPER.....	300	100	400
APRON FEEDER.....	3700	600	4300
BALER.....	79800	20000	99800
ROLLER CONVEYOR.....	2100	300	2400
CAR PULLER.....	2500	200	2700
HAMMERMILL.....	2800	400	3200
TERTIARY SCREEN.....	2200	300	2500
BELT CONVEYOR.....	5700	1000	6700
BELT CONVEYOR.....	7400	1300	8700
SURGE HOPPER.....	1300	100	1400
PUMP.....	1800	100	1900
MAGNETIC SEPARATOR.....	11500	1100	12600
BELT CONVEYOR.....	7500	1300	8800
SURGE HOPPER.....	400	100	500
SPIRAL CLASSIFIER.....	5800	600	6400
PUMP.....	900	100	1000
TOTAL.....	153800	30200	184000
CRANE.....			(2) 6600
TOTAL EQUIPMENT COST X FACTOR INDICATED			
FOUNDATIONS, X .070.....			10800
BUILDINGS, X .250.....			38500
STRUCTURES, X .100.....			15400
INSTRUMENTATION, X .010.....			1500
ELECTRICAL, X .140.....			21500
PIPING, X .100.....			15400
PAINTING, X .010.....			1500
MISCELLANEOUS, X .100.....			15400
TOTAL.....			120000
TOTAL DIRECT COST.....			310600
FIELD INDIRECT, 10.0 PERCENT OF TOTAL DIRECT COST.....			31100
TOTAL CONSTRUCTION COST.....			341700
ENGINEERING, 5.0 PERCENT OF TOTAL CONSTRUCTION COST...			17100
ADMINISTRATION AND OVERHEAD, 5.0 PERCENT OF TOTAL CONSTRUCTION COST.....			17100
SUBTOTAL.....			375900
CONTINGENCY, 10.0 PERCENT OF ABOVE SUBTOTAL.....			37600
SUBTOTAL.....			413500
CONTRACTOR'S FEE, 5.0 PERCENT OF ABOVE SUBTOTAL.....			20700
SECTION COST.....			434200

(1) EQUIPMENT COSTS ARE BASED ON THE M AND S INDEX OF 386.1.
(2) INSTALLED COST.

TABLE B-5.-EQUIPMENT COST SUMMARY, GLASS RECOVERY SECTION
400 TPD INCINERATOR RESIDUE PLANT--8 HOUR DAY

ITEM	COST (1)		
	EQUIPMENT	LABOR	TOTAL
HARZ JIG.....	\$ 54700	\$ 5500	\$ 60200
PUMP.....	1900	100	2000
BELT CONVEYOR.....	6700	1200	7900
ROLL CRUSHER.....	10700	1100	11800
VIBRATING SCREEN.....	2600	300	2900
BELT CONVEYOR.....	7400	1300	8700
PUMP.....	3100	100	3200
SPIRAL CLASSIFIER.....	5800	600	6400
PUMP.....	3600	100	3700
MINERAL JIG.....	14700	1500	16200
PUMP.....	1500	100	1600
PUMP.....	2100	100	2200
VIBRATING SCREEN.....	3400	400	3800
PUMP.....	1900	100	2000
ROLL CRUSHER.....	8800	900	9700
VIBRATING SCREEN.....	4400	500	4900
PUMP.....	2500	100	2600
MATRIX SEPARATOR.....	112200	11200	123400
PUMP.....	1500	100	1600
PUMP.....	2600	100	2700
SPIRAL CLASSIFIER.....	5000	500	5500
PUMP.....	2900	100	3000
FLUTATION UNIT.....	22500	2200	24700
PUMP.....	1800	100	1900
VIBRATING SCREEN.....	2000	200	2200
PUMP.....	600	100	700
BELT CONVEYOR.....	7000	1300	8300
GLASS DRYER.....	82900	13300	96200
HOPPER.....	200	100	300
SCREW FEEDER.....	1100	200	1300
CYCLONE DUST COLLECTOR.....	5000	500	5500
BELT CONVEYOR.....	10500	1900	12400
STORAGE BIN.....	5000	200	5200
TOTAL.....	398600	46100	444700
TOTAL EQUIPMENT COST X FACTOR INDICATED			
FOUNDATIONS, X .070.....			27900
BUILDINGS, X .250.....			99700
STRUCTURES, X .100.....			39900
INSTRUMENTATION, X .010.....			4000
ELECTRICAL, X .140.....			55800
PIPING, X .100.....			39900
PAINTING, X .010.....			4000
MISCELLANEOUS, X .100.....			39900
TOTAL.....			311100
TOTAL DIRECT COST.....			755800
FIELD INDIRECT, 10.0 PERCENT OF TOTAL DIRECT COST.....			75600
TOTAL CONSTRUCTION COST.....			831400
ENGINEERING, 5.0 PERCENT OF TOTAL CONSTRUCTION COST...			41600
ADMINISTRATION AND OVERHEAD, 5.0 PERCENT OF TOTAL			
CONSTRUCTION COST.....			41600
SUBTOTAL.....			914600
CONTINGENCY, 10.0 PERCENT OF ABOVE SUBTOTAL.....			91500
SUBTOTAL.....			1006100
CONTRACTOR'S FEE, 5.0 PERCENT OF ABOVE SUBTOTAL.....			50300
SECTION COST.....			1056400

(1) EQUIPMENT COSTS ARE BASED ON THE M AND S INDEX OF 386.1.

TABLE B-6.-EQUIPMENT COST SUMMARY,
NONFERROUS METALS UPGRADING SECTION
400 TPD INCINERATOR RESIDUE PLANT--8 HOUR DAY

ITEM	COST(1)		
	EQUIPMENT	LABOR	TOTAL
HEAVY-MEDIUM SEPARATOR.....	\$ 4400	\$ 900	\$ 5300
SINK DRAINAGE SCREEN.....	1400	200	1600
SINK WASHING SCREEN.....	1600	200	1800
FLOAT DRAINAGE SCREEN.....	1400	200	1600
FLOAT WASHING SCREEN.....	1600	200	1800
DILUTE MEDIUM SUMP.....	600	100	700
MAGNETIC FLOCCULATOR.....	200	100	300
MAGNETIC SEPARATOR.....	5400	500	5900
PUMP.....	500	100	600
DENSIFIER.....	3700	400	4100
STORAGE TANK.....	1000	100	1100
PUMP.....	500	100	600
DENSE MEDIUM SUMP.....	2700	100	2800
PUMP.....	1500	100	1600
BELT CONVEYOR.....	5100	900	6000
BELT CONVEYOR.....	5100	900	6000
DEMAGNETIZING COIL.....	200	100	300
TOTAL.....	36900	5200	42100
TOTAL EQUIPMENT COST X FACTOR INDICATED			
FOUNDATIONS, X .070.....			2600
BUILDINGS, X .250.....			9200
STRUCTURES, X .050.....			1800
INSTRUMENTATION, X .010.....			400
ELECTRICAL, X .140.....			5200
PIPING, X .100.....			3700
PAINTING, X .010.....			400
MISCELLANEOUS, X .100.....			3700
TOTAL.....			27000
TOTAL DIRECT COST.....			69100
FIELD INDIRECT, 10.0 PERCENT OF TOTAL DIRECT COST.....			6900
TOTAL CONSTRUCTION COST.....			76000
ENGINEERING, 5.0 PERCENT OF TOTAL CONSTRUCTION COST...			3800
ADMINISTRATION AND OVERHEAD, 5.0 PERCENT OF TOTAL			
CONSTRUCTION COST.....			3800
SUBTOTAL.....			83600
CONTINGENCY, 10.0 PERCENT OF ABOVE SUBTOTAL.....			8400
SUBTOTAL.....			92000
CONTRACTOR'S FEE, 5.0 PERCENT OF ABOVE SUBTOTAL.....			4600
SECTION COST.....			96600

(1) EQUIPMENT COSTS ARE BASED ON THE M AND S INDEX OF 386.1.

