M-157

Plant Descriptions
of

Penn-Dixie Cement Corp.
Plant No. 9, West Winfield, Pa.
By J. C. McGrath, Supt.

Medusa Portland Cement Co.
Wampum, Pa. Plant
By W. B. Hanlon, Director of Engg.

Universal Atlas Cement Division of United States Steel Corp.
Universal, Pa. Plant
By E. F. Harchelroad, Plant Mgr.

Green Bag Cement Division of Pittsburgh Coke & Chemical Co.
Neville Island Plant
By H. J. Haffner, Supt.

November, 1958

PORTLAND CEMENT ASSOCIATION
Research and Development Laboratories

5420 Old Orchard Road Skokie, Ill.

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GENERAL TECHNICAL COMMITTEE

PORTLAND CEMENT ASSOCIATION

Sept. 22-25, 1958, Pittsburgh, Pa.

PENN-DIXIE CEMENT CORPORATION

NAZARETH, PA.

PLANT NO. 9 WEST WINFIELD, PA.

DESCRIPTION OF

MINE AND PLANT OPERATIONS

AUGUST, 1958

PENN-DIXIE CEMENT CORPORATION
PLANT NO. 9

GEOLOGY AND MINING OF RAW MATERIALS

GEOLOGY

With the exception of gypsum, we have at West Winfield all the materials that are necessary for the production of cement. The two principal materials, shale and limestone, are of sedimentary marine origin. Shales are merely compressed mud or fine particles settled in areas of quiet water.

The limestone deposit at West Winfield is called the Vanport Seam, which is a pure and uniform high calcium carbonate, that can be traced through several counties of western Pennsylvania for about a hundred miles with only slight variation in its characteristics. It was named after the town of Vanport and was formerly called ferriferous limestone because of a thin layer of carbonate of iron over the top of the limestone seam. The remains of life (animal and plant fossils) found in the Vanport seam place this deposit in the carboniferous age in the geological scale of time. Most common fossils found in the limestone are the crinoid stems and brachiopods.

The limestone deposit at West Winfield lies in a horizontal position and its average thickness is 22 feet. There is an overburden in places which is several hundred feet deep and for this reason the limestone is mined rather than quarried.

The argilaceous material (shale) lies immediately below the limestone seam and is mined in the rooms where the limestone has been exhausted. To compensate for the low silica content of this shale, sandstone is added, which is extracted from our mine in areas where the limestone is eroded.

The accompanying Sketch A shows the sequence of rock layers existing at West Winfield.

MINING METHOD

The conventional room and pillar system of mining is used because of the uniform thickness and horizontal stratification of the limestone deposit.

The mine is divided into five sections, each section comprising a set of entries and rooms off these entries. As shown on accompanying Sketch B of typical arrangement of rooms and entries, the entries are advanced in a northwesterly direction and the rooms are driven at 90° off the entries in a northeasterly or southwesterly direction. The centerline distance between sections, or set of entries is 800 feet, and between rooms and entries it is 65 feet. The width of both rooms and entries is 30 to 35 feet, and the thickness of the pillars is also 30 to 35 feet. Cross cuts between rooms and between entries are broken through at intervals of 90 feet to 210 feet. The average height of the rooms, where cave-ins have not occurred, is 18 feet.

DRILLING AND BLASTING

The face is worked with the triangular block and cut system. See Sketch C. Both rooms and entries are advanced with successive "V" cuts, each of which breaks a roughly triangular block of stone. The holes for each V are loaded with dynamite and are fired simultaneously with electric blasting caps. The angle at the apex of the V is 90 degrees. The length of the holes in the face cut (angle) are ten feet, and of those in the rib cut (corner) eight feet. After the initial V cut is taken out, two cuts can be blasted at once in each room or entry.

The chief advantage of this system of blasting lies in the large volume of blasted stone that can be accumulated in a single room. Rooms can be advanced from 20 to 30 feet and filled with from 1,000 to 3,000 tons of stone.

Three men (driller, drill helper and popshooter) work in each room. Driller and drill helper drill the V cuts, while the popshooter does the secondary drilling and when necessary secondary shooting and also the trimming of the roof, face and ribs.

All of the initial drilling is done with tripod mounted Gardner-Denver No. 89 drifter drills using 1-1/4 inch follow drill steel and 1-5/8 inch Timken detachable steel bits.

