A D-H
8/7/79

Pozzolana may begin as fly ash

PORTLAND (AP) — The 500 tons of fly ash expected to be produced by the Boardman coal-fired electrical power plant could be a bother to dispose of — or it could be a profitiable byproduct.

Portland General Electric Co. is trying to sell the fly ash that will come from the plant when it goes into operation next year in north-central Oregon.

If the utility is successful, the lowly fly ash will be known as pozzolana.

The word is derived from the name of a town in Italy called Pozzuoli where the Romans mined the ash as it was found naturally as a result of volcanic action.

The Romans used it to make cement. It still is used that way.

"This material is really nothing new," says Art Heizenrader, director of the Oregon Concrete and Aggregate Producers Association. "It's older than the Portland cement we presently known in the cement industry."

Portland cement is named after Portland, England, and is a manufactured product that has existed for just over 200 years, he said.

"Portland cement is like a Betty Crocker cake mix. Just add water, stir and you've really got some cake," he said.

But cement producers have found that pozzolana can be stirred in the cement mix as a substitute for other ingredients.

"Last year, when cement started getting scarce, the industry began looking for the material as a supplement," he said.

Because pozzolana will harden under water, it frequently is used in bridge piers and is going into the cement for the Interstate 205 bridge across the Columbia River east of Portland.

OREGONIAN
Aug 7, 1979

Fly ash flurries

PGE hopes to cement profits with pozzolana

By ED MOSEY
of The Oregonian staff

It gushes over the tops of boots like water, ripples away from footsteps in little tides. Next year, when the Boardman coal plant is operating at full power, 500 tons a day of it will be produced.

If Portland General Electric Co. must bury it, just call it fly ash, the talc-like residue of burned coal. But if the firm can sell it — and PGE is trying to do just that — call it pozzolana.

The word "pozzolana" is derived from the name of a town near Naples, Italy: Pozzuoli. It was there that the Romans mined the ash as it was found naturally in the ground, the result of volcanic action. They used it then, as it is used now, to make cement.

Art Heizenrader, director of the Oregon Concrete and Aggregate Producers Association, can get up a pretty good head of steam when he talks about the stuff. The fact that Boardman will produce it should mean the state's cement industry will have all it needs for years to come.

"This material is really nothing new," Heizenrader says. "It's older than the Portland cement we presently know in the cement industry."

Portland cement is named after Portland, England, and is a manufactured product that has existed for just over 200 years, he said.

"Portland cement is like a Betty Crocker cake mix. Just add water, stir and you've got some cake," he said. But cement producers and engineers have found that pozzolana can be stirred in the cement mix as a substitute for other ingredients.

"Last year, when cement started getting scarce, the industry began looking for the material as a supplement," he said.

Although Portland cement has good quality without the pozzolana, the latter is useful as a mixture for certain uses. Because pozzolana will harden under water, it is frequently used in bridge piers, and, in fact, it is going into the cement mixed by Willamette Western for the Interstate 205 bridge. The U.S. Army Corps of Engineers also used large quantities in the construction of dams on the Columbia River.

Usually, the pozzolana comprises 15 percent to 30 percent of the cement. That's the mixture in the hardening material, not including the sand and gravel.

The substance is used more in the East than here, says Heizenrader, because more coal is burned there. A Seattle firm, Pozzolanic Northwest, Inc., has distributed pozzolana for more than 40 years.

When used in construction of massive cement structures, explains Heizenrader, the pozzolana absorbs lime and reduces leaching. It also provides a slower, cooler curing period, which reduces cracking. Cement produces heat when it cures.

Jack Lentsch, manager of generation licensing for PGE, says the company is negotiating now to sell the ash. He would not discuss in detail what he thought the firm might get for the substance, although it could be around $2 a ton, he said.

Only the fine powder is usable in cement — the ash that air pollution control devices pull from the stack before it can escape into the air. The heavier bottom ash might be used for other purposes, perhaps road building.

The Oregon Department of Energy and PGE are trying to work out differences of opinion about how much monitoring of the substance should be done for radioactivity. Like any stone or mineral, coal contains some radioactive material. PGE contends the ash will contain radon and daughters of uranium, but in concentrations well within state health standards.

BYPRODUCT — Portland General Electric's coal plant at Boardman, which goes on line next year to produce electricity, will produce approximately 500 tons per day of fly ash, the talc-like by-product of burned coal. As pozzolana, it can be used in cement. PGE hopes to sell it for $2 a ton.

The problem, maintains Lentsch, is that more monitoring might be required than is really necessary, and that would increase PGE's expenses and make the pozzolana less marketable. If PGE can't sell it, the company must pay to bury it.

Charlie Amato of the U.S. Department of Energy, which has studied fly ash, says uranium and thorium are distributed about uniformly in the Earth in trace amounts. Burning coal concentrates radioactivity in the ash, but probably not in significant strength to cause health concerns, he says. As long as the substance is monitored periodically, it is as safe as limestone, which has radioactivity in about the same proportion.

OREGON STATE COLLEGE
School of Engineering and Industrial Arts
Corvallis, Oregon

July 3, 1952

Engineering
Experiment Station

Address reply to writer
100 Mines Building

Mr. F. W. Libbey, Director
State Department of Geology and Mineral Industries
1069 State Office Building
Portland 1, Oregon

Dear Mr. Libbey:

In reply to your letter of June 12, I shall tell you what I can about the pozzolanic tests to date.

The only thesis work done was that by Mr. N. R. Brandenburg which was completed last June 1951. A copy of his thesis was sent to Raw Materials Survey with the belief that it would be available both to their office and to yours. The OSC Library has two copies and the Mechanical Engineering Department has one copy. These are available for loan.

The samples which your office submitted a year ago, as well as several others, were made into 2" cubes by Ray Horton during the month of June 1951. All specimens were prepared using 35 percent cement replacement on a solid volume basis.

Compressive strength tests have been made at the ages of 3 months, 6 months, and just recently at the age of one year.

During this past year another graduate student working for the Engineering Experiment Station (but not on a thesis) used the same samples for lime-reactivity tests.

The following information shown tabulated may give you some idea of the results of these tests. In general, it is apparent that:

1. None of the materials in their natural state develops over 40 percent of the control sample.

2. All materials were improved by grinding.

3. The correlation between the portland cement specimens and the 7-day lime specimens was quite good although the extremely fine ground samples gave disproportionately high strengths with the lime test.

The results on the whole have been disappointing as we had hoped that the ash samples would show up as well as the commercial fly ash. On the lime test

a good pozzolanic material should develop 1000 psi at 7 days.

I am again working for the Bonneville Power Administration this summer, but expect to prepare the information we now have for a bulletin next winter.

Very truly yours,

/s/ C. O. Heath, Assoc. Professor of
Engineering Materials

COH:jb
cc Raw Materials Survey
Mr. W. E. Miller
Professor S. H. Graf

July 3, 1952

RESULTS OF TESTS FOR POZZOLANIC ACTION IN PUMICITES

Lab No.	Sample No.	Description	Specific surface sq. cm/g		Relative compressive Strength, % 35% Cement Replacement			Lime
			As received	Ground	3 mo	6 mo	1 year	psi
1	---	Control - (100%	Type II	Port. Cemt)	100	100	100	
6	P-11189	Silty clay		1680	58.5	50	43	
5	P-11190	Merritt ash	1550		31.5	36	36	249
7	P-11190	Merritt ash		3320	79	75	72	844
10	P-11191	Light ash	3370		44.5	40	39	534
23	P-11191	Light ash		(Very fine)	75	70.5	84	2450
9	P-11192	Dark ash	1620		33	34	36	880
12	P-11192	Dark ash		5500	74	73	72	1745
13	P-11235	Red ash		3100	42	34	29	341
11	P-11243	Grey tuff	As received		35	40	37	374
18	P-11243	Grey tuff		3440	51	57	61	399
8	P-11934	Bend top ash		2430	52	49	49	
16	P-11934	Bend top ash		3270	63	58	64	672
15	P-11935	Pumice		2900	73	73	74	738
21	P-11935	Pumice		3880	85	86	75	840
3	P-11936	Tumalo ash	4790		41	34	32	810
17	P-11936	Tumalo ash		5110	54	48	46	1105
14	P-8484	Pumice dust		3370	58	68.5	67	525
19	P-8480		As received		50	50.5	47	543
20	P-8480			2310	72	73	78	828
2		Commercial fly ash		3060	92	92	83	1051

CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER
SACRAMENTO DISTRICT
WRIGHT BLDG., 1209-8TH ST.
SACRAMENTO, CALIFORNIA

ADDRESS REPLY TO:
DISTRICT ENGINEER
SACRAMENTO DISTRICT
CORPS OF ENGINEERS, U.S. ARMY
P. O. BOX 1739
SACRAMENTO 8, CALIFORNIA

REFER TO FILE NO. SPKGC 411.8

25 SEP 1956

State of Oregon
Department of Geology and Mineral Industries
702 Woodlark Building
Portland 5, Oregon

Gentlemen:

Advance information has been received from the Office, Chief of Engineers, Washington, D.C., that, as a result of investigations at the Waterways Experiment Station, Vicksburg, Mississippi, pozzolanic materials will be considered for use in Civil Works construction.

A data sheet and a tabulation of test requirements have been prepared for distribution to producers of these materials. Copies of these forms are inclosed for your information.

Information on sources of supply and addresses of companies which produce pozzolanic materials in Oregon will be greatly appreciated.

FOR THE DISTRICT ENGINEER:

Sincerely yours,

for F. KOCHIS
Chief, Engineering Division

2 Incl
1. Data Sheet
2. Tables

Tables Prescribing Requirements for Portland-Pozzolan Cement and Pozzolan as Covered by Federal Specification SS-C-208b

A. PORTLAND-POZZOLAN CEMENT:

Requirements:

1. Portland cement or Portland-cement clinker used in the portland-pozzolan cement shall conform to the requirements for chemical composition for type I, Federal Specification SS-C-192. Pozzolans used in portland-pozzolan cement shall conform to requirements specified in table III.

2. The percentage of pozzolan in the portland-pozzolan cement shall not be less than 15 percent nor more than 35 percent, by weight. The manufacturer shall state the source, amount, and composition of the pozzolan used in the finished portland-pozzolan cement. The amount of pozzolan in the finished cement shall not vary more than ±5.0 percentage points by weight from the amount stated by the manufacturer.