TABLE B-7.-DIRECT LABOR REQUIREMENTS,
400 TPD INCINERATOR RESIDUE PLANT--8 HOUR DAY

SECTION AND ITEM	DIRECT LABOR ASSIGNMENT			
	NUMBER OF MEN	SHIFTS PER DAY	DAYS PER WEEK	TOTAL MEN REQUIRED
PRIMARY SEPARATION AND WATER RECOVERY SECTION				
FRONT END LOADER.....	1.0	1	5	1.0
TROMMEL.....	2.0	1	5	2.0
SHREDDER.....	1.0	1	5	1.0
SUBTOTAL.....				4.0
METAL RECOVERY SECTION				
BALER.....	1.0	1	5	1.0
CRANE.....	1.0	1	5	1.0
HAMMERMILL.....	1.0	1	5	1.0
SUBTOTAL.....				3.0
GLASS RECOVERY SECTION				
HARZ JIG.....	1.0	1	5	1.0
SUBTOTAL.....				1.0
NONFERROUS METALS UPGRADING SECTION				
HEAVY-MEDIUM SEPARATOR.....	1.0	1	5	1.0
SUBTOTAL.....				1.0
TOTAL.....				9.0

TABLE B-8.--ESTIMATED ANNUAL OPERATING COST,
400 TPD INCINERATOR RESIDUE PLANT--8 HOUR DAY

	ANNUAL COST	COST PER TON INCINERATOR RESIDUE
DIRECT COST		
RAW MATERIALS		
INCINERATOR RESIDUE		
AT \$.00 PER TON.....	\$ 0	\$.00
FLOCCULANT AT \$1.70 PER POUND.....	3300	.03
FLOTATION REAGENT		
AT \$.67 PER POUND.....	5900	.06
FERROSILICON AT \$.16 PER POUND.....	100	.01
TOTAL.....	9300	.10
UTILITIES		
ELECTRIC POWER AT 1 CENT PER KWHR....	13000	.13
WATER, PROCESS AT 50 CENTS PER MGAL....	3400	.03
NATURAL GAS AT 80 CENTS PER MMBTU....	13100	.13
TOTAL.....	29500	.29
DIRECT LABOR		
LABOR AT \$5.00 PER HOUR.....	93600	.90
SUPERVISION, 25 PERCENT OF LABOR.....	23400	.22
TOTAL.....	117000	1.12
PLANT MAINTENANCE		
LABOR.....	57000	.55
SUPERVISION, 25 PERCENT OF		
MAINTENANCE LABOR.....	14300	.14
MATERIALS.....	47500	.46
TOTAL.....	118800	1.15
PAYROLL OVERHEAD, 25 PERCENT OF		
ABOVE PAYROLL.....	47100	.45
OPERATING SUPPLIES, 20 PERCENT OF		
PLANT MAINTENANCE.....	23800	.23
TOTAL DIRECT COST.....	345500	3.34
INDIRECT COST, 20 PERCENT OF		
DIRECT LABOR AND MAINTENANCE.....	47200	.45
FIXED COST		
INSURANCE, 1.0 PERCENT OF TOTAL		
PLANT COST.....	27900	.27
DEPRECIATION, 20 YEAR LIFE.....	139600	1.34
TOTAL OPERATING COST.....	560200	5.40

APPENDIX C.--670-TON-PER-DAY INCINERATOR RESIDUE
PLANT--24-HOUR DAY

TABLE C-1. - Raw material, utility, and labor requirements,
670-tpd incinerator residue plant--24-hour day

	Quantity per ton of dry incinerator residue
Flocculant.....pound..	0.02
Ferrosilicon.....do....	0.01
Flotation reagent.....do....	0.08
Electric power.....kilowatt-hours..	13.05
Process water.....thousand gallons..	0.07
Natural gas.....million Btu..	0.14
Direct operating labor.....man-hour..	0.30

TABLE C-2. - Major items of equipment, 670-tpd incinerator
residue plant--24-hour day

Section and item	Quantity	Unit size
Primary separation and water recovery:		
Trommel.....	1	4 feet in diameter by 12 feet long.
Shredder.....	1	450 horsepower.
Thickener.....	1	40 feet in diameter.
Rotary vacuum filter.....	1	200 square feet.
Metal recovery:		
Permanent-magnet drum separator	1	30 inches in diameter by 12 inches wide.
Baler.....	1	100 horsepower.
Hammer mill.....	1	7.5 horsepower.
Electromagnet drum separator...	1	30 inches in diameter by 18 inches wide.
Glass recovery:		
Harz jig.....	3	24 by 36 inches, 4 compartments.
Roll crusher.....	1	15 horsepower.
Mineral jig.....	2	16 by 24 inches, duplex.
Roll crusher.....	1	10 horsepower.
Matrix-type, high-intensity magnetic separator.....	1	10 tons per hour.
	1	5 tons per hour.
Flotation unit.....	1	38 by 38 inches; 6 cells.
Dryer.....	1	4.5 feet in diameter by 44 feet long.
Nonferrous metals upgrading:		
Heavy-medium separator.....	1	2 feet in diameter by 5 feet long.
Permanent-magnet drum separator	1	30 inches in diameter by 12 inches wide.

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TABLE C-3.-EQUIPMENT COST SUMMARY,
PRIMARY SEPARATION AND WATER RECOVERY SECTION
670 TPD INCINERATOR RESIDUE PLANT--24 HOUR DAY

ITEM	COST(1)		
	EQUIPMENT	LABOR	TOTAL
HOPPER.....	\$ 1500	\$ 100	\$ 1600
APRON FEEDER.....	5500	800	6300
BELT CONVEYOR.....	23300	4200	27500
TROMMEL.....	9200	1100	10300
BELT CONVEYOR.....	16000	2900	18900
BELT CONVEYOR.....	10000	1800	11800
PRIMARY SCREEN.....	3500	400	3900
BELT CONVEYOR.....	6900	1200	8100
BELT CONVEYOR.....	7500	1300	8800
PUMP.....	1600	100	1700
SURGE BIN.....	4900	200	5100
APRON FEEDER.....	5500	800	6300
SHREDDER.....	51900	7300	59200
SECONDARY SCREEN.....	2300	300	2600
BUCKET ELEVATOR.....	4200	600	4800
BELT CONVEYOR.....	5800	1000	6800
PUMP.....	1100	100	1200
SPIRAL CLASSIFIER.....	4500	400	4900
PUMP.....	900	100	1000
BELT CONVEYOR.....	5200	900	6100
SURGE HOPPER.....	300	100	400
MIXING TANK.....	3000	300	3300
METERING PUMPS.....	900	100	1000
SCALE.....	200	100	300
THICKENER.....	17900	1800	19700
PUMP.....	1500	100	1600
PUMPS.....	3800	100	3900
ROTARY VACUUM DRUM FILTER.....	27700	2800	30500
BELT CONVEYOR.....	2900	500	3400
STORAGE TANK.....	10000	1000	11000
PUMP.....	2700	100	2800
TOTAL.....	242200	32600	274800
FRONT END LOADER.....			8100
TOTAL EQUIPMENT COST X FACTOR INDICATED			
FOUNDATIONS, X .070.....			17000
BUILDINGS, X .250.....			60600
STRUCTURES, X .050.....			12100
INSTRUMENTATION, X .010.....			2400
ELECTRICAL, X .140.....			33900
PIPING, X .100.....			24200
PAINTING, X .010.....			2400
MISCELLANEOUS, X .100.....			24200
TOTAL.....			176800
TOTAL DIRECT COST.....			459700
FIELD INDIRECT, 10.0 PERCENT OF TOTAL DIRECT COST.....			46000
TOTAL CONSTRUCTION COST.....			505700
ENGINEERING, 5.0 PERCENT OF TOTAL CONSTRUCTION COST...			25300
ADMINISTRATION AND OVERHEAD, 5.0 PERCENT OF TOTAL CONSTRUCTION COST.....			25300
SUBTOTAL.....			556300
CONTINGENCY, 10.0 PERCENT OF ABOVE SUBTOTAL.....			55600
SUBTOTAL.....			611900
CONTRACTOR'S FEE, 5.0 PERCENT OF ABOVE SUBTOTAL.....			30600
SECTION COST.....			642500

