

5.2. UNDERGROUND MINING--OPERATING COSTS

5.2.6. GENERAL EXPENSE
ADMINISTRATIVE COSTS

The general expense curve for underground mining administrative salaries and wages is intended to cover the supervision and various other administrative functions required for underground mines of varying sizes. The number of administrative employees varies from 3 to 4 persons at a smaller mine (100-300 mtpd) to as many as 40 or more in large mines (7,000 mtpd and up). The total daily cost is the sum of three cost curves (labor, supplies, and equipment operation) based on a production rate (X), in metric tons ore per day. The curves are valid for operations between 100 to 50,000 mt, operating two shifts per day.

5.2.6.1. ADMINISTRATIVE SALARIES AND WAGES

BASE CURVE

(L) Administrative Salaries and Wages $(Y_L) = 33.293(X)^{0.586}$

The operating labor costs consist of the following typical range of personnel:

	Small (100 to 7,000 mtpd)	Large (7,000 to 50,000 mtpd)	Av salary per hour (base rate)
Supervision; mine, maintenance....	54%	55%	\$23.72
Clerical; secretarial, accounting.	13%	10%	\$12.84
Engineering and geology.....	21%	12%	\$23.70
Assaying.....	8%	9%	\$16.62
Purchasing, warehousing.....	2%	11%	\$16.66
Safety, first aid, security.....	2%	3%	\$20.70

Average administrative labor cost is \$20.95 per worker-hour (including burden and average shift differential).

ADJUSTMENT FACTOR

Burden Factor If the burden is other than 32%, multiply the cost obtained from the curve by the following factor:

Burden factor $(F_L) = [(1+B)/(1.32)]$
where B = known burden expressed as a decimal.

5.2.6.2. ADMINISTRATIVE PURCHASES

Daily operating costs for administrative supplies include the mine's portion of electric power and heating bill for office, assay laboratory, repair shops, and warehouses; supplies for assaying mine samples; and telephone, postage, and stationary costs. Costs also included are engineering, first aid, and safety supplies; travel and entertainment expenses; miscellaneous fees, dues, and donations; and small tool replacement costs.

BASE CURVE

(S) Administrative Purchases $(Y_S) = 33.238(X)^{0.380}$

The supply cost consists of

Electrical power and heat.....	51%
Mine sample assaying.....	24%
Telephone, postage, and stationary.....	6%
Engineering, first aid, and safety supplies...	5%
Travel and entertainment.....	9%
Miscellaneous fees, due, and donations.....	2%
Small tools.....	3%

5.2.6.3. ADMINISTRATIVE EQUIPMENT OPERATION

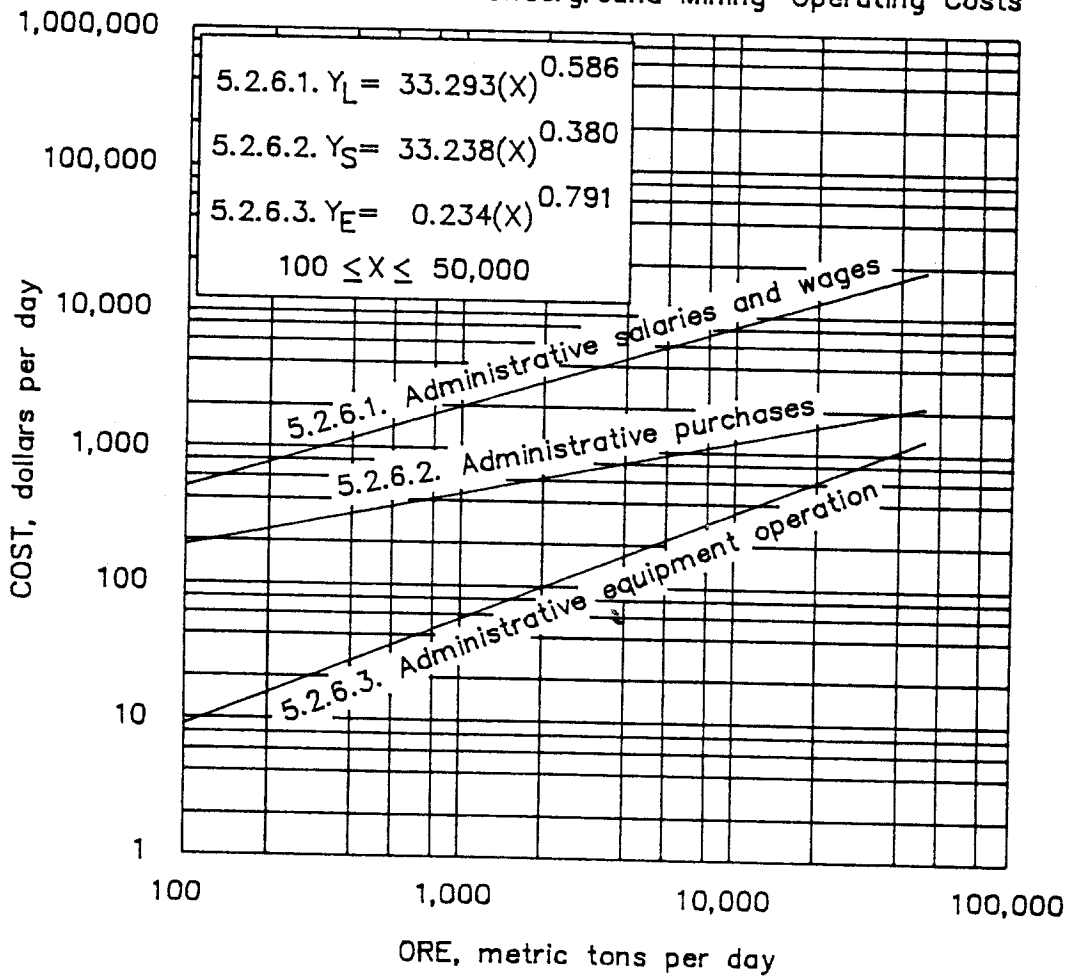
Administrative equipment operating costs include the expense for operation of vehicles and equipment used by the administrative and warehousing staff such as pickup, crew cab, flatbed trucks, and forklifts.