ROOF CONTROL

Two top layers of the limestone (average thickness of each layer two feet) are left as roof stone, mainly to reduce contamination of the limestone, and because the ferriferous shale, which generally overlies the limestone seam, will not support itself. In cases where both layers cave in, or if they must be taken down because they have loosened, the shale drops down with the layers, leaving an exposed sandstone roof, which in most cases is excellent roof stone. In areas where the sandstone has coal or shale partings, for an added protection it is roof bolted using 3/4 inch bolts with expansion shields as anchors. For this work we have scaling rigs each of which is equipped with a 30 foot long boom with a basked at the top from which two men work. The two men trim and when necessary drill and shoot as well as roof bolt the high roofs.

LOADING AND HAULING

Joy diesel-electric shuttle cars with pay load capacity of 14 tons are equipped with chemical scrubbers to treat the exhaust gases from the diesel engine. These cars are loaded with electric shovels having one cubic yard buckets. Two shuttle cars serve each shovel, except in cases where the distance between the shovel and the shuttle car unloading ramp is too great, in which case a third shuttle car is added. The shuttle cars take the stone from the rooms to the ramp, from which they unload into seven ton capacity mine cars. A seven ton DC electric locomotive pulls the loaded cars and spots them on the gathering track where trains of twenty-four cars are made up for the main haulage locomotive. The main haulage locomotive is also DC operated and weighs fifteen tons. The distance from gathering track to the mine exit is about 1-1/4 miles.

CRUSHING

The mine cars are equipped with swivel couplers so that they can be dumped with the rotary dump into the 30 inch gyratory crusher without uncoupling.

The stone discharged from the gyratory crusher is minus three inches in size, and is carried by a 36 inch wide belt conveyor to the secondary crusher which is a Pennsylvania Reversible Impactor. From the secondary crusher the stone is picked up by another 36 inch wide belt conveyor and carried to a set of double deck (4' x 14') vibrating screens with bottom screen openings of one half inch by five inches. The stone, small enough to pass through the bottom screen, is discharged on a 30 inch belt conveyor and carried to the storage silos. The oversized stone is returned to the belt feeding the secondary crusher.

The belt carrying stone from the vibrating screens is 30 inches wide and 575 feet long. It discharges the stone at the transfer building onto a 30 inch wide and 384 foot long belt from which the material can be discharged direct into number one silo, or onto a 30 inch wide and 141 foot long distributing belt conveyor. The distributing belt conveyor is equipped with a belt tripper and serves the rest of the stone storage silos. The belt tripper, driven by the belt, can be spotted to unload either in a silo or onto the shale belt or sand belt, or it can be set to travel and distribute the stone into a group of silos.

The raw materials storage consists of five silos 3000 tons capacity each for limestone, one silo 2700 tons capacity for shale and another 2700 tons capacity silo for sandstone.

POWER

A 2300 volt electric power line is brought in the mine through a bore hole and stepped down to 440 volts with transformers, for the operation of the shovels, scaling rigs and the auxiliary equipment. The 250 volts D. C. for the trolley lines, from which the electric locomotives operate, is generated by two 200 KW and one 150 KW motor generator sets. Compressed air for the operation of the drills and air operated water pumps is supplied by two 1000 C.F.M. capacity compressor, and two 600 C.F.M. capacity portable compressors.