3. Detail Requirements. - The portland-pozzolan cement shall conform to the requirements for chemical properties prescribed in table I, and to physical properties prescribed in table II.

TABLE I. - Chemical Requirements

TEST	TYPE I	TYPE IA
	Percent	Percent
Sulfur trioxide (SO_3), maximum	2.5	2.5
Moisture content, maximum	3.0	3.5
Ignition loss, maximum	3.0	3.0

Encl 2

TABLE II. - Physical Requirements

TEST	TYPE I	TYPE IA
Fineness:		
Residue No. 325 sieve, maximum, percent.....	12	12
Blaine fineness meter:		
Average value, minimum, sq. cm./g.....	2900	2900
Minimum value, any one sample, sq. cm./g.....	2700	2700
Soundness, autoclave expansion, maximum, percent.....	0.5	0.5
Time of setting, Gillmore test:		
Initial, minimum, minutes.....	60	60
Final, maximum, hours.....	10	10
Compressive strength: (4.4.6) minimum:		
1 day in moist air, 6 days in water, lb./sq. in	1500	1250
1 day in moist air, 27 days in water, lb./sq. in.....	3000	2500
(The strength at 28 days shall be greater than at 7 days.)		
Air entrainment: percent by volumne.....	0-12	15-21
Water requirement, maximum, ml.....	320	280
Drying shrinkage (4.4.11), maximum, percent.....	0.12	0.11
Mortar expansion:		
At age of 14 days, maximum, percent.....	0.020	0.020
At age of 8 weeks, maximum, percent.....	0.060	0.060
False set, minimum, penetration mm.....	10	10
(This requirement applies only when specifically requested in the invitation for bids.)		

Type I. - Portland-Pozzolan cement non-airentraining.

Type IA. - Portland-pozzolan cement airentraining.

B. Pozzolan. - Pozzolan which is blended with finished portland cement to produce portland-pozzolan cement shall meet the requirements prescribed in table III. The fineness requirements need not apply to pozzolan which is interground with portland-cement clinker to produce the portland-pozzolan cement. For evaluating the contribution to compressive strength, coarse pozzolans shall be ground only to the extent of having a residue on the No. 325 sieve of 12±2 percent. For materials such as diatomaceous earth with essentially no residue on a No. 325 sieve, the minimum residue need not apply.

TABLE III. - Physical requirements - Pozzolan

TEST	TYPE P[1]	TYPE F[2]
Fineness		
Residue No. 325 sieve, maximum, percent.....	12.0	12.0
Blaine fineness meter, minimum, sq. cm./g.....	- -	3000
Contribution to compressive strength (4.5.3):		
Percent of control 28 days, minimum..... (The compressive strength of the portland-pozzolan cubes at 90 days shall not be less than the strength at 28 days.)	75	85

[1]Type P refers to natural materials such as clays, shales, diatomaceous earths, tuffs, volcanic ash and pumicite, either calcined or uncalcined. Many natural pozzolans are improved by calcining between 1,400°F. and 1,800°F.

[2]Type F refers to fly ash, an artificial pozzolan which is a fine ash collected from the flue gases at the stacks of power plants burning pulverized coal.

MATERIALS FOR POZZOLAN

R. C. Mielenz, K. T. Greene, N. C. Schieltz, and M. E. King

Bureau of Reclamation, Denver Federal Center, Denver, Colorado

Interest in pozzolans for use in concrete is increasing to such an extent that it behooves the geologist to learn their properties and identity. Pozzolans are siliceous and aluminous materials which react with lime at ordinary temperatures producing cementitious compounds.

Natural pozzolanic materials can be identified by petrographic methods. Effective volcanic ashes are rhyolitic, dacitic, andesitic, or phonolitic. Clayey materials may contain laolinite, montmorillonite-type minerals, illite (hydromica), or palygorskite; clayey pozzolans require calcination to activate the clay and reduce water requirement. Opaline pozzolans include diatomaceous earth, siliceous shales, and some cherts. Diatomaceous earth is the most active of natural pozzolans, but its use ordinarily increases water requirement and hence drying shrinkage of mortar and concrete. Industrial by-products include fly-ash, ground brick, and blast-furnace slag.

Investigations of pozzolans are being conducted by many organizations in the United States. When used to replace a portion of the portland cement in concrete, many satisfactory pozzolans will decrease costs; reduce heat of hydration; increase workability; decrease water gain and segregation; increase resistance to aggressive waters; and increase tensile strength, usually without critical loss in strength or durability. Less satisfactory pozzolans introduce adverse properties to the concrete. Some pozzolans will prevent or greatly retard the interaction of cement alkalies and aggregates, a process sometimes causing intense deterioration of concrete.

Natural pozzolans which control alkali-aggregate reaction in concrete include: opaline materials; calcined kaolinite, certain montmorillonite-type minerals, and palygorskite; and certain rhyolite pumicites. These pozzolans are the most valuable.

Bulletin of the Geological Society of America, Vol. 60, No. 12, Pt. 2, p.1964, December 1949

COPY

STATE DEPARTMENT OF GEOLOGY AND
MINERAL INDUSTRIES
1069 STATE OFFICE BUILDING
PORTLAND 1, OREGON

March 5, 1965

Mr. N. S. Wagner
State Assay Laboratory
2033 First Street
Baker, Oregon

Dear Wag:

Dave King, U.S.B.M., Spokane, was in the office yesterday and outlined a program for obtaining samples of pozzolanic materials. It seems that the Bureau is anxious to obtain quite a few samples in connection with a cooperative project with the Bureau of Reclamation. They have asked us if we could obtain 100-pound samples from the following areas:

1. One sample each from the two pumice producers in the Bend area, with one additional sample of some of the volcanic ash or pumicite if there should be a suitably large deposit in the vicinity.

2. A sample representative of the large reserves in the Chemult area.

3. A sample of diatomite from either Terrebonne, Telocaset, or Harper Basin.

4. A typical sample of clinoptilolite.

5. A sample of Harper ash.

King will supply you with large sample bags and mailing tags in the very near future.

Hollis and I feel that this is a worthwhile project and can probably be accomplished with your squiring the U.P. boys around. There is no real deadline except that they would like to have some of the samples within the next 30 days and the last not later than six months from now.

King has already visited the Kaiser plant at Shutler and was planning on visiting the Empire Building Materials Company west of town after he left here yesterday.

Here are some forms which should be filled out and sent to King when you submit the samples. Don't worry too much about the plant data sheet since King has indicated that if it is not convenient to get this data he will drop around and pick it up at his leisure. The report should be sent to: David P. King, Geologist, Spokane Office of Mineral Resources, Area VII, 1430 N. Washington Street, Spokane.

Regards,

Ralph

RSM:lk
Encl.

BEND AREA

6 MONTHS

1. 1 SAMPLE PER DEPOSIT

A. LUMP

B. FINES (ASH)

(BOTH OF 3 PROPERTIES)

CHEMUNG AREA

1 GENERAL SAMPLE

DIATOMITE

1 LARGE SAMPLE

TERREBONNE OR TELOCASET OR HACKE

CLINOPTILOLITE — 1 SAMPLE

ASH

(DENN

4 15-25 TON AT JOB SITE

20-30% WT FOR SUBS CEMENT

Spokane Office of Mineral Resources
Area VII

October 8, 1965

Mr. Robert Van Atta
Department of Geology
Portland State College
724 Southwest Harrison
Portland, Oregon

Dear Mr. Van Atta:

I am one of several Bureau of Mines Geologists investigating and testing the pozzolan resources in the United States. Pozzolan is fine-ground active glass, either natural or artificial, which can often be used beneficially as a cement-replacement in mass-concrete structures, such as dams and piers; or in applications such as aqueducts, tunnel-linings, or concrete pipe. In the Portland area, there is a potential market for pozzolan in concrete pipe, piers, sea walls, and dams to be built along the Columbia and Snake Rivers.

This August when I was looking for leads to potential pozzolan deposits, Mr. Ralph S. Mason of the Oregon Department of Geology and Mineral Industries informed me that you were working on your Doctor's thesis this summer in the Portland area, and know the geology of this area pretty well. He recommended that I contact you.

The ideal pozzolan find in the Portland area would be a tuff or tuffaceous sandstone containing over 70 percent volcanic glass, is in a bed ten feet or more thick, and has a less than 1:1 overburden strip-ratio. Also, it would be desirable to locate a deposit that is within 10 miles of a rail siding, or 25 road-haul miles or less from Portland, Oswego, or a barge shipping point on the Columbia River. I would be grateful if you could recollect and pinpoint one or two deposits for me that at least roughly meet these parameters. If you do not know of any deposits, I would still appreciate any comments you wish to make on the prospects of finding one in the Portland area. I have enclosed a self-addressed envelope. Any assistance you are able to give me would be greatly appreciated.

Sincerely yours,

David P. King
Geologist

Enclosure
DPKing:aw
cc: RSMason
LLBrown
MLWright
SO
DF

January 20, 1965

Memorandum

To: All Pozzolan Project Leaders

From: David P. King, Geologist, Spokane Office of Mineral Resources, Area VII

Subject: Reclamation Laboratory Reports

Attached is a list of 34 Reclamation laboratory documents on file in the library of Area VII's Spokane Office of Mineral Resources. Reclamation loaned these reports to this office with the understanding that they would be made available to the other Bureau of Mines pozzolan projects. For the most part, Reclamation has only one or two library copies of its reports in its files. Reclamation anticipated problems if each project Area were to apply individually for their own set of reports. Reclamation felt that on the one hand they may not be able to meet the demand if several Areas were to apply for the same document; while on the other hand, they may be left without copies to loan to other parties. For our part, common sense also dictates that we should not saddle Reclamation with library circulation problems that we could handle within our own agency.

Charlie Weiler sent me a list of 65 of Reclamation's laboratory reports that he had obtained prior to my visit to Reclamation. Only six of these reports are duplicates of ones Area VII has on file. Charlie has advised me that he will shortly distribute a list of Reclamation documents he has on hand to the other Area projects. Between us, we do not have all the Reclamation reports which are relevant to all projects. We collected only those reports which we felt would have bearing on our own projects; however, some of these reports may contain information relevant to other or all Area projects.