BASE CURVE

(E) Administrative Equipment Operation $(Y_E) = 0.234(X)^{0.791}$

The equipment operating cost consists of 3% for repair and overhaul parts, 93% for fuel and lubrication, and 4% for tires.

Underground Mining—Operating Costs



5.2.6.1.-3. General expenses
ADMINISTRATIVE SALARIES AND WAGES
ADMINISTRATIVE PURCHASES
ADMINISTRATIVE EQUIPMENT OPERATION

5.2. UNDERGROUND MINING--OPERATING COSTS

5.2.7. INFRASTRUCTURE

5.2.7.3. TOWNSITE-CAMPSITE

CAMPSITE

Where conditions such as remote location or seasonal operation require a single status-campsite (i.e., room, board, and recreation facility), the daily operating cost should be derived from the following base cost curve. Today a caterer is usually employed to provide board, housekeeping, and recreation supervision. Heat, lights, garbage disposal, and plant maintenance are usually provided by the owner.

BASE CURVE

The total daily cost is derived from the supply curve based on the total number of persons who occupy the campsite (X). The curve is valid for campsites occupied by 20 to 1,000 persons. All persons receive both room and board.

$$(S) \text{ Supply Operating Cost } (Y_S) = 37.143(X)^{0.897}$$

	Small (20 to 450 persons)	Large (450 to 1,000 persons)
Board.....	61.5%	59.0%
Housekeeping and recreation.	23.9%	23.0%
Heat.....	6.4%	9.0%
Light.....	2.4%	3.4%
Maintenance.....	5.8%	5.6%

If the number of persons requiring board varies from the number of persons requiring room, use the following equation:

$$(S) \text{ Supply Operating Cost } (Y_S) = [37.143(X)^{0.897}][0.60(B/R)+0.40(R)]$$

where B = number of persons requiring board only,
and R = number of persons requiring room only.

These curves are based on a caterer who provides all necessary personnel for food service, housekeeping, distribution and collection of mail, monitoring recreation, etc., and all necessary supplies, such as pots, pans, dishes, silverware, sheets, pillowcases, blankets, waste cans, recreation supplies, janitorial supplies, food, etc. The evaluator must add the cost for local, State, or Federal taxes where required.

ADJUSTMENT FACTORS

Owner-Operator Factor When the facility is owner-operated rather than catered, multiply the cost obtained from the curve by the following factor:

$$\text{Owner-operator factor } (F_0) = 0.93$$

Diesel Power Factor When the electric power is provided by a diesel-electric system rather than a power line grid, multiply the cost obtained from the curve by the following factor:

$$\text{Diesel power factor } (F_D) = 1.04$$

TRAILER COURT

Where conditions such as remote location or lack of available housing require installation of a family trailer court complete with utilities, laundromat, recreation facilities, blacktop driveway, and possibly swimming pool, the daily operating cost should be derived from the following two curves. The total daily cost is derived from the supply curve, based on the total number of trailer spaces, (X), required. The curve is valid for trailer courts with 20 to 1,000 units.

BASE CURVE

The curves are based on trailer and facility maintenance, insurance, casualty insurance, supervisory and worker wages, plus overhead, heat, and lights.