VENTILATION

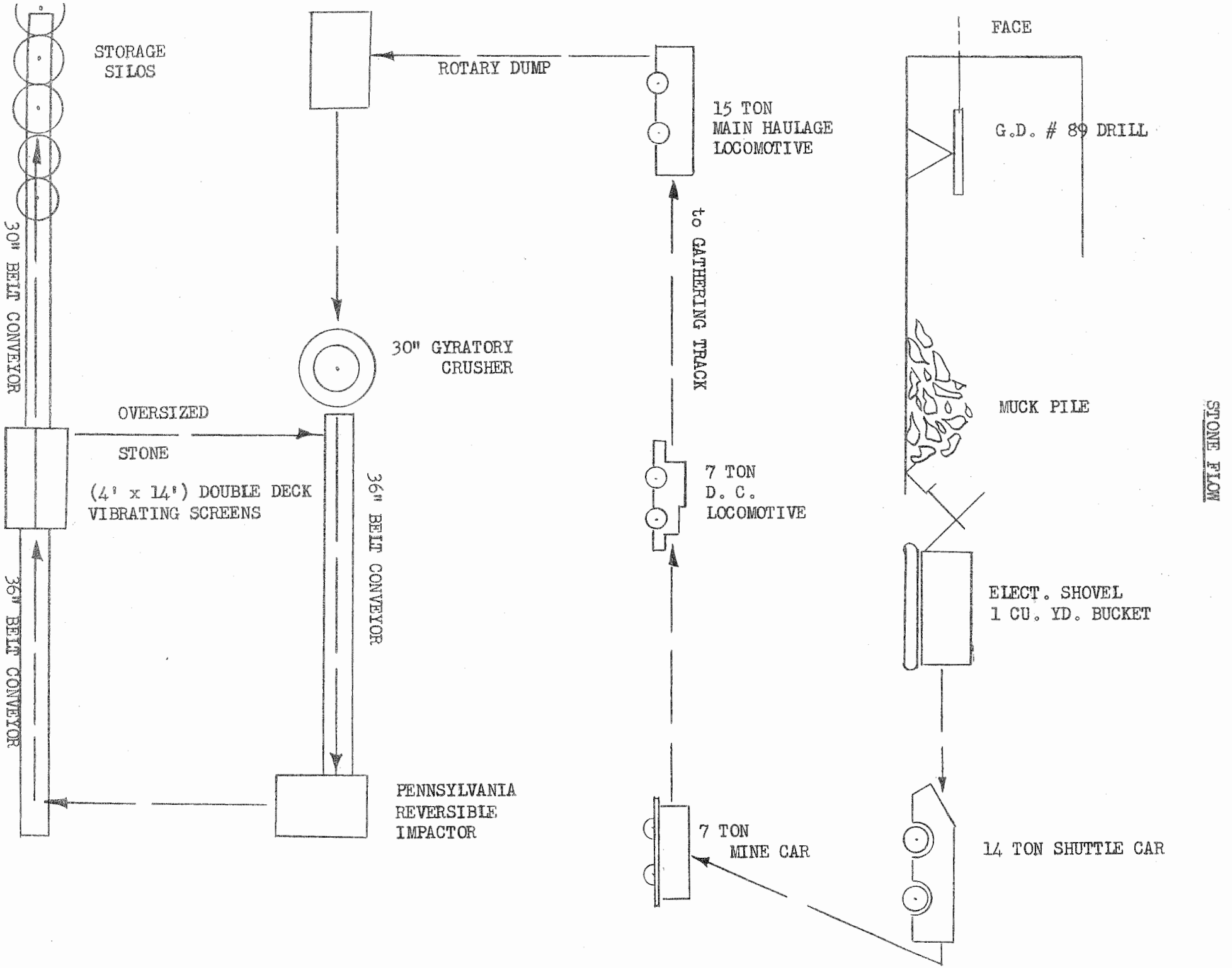
A Joy six foot oxivane fan with rated capacity up to 125,000 C.F.M. brings outside air into the mine. The fan exhausts the air. However, it can be reversed.

To control and to bring the air flow to the working faces, brattices are installed in the breakthroughs between the entries and other openings where they are necessary. Cinder blocks and mortar are used to build permanent brattices, while temporary brattices are of plastic or burlap material.

TRANSPORTATION OF MEN AND SUPPLIES

The man-transport train is made of specially built cars for the men to ride, and is pulled with one of the gathering locomotives at the beginning and end of each shift. For safety purposes, the overhead D. C. trolley line is guarded, where its height above the rail is less than seven feet six inches. The gauge of the track on which the man-transport cars and also the stone cars run is 36 inches.

Supplies needed for the underground operation are hauled in with trucks.


STORAGE SILOS
ROTARY DUMP
15 TON MAIN HAULAGE LOCOMOTIVE
FACE
G.D. # 89 DRILL
30" BELT CONVEYOR
30" GYRATORY CRUSHER
to GATHERING TRACK
MUCK PILE
STONE FLOW
OVERSIZED STONE
(4' x 14') DOUBLE DECK VIBRATING SCREENS
36" BELT CONVEYOR
7 TON D. C. LOCOMOTIVE
ELECT. SHOVEL 1 CU. YD. BUCKET
36" BELT CONVEYOR
PENNSYLVANIA REVERSIBLE IMPACTOR
7 TON MINE CAR
14 TON SHUTTLE CAR

