1903

A design of an ore dressing plant

Arthur Ignatius D'Arcy

Department: Mining Engineering

T H E S I S

for the

D E G R E E

of

BACHELOR OF SCIENCE IN MINE ENGINEERING

Subject.

A DESIGN OF AN ORE DRESSING PLANT.

A.I.D'Arcy.

A DESIGN

OF AN

ORE DRESSING PLANT.

The ore.

The ore consists of ten percent zinc blond, two percent galena, one percent marcosite and eight-seven percent calcite.

The ore will contain on an average thirty percent fines(Pieces smaller than one inch in diamter) The valuable mineral is disseminated through the rock and the size of the largest grain of pure mineral will not exceed a diameter of six millimeters.

The Building.

The structure will be mainly of timber, covered with corrugated iron on the roof and sides.

Capacity.

The capacity of the mill is to be 200 tons of ore in twenty-four hours.

Crushing.

With the above data given the first problem to present itself is the size of ore to be crushed in order to separate the minerals.

Fine crushing is to be avoided as it produces a larger amount of slimes and a consequent loss of valuable mineral.

However on account of the dissemination of mineral, the ore will have to be crushed to pass a six millimeter ring (The size of the largest grain of pure mineral being six millimeters in diameter).

Having crushed all the ore to pass a six millimeter ring, the next question is to find the size mesh necessary for the next screen in order that the valuable mineral shall be separated from the lighter or worthless portion.

The velocity of a body in a given medium is expressed by the formula

$$V \pm C\sqrt{d(\delta - m)}$$

Where d is the diameter of the body

" V " " velocity

" C " a constant depending on size

" δ " the specific gravity of the body

" m " the medium being unity for water

Now we see that if we have two bodies of the same size but differing in specific gravity, falling in water, the velocity of one will be greater than that of the other and thus a separation is effected.

The formula expressing the relation of bodies having the same velocity is

$$\frac{d}{d_1} = \frac{\delta_1 - 1}{\delta - 1}$$

δ + δ being the specific gravity of the bodies

d + d being the corresponding diameter of the bodies.

The specific gravity of galena is				2.5	?
"	"	"	" Marcosite is	4.75	
"	"	"	" zinc blend is	4.00	
"	"	"	" calcite	2.6	

The diameter of the largest pieces of ore that enter the screens are six millimeters in diameter.

We wish to find the mesh of the next screens. This is obtained by using the above formula and it is thus found that in order to obtain a separation of the galena from the other material, the second screen must have a mesh of four millimeters and the third screen a mesh of 2.5 millimeters in diameter.

Operation.

The operation of the mill consists of first, bring the ore into the mill and dumping it upon the grizzly with openings of one and one-half inches.

The larger pieces of ore, which will not pass through the grizzly, slide down to the next level and are fed into a crusher set to crush to one and one-half inches.

The ore as it passes through the grizzley and crusher falls into a large bin.

From the bin the ore passes to an automatic feeder and is fed intoa set of rolls set to crush to twelve millimeters.

The ore as it comes from the rolls passes through a shoot to an elevator and is elevated to the first screen, having perferations six millimeters in diameter. The oversize from the first screen passes to the second set of rolls, set to crush to a diameter of six millimeters.

From the second set of rolls the ore passes to the first elevator and is again elevated to the first screen.

The undersize (portion which passes through the screen) from the first screen passes to the second screen. (4 millimeter mesh).

The oversize (portion unable to pass through the screen perferations) from the second screen passes to the first jig.

The undersize from the second screen passes to the third screen (2.5 millimeter mesh).

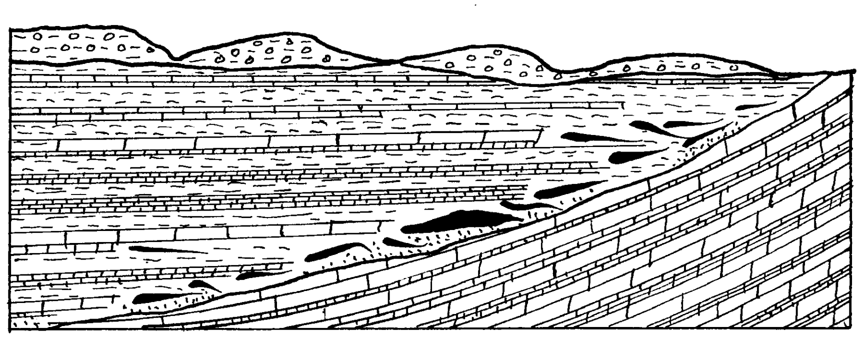
Second,- The Lower Coal Measures are unconformable upon the Limestones of the Lower Carboniferous.

Third. With few exceptions the earliest formed coal seams are for more extensive both geographically and vertically than the later ones.

