

The Geology of the Raw Materials
Used in the Manufacture of
Portland Cement at the
Monolith Portland
Midwest Company

Prepared for
Dr. D. L. Blackstone Jr.
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by
D. M. Finefrock

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Affiliations The Monolith Portland Midwest Company of Laramie is a smaller branch of Monolith of California located near Los Angeles. A large wholesale office is maintained at Denver for the Rocky Mountain Region.

Plant Location The plant at Laramie is situated three miles south of town on highway 287 to Denver. The Union Pacific mainline is also adjacent, and the plant serves rail or truck with equal ease the year round.

Products

Manufactured

All types of cement are manufactured, including regular portland cement, modified or fast setting cement, sulfate for use in areas of strong alkalinity, brick cement, plastic or waterproof cement used in damp cellars and oil well cement containing a large portion of bentonite to increase sealing properties.

Process

The process employed is generally called the "wet method." The raw materials are ground in a ball mill with addition of water. The resulting mixture or slurry is .85% fine (200 mesh) and contains from 35-40% water, 66% (of solids) CaO and 2.5-3.0% Fe₂O₃. The slurry is blended and held in large storage tanks until it is fed into a large (13' x 350') rotary kiln and sintered into a clinker which is discharged from the hot end of the kiln.

Fuel

Coal is ground (90% through 200 mesh) in a tube mill and blown into the rotating kiln by compressed air. From 50 - 60 pounds of coal per minute are blown into the kiln and burned. The cold, or feed end, of the kiln is about 750° F. and the discharge or hot end is kept between 2200° F. and 2800° F.

Finish Mills

The hot clinker from the kiln is stored for several days to several weeks allowing it to cool. One large tube mill and two ball mills finish grinding the clinker with the addition of gypsum (from 1.6 to 2.0%) by a mechanical feeder.

The finished cement, 92 - 98% through 200 mesh, is blown by compressed air into large storage silos and sold from these.

CementComponents

Portland cement is composed of a mixture of mineral ingredients containing lime (CaO), alumina (Al₂O₃), and silica (SiO₂), together with minor amounts of iron oxide (Fe₂O₃) and a trace of the rare earth oxides.

Analysis of regular cement made November 2, 1952:

SiO ₂ -----	22.26%
Fe ₂ O ₃ -----	2.68
Al ₂ O ₃ -----	5.82
CaO-----	65.14
Na ₂ O-----	.12
K ₂ O-----	.52

MgO-----	.99
SO ₃ -----	1.74
	99.72%

The sources of all these materials, except the iron oxide, are owned and produced by Monolith, including the coal used in the kiln.

Limestone Limestone is used to increase the lime content as the other materials do not supply enough to make a good cement.

The limestone is quarried one mile east of Laramie on the north side of Route 30, specifically in Sec. 36, T. 15N., R. 72W. The limestone is the second lime of the Pennsylvanian Casper formation. This rock unit is exposed on or near the surface for almost the entirety of Section 36, with from 0 to 1 ft. overburden. The quarry is near the west end of a westward plunging anticlinal fold. The surrounding rocks dip away at 5 - 10 N.W. and 20° S.W.

The quarry is 2000 feet long and 800 feet wide and from 15 to 25 feet deep, a bedding plane forming the floor in the east half. Road entrance to the quarry is gained by a natural "roadcut" formed by a normal fault, one of several on the south side of the fold.

Five trucks hauling 8 hours a day, five days a week keep a continual supply of limestone at the plant.

Analysis of average limestone

CaO-----	97.98%
SiO ₂ -----	1.00
Al ₂ O ₃ -----	.45

MgO-----	.34
Fe ₂ O ₃ -----	<u>.21</u>
Total	99.98%

Monolith has a lease on the S 1/2, Sec. 36 and this area contains several years' supply at the abnormally high rate of use.

Shale Deposit Silica and alumina are the principal compounds sought for in the shale deposit, however, a comparatively high proportion of CaO is contained in certain layers boosting the value as a cement rock.

The rather large open pits are 12 miles southwest of Laramie in Sec. 6, T.14N., R.74W. along the Laramie River. The rock unit quarried is from the Niobrara formation, Cretaceous in age. The Niobrara formation outcrops as island-like masses projecting through the Quaternary alluvium. This particular mass is a narrow ridge about 12 miles long and about 1/4 mile wide trending west to southwest. At the quarry site it forms a rather prominent bluff on the north side of the River. Different horizons show a wide range of chemical composition, but on the whole it may be described as a fossiliferous, limey-shale light to dark gray in color, easily fractured along its many bedding planes.