(S) Supply Operating Cost $(Y_S \text{ FREE}) = 49.514(X)^{0.590}$
Company-owned mobile homes, spaces, and facilities where the trailers and spaces are free to supervisors and workers. The company pays all operating costs on the facility.

(S) Supply Operating Cost $(Y_S \text{ RENTED}) = 1,676.049(X)^{-0.716}$
Company-owned mobile homes, spaces, and facilities where the trailers and spaces are rented to supervisors and workers. The company pays for any loss on the facility.

ADJUSTMENT FACTORS

Swimming Pool Factor When the trailer court does not provide a swimming pool, multiply the curve $(Y_S \text{ FREE})$ by the following factor:

$$\text{Swimming pool factor } (F_P \text{ FREE}) = 0.82$$

When the spaces and trailers are rented and the trailer court has 52 or more units it will show a profit. If there are less than 52 units, multiply the curve $(Y_S \text{ RENTED})$ by the following factor:

$$\text{Swimming pool factor } (F_P \text{ RENTED}) = 0.05$$

Trailer Space Rental Factor When the occupants rent trailer space for their own trailers, multiply the curve $(Y_S \text{ FREE})$ by the following factor:

$$\text{Trailer space rental factor } (F_R \text{ FREE}) = 0.36$$

PERMANENT HOUSING

Company totally owned and operated townsites are decreasing in number because of their high cost and persistent social problems. The trend seem to be toward small family housing facilities combined with an existing nearby city.

Large townsite permanent housing:

Today, the military appears to be the greatest user of this type of facility. The Air Force provides housing to its officers and enlisted personnel. The Government pays for housing and facility maintenance, all utilities, supervisor, and worker labor, etc. The average operating costs for 1983 were:

McCord Air Base - 993 units: \$6.66 per day per unit.

Fairchild Air Base - 1,580 units: \$6.93 per day per unit.