SKETCH-A

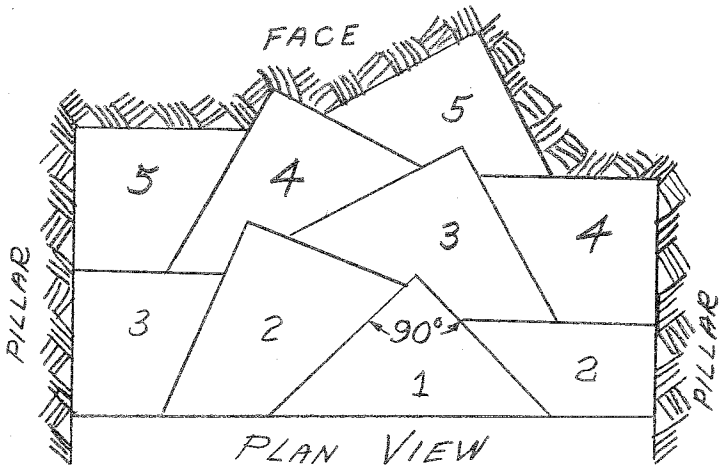
SEQUENCE OF ROCK LAYERS AT WEST WINFIELD

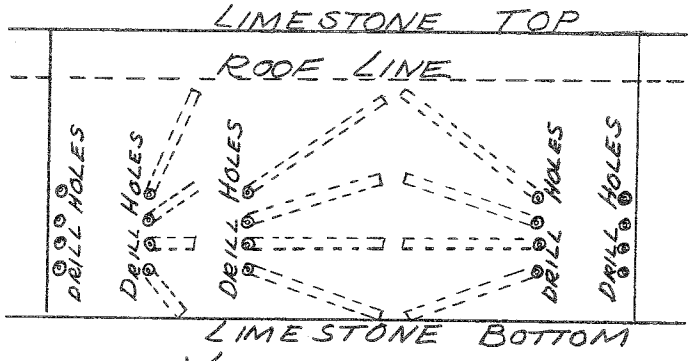
SURFACE

50' to 60'	LOWER FREEPORT SANDSTONE
25' to 30'	LOWER FREEPORT SHALE
	UPPER KITTANNING COAL
10' to 25'	UPPER KITTANNING SHALE
50' to 70'	WORTHINGTON SANDSTONE
5' to 25'	WORTHINGTON SHALE
	MIDDLE KITTANNING COAL
35' to 50'	MIDDLE KITTANNING SHALE
	LOWER KITTANNING COAL
15' to 30'	LOWER KITTANNING SHALE
30' to 50'	LOWER KITTANNING SANDSTONE
	BURASTON IRON ORE AND FERRIFEROUS SHALE
22' ±	VANPORT LIMESTONE
10' to 15'	CLARION SHALE
	CLARION COAL
	CLARION SANDSTONE AND SHALE