With the facts as stated, showing the Iowa fields to have been formed as marginal deposits her coals may be regarded as distributed in innumerable lenticular basins, sometimes several miles in diameter and six or seven feet in thickness centrally or again only a few hundred yards in extent.

These occur at many different horizons and interlock one another so that a boring may pass through a score or more coal horizons without meeting more than one or two veins of sufficient thickness for profitable working.

The appended ideal cross section of the Iowa Carboniferous rocks show these features and represent graphically the sequence of strata found in the district under consideration where the valuable beds are generally found at from sixty to one hundred and twenty feet in depth and show a thickness of from four to five feet.



A Blake Crusher, feed opening ten by sixteen inches, capacity ten to twenty tons per hour, two hundered and fifty to three hundred revolutions per minute, weight 16000 pounds, required twelve horse power. Size of pully 30 X 8 inches. Described in catalogue No.7 of the Colorado Iron Works Co. Denver, Colorado.

Rolls.

Two sets of 16 x 36 inch rolls as described in catalogue No.7 of the Colorado Iron Works Co. Denver Colorado. One set of 20 X 12 inch rolls described in the same catalogue.

The formula for finding the capacity of a set of rolls is

$$C = 1/5 \, d \, n \, w$$

where c = the capacity in pounds per hour

" d = the diameter of the rolls in inches

" n = the number of revolutions per minute

" w = the width of the rolls in inches.

" 1/5 = ?

This formula depends very much on the condition of the rolls but is better to buy a set of rolls having a capacity greater than that shown by the formula.

One Challenge Feeder described in catalogue No 9 of the Allis-Chalmers Co.

Two elevators of standard make with 5 X 16 inch buckets.

Three trammels of standard make.

Three Hartz jigs.

Ten Overstrom Concentrating Tables.

Power.

The power required for the mill

10 Overstrom concentrating tables	=	10 H.P.
3 Hartz Jigs	=	9 " "
3 Trammels	=	3 " "
2 Elevators	=	2 " "
2 Sets of Rolls	=	36 " "
1 Crusher	=	12 " "
		72 Horse Power.

This is the actual amount of power required but on account of losses of power in transmission,etc. I think it would be better to allow about three-fourths of a horse power for each ton of ore treated,or a total of one hundred and fifty horse power.

One one-hundred-and-fifty horse power Corliss engine as described in the catalogue of the Mine and Smelter Co. Denver,Colo.

Three seventy-five horse power fire tube boilers.

The reason for not using the later and better type of boiler,such as the Heine,etc.,is the weight and consequent cost for transportation in a mountainous country.

The reason for using three boilers is that one of them may be cleaned out each day and in this way the life and efficency of the boiler will not be increased.

?

There will also be required,a feed pump,heater and supply pump to supply about 6000 gallons of water per hour.

In designing the roof trusses and supporting posts,a loading of 35 pounds per square foot was taken for the roof load and the stress diagram was drawn to a scale of one inch ,equalling 10000 pounds.

The size timber to be used was determined from the column formula given in hand-book published by the Cambria Steel Co. and the safe unit stresses were taken from the tables of the same book.

The diameter of shafting was determined by the formula

$$D = \sqrt[3]{\frac{90\,H}{R}}$$

Where D = the diameter of shaft in inches

" H = The horse power to be transmitted

" R = The number of revolutions per minute

The width of belting was determined by the formula

$$W = \frac{H\ 2750}{D \times R}$$

W = width of belt in inches

H = the horse power to be transmitted

R = number of revolutions per minute.

Dimension of the building

Total length 115 feet

" width 80 "

length of smaller part 31 feet

width of smaller part 25 "

Length of larger part 84 feet.

Bill of Material

950	feet	of	6" X 6" timber for posts,etc.
2600	"	"	8" X 8" " " " "
2000	"	"	10" X 10" " " "
2800	"		6" X 8" for trusses
300	"	"	12" X 12" for posts
3690	"	"	2" X 8"
7560	"	"	2" X 4"
14112	"	"	2" X 12" for flooring,etc.
8563	"	"	2 foot corrugated iron for roof and sides.
750	"	"	1" round iron for tursses
80	"	"	3 3/4 inch shafting
40	"	"	2.5 " "
160	"	"	1.5 " "
40	"	"	2 " "
96	"	"	18 " belting
120	"	"	10 " "
60	"	"	8 " "
480	"	"	6 " "

10 - 20" X 6" pulley

7 - 36" X 8" "

3 - 48" X 10" "

1 - 60" X 18" "

60 yards of rough masonry

20480 common brick for setting boilers,engine,etc.

1000 fire brick for boilers

400 bushels of sand

6 barrels of fire clay

60 bushels of lime

15 bushels of cement.