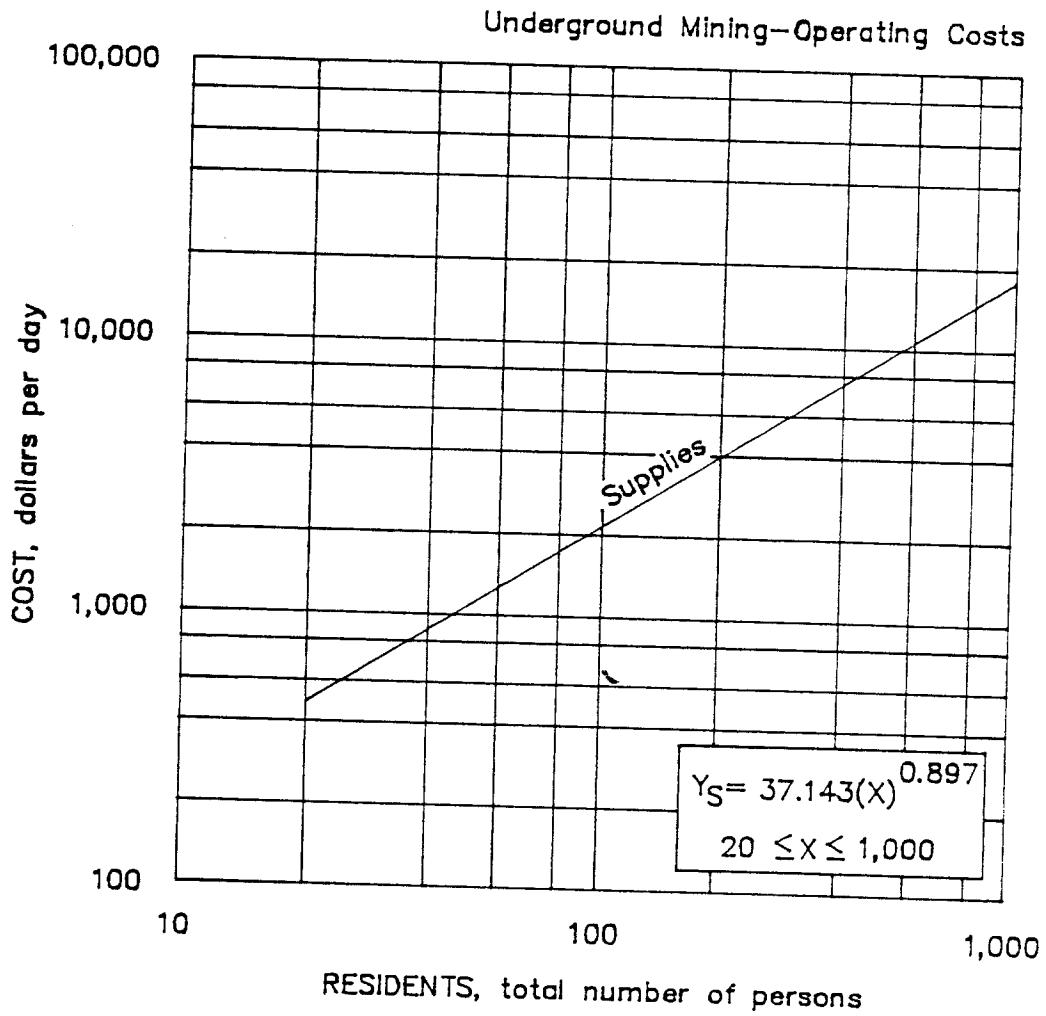
Small townsite permanent housing

These facilities are generally rented to their occupants at a modest fee with the company paying for the general maintenance, insurance, and taxes. Rent is applied to the capital investment. A new housing facility (175 family units) in the western United States, cost the company \$0.98 per day per unit to maintain.

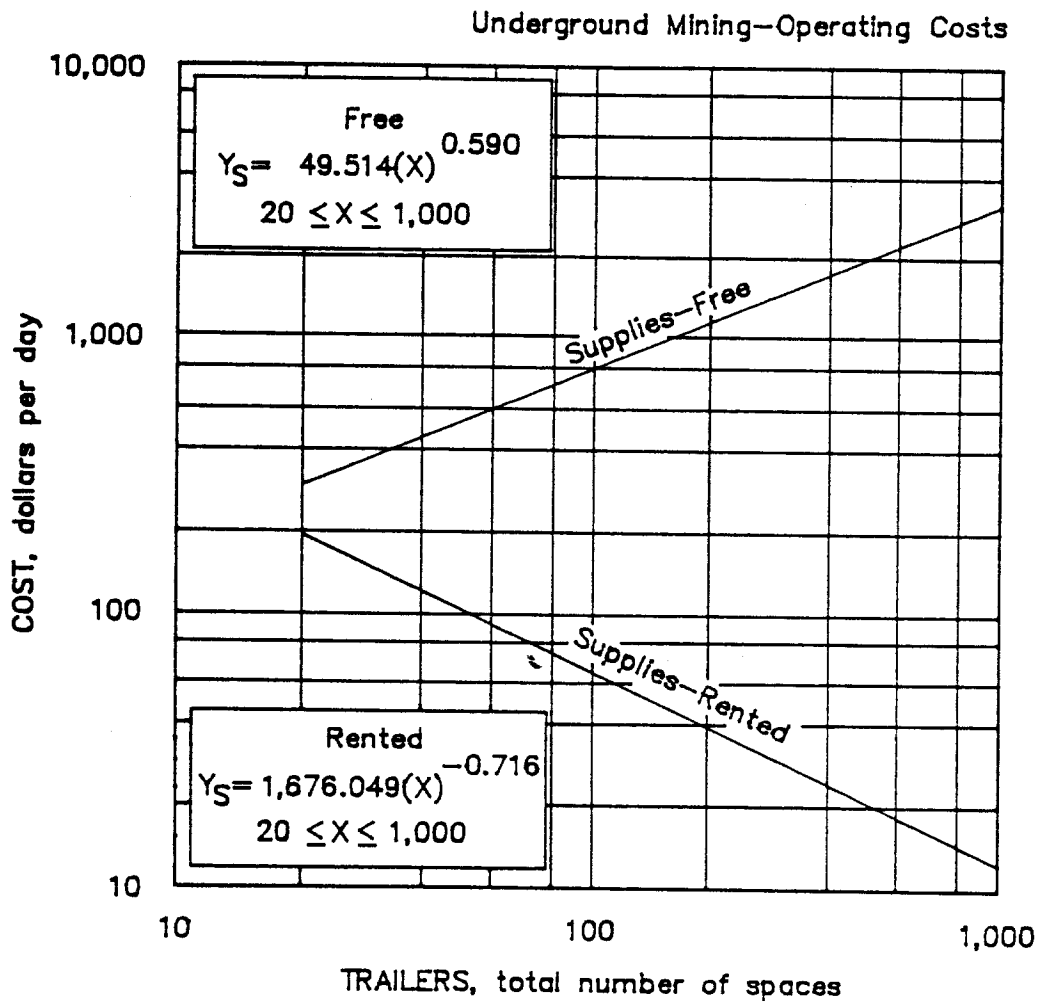
BASE CURVE

The total daily cost is derived from the supply curve based on the total number of housing units, (X), required. The curve is valid for 140 to 1,900 housing units.