(1) EQUIPMENT COSTS ARE BASED ON THE M AND S INDEX OF 386.1.

TABLE C-4.-EQUIPMENT COST SUMMARY, METAL RECOVERY SECTION
670 TPD INCINERATOR RESIDUE PLANT--24 HOUR DAY

ITEM	COST(1)		
	EQUIPMENT	LABOR	TOTAL
MAGNETIC SEPARATOR.....	\$ 5400	\$ 500	\$ 5900
BELT CONVEYOR.....	9900	1800	11700
SURGE HOPPER.....	200	100	300
APRON FEEDER.....	3700	600	4300
BALER.....	79800	20000	99800
ROLLER CONVEYOR.....	2100	300	2400
CAR PULLER.....	2500	200	2700
HAMMERMILL.....	2600	400	3000
TERTIARY SCREEN.....	2100	300	2400
BELT CONVEYOR.....	5700	1000	6700
BELT CONVEYOR.....	7400	1300	8700
SURGE HOPPER.....	1900	100	2000
PUMP.....	1500	100	1600
MAGNETIC SEPARATOR.....	8500	800	9300
BELT CONVEYOR.....	7400	1300	8700
SURGE HOPPER.....	200	100	300
SPIRAL CLASSIFIER.....	5000	500	5500
PUMP.....	700	100	800
TOTAL.....	146600	29500	176100
CRANE.....			(2) 6600
TOTAL EQUIPMENT COST X FACTOR INDICATED			
FOUNDATIONS, X .070.....			10300
BUILDINGS, X .250.....			36700
STRUCTURES, X .100.....			14700
INSTRUMENTATION, X .010.....			1500
ELECTRICAL, X .140.....			20500
PIPING, X .100.....			14700
PAINTING, X .010.....			1500
MISCELLANEOUS, X .100.....			14700
TOTAL.....			114600
TOTAL DIRECT COST.....			297300
FIELD INDIRECT, 10.0 PERCENT OF TOTAL DIRECT COST.....			29700
TOTAL CONSTRUCTION COST.....			327000
ENGINEERING, 5.0 PERCENT OF TOTAL CONSTRUCTION COST...			16300
ADMINISTRATION AND OVERHEAD, 5.0 PERCENT OF TOTAL CONSTRUCTION COST.....			16300
SUBTOTAL.....			359600
CONTINGENCY, 10.0 PERCENT OF ABOVE SUBTOTAL.....			36000
SUBTOTAL.....			395600
CONTRACTOR'S FEE, 5.0 PERCENT OF ABOVE SUBTOTAL.....			19800
SECTION COST.....			415400

(1) EQUIPMENT COSTS ARE BASED ON THE M AND S INDEX OF 386.1.

(2) INSTALLED COST.

TABLE C-5.-EQUIPMENT COST SUMMARY, GLASS RECOVERY SECTION
670 TPD INCINERATOR RESIDUE PLANT--24 HOUR DAY

ITEM	COST(1)		
	EQUIPMENT	LABOR	TOTAL
HARZ JIG.....	\$ 27300	\$ 2700	\$ 30000
PUMP.....	1600	100	1700
BELT CONVEYOR.....	6700	1200	7900
ROLL CRUSHER.....	8800	900	9700
VIBRATING SCREEN.....	2100	300	2400
BELT CONVEYOR.....	7400	1300	8700
PUMP.....	2400	100	2500
SPIRAL CLASSIFIER.....	5000	500	5500
PUMP.....	2900	100	3000
MINERAL JIG.....	9800	1000	10800
PUMP.....	1500	100	1600
PUMP.....	1700	100	1800
VIBRATING SCREEN.....	2600	300	2900
PUMP.....	1600	100	1700
ROLL CRUSHER.....	8800	900	9700
VIBRATING SCREEN.....	3100	400	3500
PUMP.....	2100	100	2200
MATRIX SEPARATOR.....	56100	5600	61700
MATRIX SEPARATOR.....	37500	3700	41200
PUMP.....	1500	100	1600
PUMP.....	2100	100	2200
SPIRAL CLASSIFIER.....	5000	500	5500
PUMP.....	2400	100	2500
FLOTATION UNIT.....	11300	1100	12400
PUMP.....	1500	100	1600
VIBRATING SCREEN.....	1900	200	2100
PUMP.....	500	100	600
BELT CONVEYOR.....	7000	1300	8300
GLASS DRYER.....	58900	9400	68300
HOPPER.....	100	100	200
SCREW FEEDER.....	1100	200	1300
CYCLONE DUST COLLECTOR.....	3000	300	3300
BELT CONVEYOR.....	10400	1900	12300
STORAGE BIN.....	7700	400	8100
TOTAL.....	303400	35400	338800
TOTAL EQUIPMENT COST X FACTOR INDICATED			
FOUNDATIONS, X .070.....			21200
BUILDINGS, X .250.....			75900
STRUCTURES, X .100.....			30300
INSTRUMENTATION, X .010.....			3000
ELECTRICAL, X .140.....			42500
PIPING, X .100.....			30300
PAINTING, X .010.....			3000
MISCELLANEOUS, X .100.....			30300
TOTAL.....			236500
TOTAL DIRECT COST.....			575300
FIELD INDIRECT, 10.0 PERCENT OF TOTAL DIRECT COST.....			57500
TOTAL CONSTRUCTION COST.....			632800
ENGINEERING, 5.0 PERCENT OF TOTAL CONSTRUCTION COST...			31600
ADMINISTRATION AND OVERHEAD, 5.0 PERCENT OF TOTAL			
CONSTRUCTION COST.....			31600
SUBTOTAL.....			696000
CONTINGENCY, 10.0 PERCENT OF ABOVE SUBTOTAL.....			69600
SUBTOTAL.....			765600
CONTRACTOR'S FEE, 5.0 PERCENT OF ABOVE SUBTOTAL.....			38300
SECTION COST.....			803900

(1) EQUIPMENT COSTS ARE BASED ON THE M AND S INDEX OF 386.1.