Area VII encourages you to borrow any of the reports on our list. We offer them to you through our library. Attached are copies of our "Intra-Bureau of Mines Loan" form which you should use in applying for these reports. The forms are, for the most part, self-explanatory. We recommend that you fill out the form. It would suffice to list the reports you want by number only (for example, Ce 73, Pet-90B, etc.). In the

blank space following "return date" put the date three weeks from date you mail your loan request; the extra week is to allow for mailing time both ways. Sufficient copies of the loan-form are enclosed so that you may keep copies for your records.

Since the reports Charlie and I have on file do not represent all of the Reclamation reports which may bear on your project, you may, of course, need to turn to Reclamation for other reports. However, you may want to check our lists of Reclamation reports before you apply to Reclamation for any.

Now to the question of how you find the Reclamation reports that may have relevance to your project. Charlie and I have copies of the indexes to Reclamation's reports (see item 1 of attached appendix). Your first course of action would be to borrow these indexes, and from them, make up a list of those reports you wish to acquire. For those reports you cannot obtain from Area VI or VII, you would need to apply for them to:

Henry C. James, Chief
Library Branch
Bureau of Reclamation
Denver Federal Center
Denver, Colorado

It would be appreciated if you would then circulate a list of those reports you obtain directly from Reclamation's library.

Thank you.

David P. King

David P. King

Attachment

DPKing:aw

cc: O. M. Bishop, Area III
R. E. Dawes, Area III
H. F. Robertson, Area IV (2 copies)
R. L. Bolmer, Area V (2 copies)
F. E. Williams, Area V
C. T. Weiler, Area VI
D. G. Irving, Area VI
R. B. Maurer, Area VI
L. L. Brown, Area VII
M. L. Wright, Area VII
SO
Df

APPENDIX "A" - RECLAMATION REPORTS ON FILE AT AREA VII SPOKANE OFFICE

Note: All pozzolan project leaders are encouraged to apply to this office for any of the file reports listed below. Loans are on a two-week basis, but are renewable if advance notice is given. Intra-Bureau of Mines Library loan slips are attached for your convenience.

1. INDEXES TO RECLAMATION'S LABORATORY FILE REPORTS AND PROJECT LOCATIONS

(RR-All Areas)* Index to Laboratory and other Numbered Reports (Preliminary Edition), from January 1900 to January 1957, inclusive, Division of Administrative Services, Technical Information Branch, Technical Library Section, January 1, 1957, 316 pages.

(RR-All Areas)* Index to Concrete Laboratory Reports ("C" Series), January 1957 to June 1963, inclusive, A preliminary list, 75 pages.

(RR-All Areas)* Names & Locations of Reclamations Stations & Projects, April 6, 1962, 75 pages.

2. CEMENT LABORATORY REPORTS

Ce 40
(PI-All Areas)* Blanks, R. F. and others. Alkalies in Cement and their Effect on Aggregates and Concretes, Progress Report, July 1, 1942, 230 pages.

Ce 73
(VII)* Mielenz, R. C. and H. W. B. Investigation of Concrete Pipe, Yakima Project, Engineering & Geological Control & Research Division, Branch of Design & Construction, October 9, 1944, 3 pages.

3. CHEMICAL ENGINEERING LABORATORY REPORTS

CH 94
(VII)* Halstead, L. Investigation of Pozzolanic Materials for Hungry Horse Dam, Research and Geology Division, Branch of Design & Construction, June 1948, 7 pages.

CH 95
(PI-III,VII)* Halstead, L. Physical and Chemical Properties of Fly-Ash - Hungry Horse Dam, Research and Geology Division, Branch of Design and Construction, June 1948, 10 pages.

4. CONCRETE LABORATORY REPORTS

C 480 (PI-All Areas)* — Adams, R. F. Progress Report-Concrete Investigations for Hungry Horse Dam, Research and Geology Division, Branch of Design & Construction, March 13, 1950, 50 pages, contains Appendixes A, B, C.

C 505 (PI-All Areas)* — Ore, E. L. Investigations of Crazing, Cracking, and Excess Pozzolan in Concrete, Davis Dam, Davis Dam Project, Arizona, Research and Geology Division, Branch of Design & Construction, June 2, 1950, 8 pages.

C 612 (PI-All Areas)* — Elfert, R. J. Preliminary Investigation of the Effect of a Finely Ground Diatomaceous Earth on the Properties of Concrete, Engineering Laboratories Branch, Design & Construction Division, January 7, 1952, 6 pages.

C 656 (PI-III,VII)* — Porter, L. C. Concrete Mix Investigations for Canyon Ferry Dam, Canyon Ferry Unit, Helena, Great Falls Division, Missouri River Basin Project, Engineering Laboratories Branch, Design and Construction Division, June 22, 1953, 26 pages.

C 660.1 (PI-All Areas)* — Cordon, William A. Experience with Pozzolans and Entrained Air in Concrete, presented at the Annual Fall Meeting of the General Technical Committee, Portland Cement Association, Sept. 29-Oct. 2, 1952, Denver, Colorado, 10 pages.

C 740 (VII)* — McMillen, D. S. Investigation of Supplemental Pozzolan for Hungry Horse Dam Concrete, Hebnes Pit Pozzolan, Engineering Laboratories, May 10, 1954, 4 pages.

C 797 (VII)* — Harboe, E.M. Progress Report Investigations of Creep Characteristics of Concrete for Grand Coulee Dam, Columbia River Project, Engineering Laboratories, March 28, 1955, 3 pages.

C 828.2 (RR-All Areas)* — Price, Walter H. Fly Ash in Heavy Construction, Engineering Laboratories July 31, 1956, 8 pages.

C 880 (PI-All Areas)* — Crosby, A. B. Properties of Mass Concrete in United States and Foreign Dams, Division of Engineering Laboratories, July 11, 1958, 3 pages.

C 968 N/A * — Smith, F. L. Resistance to Sulfate Attack of Concrete Using Special Cements as Compared with Concrete using Type V Sulfate-resisting Cement. Division of Engineering Laboratories, May 18, 1961, 4 pages.

C 989 (RR-All Areas)* — Flack, H. L. Five Year Progress Report on Investigation of the Durability of Concretes with Different Types and Percentages of Pozzolans, Division of Engineering Laboratories, August 25, 1961, 11 pages.

C 1009 (PI-All Areas) * — Harboe, E. M. Properties of Mass Concrete in Bureau of Reclamation Dams, Division of Engineering Laboratories, December 6, 1961, 6 pages.

C 1017.1 (PI-All Areas)* — Price, Walter H., and Elmo C. Higginson, Present Bureau of Reclamation Practices in Mass Concrete Technology, presented at the 58th Annual Convention, American Concrete Institute, Denver, March 13-15, 1962, 17 pages.

5. MATERIALS INVESTIGATIONS REPORTS

MI 10 (RR-VI,VII)* — Martin, A. R. Investigations of Construction Materials for Projects in Region 2, Research and Geology Division, Branch of Design and Construction, Denver, Colo., January 23, 1951, 68 pages.

6. PETROGRAPHIC LABORATORY REPORTS (Recent reports are designated Chemical Engineering Laboratory Reports)

Pet 60 (Area VII only)* — McConnell, Duncan. Bentonite Sample - Rathdrum Prairie Project, Idaho, Petrography Laboratory, Denver, Colo., February 9, 1944, 1 page.

Pet 90B (RR-All Areas)* — Mielenz, R. C. Materials for Pozzolan: A Report for the Engineering Geologist, Research and Geology Division, Branch of Design & Construction, Denver, Colo., June 6, 1950, 25 pages.

Pet 92 (PI-All Areas)* Rhoades, Roger and Richard C. Mielenz. Petrographic and Mineralogic Characteristics of Aggregates, Reprint from the Copyrighted, Symposium on Mineral Aggregates, Special Technical Publication No. 83, published by the American Society for Testing Materials, 1948.

Pet 102 (RR-All Areas)* Mielenz, R. C. Pozzolans and Cement-Pozzolan Reactions, Engineering Laboratories Branch, Design and Construction Division, December 29, 1952, (A paper presented October 1, 1952, to the General Technical Committee of the Portland Cement Association meeting in Denver, Colorado).

Pet 121 (PI-All Areas)* Benton, Elton, J. Hydration of Portland-Pozzolan Cement, A Research Project Sponsored by the National Science Foundation, Division of Engineering Laboratories, September 9, 1957, 23 pages.

Pet 123 (PI-All Areas)* Holland, W. Y. Summary of the Results of a Study of the Alkali Release from Various Combinations of Pozzolans with Hydrated Lime Versus the Expansion due to the Alkali-Aggregate Reaction in Pyrex Mortar Bars, Division of Engineering Laboratories, May 31, 1961 Revision of original report issued June 3, 1959, 12 pages.

Pet 127 (PI-All Areas)* Benton, E. J. X-ray Identification of the Complex Calcium-Aluminate Hydrates - Progress Report, Division of Engineering Laboratories, November 16, 1961, 6 pages.

Pet 128 (RR-All Areas)* Benton, E. J. Investigation of the Correlation of Mineralogy of Pozzolans with Performance in Concrete - Engineering and Methods Research - Progress Report, Division of Engineering Laboratories, December 5, 1961.

7. TECHNICAL MEMORANDUMS

TM 345 N/A* Rawhouser, Clarence, Volume Change in Mass Concrete, Pine Canyon Dam, Concrete Research for Boulder Dam, Progress Report, August 31, 1933, 27 pages.

TM 413 (PI-All Areas)* Holland, W. Y., W. T. Moran and W. H. Dumke, Preliminary Manual for the Identification of Pozzolanic Rocks, November 15, 1934, 16 pages.

TM 419 (PI-All Areas)* Gruen, D. R. Cement with Pozzolanic Admixtures, Translation from Proceedings of the International Association for Testing Materials, Zurich meeting, Vol. I, September 6-12, 1931, 41 pages.

TM 461 (PI-All Areas)* Feret, R. Researches into the Nature of Pozzolanic Reactions and Materials, translated from, "La Revue des Materiaux de Construction et de Travaux Publics" (Review of Construction Materials and Public Works) for February and March, 1933, Translated from French by S. P. Wing, June 24, 1935, 14 pages.

TM 500 (PI-All Areas)* Meissner, H. S., and W. T. Moran. Laboratory Procedure for Determining the Relative Cementitious Value of Pozzolanic Material, December 16, 1935, 41 pages.

* Refers to type of information and the Area Offices to which the information is likely to be of interest.