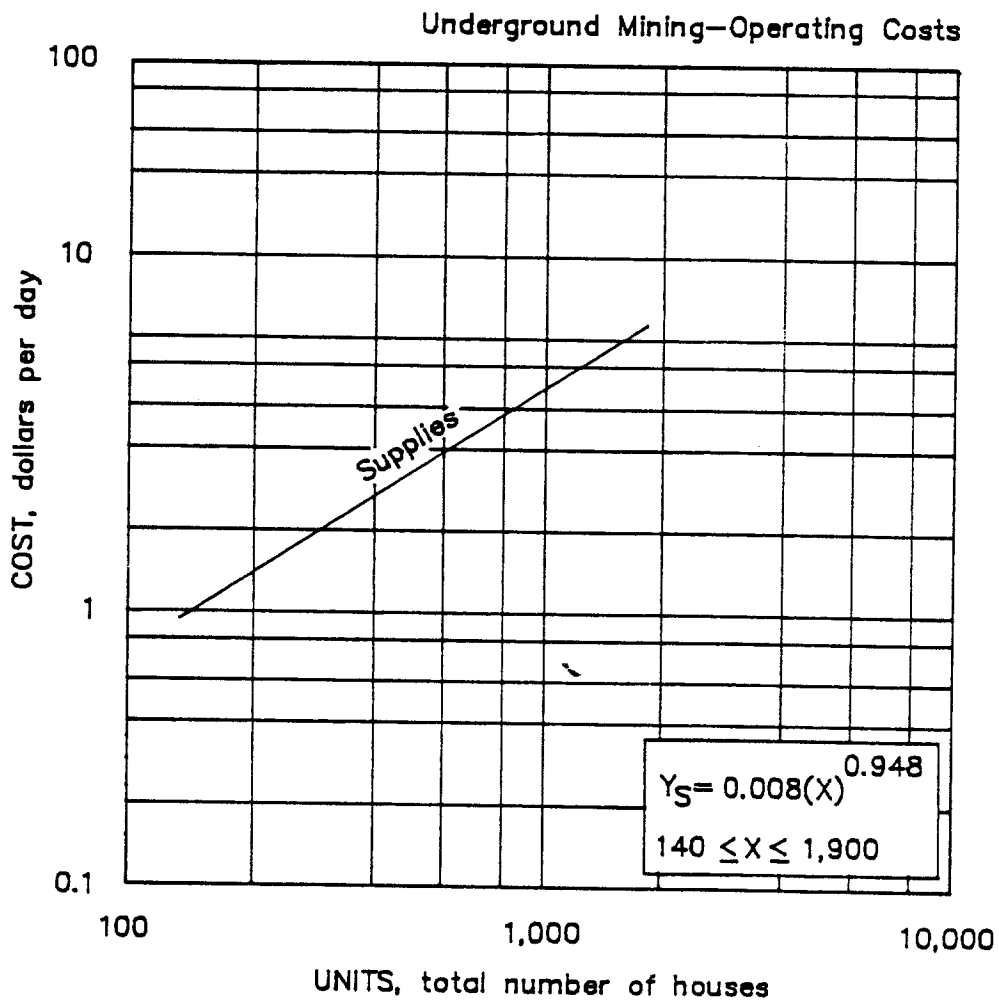
$$(S) \text{ Supply Operating Cost } (Y_S) = 0.008(X)^{0.948}$$



5.2.7.3.a Townsite-Campsite
CAMPSITE



5.2.7.3.b Townsite-Campsite
TRAILER COURT



5.2.7.3.c Townsite-Campsite
PERMANENT HOUSING

5.2. UNDERGROUND MINING--OPERATING COSTS

5.2.7. INFRASTRUCTURE

5.2.7.4.1. WASTEWATER TREATMENT
CLARIFICATION

This operation is a solids-contact clarifier used for water clarification by precipitation and/or coagulation. This cost curve is intended to remove suspended solids formed after final neutralization of out-of-pipe effluent. The curves include all principal costs associated with the operation of the unit. It does not include costs for sludge removal. The unit can selectively or simultaneously remove turbidity, color, organic matter, manganese, iron, alkalinity, taste, and odor.

The total daily cost is the sum of three separate cost curves (labor, supplies, and equipment operation) based on a tank diameter (X), in meters. The curves are valid for tank diameters between 2.74 to 45.72 m (cross-sectional area ranging from 5.9 to 1,642 m²), operating three shifts per day. Costs are based on an overflow rate of 0.377 (L/s)/m².

BASE CURVES

(L) Labor Operating Cost $(Y_L) = 38.931(X)^{0.119}$

The operating labor costs are distributed as follows:

Direct labor.....	100%
Maintenance labor.....	0%

The labor costs consist of the following typical range of personnel:

	Small (5.72 to 75 m)	Large (75 to 1,661 m)	Av salary per hour (base rate)
Laborer.....	60%	54%	\$13.66
Laboratory.....	40%	46%	15.89

Average wage for labor is \$14.43 per worker-hour (including burden and average shift differential).