TABLE C-6.-EQUIPMENT COST SUMMARY,
NONFERROUS METALS UPGRADING SECTION
670 TPD INCINERATOR RESIDUE PLANT--24 HOUR DAY

ITEM	COST(1)		
	EQUIPMENT	LABOR	TOTAL
HEAVY-MEDIUM SEPARATOR.....	\$ 6000	\$ 1200	\$ 7200
SINK DRAINAGE SCREEN.....	1400	200	1600
SINK WASHING SCREEN.....	1600	200	1800
FLOAT DRAINAGE SCREEN.....	1400	200	1600
FLOAT WASHING SCREEN.....	1600	200	1800
DILUTE MEDIUM SUMP.....	800	100	900
MAGNETIC FLOCCULATOR.....	200	100	300
MAGNETIC SEPARATOR.....	5400	500	5900
PUMP.....	500	100	600
DENSIFIER.....	3700	400	4100
STORAGE TANK.....	1200	100	1300
PUMP.....	500	100	600
DENSE MEDIUM SUMP.....	3600	200	3800
PUMP.....	1500	100	1600
BELT CONVEYOR.....	5100	900	6000
BELT CONVEYOR.....	5100	900	6000
DEMAGNETIZING COIL.....	200	100	300
TOTAL.....	39800	5600	45400
TOTAL EQUIPMENT COST X FACTOR INDICATED			
FOUNDATIONS, X .070.....			2800
BUILDINGS, X .250.....			10000
STRUCTURES, X .050.....			2000
INSTRUMENTATION, X .010.....			400
ELECTRICAL, X .140.....			5600
PIPING, X .100.....			4000
PAINTING, X .010.....			400
MISCELLANEOUS, X .100.....			4000
TOTAL.....			29200
TOTAL DIRECT COST.....			74600
FIELD INDIRECT, 10.0 PERCENT OF TOTAL DIRECT COST.....			7500
TOTAL CONSTRUCTION COST.....			82100
ENGINEERING, 5.0 PERCENT OF TOTAL CONSTRUCTION COST...			4100
ADMINISTRATION AND OVERHEAD, 5.0 PERCENT OF TOTAL CONSTRUCTION COST.....			4100
SUBTOTAL.....			90300
CONTINGENCY, 10.0 PERCENT OF ABOVE SUBTOTAL.....			9000
SUBTOTAL.....			99300
CONTRACTOR'S FEE, 5.0 PERCENT OF ABOVE SUBTOTAL.....			5000
SECTION COST.....			104300

(1) EQUIPMENT COSTS ARE BASED ON THE M AND S INDEX OF 386.1.

TABLE C-7.-DIRECT LABOR REQUIREMENTS,
670 TPD INCINERATOR RESIDUE PLANT--24 HOUR DAY

SECTION AND ITEM	DIRECT LABOR ASSIGNMENT			
	NUMBER OF MEN	SHIFTS PER DAY	DAYS PER WEEK	TOTAL MEN REQUIRED
PRIMARY SEPARATION AND WATER RECOVERY SECTION				
FRONT END LOADER.....	1.0	3	5	3.0
TROMMEL.....	2.0	3	5	6.0
SHREDDER.....	1.0	3	5	3.0
SUBTOTAL.....				12.0
METAL RECOVERY SECTION				
BALER.....	1.0	3	5	3.0
CRANE.....	1.0	3	5	3.0
HAMMERMILL.....	1.0	3	5	3.0
SUBTOTAL.....				9.0
GLASS RECOVERY SECTION				
HARZ JIG.....	1.0	3	5	3.0
SUBTOTAL.....				3.0
NONFERROUS METALS UPGRADING SECTION				
HEAVY-MEDIUM SEPARATOR.....	1.0	1	5	1.0
SUBTOTAL.....				1.0
TOTAL.....				25.0

TABLE C-8.-ESTIMATED ANNUAL OPERATING COST,
670 TPD INCINERATOR RESIDUE PLANT--24 HOUR DAY

	ANNUAL COST	COST PER TON INCINERATOR RESIDUE
DIRECT COST		
RAW MATERIALS		
INCINERATOR RESIDUE		
AT \$.00 PER TON.....	\$ 0	\$.00
FLOCCULANT AT \$1.70 PER POUND.....	5400	.03
FLOTATION REAGENT		
AT \$.67 PER POUND.....	9800	.06
FERROSILICON AT \$.16 PER POUND.....	200	.01
TOTAL.....	15400	.10
UTILITIES		
ELECTRIC POWER AT 1 CENT PER KWHR...	22700	.13
WATER, PROCESS AT 50 CENTS PER MGAL.	5700	.03
NATURAL GAS AT 80 CENTS PER MMBTU...	20000	.11
TOTAL.....	48400	.27
DIRECT LABOR		
LABOR AT \$5.00 PER HOUR.....	260000	1.49
SUPERVISION, 25 PERCENT OF LABOR....	65000	.37
TOTAL.....	325000	1.86
PLANT MAINTENANCE		
LABOR.....	46200	.27
SUPERVISION, 25 PERCENT OF		
MAINTENANCE LABOR.....	11600	.07
MATERIALS.....	38600	.22
TOTAL.....	96400	.56
PAYROLL OVERHEAD, 25 PERCENT OF		
ABOVE PAYROLL.....	95700	.55
OPERATING SUPPLIES, 20 PERCENT OF		
PLANT MAINTENANCE.....	19300	.11
TOTAL DIRECT COST.....	600200	3.45
INDIRECT COST, 20 PERCENT OF		
DIRECT LABOR AND MAINTENANCE.....	84300	.48
FIXED COST		
INSURANCE, 1.0 PERCENT OF TOTAL		
PLANT COST.....	22800	.13
DEPRECIATION, 20 YEAR LIFE.....	114000	.65
TOTAL OPERATING COST.....	821300	4.71

APPENDIX D.--1,000-TON-PER-DAY INCINERATOR RESIDUE
PLANT--24-HOUR DAY

TABLE D-1. - Raw material, utility, and labor requirements,
1,000-tpd incinerator residue plant--
24-hour day

	Quantity per ton of dry incinerator residue
Flocculant.....pound..	0.02
Ferrosilicon.....do....	0.01
Flotation reagent.....do....	0.08
Electric power.....kilowatt-hours..	12.22
Process water.....thousand gallons..	0.07
Natural gas.....million Btu..	0.13
Direct operating labor.....man-hour..	0.20

TABLE D-2. - Major items of equipment, 1,000-tpd incinerator
residue plant--24-hour day

Section and item	Quantity	Unit size
Primary separation and water recovery:		
Trommel.....	1	7 feet in diameter by 15 feet long.
Shredder.....	1	650 horsepower.
Thickener.....	1	50 feet in diameter.
Rotary vacuum filter.....	1	300 square feet.
Metal recovery:		
Permanent-magnet drum separator	1	30 inches in diameter by 18 inches wide.
Baler.....	1	100 horsepower.
Hammer mill.....	1	10 horsepower.
Electromagnet drum separator...	1	30 inches in diameter by 24 inches wide.
Glass recovery:		
Harz jig.....	5	24 by 36 inches, 4 compartments.
Roll crusher.....	1	25 horsepower.
Mineral jig.....	2	16 by 24 inches, duplex.
Roll crusher.....	1	15 horsepower.
Matrix-type, high-intensity magnetic separator.....	2	10 tons per hour.
Flotation unit.....	2	38 by 38 inches, 6 cells.
Dryer.....	1	5 feet in diameter by 49 feet long.
Nonferrous metals upgrading:		
Heavy-medium separator.....	1	2 feet in diameter by 5 feet long.
Permanent-magnet drum separator	1	30 inches in diameter by 12 inches wide.