PI - General Information on pozzolan.
RR - Recommended reading, contains test data or fundamental pozzolan background information.
N/A - Not applicable to project.

BUREAU OF MINES POZZOLANIC MATERIALS PROJECT
Denver Pozzolan Testing Laboratory

Mineral Resource Area VII
Sample No. P-99
Laboratory No. D-759

Results of physical tests on raw or calcined natural pozzolan for use as an admixture in portland cement concrete (ASTM Specifications C402-63T)

Test material Pumicite

Source Expanded Dooley-Mtn.-Perlite, Baker County, Oregon

Special instructions Grind material to required fineness only. Do not calcine material.

Mineral composition, percent		Chemical analysis, percent		
			ASTM specs.	Test mat'l.
Active: Volcanic glass Type I	99+			
n= 1.49		$SiO_2+Al_2O_3+Fe_2O_3$	70.0 min.	
		MgO.....	5.0 max.	
		SO_3.....	3.0 max.	
Other: Feldspar	Trace	L.O.I.....	10.0 max.	
Sericite	Trace	Moisture.....	3.0 max.	

Sample preparation: Calcining none °F for ____ hours in ____

Grinding 15 minutes with 12 x 14-inch laboratory ball mill.

Physical Test Data		
Specific gravity 2.32	ASTM specs.	Test mat'l.
Fineness:		
Mean particle diameter.....microns	9.0 max.	2.9
Material retained on No. 325 sieve.....percent	12.0 max.	6.3
Pozzolanic activity index:		
Compressive strength with portland cement @ 28 days.....percent of control	75 min.	82
Compressive strength with lime @ 7 days.....psi	600 min.	807
Water requirement.....percent of control	115 max.	110
Change in drying shrinkage of mortar bars @ 28 days.....percent	0.03 max.	0.01
Soundness: Autoclave expansion or contraction....percent	0.50 max.	- 0.01
Reactivity with cement alkalies:		
Reduction of mortar expansion @ 14 days.....percent	75 min.	87

Does test material meet specifications? Yes.

Remarks or comments: ____

(Use other side if necessary)

Mineral Resource Area VII

Sample No. P-106

Laboratory No. D-747

BUREAU OF MINES POZZOLANIC MATERIALS PROJECT
Denver Pozzolan Testing Laboratory

Results of physical tests on raw or calcined natural pozzolan for use as an admixture in portland cement concrete (ASTM Specifications C402-63T)

Test material Pumicite

Source East Birch Creek Pumicite, Pilot Rock, Umatilla County, Oregon

Special instructions Grind material to required fineness only.

Mineral composition, percent		Chemical analysis, percent		
			ASTM specs.	Test mat'l.
Active: Volcanic glass Type I	97			
Index = 1.51		$SiO_2+Al_2O_3+Fe_2O_3$	70.0 min.	
		MgO.....	5.0 max.	
		SO_3.....	3.0 max.	
Other: Feldspar	2	L.O.I.....	10.0 max.	
Ferromagnesian minerals	1	Moisture.....	3.0 max.	

Sample preparation: Calcining none °F for ____ hours in ____

Grinding 15 minutes with 12 x 14-inch laboratory ball mill

Physical Test Data		
Specific gravity 2.44	ASTM specs.	Test mat'l.
Fineness:		
Mean particle diameter.....microns	9.0 max.	5.0
Material retained on No. 325 sieve.....percent	12.0 max.	6.4
Pozzolanic activity index:		
Compressive strength with portland cement @ 28 days.....percent of control	75 min.	89
Compressive strength with lime @ 7 days.....psi	600 min.	932
Water requirement.....percent of control	115 max.	106
Change in drying shrinkage of mortar bars @ 28 days.....percent	0.03 max.	0.00
Soundness: Autoclave expansion or contraction....percent	0.50 max.	0.03
Reactivity with cement alkalies:		
Reduction of mortar expansion @ 14 days.....percent	75 min.	71

Does test material meet specifications? Yes, on all critical tests.

Remarks or comments:

(Basaltic rock fragments observed from sample before testing.)

(Use other side if necessary)

BUREAU OF MINES POZZOLANIC MATERIALS PROJECT
Denver Pozzolan Testing Laboratory

Mineral Resource Area VII
Sample No. P-80
Laboratory No. D-745

Results of physical tests on raw or calcined natural pozzolan for use as an admixture in portland cement concrete (ASTM Specifications C402-63T)

Test material Diatomaceious Pumicite
Source Harper Ash, Malhuer County, Oregon
Special instructions Grind to required fineness.

Mineral composition, percent		Chemical analysis, percent		
			ASTM specs.	Test mat'l.
Active: Volcanic glass Type I Index = 1.50	74	$SiO_2+Al_2O_3+Fe_2O_3$	70.0 min.	
Diatoms	25	MgO.....	5.0 max.	
		SO_3.....	3.0 max.	
Other: Feldspar	1	L.O.I.....	10.0 max.	
		Moisture.....	3.0 max.	

Sample preparation: Calcining none °F for ____ hours in ____
Grinding 20 minutes with 12 x 14-inch laboratory ball mill

Physical Test Data	ASTM specs.	Test mat'l.
Specific gravity 2.41		
Fineness:		
Mean particle diameter.....microns	9.0 max.	2.7
Material retained on No. 325 sieve.....percent	12.0 max.	6.0
Pozzolanic activity index:		
Compressive strength with portland cement @ 28 days.....percent of control	75 min.	71
Compressive strength with lime @ 7 days.....psi	600 min.	1009
Water requirement.....percent of control	115 max.	126
Change in drying shrinkage of mortar bars @ 28 days.....percent	0.03 max.	0.02
Soundness: Autoclave expansion or contraction....percent	0.50 max.	0.01
Reactivity with cement alkalies:		
Reduction of mortar expansion @ 14 days.....percent	75 min.	77

Does test material meet specifications? No
Remarks or comments: Excess water requirement (due to diatom. content) probably accounts for low compressive strength.

(Use other side if necessary)

Mineral Resource Area VII

BUREAU OF MINES POZZOLANIC MATERIALS PROJECT
Denver Pozzolan Testing Laboratory

Sample No. P-70

Laboratory No. D-742

Results of physical tests on raw or calcined natural pozzolan for use as an admixture in portland cement concrete (ASTM Specifications C402-63T)

Test material Pumice

Source Bend Pink Pumice, Deschutes County, Oregon

Special instructions Grind to required fineness only.

Mineral composition, percent		Chemical analysis, percent		
			ASTM specs.	Test mat'l.
Active: Volcanic glass Type I Index= 1.50	97	$SiO_2+Al_2O_3+Fe_2O_3$	70.0 min.	
		MgO.....	5.0 max.	
		SO_3.....	3.0 max.	
Other: Feldspar	3	L.O.I.....	10.0 max.	
		Moisture.....	3.0 max.	

Sample preparation: Calcining none °F for ____ hours in ____

Grinding 30 minutes with 12 x 14-inch laboratory ball mill

Physical Test Data	ASTM specs.	Test mat'l.
Specific gravity 2.48		
Fineness:		
Mean particle diameter.....microns	9.0 max.	3.6
Material retained on No. 325 sieve.....percent	12.0 max.	5.2
Pozzolanic activity index:		
Compressive strength with portland cement @ 28 days.....percent of control	75 min.	86
Compressive strength with lime @ 7 days.....psi	600 min.	1060
Water requirement.....percent of control	115 max.	105
Change in drying shrinkage of mortar bars @ 28 days.....percent	0.03 max.	0.01
Soundness: Autoclave expansion or contraction....percent	0.50 max.	0.00
Reactivity with cement alkalies:		
Reduction of mortar expansion @ 14 days.....percent	75 min.	64

Does test material meet specifications? Yes, in all critical tests.

Remarks or comments: ____

(Use other side if necessary)

Mineral Resource Area VII

BUREAU OF MINES POZZOLANIC MATERIALS PROJECT
Denver Pozzolan Testing Laboratory

Sample No. P-71

Laboratory No. D-743

Results of physical tests on raw or calcined natural pozzolan for use as an admixture in portland cement concrete (ASTM Specifications C402-63T)

Test material Pumice

Source Bend Pink Pumice, Deschutes County, Oregon

Special instructions Grind to required fineness only.

Mineral composition, percent		Chemical analysis, percent		
Active: Volcanic glass Type I	99		ASTM specs.	Test mat'l.
Index = 1.50		$SiO_2+Al_2O_3+Fe_2O_3$	70.0 min.	
		MgO.....	5.0 max.	
		SO_3.....	3.0 max.	
Other: Feldspar	1	L.O.I.....	10.0 max.	
		Moisture.....	3.0 max.	

Sample preparation: Calcining none °F for ____ hours in ____

Grinding 30 minutes with 12 x 14-inch laboratory ball mill.

Physical Test Data	ASTM specs.	Test mat'l.
Specific gravity 2.38		
Fineness:		
Mean particle diameter.....microns	9.0 max.	3.87
Material retained on No. 325 sieve.....percent	12.0 max.	5.8
Pozzolanic activity index:		
Compressive strength with portland cement @ 28 days.....percent of control	75 min.	80
Compressive strength with lime @ 7 days.....psi	600 min.	873
Water requirement.....percent of control	115 max.	104
Change in drying shrinkage of mortar bars @ 28 days.....percent	0.03 max.	0.01
Soundness: Autoclave expansion or contraction....percent	0.50 max.	0.01
Reactivity with cement alkalies:		
Reduction of mortar expansion @ 14 days.....percent	75 min.	70

Does test material meet specifications? Yes, in all critical tests.

Remarks or comments: ____

(Use other side if necessary)

Mineral Resource Area VII

Sample No. P-77

Laboratory No. D-744

BUREAU OF MINES POZZOLANIC MATERIALS PROJECT
Denver Pozzolan Testing Laboratory

Results of physical tests on raw or calcined natural pozzolan for use as an admixture in portland cement concrete (ASTM Specifications C402-63T)

Test material Pumicite

Source (Unknown)

Special instructions Grind to its required fineness

Mineral composition, percent		Chemical analysis, percent		
Active:			ASTM specs.	Test mat'l.
		$SiO_2+Al_2O_3+Fe_2O_3$	70.0 min.	
		MgO.....	5.0 max.	
		SO_3.....	3.0 max.	
Other:		L.O.I.....	10.0 max.	
		Moisture.....	3.0 max.	