(S) Supply Operating Cost $(Y_S) = 1.083(X)^{0.633}$

The supply curve consists of electric power and maintenance supplies.

	Small (5.72 to 75 m)	Large (75 to 1,661 m)
Electric.....	60%	34%
Maintenance.....	40%	66%

(E) Equipment Operating Cost $(Y_E) = 0.505(X)^{1.064}$

The equipment operation curve consists of 100% for repair parts and covers the daily operation cost for all clarification equipment.

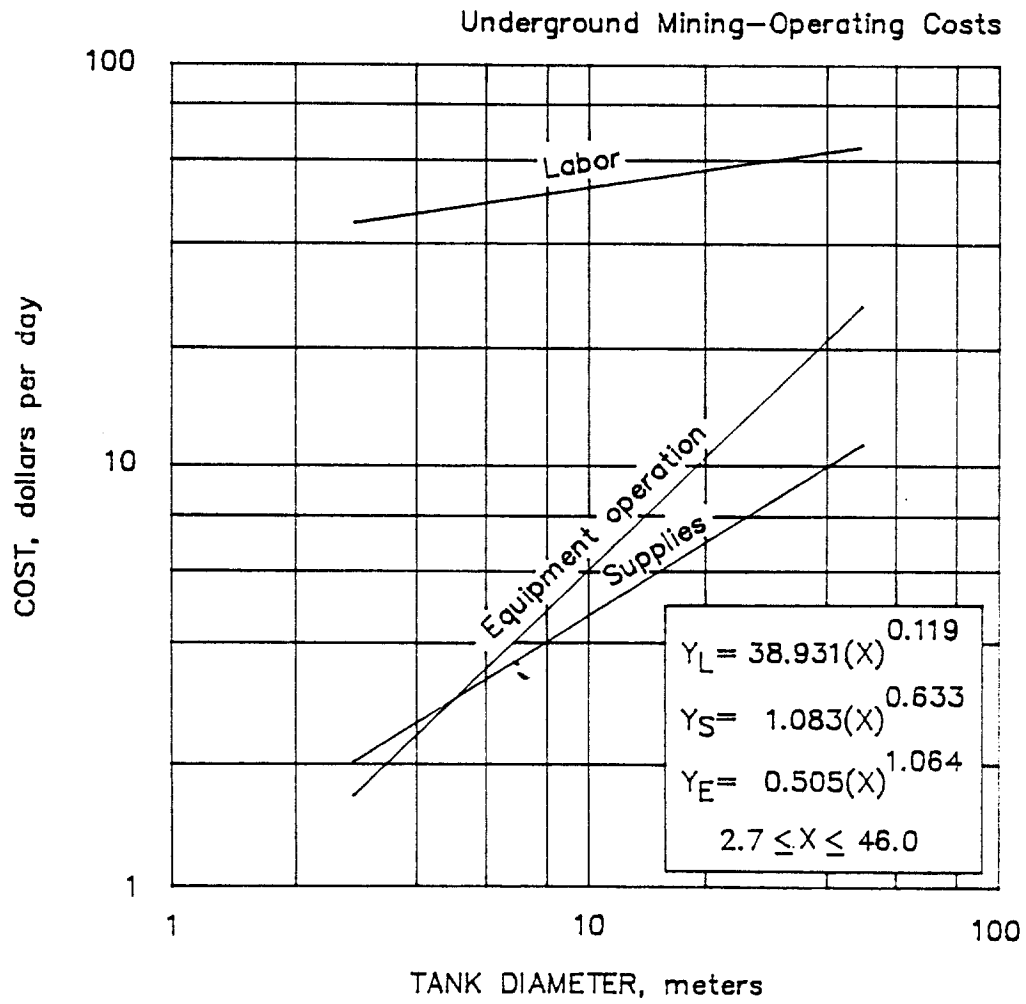
ADJUSTMENT FACTOR

Flocculant Factor Normally, additional flocculants are not needed in the mine waste water treatment after neutralization. However, if polymers are needed or used, add the following factor to the supply cost obtained from the curve:

$$\text{Supply factor } (F_s) = 0.334(D)^{1.812}$$

where D = clarifier tank diameter, in meters.

The polymer is based on a standard dosage of 1.5 mg/L influent and an average polymer cost of 2.10/lb.



5.2.7.4.1. Wastewater treatment
CLARIFICATION

5.2. UNDERGROUND MINING--OPERATING COSTS

5.2.7. INFRASTRUCTURE

5.2.7.4.2. WASTEWATER TREATMENT
NEUTRALIZATION

The Environmental Protection Agency's publication EPA-600/2-82-00/d "Treatability Manual, Vol. IV, Cost Estimating," April 1983, was the source of cost development. One is referred to this manual if further detail in neutralization costs is needed. Additionally, other waste water treatment methods are costed in this EPA manual.