SKETCH-C

TRIANGULAR BLOCK CUT METHOD

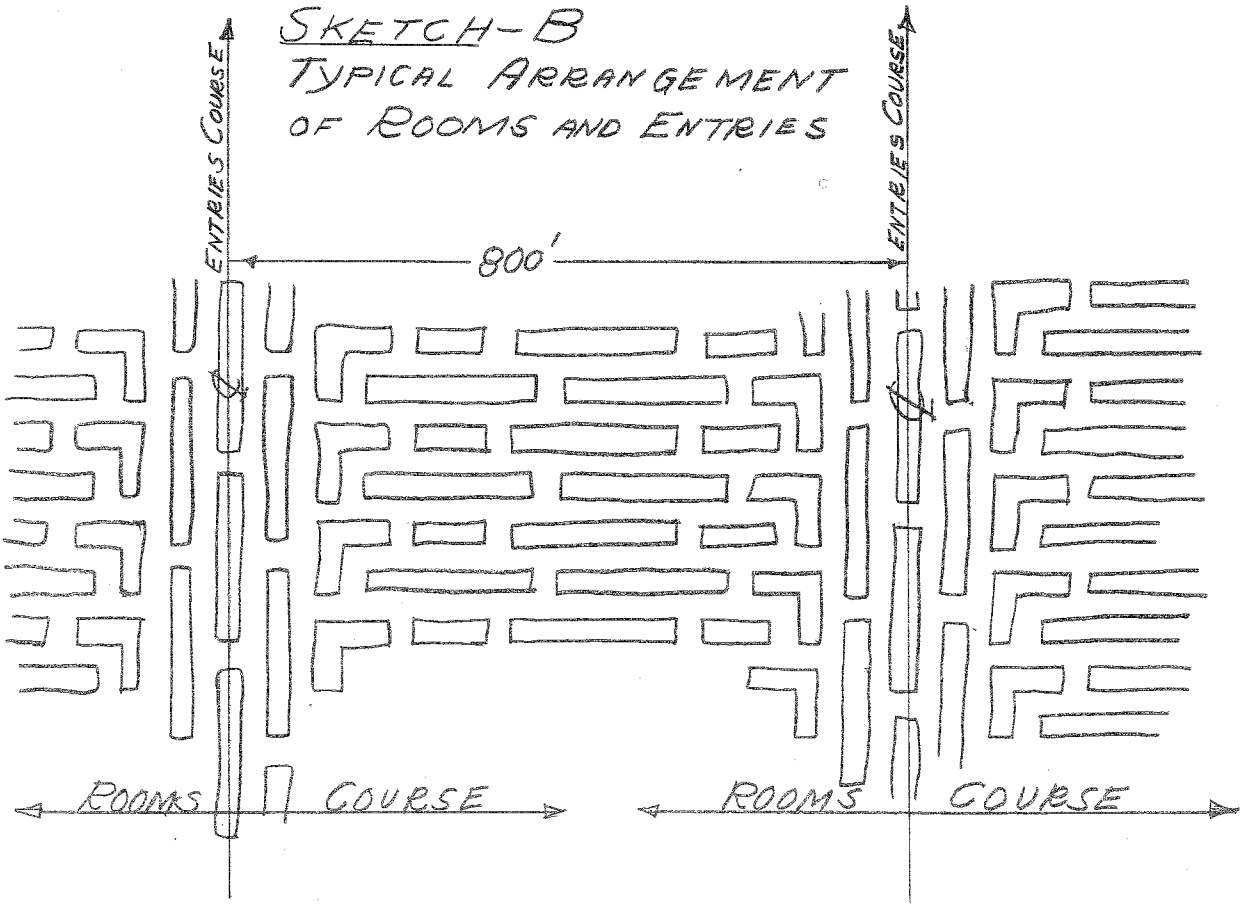




VERTICAL SECTION

SKETCH-B

TYPICAL ARRANGEMENT OF ROOMS AND ENTRIES



PLANT OPERATION RESUME

Raw Grinding

Feed for the raw mill grinding is generally drawn from three limestone silos simultaneously. Rate of feed from each silo is controlled by a 72 inch Allis-Chalmers table feeder, while the shale and sandstone feed is proportioned from the sand and shale silos by individual 16 inch Merrick Feedoweights. The proportioned raw material is carried by a common belt conveyor to a bucket elevator and distributed into the mill feed bins by a belt tripper. Material fed into the mills does not exceed one half inch in size. Slurry produced contains 35% moisture and is ground to a fineness of 88% passing through a 200 mesh sieve. Two of the three raw grinding mills are 8 x 30 ft., while the third one is 8 x 32 ft. Maximum ball size carried in the mills is three inches and production is approximately 90 barrels per hour.

A single four inch Wilfley slurry pump delivers the discharge from the mills into six grinding tanks of 700 bbl. capacity each. Slurry is drawn from these tanks into an 1800 bbl. capacity blending basin, then the corrected slurry is pumped by a four inch Wilfley slurry pump into four kiln feed tanks of 4000 bbl. capacity each. All tanks have both mechanical and air agitation. The slurry from the kiln feed tanks is pumped to two ferris wheel type slurry feeders which feed the kilns. A single overflow tank serves both kiln feeders and the excess is returned to the kiln tanks.

Kilns

Both kilns are 250 ft. long and have an 11 ft. 6 in. inside diameter, excepting for the 15 ft. diameter calcining zone which is located 27 ft. 5 in. from the firing end and extends 56 feet back, including conical end sections. The kilns are lined with 6 in. brick using basic brick in the hot zones and alumina brick for the rest of the kiln lengths. Chain sections consisting of loops of 5/8 inch chains extend 62 feet starting a few feet from the feed end.

Coal delivered to the mill is put through a 24 x 24 inch single roll crusher and reduced to one inch top size and placed into the coal mill feed bins. The coal mills are No. 533 Raymond bowl mills with independent roll type feeders rated to pulverize 13,000 to 13,750 lbs. per hour to a fineness of 80 to 85 percent passing through a 200 mesh sieve.

Two Fuller Narsted coolers are used to cool the clinker discharged from the kilns. They consist of 5 x 60 feet horizontal stationary cooler grates and spreading chain conveyors. The clinker coolers are designed to cool the clinker by air supplied under pressure under the moving clinker bed. The clinker is cooled from 2500°F down to 150°F at a rate of 2500 bbls. of clinker per day per cooler. The air is supplied by two fans with a rated capacity of 54,000 cfm at seven inches static pressure. Clinker from the coolers is put through 10 x 20 inch Traylor jaw crusher, discharged onto a skip pan conveyor then elevated to the storage silos.