Not provided

Sample preparation: Calcining none °F for ____ hours in ____

Grinding 25 minutes with 12 x 14-inch laboratory ball mill

Physical Test Data		
Specific gravity 2.35	ASTM specs.	Test mat'l.
Fineness:		
Mean particle diameter.....microns	9.0 max.	5.5
Material retained on No. 325 sieve.....percent	12.0 max.	7.1
Pozzolanic activity index:		
Compressive strength with portland cement @ 28 days.....percent of control	75 min.	78
Compressive strength with lime @ 7 days.....psi	600 min.	990
Water requirement.....percent of control	115 max.	101
Change in drying shrinkage of mortar bars @ 28 days.....percent	0.03 max.	0.01
Soundness: Autoclave expansion or contraction....percent	0.50 max.	0.00
Reactivity with cement alkalies:		
Reduction of mortar expansion @ 14 days.....percent	75 min.	61

Does test material meet specifications? Yes, in all critical tests.

Remarks or comments: ____

(Use other side if necessary)

BUREAU OF MINES POZZOLANIC MATERIALS PROJECT
Denver Pozzolan Testing Laboratory

Mineral Resource Area VII
Sample No. P-63
Laboratory No. D-755

Results of physical tests on raw or calcined natural pozzolan for use as an admixture in portland cement concrete (ASTM Specifications C402-63T)

Test material Pumice

Source Paunina Pumice Klamath County, Oregon

Special instructions Grind material to required fineness only.

Mineral composition, percent		Chemical analysis, percent		
			ASTM specs.	Test mat'l.
Active: Volcanic glass Type I	96			
Index = 1.51		$SiO_2+Al_2O_3+Fe_2O_3$	70.0 min.	
		MgO.....	5.0 max.	
		SO_3.....	3.0 max.	
Other: Feldspar	3	L.O.I.....	10.0 max.	
Ferromagnesian Minerals	1	Moisture.....	3.0 max.	

Sample preparation: Calcining none °F for ____ hours in ____

Grinding 30 minutes with 12 x 14-inch laboratory ball mill.

Physical Test Data	ASTM specs.	Test mat'l.
Specific gravity 2.53		
Fineness:		
Mean particle diameter.....microns	9.0 max.	5.0
Material retained on No. 325 sieve.....percent	12.0 max.	10.9
Pozzolanic activity index:		
Compressive strength with portland cement @ 28 days.....percent of control	75 min.	78
Compressive strength with lime @ 7 days.....psi	600 min.	932
Water requirement.....percent of control	115 max.	105
Change in drying shrinkage of mortar bars @ 28 days.....percent	0.03 max.	0.01
Soundness: Autoclave expansion or contraction....percent	0.50 max.	0.02
Reactivity with cement alkalies:		
Reduction of mortar expansion @ 14 days.....percent	75 min.	62

Does test material meet specifications? Yes, in all critical tests.

Remarks or comments: ____

(Use other side if necessary)

Mineral Resource Area VII

BUREAU OF MINES POZZOLANIC MATERIALS PROJECT
Denver Pozzolan Testing Laboratory

Sample No. P-65

Laboratory No. D-739

Results of physical tests on raw or calcined natural pozzolan for use as an admixture in portland cement concrete (ASTM Specifications C402-63T)

Test material ~~Pumicite~~ and Pumice

Source Yamsey Railroad Siding, Chemult, Oregon (Kirk-Chemult Area, Klamath County)

Special instructions Grind material to its required fineness.

Mineral composition, percent		Chemical analysis, percent		
Active: Volcanic glass	90		ASTM specs.	Test mat'l.
N= 1.51 - 1.53		$SiO_2+Al_2O_3+Fe_2O_3$	70.0 min.	
		MgO.....	5.0 max.	
		SO_3.....	3.0 max.	
Other: Feldspar	6	L.O.I.....	10.0 max.	
Ferromagnesium silicate	2-3	Moisture.....	3.0 max.	
Mica	1			

Sample preparation: Calcining none °F for ____ hours in ____

Grinding 30 minutes with 12 x 14-inch laboratory ball mill

Physical Test Data	ASTM specs.	Test mat'l.
Specific gravity 2.60		
Fineness:		
Mean particle diameter.....microns	9.0 max.	3.6
Material retained on No. 325 sieve.....percent	12.0 max.	8.1
Pozzolanic activity index:		
Compressive strength with portland cement @ 28 days.....percent of control	75 min.	84
Compressive strength with lime @ 7 days.....psi	600 min.	965
Water requirement.....percent of control	115 max.	105
Change in drying shrinkage of mortar bars @ 28 days.....percent	0.03 max.	0.00
Soundness: Autoclave expansion or contraction....percent	0.50 max.	0.02
Reactivity with cement alkalies:		
Reduction of mortar expansion @ 14 days.....percent	75 min.	65

Does test material meet specifications? Yes, in all critical tests.

Remarks or comments: ____

(Use other side if necessary)

Mineral Resource Area VII

BUREAU OF MINES POZZOLANIC MATERIALS PROJECT
Denver Pozzolan Testing Laboratory

Sample No. P-67

Laboratory No. D-740

Results of physical tests on raw or calcined natural pozzolan for use as an admixture in portland cement concrete (ASTM Specifications C402-63T)

Test material Pumice (pumicite)

Source Kirk, Oregon (Kirk Conglomeratic Pumicite, Klamath County)

Special instructions Grind material to its required fineness

Mineral composition, percent		Chemical analysis, percent		
			ASTM specs.	Test mat'l.
Active: Volcanic glass	94			
N= 1.505		$SiO_2+Al_2O_3+Fe_2O_3$	70.0 min.	
Diatoms	Trace	MgO.....	5.0 max.	
		SO_3.....	3.0 max.	
Other: Feldspar	5	L.O.I.....	10.0 max.	
Ferromagnesium silicates	Trace	Moisture.....	3.0 max.	

Sample preparation: Calcining none °F for ____ hours in ____

Grinding 30 minutes with 12 x 14-inch laboratory ball mill

Physical Test Data		
Specific gravity 2.51	ASTM specs.	Test mat'l.
Fineness:		
Mean particle diameter.....microns	9.0 max.	3.6
Material retained on No. 325 sieve.....percent	12.0 max.	7.3
Pozzolanic activity index:		
Compressive strength with portland cement @ 28 days.....percent of control	75 min.	77
Compressive strength with lime @ 7 days.....psi	600 min.	1105
Water requirement.....percent of control	115 max.	105
Change in drying shrinkage of mortar bars @ 28 days.....percent	0.03 max.	0.00
Soundness: Autoclave expansion or contraction....percent	0.50 max.	0.00
Reactivity with cement alkalies:		
Reduction of mortar expansion @ 14 days.....percent	75 min.	60

Does test material meet specifications? Yes, in all critical tests.

Remarks or comments: ____

(Use other side if necessary)

BUREAU OF MINES POZZOLANIC MATERIALS PROJECT
Denver Pozzolan Testing Laboratory

Mineral Resource Area VII
Sample No. P-62
Laboratory No. D-741

Results of physical tests on raw or calcined natural pozzolan for use as an admixture in portland cement concrete (ASTM Specifications C402-63T)

Test material Pumice
Source Deschutes Pink Pumice (Cascade Pumice Corp.) Deschutes County, Oregon
Special instructions Grind to required fineness only.

Mineral composition, percent		Chemical analysis, percent		
			ASTM specs.	Test mat'l.
Active: Volcanic glass Type I Index 1.505	97	$SiO_2+Al_2O_3+Fe_2O_3$	70.0 min.	
Diatoms	Trace	MgO.....	5.0 max.	
		SO_3.....	3.0 max.	
Other: Feldspar	2	L.O.I.....	10.0 max.	
Ferromagnesian minerals	Trace	Moisture.....	3.0 max.	
Rutile	Trace			

Sample preparation: Calcining none °F for ____ hours in ____
Grinding 30 minutes with 12 x 14-inch laboratory ball mill

Physical Test Data		
Specific gravity 2.41	ASTM specs.	Test mat'l.
Fineness:		
Mean particle diameter.....microns	9.0 max.	4.7
Material retained on No. 325 sieve.....percent	12.0 max.	5.0
Pozzolanic activity index:		
Compressive strength with portland cement @ 28 days.....percent of control	75 min.	81
Compressive strength with lime @ 7 days.....psi	600 min.	890
Water requirement.....percent of control	115 max.	102
Change in drying shrinkage of mortar bars @ 28 days.....percent	0.03 max.	0.01
Soundness: Autoclave expansion or contraction....percent	0.50 max.	0.00
Reactivity with cement alkalies:		
Reduction of mortar expansion @ 14 days.....percent	75 min.	61

Does test material meet specifications? Yes, in all critical tests.
Remarks or comments: ____

(Use other side if necessary)

1-19-66

Mineral Resource Area VII

Sample No. P-56

Laboratory No. D-738

BUREAU OF MINES POZZOLANIC MATERIALS PROJECT
Denver Pozzolan Testing Laboratory

Results of physical tests on raw or calcined natural pozzolan for use as an admixture in portland cement concrete (ASTM Specifications C402-63T)

Test material Pumicite

Source Adrian, Oregon

Special instructions

Mineral composition, percent		Chemical analysis, percent		
			ASTM specs.	Test mat'l.
Active: Volcanic glass	96			
n= 1.500		$SiO_2+Al_2O_3+Fe_2O_3$	70.0 min.	
		MgO.....	5.0 max.	
		SO_3.....	3.0 max.	
Other: Feldspar	3	L.O.I.....	10.0 max.	
Ferromagnesium silicates	<1	Moisture.....	3.0 max.	

Sample preparation: Calcining none °F for ____ hours in

Grinding 30 minutes with 12 x 14-inch laboratory ball mill

Physical Test Data	ASTM specs.	Test mat'l.
Specific gravity 2.30		
Fineness:		
Mean particle diameter.....microns	9.0 max.	3.8
Material retained on No. 325 sieve.....percent	12.0 max.	3.8
Pozzolanic activity index:		
Compressive strength with portland cement @ 28 days.....percent of control	75 min.	87
Compressive strength with lime @ 7 days.....psi	600 min.	848
Water requirement.....percent of control	115 max.	105
Change in drying shrinkage of mortar bars @ 28 days.....percent	0.03 max.	0.01
Soundness: Autoclave expansion or contraction....percent	0.50 max.	0.02
Reactivity with cement alkalies:		
Reduction of mortar expansion @ 14 days.....percent	75 min.	58

Does test material meet specifications? Yes, in all critical tests.