The operating cost curves are used when neutralization of waste water effluent (out-of-pipe) is required. The basic design variable is waste water flow. It is assumed that flow equalization is provided by a tailings pond. The costs apply to the neutralization of either acidic or basic wastewater streams originating from mine, mill, or combined mine and mill after it flows out-of-pipe from the central impoundment pond. In most mining operations further waste water treatment costs are not required. The system consists of chemical addition and two-stage neutralization tanks. It is assumed that pH and suspended-dissolved solid content of influent to the system will be unknown at this level of costing. Basis of design uses a standard dosage of 100 mg/L lime and 100 mg/L acid to achieve a pH of 7.0 over a pH range of 6.5 to 8.0.

BASE CURVES

The total daily cost is the sum of three cost curves (labor, supplies, and equipment operation) based on the waste water flow rate (X), in liters of effluent to be treated per second per day. The curves are valid for operations between 0.001 to 876 L/s (22.8 gal to 20 million gal/d), operating three shifts per day. The curves include all costs associated with the operation of a neutralization system such as labor, lime, acid, power, service water, and laboratory expenses.

(L) Labor Operating Costs $(Y_L) = 84.85(X)^{0.000}$

The operating labor costs are distributed as follows:

Direct labor.....	100%
Maintenance labor.....	0%

The labor costs consist of the following typical range of personnel:

		Av salary per hour (base rate)
Laborer.....	89%	<u>\$15.80</u>
Laboratory.....	11%	15.80

The average labor cost is \$15.80 per worker-hour (including burden and average shift differential).

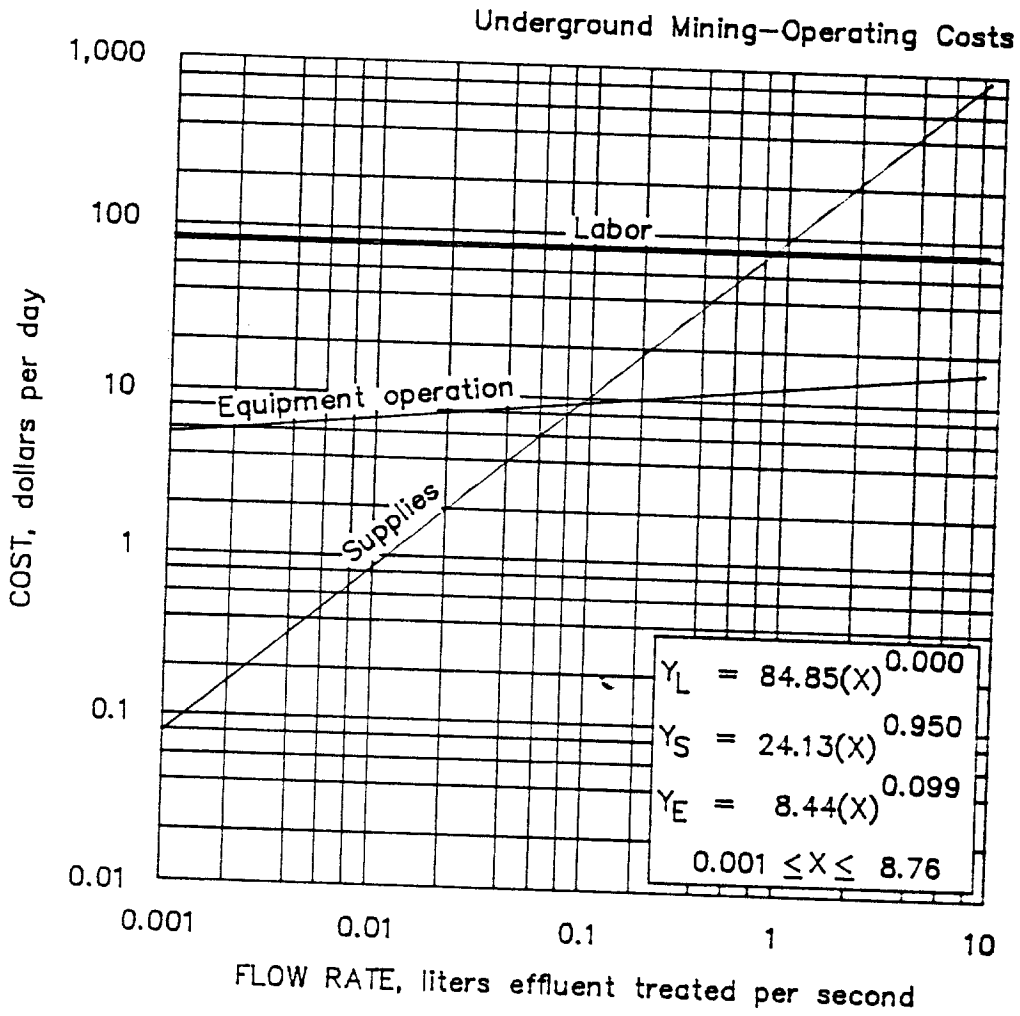
(S) Supply Operating Costs $(Y_S 0.001-8.76 \text{ L/s}) = 24.13(X)^{0.950}$
 $(Y_S 8.76-876 \text{ L/s}) = 21.282(X)^{0.997}$