Clinker Grinding & Finishing

Under each of the clinker storage silos are 24 inch Merrick Feedoweights feeding a 24 inch belt conveyor which discharges into a bucket elevator serving two overhead mill feed bins. Gypsum is brought in by rail, discharged into a track hopper, is fed by a vibrator to a bucket elevator filling two overhead gypsum bins. Jeffrey-Traylor Waytrols proportion the gypsum onto a belt conveyor which discharges into the bucket elevator carrying clinker to the overhead mill feed bins.

Two Bradley-Hercules mills used for preliminary grinding carry seven mesh, 0.012 wire and produce 150 bbl. per hour each mill of finish mill feed. Finished cement is produced by two 8 x 30 ft. compartment mills at a rate of 150 bbl. per hour per mill. The compartment mills have a 20 foot long first section charged with minus one inch balls and a 10 foot long compartment charged with minus 5/8 inch balls. The finished cement is pumped with Fuller-Kinyon pumps to the storage silos which have a 357,000 bbls. capacity and also into the two high gypsum and high lime silos used in production of high early and mortar cement.

Mortar and High Early Processing

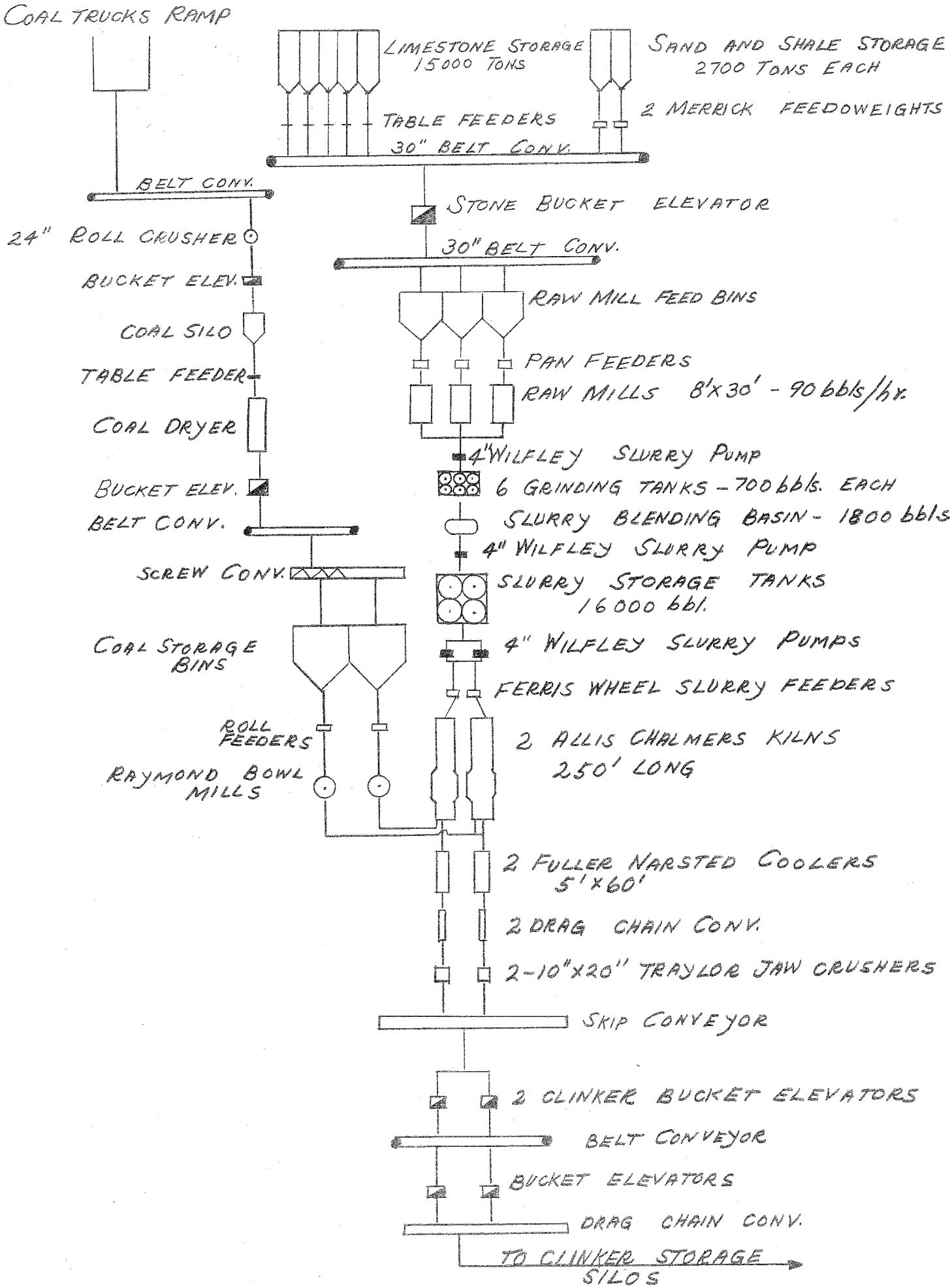
High limestone used for manufacture of mortar cement is withdrawn from its silo by table feeder direct onto a 24 inch belt conveyor which delivers the stone in the mill room and is elevated to a feed bin serving a Raymond roller mill. The limestone is pulverized to a fineness of 94 percent passing through a 200 mesh sieve and is stored into a 350 bbl. bin from which a screw conveyor feeds the pulverized limestone into one side of a Butler automatic weighing scale. Cement is drawn from either silo by six inch airslides and is elevated to another 350 bbl. bin on the other side of the Butler automatic scales. The proportioned limestone and cement are discharged into a 6 x 22 ft. tube mill. The finished product is pumped to mortar storage silos by a 5 inch, type "L", F.K. pump.