TABLE D-3.-EQUIPMENT COST SUMMARY,
PRIMARY SEPARATION AND WATER RECOVERY SECTION
1000 TPD INCINERATOR RESIDUE PLANT--24 HOUR DAY

ITEM	COST(1)		
	EQUIPMENT	LABOR	TOTAL
HOPPER.....	\$ 2100	\$ 100	\$ 2200
APRON FEEDER.....	5500	800	6300
BELT CONVEYOR.....	23300	4200	27500
TROMMEL.....	13600	1600	15200
BELT CONVEYOR.....	16000	2900	18900
BELT CONVEYOR.....	10000	1800	11800
PRIMARY SCREEN.....	3400	400	3800
BELT CONVEYOR.....	6900	1200	8100
BELT CONVEYOR.....	7500	1300	8800
PUMP.....	1900	100	2000
SURGE BIN.....	6800	300	7100
APRON FEEDER.....	5500	800	6300
SHREDDER.....	67000	9400	76400
SECONDARY SCREEN.....	2600	300	2900
BUCKET ELEVATOR.....	4300	600	4900
BELT CONVEYOR.....	5800	1000	6800
PUMP.....	1200	100	1300
SPIRAL CLASSIFIER.....	4500	400	4900
PUMP.....	1100	100	1200
BELT CONVEYOR.....	5200	900	6100
SURGE HOPPER.....	500	100	600
MIXING TANK.....	3000	300	3300
METERING PUMPS.....	1100	100	1200
SCALE.....	200	100	300
THICKENER.....	24300	2400	26700
PUMP.....	1900	100	2000
PUMPS.....	4300	100	4400
ROTARY VACUUM DRUM FILTER.....	33400	3300	36700
BELT CONVEYOR.....	2900	500	3400
STORAGE TANK.....	17000	1700	18700
PUMP.....	4000	200	4200
TOTAL.....	286800	37200	324000
FRONT END LOADER.....			8100
TOTAL EQUIPMENT COST X FACTOR INDICATED			
FOUNDATIONS, X .070.....			20100
BUILDINGS, X .250.....			71700
STRUCTURES, X .050.....			14300
INSTRUMENTATION, X .010.....			2900
ELECTRICAL, X .140.....			40200
PIPING, X .100.....			28700
PAINTING, X .010.....			2900
MISCELLANEOUS, X .100.....			28700
TOTAL.....			209500
TOTAL DIRECT COST.....			541600
FIELD INDIRECT, 10.0 PERCENT OF TOTAL DIRECT COST.....			54200
TOTAL CONSTRUCTION COST.....			595800
ENGINEERING, 5.0 PERCENT OF TOTAL CONSTRUCTION COST...			29800
ADMINISTRATION AND OVERHEAD, 5.0 PERCENT OF TOTAL			
CONSTRUCTION COST.....			29800
SUBTOTAL.....			655400
CONTINGENCY, 10.0 PERCENT OF ABOVE SUBTOTAL.....			65500
SUBTOTAL.....			720900
CONTRACTOR'S FEE, 5.0 PERCENT OF ABOVE SUBTOTAL.....			36000
SECTION COST.....			756900

(1) EQUIPMENT COSTS ARE BASED ON THE M AND S INDEX OF 386.1.

TABLE D-4.-EQUIPMENT COST SUMMARY, METAL RECOVERY SECTION
1000 TPD INCINERATOR RESIDUE PLANT--24 HOUR DAY

ITEM	COST(1)		
	EQUIPMENT	LABOR	TOTAL
MAGNETIC SEPARATOR.....	\$ 6900	\$ 700	\$ 7600
BELT CONVEYOR.....	9900	1800	11700
SURGE HOPPER.....	300	100	400
APRON FEEDER.....	3700	600	4300
BALER.....	79800	20000	99800
ROLLER CONVEYOR.....	2100	300	2400
CAR PULLER.....	2500	200	2700
HAMMERMILL.....	2700	400	3100
TERTIARY SCREEN.....	2100	300	2400
BELT CONVEYOR.....	5700	1000	6700
BELT CONVEYOR.....	7400	1300	8700
SURGE HOPPER.....	2600	100	2700
PUMP.....	1700	100	1800
MAGNETIC SEPARATOR.....	10100	1000	11100
BELT CONVEYOR.....	7400	1300	8700
SURGE HOPPER.....	300	100	400
SPIRAL CLASSIFIER.....	5800	600	6400
PUMP.....	900	100	1000
TOTAL.....	151900	30000	181900
CRANE.....			(2) 6600
TOTAL EQUIPMENT COST X FACTOR INDICATED			
FOUNDATIONS, X .070.....			10600
BUILDINGS, X .250.....			38000
STRUCTURES, X .100.....			15200
INSTRUMENTATION, X .010.....			1500
ELECTRICAL, X .140.....			21300
PIPING, X .100.....			15200
PAINTING, X .010.....			1500
MISCELLANEOUS, X .100.....			15200
TOTAL.....			118500
TOTAL DIRECT COST.....			307000
FIELD INDIRECT, 10.0 PERCENT OF TOTAL DIRECT COST.....			30700
TOTAL CONSTRUCTION COST.....			337700
ENGINEERING, 5.0 PERCENT OF TOTAL CONSTRUCTION COST...			16900
ADMINISTRATION AND OVERHEAD, 5.0 PERCENT OF TOTAL CONSTRUCTION COST.....			16900
SUBTOTAL.....			371500
CONTINGENCY, 10.0 PERCENT OF ABOVE SUBTOTAL.....			37100
SUBTOTAL.....			408600
CONTRACTOR'S FEE, 5.0 PERCENT OF ABOVE SUBTOTAL.....			20400
SECTION COST.....			429000

(1) EQUIPMENT COSTS ARE BASED ON THE M AND S INDEX OF 386.1.

(2) INSTALLED COST.

TABLE D-5.-EQUIPMENT COST SUMMARY, GLASS RECOVERY SECTION
1000 TPD INCINERATOR RESIDUE PLANT--24 HOUR DAY

ITEM	COST(1)		
	EQUIPMENT	LABOR	TOTAL
HARZ JIG.....	\$ 45600	\$ 4600	\$ 50200
PUMP.....	1800	100	1900
BELT CONVEYOR.....	6700	1200	7900
ROLL CRUSHER.....	9800	1000	10800
VIBRATING SCREEN.....	2400	300	2700
BELT CONVEYOR.....	7400	1300	8700
PUMP.....	2800	100	2900
SPIRAL CLASSIFIER.....	5800	600	6400
PUMP.....	3400	100	3500
MINERAL JIG.....	9800	1000	10800
PUMP.....	1500	100	1600
PUMP.....	1900	100	2000
VIBRATING SCREEN.....	3000	400	3400
PUMP.....	1800	100	1900
ROLL CRUSHER.....	8800	900	9700
VIBRATING SCREEN.....	3900	500	4400
PUMP.....	2400	100	2500
MATRIX SEPARATOR.....	112200	11200	123400
PUMP.....	1500	100	1600
PUMP.....	2400	100	2500
SPIRAL CLASSIFIER.....	5000	500	5500
PUMP.....	2700	100	2800
FLOTATION UNIT.....	22500	2200	24700
PUMP.....	1700	100	1800
VIBRATING SCREEN.....	2000	200	2200
PUMP.....	500	100	600
BELT CONVEYOR.....	7000	1300	8300
GLASS DRYER.....	66200	10600	76800
HOPPER.....	200	100	300
SCREW FEEDER.....	1100	200	1300
CYCLONE DUST COLLECTOR.....	3700	400	4100
BELT CONVEYOR.....	10400	1900	12300
STORAGE BIN.....	10600	500	11100
TOTAL.....	368500	42100	410600
TOTAL EQUIPMENT COST X FACTOR INDICATED			
FOUNDATIONS, X .070.....			25800
BUILDINGS, X .250.....			92100
STRUCTURES, X .100.....			36800
INSTRUMENTATION, X .010.....			3700
ELECTRICAL, X .140.....			51600
PIPING, X .100.....			36800
PAINTING, X .010.....			3700
MISCELLANEOUS, X .100.....			36800
TOTAL.....			287300
TOTAL DIRECT COST.....			697900
FIELD INDIRECT, 10.0 PERCENT OF TOTAL DIRECT COST.....			69800
TOTAL CONSTRUCTION COST.....			767700
ENGINEERING, 5.0 PERCENT OF TOTAL CONSTRUCTION COST...			38400
ADMINISTRATION AND OVERHEAD, 5.0 PERCENT OF TOTAL			
CONSTRUCTION COST.....			38400
SUBTOTAL.....			844500
CONTINGENCY, 10.0 PERCENT OF ABOVE SUBTOTAL.....			84400
SUBTOTAL.....			928900
CONTRACTOR'S FEE, 5.0 PERCENT OF ABOVE SUBTOTAL.....			46400
SECTION COST.....			975300