The supply costs consists of electric power, water, and chemicals and lime in the following proportions:

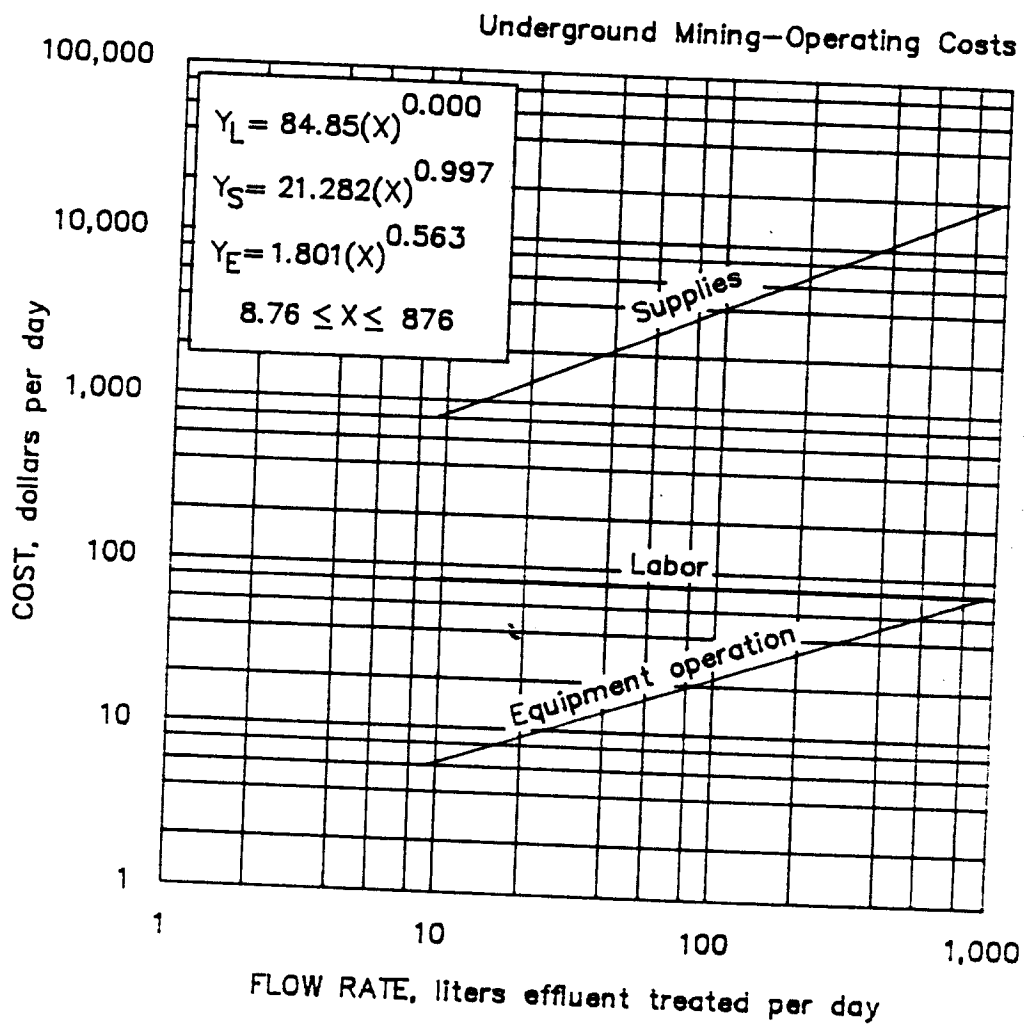
	Small (0 to 8.76 L/s)	Large (8.76 to 876 L/s)
Electric power.....	3%	2%
Water.....	80%	89%
Chemicals and lime.....	17%	9%

(E) Equipment Operating Costs $(Y_E 0.001-8.76 \text{ L/s}) = 8.44(X)^{0.099}$
 $(Y_E 8.76-876 \text{ L/s}) = 1.801(X)^{0.563}$

The equipment operation curve consists of 100% for repair parts and covers the daily operation cost for all neutralization equipment.



5.2.7.4.2.a Wastewater treatment
NEUTRALIZATION



5.2.7.4.2.b Wastewater treatment
NEUTRALIZATION