Remarks or comments:

(Use other side if necessary)

1-19-66

Mineral Resource Area VII

BUREAU OF MINES POZZOLANIC MATERIALS PROJECT
Denver Pozzolan Testing Laboratory

Sample No. P-55

Laboratory No. D-737

Results of physical tests on raw or calcined natural pozzolan for use as an admixture in portland cement concrete (ASTM Specifications C402-63T)

Test material Tuff

Source Adrian, Oregon

Special instructions Grind material to required fineness.

Mineral composition, percent		Chemical analysis, percent		
			ASTM specs.	Test mat'l.
Active: Volcanic glass	96			
n= 1.500		$SiO_2+Al_2O_3+Fe_2O_3$	70.0 min.	
? Draxtoms ?	Trace	MgO.....	5.0 max.	
		SO_3.....	3.0 max.	
Other: Feldspar	3	L.O.I.....	10.0 max.	
Ferromagnesium silicates	1	Moisture.....	3.0 max.	
Biotite	Trace			

Sample preparation: Calcining none °F for ____ hours in ____

Grinding 25 minutes with 12 x 14-inch laboratory ball mill

Physical Test Data		
	ASTM specs.	Test mat'l.
Specific gravity 2.34		
Fineness:		
Mean particle diameter.....microns	9.0 max.	4.8
Material retained on No. 325 sieve.....percent	12.0 max.	6.7
Pozzolanic activity index:		
Compressive strength with portland cement @ 28 days.....percent of control	75 min.	82
Compressive strength with lime @ 7 days.....psi	600 min.	1040
Water requirement.....percent of control	115 max.	106
Change in drying shrinkage of mortar bars @ 28 days.....percent	0.03 max.	0.02
Soundness: Autoclave expansion or contraction....percent	0.50 max.	0.01
Reactivity with cement alkalies:		
Reduction of mortar expansion @ 14 days.....percent	75 min.	48

Does test material meet specifications? Yes, in all critical tests.

Remarks or comments: ____

(Use other side if necessary)

1-19-66

Mineral Resource Area VII

BUREAU OF MINES POZZOLANIC MATERIALS PROJECT
Denver Pozzolan Testing Laboratory

Sample No. P-53

Laboratory No. D-736

Results of physical tests on raw or calcined natural pozzolan for use as an admixture in portland cement concrete (ASTM Specifications C402-63T)

Test material Tuff

Source Pleasant Valley, Oregon

Special instructions Grind material to required fineness if required.

Mineral composition, percent		Chemical analysis, percent		
			ASTM specs.	Test mat'l.
Active: Volcanic glass	99			
n= 1.505		$SiO_2+Al_2O_3+Fe_2O_3$	70.0 min.	
		MgO.....	5.0 max.	
		SO_3.....	3.0 max.	
Other: Feldspar	1	L.O.I.....	10.0 max.	
		Moisture.....	3.0 max.	

Sample preparation: Calcining none °F for ____ hours in ____

Grinding 30 minutes with 12 x 14-inch laboratory ball mill

Physical Test Data	ASTM specs.	Test mat'l.
Specific gravity 2.42		
Fineness:		
Mean particle diameter.....microns	9.0 max.	3.0
Material retained on No. 325 sieve.....percent	12.0 max.	8.4
Pozzolanic activity index:		
Compressive strength with portland cement @ 28 days.....percent of control	75 min.	88
Compressive strength with lime @ 7 days.....psi	600 min.	1208
Water requirement.....percent of control	115 max.	109
Change in drying shrinkage of mortar bars @ 28 days.....percent	0.03 max.	0.04
Soundness: Autoclave expansion or contraction....percent	0.50 max.	0.01
Reactivity with cement alkalies:		
Reduction of mortar expansion @ 14 days.....percent	75 min.	60

Does test material meet specifications? No

Remarks or comments: ____

(Use other side if necessary)

Mineral Resource Area VII

BUREAU OF MINES POZZOLANIC MATERIALS PROJECT
Denver Pozzolan Testing Laboratory

Sample No. P-51

Laboratory No. D-735

Results of physical tests on raw or calcined natural pozzolan for use as an admixture in portland cement concrete (ASTM Specifications C402-63T)

Test material Perlite

Source Perlyte King Mine, Baker County, Oregon

Special instructions Grind material to required fineness if required.

Mineral composition, percent		Chemical analysis, percent		
			ASTM specs.	Test mat'l.
Active: Volcanic glass	99			
n= 1.500		$SiO_2+Al_2O_3+Fe_2O_3$	70.0 min.	
		MgO.....	5.0 max.	
		SO_3.....	3.0 max.	
Other: Feldspar	1	L.O.I.....	10.0 max.	
		Moisture.....	3.0 max.	

Sample preparation: Calcining none °F for ____ hours in ____

Grinding 60 minutes with 12 x 14-inch laboratory ball mill.

Physical Test Data	ASTM specs.	Test mat'l.
Specific gravity 2.37		
Fineness:		
Mean particle diameter.....microns	9.0 max.	5.7
Material retained on No. 325 sieve.....percent	12.0 max.	5.5
Pozzolanic activity index:		
Compressive strength with portland cement @ 28 days.....percent of control	75 min.	84
Compressive strength with lime @ 7 days.....psi	600 min.	919
Water requirement.....percent of control	115 max.	99
Change in drying shrinkage of mortar bars @ 28 days.....percent	0.03 max.	0.00
Soundness: Autoclave expansion or contraction....percent	0.50 max.	0.01
Reactivity with cement alkalies:		
Reduction of mortar expansion @ 14 days.....percent	75 min.	58

Does test material meet specifications? Yes, in all critical tests.

Remarks or comments: ____

(Use other side if necessary)

BUREAU OF MINES POZZOLANIC MATERIALS PROJECT
Denver Pozzolan Testing Laboratory

Mineral Resource Area VII
Sample No. P-37
Laboratory No. D-719

Results of physical tests on raw or calcined natural pozzolan for use as an admixture in portland cement concrete (ASTM Specifications C402-63T)

Test material Pumicite
Source Bend, Oregon (Stockpile at plant 7 mile north of Bend, Oregon)
Special instructions Grind to required fineness. Test material uncalcined

Mineral composition, percent		Chemical analysis, percent		
			ASTM specs.	Test mat'l.
Active: Volcanic glass	99			
n= 1.50		$SiO_2+Al_2O_3+Fe_2O_3$	70.0 min.	
		MgO.....	5.0 max.	
		SO_3.....	3.0 max.	
Other: Feldspar	1	L.O.I:.....	10.0 max.	
		Moisture.....	3.0 max.	

Sample preparation: Calcining none °F for ____ hours in ____
Grinding 30 minutes with 12 x 14-inch laboratory ball mill

Physical Test Data		
Specific gravity 2.39	ASTM specs.	Test mat'l.
Fineness:		
Mean particle diameter.....microns	9.0 max.	3.8
Material retained on No. 325 sieve.....percent	12.0 max.	3.6
Pozzolanic activity index:		
Compressive strength with portland cement @ 28 days.....percent of control	75 min.	85
Compressive strength with lime @ 7 days.....psi	600 min.	826
Water requirement.....percent of control	115 max.	106
Change in drying shrinkage of mortar bars @ 28 days.....percent	0.03 max.	0.00
Soundness: Autoclave expansion or contraction....percent	0.50 max.	0.00
Reactivity with cement alkalies:		
Reduction of mortar expansion @ 14 days.....percent	75 min.	74

Does test material meet specifications? Yes, in all critical tests.
Remarks or comments: ____

(Use other side if necessary)

M' ral Resource Area VII

BUREAU OF MINES POZZOLANIC MATERIALS PROJECT
Denver Pozzolan Testing Laboratory

Sample No. P-35

Laboratory No. D-718

Results of physical tests on raw or calcined natural pozzolan for use as an admixture in portland cement concrete (ASTM Specifications C402-63T)

Test material Pumicite

Source Central Oregon Pumice Company. 2½ miles west of Bend, Oregon

Special instructions Grind to required fineness. Do no calcine this material.

Mineral composition, percent		Chemical analysis, percent		
			ASTM specs.	Test mat'l.
Active: Volcanic glass	98			
n= 1.50		$SiO_2+Al_2O_3+Fe_2O_3$	70.0 min.	
		MgO.....	5.0 max.	
		SO_3.....	3.0 max.	
Other: Feldspar		L.O.I.....	10.0 max.	
		Moisture.....	3.0 max.	

Sample preparation: Calcining none °F for ____ hours in ____

Grinding 30 minutes with 12 x 14-inch laboratory ball mill

Physical Test Data	ASTM specs.	Test mat'l.
Specific gravity 2.38		
Fineness:		
Mean particle diameter.....microns	9.0 max.	4.0
Material retained on No. 325 sieve.....percent	12.0 max.	6.0
Pozzolanic activity index:		
Compressive strength with portland cement @ 28 days.....percent of control	75 min.	85
Compressive strength with lime @ 7 days.....psi	600 min.	836
Water requirement.....percent of control	115 max.	106
Change in drying shrinkage of mortar bars @ 28 days.....percent	0.03 max.	0.00
Soundness: Autoclave expansion or contraction....percent	0.50 max.	0.00
Reactivity with cement alkalies:		
Reduction of mortar expansion @ 14 days.....percent	75 min.	73

Does test material meet specifications? Yes, in all critical tests.

Remarks or comments: ____

(Use other side if necessary)

Mineral Resource Area VII

BUREAU OF MINES POZZOLANIC MATERIALS PROJECT
Denver Pozzolan Testing Laboratory

Sample No. P-34

Laboratory No. D-717 C-18

Results of physical tests on raw or calcined natural pozzolan for use as an admixture in portland cement concrete (ASTM Specifications C402-63T)

Test material Tuffaceous Siltstone

Source Banks, Oregon

Special instructions Grind to required fineness. Calcine at 1800°F.