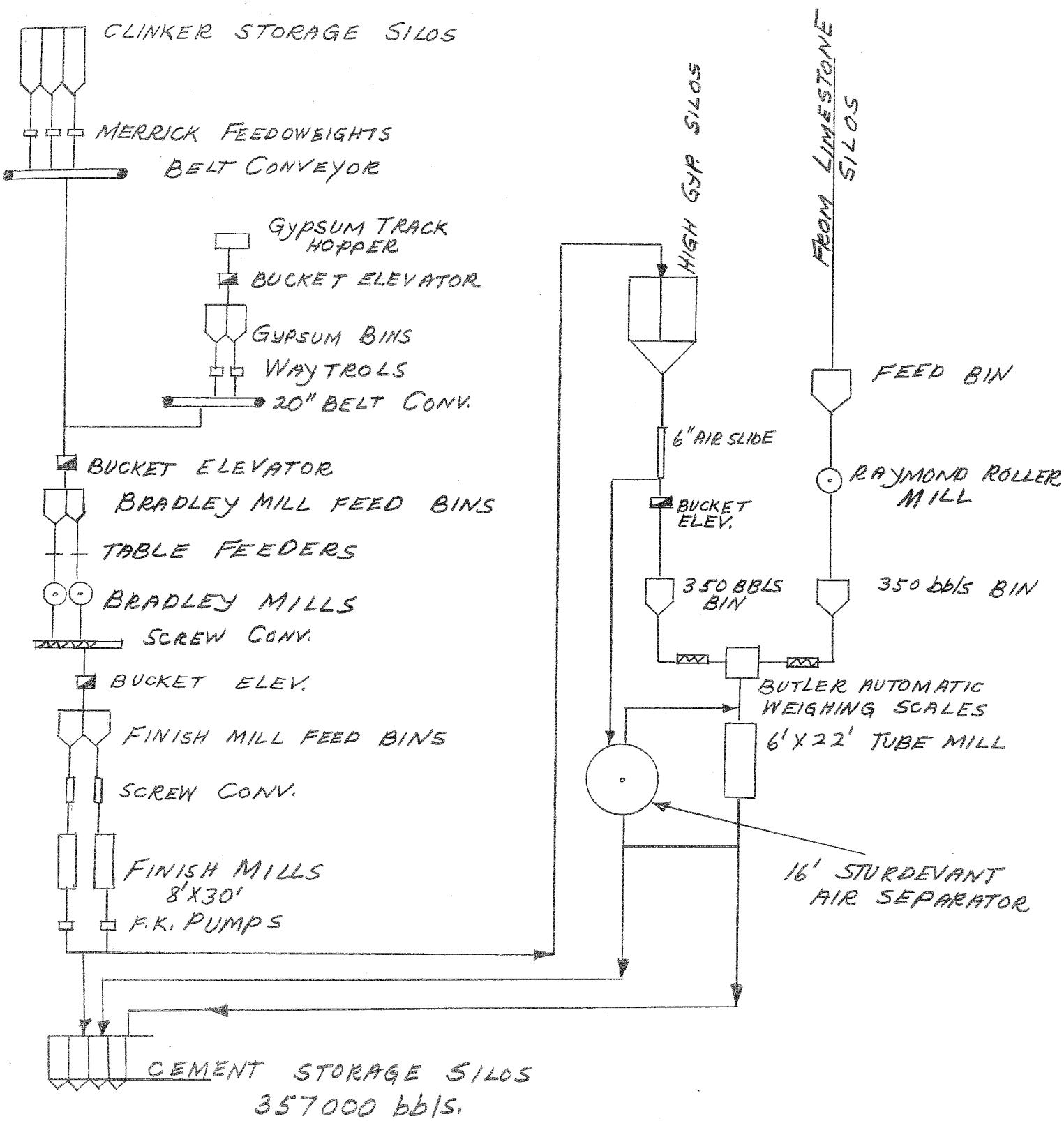
In producing high early cement, preground cement from the silos is reground in the 6 x 22 ft. tube mill in closed circuit with a 16 ft. Sturtevant air separator. The finished product is conveyed to storage by separate F. K. pump and lines.