(1) EQUIPMENT COSTS ARE BASED ON THE M AND S INDEX OF 386.1.

**TABLE D-6.--EQUIPMENT COST SUMMARY,
NONFERROUS METALS UPGRADING SECTION
1000 TPD INCINERATOR RESIDUE PLANT--24 HOUR DAY**

ITEM	CCST(1)		
	EQUIPMENT	LABOR	TOTAL
HEAVY-MEDIUM SEPARATOR.....	\$ 6000	\$ 1200	\$ 7200
SINK DRAINAGE SCREEN.....	1400	200	1600
SINK WASHING SCREEN.....	1600	200	1800
FLOAT DRAINAGE SCREEN.....	1400	200	1600
FLOAT WASHING SCREEN.....	1600	200	1800
DILUTE MEDIUM SUMP.....	900	100	1000
MAGNETIC FLOCCULATOR.....	200	100	300
MAGNETIC SEPARATOR.....	5400	500	5900
PUMP.....	500	100	600
DENSIFIER.....	3700	400	4100
STORAGE TANK.....	1400	100	1500
PUMP.....	500	100	600
DENSE MEDIUM SUMP.....	4500	200	4700
PUMP.....	1500	100	1600
BELT CONVEYOR.....	5100	900	6000
BELT CONVEYOR.....	5100	900	6000
DEMAGNETIZING COIL.....	200	100	300
TOTAL.....	41000	5600	46600
TOTAL EQUIPMENT COST X FACTOR INDICATED			
FOUNDATIONS, X .070.....			2900
BUILDINGS, X .250.....			10300
STRUCTURES, X .050.....			2000
INSTRUMENTATION, X .010.....			400
ELECTRICAL, X .140.....			5700
PIPING, X .100.....			4100
PAINTING, X .010.....			400
MISCELLANEOUS, X .100.....			4100
TOTAL.....			29900
TOTAL DIRECT COST.....			76500
FIELD INDIRECT, 10.0 PERCENT OF TOTAL DIRECT COST.....			7600
TOTAL CONSTRUCTION COST.....			84100
ENGINEERING, 5.0 PERCENT OF TOTAL CONSTRUCTION COST...			4200
ADMINISTRATION AND OVERHEAD, 5.0 PERCENT OF TOTAL CONSTRUCTION COST.....			4200
SUBTOTAL.....			92500
CONTINGENCY, 10.0 PERCENT OF ABOVE SUBTOTAL.....			9200
SUBTOTAL.....			101700
CONTRACTOR'S FEE, 5.0 PERCENT OF ABOVE SUBTOTAL.....			5100
SECTION COST.....			106800

(1) EQUIPMENT COSTS ARE BASED ON THE M AND S INDEX OF 386.1.

TABLE D-7.-DIRECT LABOR REQUIREMENTS,
1000 TPD INCINERATOR RESIDUE PLANT--24 HOUR DAY

SECTION AND ITEM	DIRECT LABOR ASSIGNMENT			
	NUMBER OF MEN	SHIFTS PER DAY	DAYS PER WEEK	TOTAL MEN REQUIRED
PRIMARY SEPARATION AND WATER RECOVERY SECTION				
FRONT END LOADER.....	1.0	3	5	3.0
TROMMEL.....	2.0	3	5	6.0
SHREDDER.....	1.0	3	5	3.0
SUBTOTAL.....				12.0
METAL RECOVERY SECTION				
BALER.....	1.0	3	5	3.0
CRANE.....	1.0	3	5	3.0
HAMMERMILL.....	1.0	3	5	3.0
SUBTOTAL.....				9.0
GLASS RECOVERY SECTION				
HARZ JIG.....	1.0	3	5	3.0
SUBTOTAL.....				3.0
NONFERROUS METALS UPGRADING SECTION				
HEAVY-MEDIUM SEPARATOR.....	1.0	1	5	1.0
SUBTOTAL.....				1.0
TOTAL.....				25.0

TABLE D-8.--ESTIMATED ANNUAL OPERATING COST,
1000 TPD INCINERATOR RESIDUE PLANT--24 HOUR DAY

	ANNUAL COST	COST PER TON INCINERATOR RESIDUE
DIRECT COST		
RAW MATERIALS		
INCINERATOR RESIDUE		
AT \$.00 PER TON.....	\$ 0	\$.00
FLOCCULANT AT \$1.70 PER POUND.....	8100	.03
FLOTATION REAGENT		
AT \$.67 PER POUND.....	14600	.06
FERROSILICON AT \$.16 PER POUND.....	400	.01
TOTAL.....	23100	.10
UTILITIES		
ELECTRIC POWER AT 1 CENT PER KWHR...	31800	.12
WATER, PROCESS AT 50 CENTS PER MGAL.	8500	.03
NATURAL GAS AT 80 CENTS PER MMBTU...	26600	.10
TOTAL.....	66900	.25
DIRECT LABOR		
LABOR AT \$5.00 PER HOUR.....	260000	1.00
SUPERVISION, 25 PERCENT OF LABOR....	65000	.25
TOTAL.....	325000	1.25
PLANT MAINTENANCE		
LABOR.....	55000	.21
SUPERVISION, 25 PERCENT OF		
MAINTENANCE LABOR.....	13800	.05
MATERIALS.....	45800	.18
TOTAL.....	114600	.44
PAYROLL OVERHEAD, 25 PERCENT OF		
ABOVE PAYROLL.....	98500	.38
OPERATING SUPPLIES, 20 PERCENT OF		
PLANT MAINTENANCE.....	22900	.09
TOTAL DIRECT COST.....	651000	2.51
INDIRECT COST, 20 PERCENT OF		
DIRECT LABOR AND MAINTENANCE.....	87900	.34
FIXED COST		
INSURANCE, 1.0 PERCENT OF TOTAL		
PLANT COST.....	26300	.10
DEPRECIATION, 20 YEAR LIFE.....	131500	.51
TOTAL OPERATING COST.....	896700	3.46