The quarry is easily accessible from highway 230 by car, but the company has constructed a single track to the deposit and operates a steam locomotive and 15 to 20 flat cars each carrying 3 large skips into which the rock is loaded and hauled to the plant.

Two pits or drop cuts are worked alternately. One in a lower sequence of the formation for "high rock," high percentage of silica, alumina and lime, and one in a higher sequence for "low rock," (higher in silica) low in alumina and lime. The area has been extensively core drilled and a large scale map prepared. The core hole and rock analyses from the holes have been plotted on a map. Future quarrying operations are planned from this map. In the bottom of the present pit one core hole was drilled to a depth of 60 feet with satisfactory findings, indicating a large and adequate supply is immediately available.

Average analysis of low shale

SiO ₂ -----	39.60%
Fe ₂ O ₃ -----	1.66
Al ₂ O ₃ -----	12.76
CaO-----	24.42
Na ₂ O-----	1.06
K ₂ O-----	2.00
SO ₃ -----	.38
H ₂ O-----	18.70
	<u>97.52%</u>

Gypsum

Gypsum is added to the cement for its SO₃ content, therefore, the higher the percentage of SO₃ the less rock must be used. For several years Monolith tried to develop some of the gypsite beds around the Laramie Basin, but none proved worth while. Either the deposit was too small or too low in SO₃.

Currently, gypsum is obtained from an open pit quarry 13 miles north of Rock River in Sec. 35, T. 23N., R. 77W. The deposit is in the Triassic Chugwater formation and is exposed along the north bank of Rock Creek. The creek has breached the nose of a southwest plunging anticline. The deposit is approximately 30 feet thick, forming a lenses-like mass covering an area of 109 acres. It is easily accessible over county roads and a Union Pacific spur is about 3 1/2 miles away down a fairly level road; almost all of the gypsum is transported by rail to the plant. Average consumption of rock containing 40% SO₃ is 18 tons per day.

Gypsum is exposed for a distance of 6/10 mile (car speedometer) with from 0 to 3 - 4 feet of overburden along the creek and about a mile in a northeasterly direction along the ridge. The lower 5 to 10 feet of the mass contains a much purer grade of gypsum than the upper portion. Near the surface there is an exposure of exceptionally large selemite crystals. The entire mass dips 10° to the west.

Analysis of Gypsum

SiO ₂ -----	.49%
Al ₂ O ₃ / Fe ₂ O ₃ ---	.25
CaO-----	37.78
SO ₃ -----	40.98
MgO-----	.53
H ₂ O-----	20.02
	<u>100.05%</u>

Coal Coal for the kiln is supplied from a company-owned mine near Hanna, Wyoming and transported by rail to Laramie. The mine is located in Sec. 19, T.22N., R.81W. very near the Union Pacific railroad by which the coal is hauled to Laramie, The mine is on the eastern side of the Hanna Basin, the surface rocks are part of the Hanna formation and are Paleocene and Eocene in age. Approximately 3 1/2 car loads of coal are burned daily at the plant.

Partial analysis of coal

B. T. U. content-----	10.981
Ash (percent)-----	7.39%
Sulfur-----	.29%
Water (in seam)-----	14.4%

Conclusions In concluding, I believe the Monolith is well located for the raw materials needed and is nearly self-sufficient with exception of the iron ore purchased from the Colorado Fuel and Iron (it is a Sunrise, Wyoming product).

Monolith is a good example of geologic investigation and planning before plant location.

The Monolith employs 150 men from Laramie the year around and is a large factor in the economic life of Laramie.

REFERENCES

- 1) 1952 Edition Geologic Map of Wyoming
- 2) U.S.G.S. Bull. 804 by C. E. Dobbin, C. F. Bowen, and H. W. Hoots. "Geology and Coal and Oil Resources of the Hanna and Carbon Basins, Carbon County, Wyoming"
- 3) U.S.G.S. Bull. 364 by N. H. Darton and C. E. Siebenthal. "Geology and Mineral Resources of the Laramie Basin, Wyoming"
- 4) The Geological Survey of Wyoming, Bull. 45 by Frank W. & Doris B. Osterwald. "Wyoming Mineral Resources"