Packing & Shipping

Cement for the packing machines and the two F. K. pumps pumping cement to the truck bulk loading plant is withdrawn from the east bank of silos with F. L. Smidth exbinners onto eighteen inch screw conveyors, which feed the truck bulk loading F. K. pumps or the bucket elevator serving the packing machine bins. From the West bank of silos, cement is pumped with two seven inch Type "E" and one eight inch Type "H" F. K. pumps through an alleviator to the eighteen inch screw conveyor feeding the packing machine bins, or to another eighteen inch screw conveyor which discharges into a bin furnishing cement for one of the F. K. pumps pumping to the truck bulk loading plant. Packaging of cement is done with four Bates four spout, 300 bbl. per hour packing machines, while mortar cement is packaged with one Bates and one St. Regis four spout, 300 bbl. per hour packing machines. Bulk railroad cars are loaded from spouts on the sides of the storage silos, while bulk trucks are loaded at the truck bulk loading plant.

FLOW SHEET


COAL TRUCKS RAMP
LIMESTONE STORAGE 15000 TONS
SAND AND SHALE STORAGE 2700 TONS EACH
2 MERRICK FEEDOWEIGHTS
TABLE FEEDERS
30" BELT CONV.
BELT CONV.
STONE BUCKET ELEVATOR
24" ROLL CRUSHER
30" BELT CONV.
BUCKET ELEV.
RAW MILL FEED BINS
COAL SILO
PAN FEEDERS
TABLE FEEDER
RAW MILLS 8'X30' - 90 bbls/hr.
COAL DRYER
4" WILFLEY SLURRY PUMP
BUCKET ELEV.
6 GRINDING TANKS - 700 bbls. EACH
BELT CONV.
SLURRY BLENDING BASIN - 1800 bbls
4" WILFLEY SLURRY PUMP
SCREW CONV.
SLURRY STORAGE TANKS 16000 bbl.
COAL STORAGE BINS
4" WILFLEY SLURRY PUMPS
FERRIS WHEEL SLURRY FEEDERS
ROLL FEEDERS
2 ALLIS CHALMERS KILNS 250' LONG
RAYMOND BOWL MILLS
2 FULLER NARSTED COOLERS 5'X60'
2 DRAG CHAIN CONV.
2-10"X20" TRAYLOR JAW CRUSHERS
SKIP CONVEYOR
2 CLINKER BUCKET ELEVATORS
BELT CONVEYOR
BUCKET ELEVATORS
DRAG CHAIN CONV.
TO CLINKER STORAGE SILOS


CLINKER STORAGE SILOS
MERRICK FEEDOWEIGHTS
BELT CONVEYOR
GYPSUM TRACK HOPPER
BUCKET ELEVATOR
GYPSUM BINS
WAYTROLS
20" BELT CONV.
BUCKET ELEVATOR
BRADLEY MILL FEED BINS
TABLE FEEDERS
BRADLEY MILLS
SCREW CONV.
BUCKET ELEV.
FINISH MILL FEED BINS
SCREW CONV.
FINISH MILLS 8'X30'
F.K. PUMPS
HIGH GYP. SILOS
FROM LIMESTONE SILOS
6" AIR SLIDE
BUCKET ELEV.
350 BBLS BIN
FEED BIN
RAYMOND ROLLER MILL
350 bbls BIN
BUTLER AUTOMATIC WEIGHING SCALES
6'X22' TUBE MILL
16' STURDEVANT AIR SEPARATOR
CEMENT STORAGE SILOS
357000 bbls.