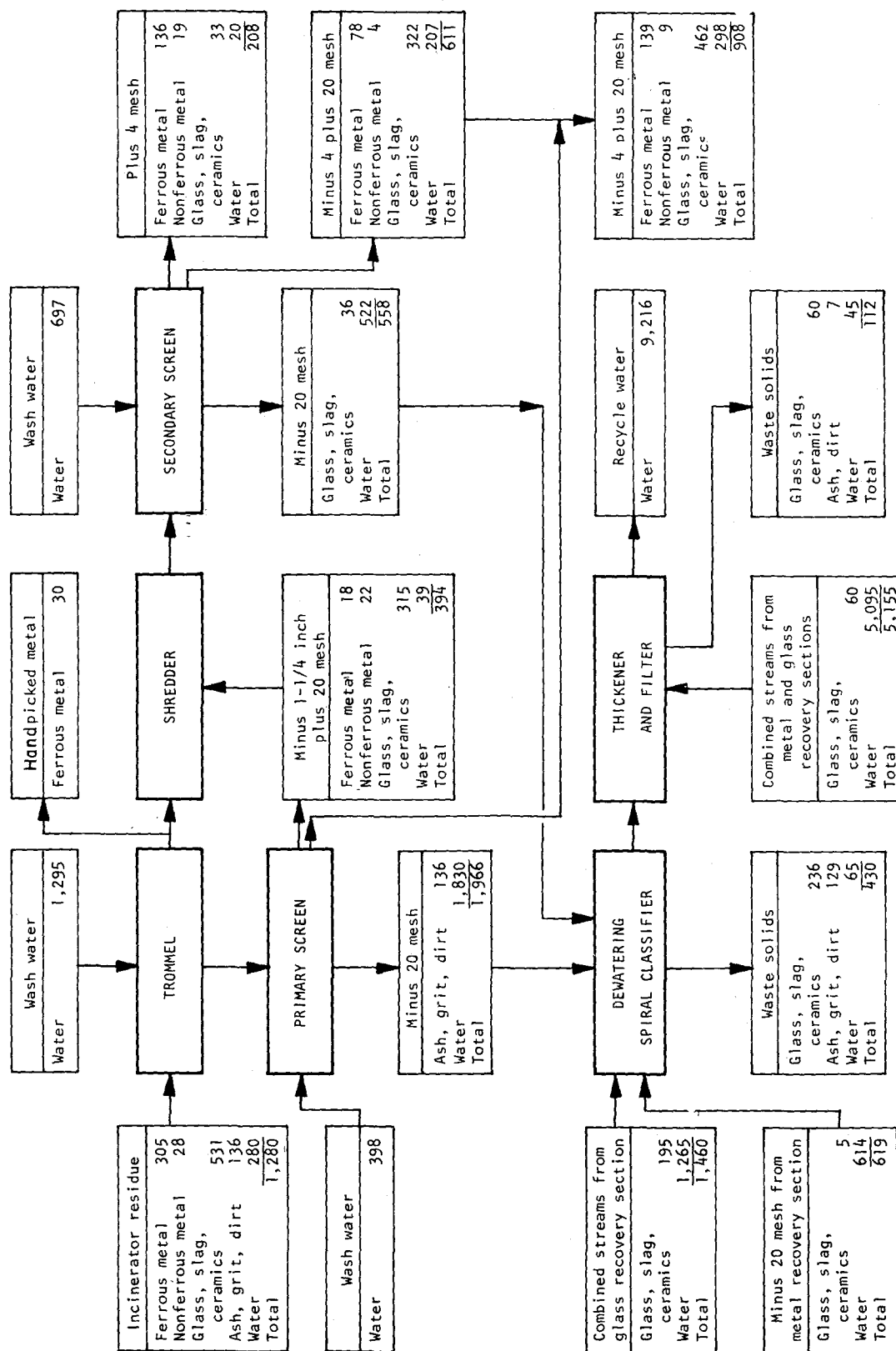


FIGURE D-1. - Material balance, primary separation and water recovery section, tons per day.

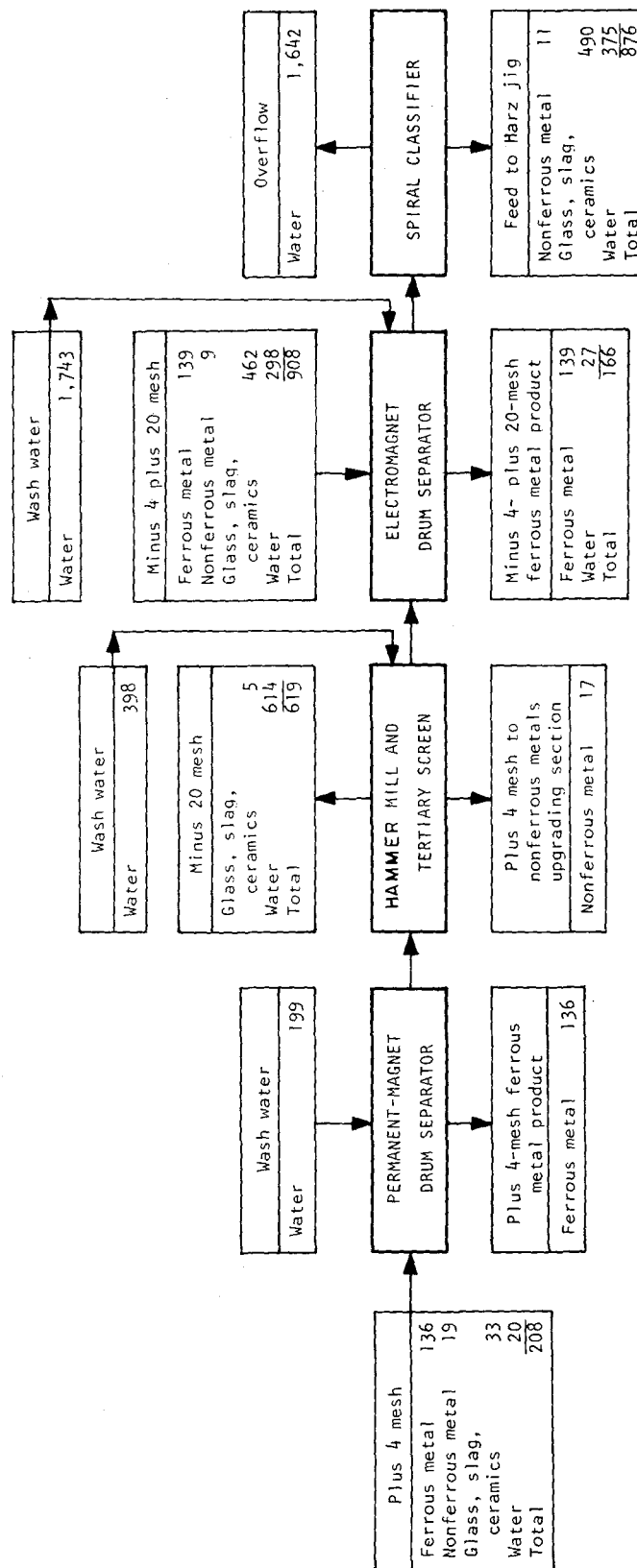


FIGURE D-2. - Material balance, metal recovery section, tons per day.