Mineral composition, percent		Chemical analysis, percent		
			ASTM specs.	Test mat'l.
Active: Volcanic glass	30-35			
Clay (montmorillonite)	50-55	$SiO_2+Al_2O_3+Fe_2O_3$	70.0 min.	
Diatoms & Zeolite	1	MgO.....	5.0 max.	
n= 1.50 - 1.52		SO_3.....	3.0 max.	
Other: Feldspar & Quartz	10	L.O.I.....	10.0 max.	
Calcite (fossil)	1	Moisture.....	3.0 max.	
Ferromagnesian minerals,				
Chlorite and Limonite	2-4			

Sample preparation: Calcining 1800 °F for 3 1/3 hours in Muffle furnace

Grinding 45 minutes with 12 x 14-inch laboratory ball mill

Physical Test Data	ASTM specs.	Test mat'l.
Specific gravity 2.57		
Fineness:		
Mean particle diameter.....microns	9.0 max.	3.4
Material retained on No. 325 sieve.....percent	12.0 max.	9.2
Pozzolanic activity index:		
Compressive strength with portland cement @ 28 days.....percent of control	75 min.	83
Compressive strength with lime @ 7 days.....psi	600 min.	985
Water requirement.....percent of control	115 max.	105
Change in drying shrinkage of mortar bars @ 28 days.....percent	0.03 max.	0.00
Soundness: Autoclave expansion or contraction....percent	0.50 max.	0.01
Reactivity with cement alkalies:		
Reduction of mortar expansion @ 14 days.....percent	75 min.	71

Does test material meet specifications? Yes, on all critical tests

Remarks or comments:

(Use other side if necessary)

Mineral Resource Area VII

BUREAU OF MINES POZZOLANIC MATERIALS PROJECT
Denver Pozzolan Testing Laboratory

Sample No. P-34

Laboratory No. D-717 C-16

Results of physical tests on raw or calcined natural pozzolan for use as an admixture in portland cement concrete (ASTM Specifications C402-63T)

Test material Tuffaceous Siltstone

Source Banks, Oregon

Special instructions Grind to required fineness. Test material calcined at 1600° F.

Mineral composition, percent		Chemical analysis, percent		
			ASTM specs.	Test mat'l.
Active: Volcanic glass	30-35			
Clay (montmorillonite)	50-55	$SiO_2+Al_2O_3+Fe_2O_3$	70.0 min.	
Diatoms & Zeolite	1	MgO.....	5.0 max.	
n=1.50 - 1.52		SO_3.....	3.0 max.	
Other: Feldspar & Quartz	10	L.O.I.....	10.0 max.	
Calcite (fossil)	1	Moisture.....	3.0 max.	
Ferromagnesian materials,	2-4			
Chlorite & Limonite				

Sample preparation: Calcining 1600 °F for 3½ hours in muffle furnace

Grinding 30 minutes with 12 x 14-inch laboratory ball mill

Physical Test Data		
Specific gravity 2.37	ASTM specs.	Test mat'l.
Fineness:		
Mean particle diameter.....microns	9.0 max.	3.5
Material retained on No. 325 sieve.....percent	12.0 max.	10.2
Pozzolanic activity index:		
Compressive strength with portland cement @ 28 days.....percent of control	75 min.	77
Compressive strength with lime @ 7 days.....psi	600 min.	974
Water requirement.....percent of control	115 max.	108
Change in drying shrinkage of mortar bars @ 28 days.....percent	0.03 max.	0.01
Soundness: Autoclave expansion or contraction....percent	0.50 max.	0.00
Reactivity with cement alkalies:		
Reduction of mortar expansion @ 14 days.....percent	75 min.	73

Does test material meet specifications? Yes, on all critical tests.

Remarks or comments:

(Use other side if necessary)

BUREAU OF MINES POZZOLANIC MATERIALS PROJECT
Denver Pozzolan Testing Laboratory

Mineral Resource Area VII
Sample No. P-17
Laboratory No. D-715

Results of physical tests on raw or calcined natural pozzolan for use as an admixture in portland cement concrete (ASTM Specifications C402-63T)

Test material Volcanic Ash (Pumicite)

Source Graystone Division, Kaiser, Oregon

Special instructions Do not calcine. Grind to required fineness.

Mineral composition, percent		Chemical analysis, percent		
			ASTM specs.	Test mat'l.
Active: Volcanic glass n=1.510	80	$SiO_2+Al_2O_3+Fe_2O_3$	70.0 min.	
		MgO.....	5.0 max.	
		SO_3.....	3.0 max.	
Other: Feldspar & Quartz	18	L.O.I.....	10.0 max.	
Biotite-Ferromagnesian silicate	1	Moisture.....	3.0 max.	
Limonite	1			

Sample preparation: Calcining none °F for ____ hours in ____

Grinding 30 minutes with 12 x 14-inch laboratory ball mill

Physical Test Data	ASTM specs.	Test mat'l.
Specific gravity 2.51		
Fineness:		
Mean particle diameter.....microns	9.0 max.	3.7
Material retained on No. 325 sieve.....percent	12.0 max.	6.8
Pozzolanic activity index:		
Compressive strength with portland cement @ 28 days.....percent of control	75 min.	78
Compressive strength with lime @ 7 days.....psi	600 min.	916
Water requirement.....percent of control	115 max.	107
Change in drying shrinkage of mortar bars @ 28 days.....percent	0.03 max.	0.01
Soundness: Autoclave expansion or contraction....percent	0.50 max.	0.00
Reactivity with cement alkalies:		
Reduction of mortar expansion @ 14 days.....percent	75 min.	54

Does test material meet specifications? Yes, in all critical tests.

Remarks or comments: ____

(Use other side if necessary)

BUREAU OF MINES POZZOLANIC MATERIALS PROJECT
Denver Pozzolan Testing Laboratory

Mineral Resource Area VII
Sample No. P-16
Laboratory No. D-714

Results of physical tests on raw or calcined natural pozzolan for use as an admixture in portland cement concrete (ASTM Specifications C402-63T)

Test material Volcanic Ash (Pumicite)

Source Graystone Division, Kaiser, Oregon

Special instructions Do not calcine. Grind to required fineness only.

Mineral composition, percent		Chemical analysis, percent		
			ASTM specs.	Test mat'l.
Active: Volcanic glass n=1.500	98			
		$SiO_2+Al_2O_3+Fe_2O_3$	70.0 min.	
		MgO.....	5.0 max.	
		SO_3.....	3.0 max.	
Other: Feldspar & quartz	2	L.O.I.....	10.0 max.	
		Moisture.....	3.0 max.	

Sample preparation: Calcining none °F for ____ hours in ____

Grinding 15 minutes with 12 x 14-inch laboratory ball mill

Physical Test Data	ASTM specs.	Test mat'l.
Specific gravity 2.52		
Fineness:		
Mean particle diameter.....microns	9.0 max.	3.7
Material retained on No. 325 sieve.....percent	12.0 max.	10.7
Pozzolanic activity index:		
Compressive strength with portland cement @ 28 days.....percent of control	75 min.	75 *
Compressive strength with lime @ 7 days.....psi	600 min.	837
Water requirement.....percent of control	115 max.	109
Change in drying shrinkage of mortar bars @ 28 days.....percent	0.03 max.	0.00
Soundness: Autoclave expansion or contraction....percent	0.50 max.	0.01
Reactivity with cement alkalies:		
Reduction of mortar expansion @ 14 days.....percent	75 min.	63

Does test material meet specifications? Yes, in all critical tests.

Remarks or comments: * Only borderline quality.

(Use other side if necessary)

Mineral Resource Area VII.
Sample No. P-9
Laboratory No. D-706

BUREAU OF MINES POZZOLANIC MATERIALS PROJECT
Denver Pozzolan Testing Laboratory

Results of physical tests on raw or calcined natural pozzolan for use as an admixture in portland cement concrete (ASTM Specifications C402-63T)

Test material Ash Tuff
Source Gilliam County, Oregon
Special instructions Grind as required. Test uncalcined material

Mineral composition, percent		Chemical analysis, percent	ASTM specs.	Test mat'l.
Active: Volcanic glass n = 1.504	98	$SiO_2 + Al_2O_3 + Fe_2O_3$	70.0 min.	
		MgO	5.0 max.	
		SO_3	3.0 max.	
Other: Quartz and Feldspar	2	L.O.I.	10.0 max.	
		Moisture	3.0 max.	

Sample preparation: Calcining — °F for ____ hours in ____
Grinding 30 minutes with 12-by 14-inch laboratory ball mill

Physical Test Data	ASTM specs.	Test mat'l.
Specific gravity 2.35		
Fineness:		
Mean particle diameter.....microns	9.0 max.	5.8
Material retained on No. 325 sieve.....percent	12.0 max.	6.0
Pozzolanic activity index:		
Compressive strength with portland cement @ 28 days.....percent of control	75 min.	72 ✓
Compressive strength with lime @ 7 days.....psi	600 min.	984
Water requirement.....percent of control	115 max.	104
Change in drying shrinkage of mortar bars @ 28 days.....percent	0.03 max.	0.0
Soundness: Autoclave expansion or contraction....percent	0.50 max.	0.01
Reactivity with cement alkalies:		
Reduction of mortar expansion @ 14 days.....percent	75 min.	65

Does test material meet specifications? No (Fails one critical test)
Remarks or comments: ____

(Use other side if necessary)

BUREAU OF MINES POZZOLANIC MATERIALS PROJECT
Denver Pozzolan Testing Laboratory

Mineral Resource Area VII
Sample No. P-222
Laboratory No. D-752

Results of physical tests on raw or calcined natural pozzolan for use as an admixture in portland cement concrete (ASTM Specifications C402-63T)

Test material Tuff

Source Ritter Creek Tuff Baker County, Oregon

Special instructions Grind material to required fineness only.

Mineral composition, percent		Chemical analysis, percent		
			ASTM specs.	Test mat'l.
Active: Volcanic glass	99			
Slightly devitrified		$SiO_2+Al_2O_3+Fe_2O_3$	70.0 min.	
N= 1.501		MgO.....	5.0 max.	
		SO_3.....	3.0 max.	
Other: Feldspar and quartz	trace	L.O.I.....	10.0 max.	
		Moisture.....	3.0 max.	

Sample preparation: Calcining none °F for ____ hours in ____

Grinding 30 minutes with 12 x 14-inch laboratory ball mill

Physical Test Data	ASTM specs.	Test mat'l.
Specific gravity 2.36		
Fineness:		
Mean particle diameter.....microns	9.0 max.	4.5
Material retained on No. 325 sieve.....percent	12.0 max.	7.8
Pozzolanic activity index:		
Compressive strength with portland cement @ 28 days.....percent of control	75 min.	84
Compressive strength with lime @ 7 days.....psi	600 min.	1468
Water requirement.....percent of control	115 max.	109
Change in drying shrinkage of mortar bars @ 28 days.....percent	0.03 max.	0.07
Soundness: Autoclave expansion or contraction....percent	0.50 max.	0.03
Reactivity with cement alkalies: Reduction of mortar expansion @ 14 days.....percent	75 min.	65

Does test material meet specifications? No - excessive drying shrinkage

Remarks or comments: ____

(Use other side if necessary)

Mineral Resource Area VII

BUREAU OF MINES POZZOLANIC MATERIALS PROJECT
Denver Pozzolan Testing Laboratory

Sample No. P-108

Laboratory No. D-748

Results of physical tests on raw or calcined natural pozzolan for use as an admixture in portland cement concrete (ASTM Specifications C402-63T)

Test material Altered Tuff (Clinoptilolite)

Source Deep Creek Tuff, Grant County, Oregon

Special instructions Grind to required fineness only. *

Mineral composition, percent		Chemical analysis, percent		
Active:			ASTM specs.	Test mat'l.
Altered volcanic glass (Type I)	93	$SiO_2+Al_2O_3+Fe_2O_3$	70.0 min.	
N = 1.47-1.48		MgO.....	5.0 max.	
Zeolites	3	SO_3.....	3.0 max.	
Other:		L.O.I.....	10.0 max.	
Feldspar	1	Moisture.....	3.0 max.	
Ferromagnesian minerals, Clays	2			
Limonite	1			

Sample preparation: * Calcining none °F for ____ hours in ____

Grinding 30 minutes with 12 x 14-inch laboratory ball mill.

Physical Test Data		
Specific gravity 2.12	ASTM specs.	Test mat'l.
Fineness:		
Mean particle diameter.....microns	9.0 max.	2.9
Material retained on No. 325 sieve.....percent	12.0 max.	8.7
Pozzolanic activity index:		
Compressive strength with portland cement @ 28 days.....percent of control	75 min.	78
Compressive strength with lime @ 7 days.....psi	600 min.	877
Water requirement.....percent of control	115 max.	110
Change in drying shrinkage of mortar bars @ 28 days.....percent	0.03 max.	0.03
Soundness: Autoclave expansion or contraction....percent	0.50 max.	0.02
Reactivity with cement alkalies:		
Reduction of mortar expansion @ 14 days.....percent	75 min.	76

Does test material meet specifications? Yes

* Remarks or comments: Testing was started before instructions to calcine material were received on 1/21/66. (Calcination evidently not needed.)

(Use other side if necessary)

POZZOLAN

A good rule of thumb method to be used in computing the pozzolan requirements, if the barrelage of cement is already known, is that in mass concrete on USCE projects it requires .08 ton per bbl. of cement and in structural work .058 ton per bbl. of cement. Pozzolan is used in all structural work such as power houses, etc. Arch type dams are, of course, considered as structural, zzzhzzzzhz

Pozzolan Bibliography

"Geology and Technology of some natural Pozzolans in North Central California" by John N. Faick, Economic Geology Vol. 58 , 1963 pp 702-719.

Pozzolan specs available from US Corps of Engineers, Pittock Block

382 2051
3 PHONE BOOKS

CA-1 7681
437

8-12-62

ROUSCH

GREEN
PETER

SERIAL
CE -CRD-C-262-61

YR
SPEC

TYPE "N" OR "F"
NATURAL FIRED

IN BULK
MIX ON JOB.

POUR → JAN FEB MAR

366,630 CU FT POZZ
30% REPLACEMENT
2½ SACK MIX

UNIFORMITY VERY IMPORTANT

$15-17/TON

70¢ CU FT

CONTRACTOR TO BLND JOB.

$4.40/BBL CONC

$1.10/SACK

RARE METALS CORPORATION OF AMERICA

MEMORANDUM

To: J. R. Reynolds

Date: December 20, 1960

From: R. Kronstadt

Place: Salt Lake Ctiy, Utah

Chemical Analysis of Weiser Tailings

$SiO_2 + R_2O_3$	96.40%
L.O.I.	1.43
SO_3	0.11
MgO	<0.10
Moisture	0.35
Exchangeable alkalis	0.39

/s/ R. Kronstadt
R. Kronstadt

RK:cbl

RARE METALS CORPORATION OF AMERICA

TEXAS STREET AT STANTON • POST OFFICE BOX 1492 • EL PASO, TEXAS

ADDRESS REPLY TO
[redacted]
SALT LAKE CITY 11, UTAH

6th Floor El Paso Natural Gas Bldg.
315 East Second South
Salt Lake Cty 11, Utah

April 18, 1961

RESULTS OF TEST WORK PERFORMED BY
U. S. BUREAU OF RECLAMATION
TO DETERMINE THE POZZOLANIC QUALITIES OF THE CALCINED TAILINGS FROM
RARE METALS CORPORATION'S WEISER, IDAHO, MERCURY OPERATION

PETROGRAPHIC ANALYSIS

Description of Material: Calcined opal

PHYSICAL PROPERTIES

Fineness
Air Permeability 7,426 cm^2/gram--16,189 cm^2/cc
Percent Retained on No. 325 Sieve 2.3
Specific Gravity: 2.18
Water Requirement: 99 Percent of Control
Change of Drying Shrinkage of Mortar Bars: 0.014 Percentile
Reduction of Reactive Expansion at 14 Days: 74 Percent

Compressive Strength of 2-inch Cubes	PSI	Percent of Control
With Pozzolan Replacement: Sealed cured, 28 days	5,167	89

Compressive strength of 2- by 4-inch Cylinders of Pozzolan-Lime Mortar, psi 921 at 7 days

CHEMICAL ANALYSIS

Silicon dioxide (SiO_2))		Percent
Aluminum oxide (Al_2O_3))	97.00	Percent
Ferric oxide (Fe_2O_3))		Percent
Magnesium oxide (MgO)	0.64	Percent
Sulfur trioxide (SO_3)	0.05	Percent
Loss of ignition	0.72	Percent
Moisture content	0.04	Percent
Exchangeable alkalies as Na_2O	0.05	Percent

RARE METALS CORPORATION OF AMERICA

TEXAS STREET AT STANTON • POST OFFICE BOX 1492 • EL PASO, TEXAS

[redacted]
6th Floor El Paso Natural Gas Bldg.
315 East Second South
Salt Lake Cty 11, Utah

March 21, 1961

RESULTS OF TEST WORK PERFORMED BY
COLORADO SCHOOL OF MINES RESEARCH FOUNDATION
TO DETERMINE THE POZZOLANIC QUALITIES OF THE CALCINED TAILINGS FROM
RARE METALS CORPORATION'S WEISER, IDAHO, MERCURY OPERATION

The material used in all tests was ground to a specific surface of 7860 square centimeters per gram. The material was ground to conform with U. S. Bureau of Reclamation specifications as to particle size.

LIME-POZZOLAN TEST

This test was made according to the standard procedure of the U. S. Bureau of Reclamation.

Specimen	Diameter (Average) (Inches)	Area (Average)	Compressive Strength Lbs/sq. in.
1	2.118	3.52	933
2	2.114	3.51	963

COMPRESSIVE STRENGTH WITH PORTLAND CEMENT

The concrete test specimens were prepared in accordance with ASTM Schedules C33-46, C136-46, and C143-49.

	Percent of Control	
Specimen	7-Day Compression*	28-Day Compression*
Standard Concrete (5-Sack Mix)	100	100
10% Pozzolan	103	102
20% Pozzolan	102	101
30% Pozzolan	114	114
40% Pozzolan	82	92

*Average of four specimens

March 5, 1965

Mr. N. S. Wagner
State Assay Laboratory
2033 First Street
Baker, Oregon

Dear Wag:

Dave King, U.S.B.M., Spokane, was in the office yesterday and outlined a program for obtaining samples of pozzolanic materials. It seems that the Bureau is anxious to obtain quite a few samples in connection with a cooperative project with the Bureau of Reclamation. They have asked us if we could obtain 100-pound samples from the following areas:

1. One sample each from the two pumice producers in the Bend area, with one additional sample of some of the volcanic ash or pumicite if there should be a suitably large deposit in the vicinity.

2. A sample representative of the large reserves in the Chemult area.

3. A sample of diatomite from either Terrebonne, Telocaset, or Harper Basin.

4. A typical sample of clinoptilolite.

5. A sample of Harper ash.

King will supply you with large sample bags and mailing tags in the very near future.

Hollis and I feel that this is a worthwhile project and can probably be accomplished with your squiring the U.P. boys around. There is no real deadline except that they would like to have some of the samples within the next 30 days and the last not later than six months from now.

King has already visited the Kaiser plant at Shutler and was planning on visiting the Empire Building Materials Company west of town after he left here yesterday.

Here are some forms which should be filled out and sent to King when you submit the samples. Don't worry too much about the plant data sheet since King has indicated that if it is not convenient to get this data he will drop around and pick it up at his leisure. The report should be sent to: David P. King, Geologist, Spokane Office of Mineral Resources, Area VII, 1430 N. Washington Street, Spokane.

Regards,

Ralph

RSM:lk
Encl.

STATE DEPARTMENT OF GEOLOGY
AND MINERAL INDUSTRIES
BAKER FIELD OFFICE
2033 FIRST STREET
BAKER, OREGON 97814

June 14, 1966

Mr. Hollis Dole
1069 State Office Bldg.
Portland 1, Oregon

Dear Hollis:

A day or two ago I listened for an hour or more while Dave King, USBM reviewed the pozzonlan findings to be released soon. The Huntington cinders are good and are even now being ground by the Oregon Portland Cement Company for use in the Lower Monumental dam. What is interesting here to me is that they tried to lease from the county but ended up moving down the road a mile or so and opening a pit of their own because the county played hard to get.

Dooley perlite is good in two ways -- as it comes from the pit, and after it has been popped. In the latter case it has "outstanding" to counteract alkaline reactive aggregate.

The clinoptilotite is also excellent in some way but I forget now how.

The gist of Dave's call is that he wants for me to re-sample the Harper ash and get some data for the Dooley perlite sometime this summer but I thought you would be interested in knowing about some of the test results and especially about the Oregon Portland Cement situation.

Sincerely,

N. S. Wagner

NSW:tm