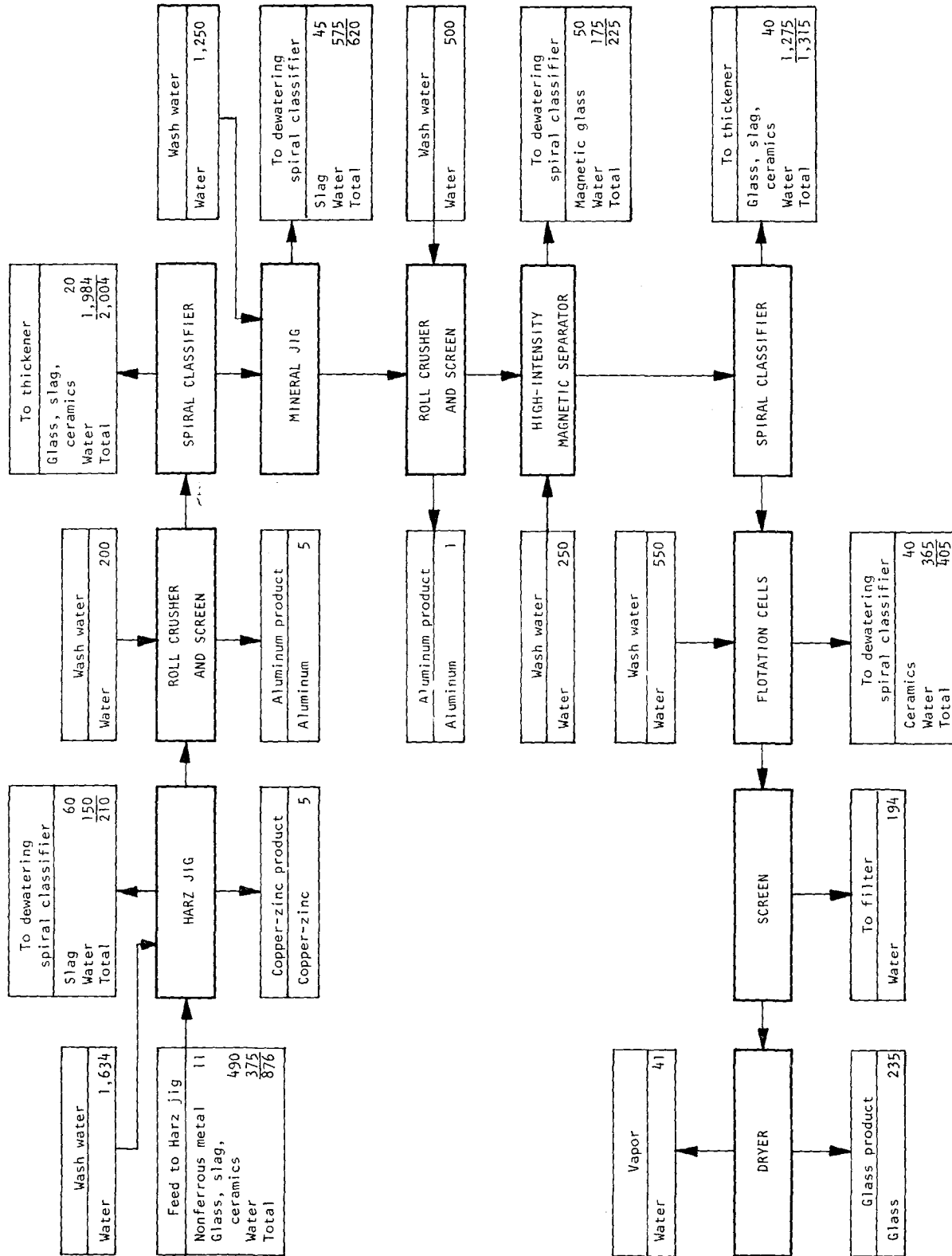


FIGURE D-3. - Material balance, glass recovery section, tons per day.

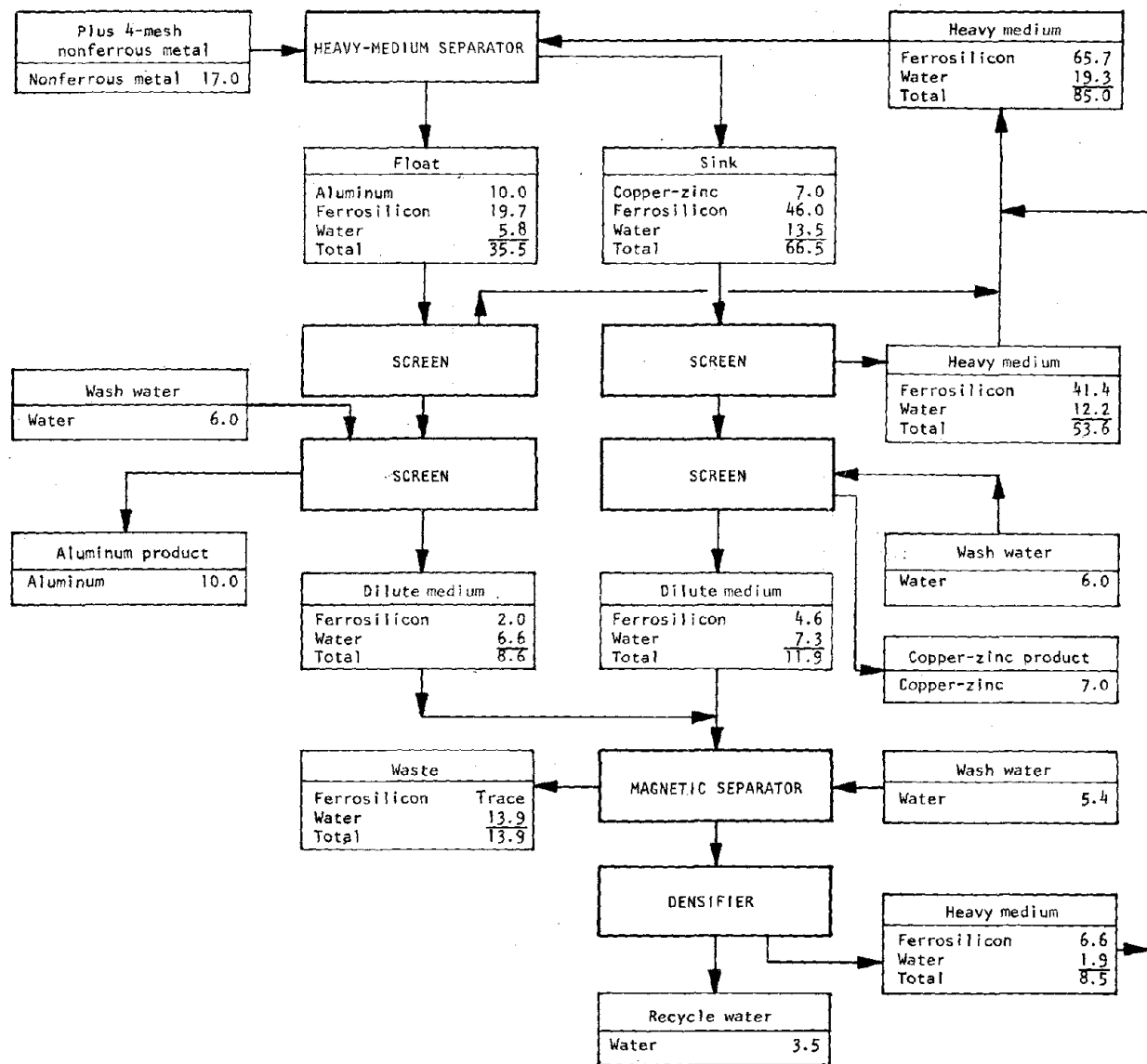


FIGURE D-4. - Material balance, nonferrous metals upgrading section, tons per day.