MR-058-06

REPORT ON INVESTIGATION FOR BRICK CLAY

ADJACENT TO FAIRBANKS, ALASKA

In January of 1947, Lt. Col. J. H. Ford and Major Delmar R. Frazier requested the writer to look over the area within a radius of 75 miles of Fairbanks to see if there were any deposits of clay therein suitable for brick-making. As the ground was still snow-covered, it was decided to wait until the latter part of April and May to make investigations in the field. In the meantime letters were written to the Bureau of Mines and to the Alaska Development Board, copies of which are attached. No information whatsoever on clays in the vicinity of Fairbanks was obtained from either of these sources.

In April after looking over several possible factory sites, Mr. T. O. Peyton, Station Agent for the Alaska Railroad, was contacted, plats of railroad land available for leasing examined, and a 4-acre tract of ground adjacent to railroad facilities, chosen for a brickyard. On April 19 a letter was sent to the office of the Alaska Railroad asking about securing a lease on the chosen plot of land. A copy of this letter and the answer received, are attached.

On April 22 a Mr. J. L. Wilson, who claimed to have discovered a large deposit of brick clay along the Alaska Railroad, was contacted just before he was leaving for Seward Peninsula. An examination of the records in Fairbanks failed to show any recorded clay placer claim locations. On April 24, a trip by train was made to Nenana where a similar examination failed to show any recorded placer claims in his name.

On May 1st, the ground having sufficiently thawed, field trips were started and samples of various alluvial deposits taken.

TABULATION OF LOCALITIES WHERE SAMPLES WERE TAKEN

Locality and Specimen No.	Description of Locality
1	on school lands on Steese Highway, 2½ miles north of Fairbanks(SW¼ Sec.36, T.1N., R.1W.)
2	In road-cut on southern side of Steese Highway on Erickson farm (N½ Sec. 36, T1N, R1W)
3	1/4 mile east of Richardson Highway on south side of Moose Creek Butte
4	At abandoned U.S.A. root cellar on Lazelle road at the foot of the south slope of Meridian Hill.
5	On Elliot Highway about 3 miles north of Scrafford (top of divide between Fox and Vault Creeks)

Locality and Specimen No.	Description of Locality
6	On Richardson Highway at mouth of Little Salcha River
7	On east side of Richardson Highway from north bank of gravel pit 1/2 miles north of the entrance to the Salchaket Lake road. (In Salchaket Townsite, NW¼ NE¼ Sec. 2, T 6 S., R 4 E., F.M.)
8	On west side of Richardson Highway, 1/4 mile south of the entrance to Salchaket Lake road
9	On east side of Richardson Highway about 1/2 mile south of the entrance to Salchaket Lake road
10	On west side of Richardson Highway in granite (diorite) sand barrow pit about 2 miles north of Birch Lake
11	On west side of Richardson Highway in gravel pit about 100 yards south of Birch Lake
12	On east side of Richardson Highway in gravel pit about 1 mile south of Birch Lake
13	At Birch Lake on west side of Richardson Highway on Taylor ground
14	On same side of Richardson Highway and 500 feet south of Specimen No. 10
15	On Farmers Loop road at north fork of Isabella Creek
16	In old field at foot of ridge between Isabella and Goldstream creeks on road running due north past the Fairbanks Golf and Country Club
17	On east side of Farmers Loop road on banks of small creek flowing from Balane Lake
18	At the mouth of the U.S.S.R. & M. Co. Cripple Creek drain down the Chena River from the pumping station.
19	On the north side of Richardson Highway at the site of the old Richardson Lodge (70) miles south of Fairbanks)
20	On the north side of Richardson Highway and the left limit of Gasoline Creek (68 miles south of Fairbanks).

Locality and Specimen No.	Description of Locality
21	On the north side of Richardson Highway at top of cut bank 67 miles south of Fairbanks.
22	On the north side of Richardson Highway at top of cut bank at the mouth of Canyon Creek
23	On the west side of Richardson Highway in gravel pit opposite the head of Canyon Creek and in view of Birch Lake (about 63 miles south of Fairbanks)
24	On the west side of Richardson Highway about 1 mile north of Specimen No 7

The first 17 specimens were made up into 1-inch briquettes, air-dried and then dried in the electric oven to 500 degrees F. On May 14 the briquettes were taken to the Territorial Assay Office at College and fired in an assay furance for 48 hours up to a temperature of 1200 degrees C. None of the samples were satisfactory as most fused under this temperature, except Speciments No. 3 and No. 7. It was felt that these two specimens should be looked into further so more material was obtained from these two localities and numbered speciments 3A and 7A. It was also felt that the heat of firing had been too high during the first firing, so the most promising of the material from the first 17 specimens as well as specimens 18 to 24, inclusive, and specimens 3A and 7A, were made into 2-inch briquettes. The same air-and oven-drying procedure was followed as with the previous 17 specimens and on May 19, 14 briquettes were taken to Mr. Art Glover at the Territorial Assay office at College for firing.

Brick No.	Wet size	Airdry size	Ovendry size	Kilndry size	Airdry % shrink.	Ovendry % shrink.	Kilndry % shrink.	Remarks
1		2.40"	2.35"	2.25"	2.08	2.12	2.25	unscreened
2		2.45	2.45	2.45	0	0	0	unscreened
4		2.00	2.00	2.00	0	0	0	unscreened
6		1.95	1.95	1.90	0	0	2.62	unscreened
9		2.00	2.00	2.00	0	0	0	screened, 32 mesh
18	2.1	2.05	2.05		2.38	0	(crumbled)	unscreened
19	2.1	2.05	2.00	2.00	2.38	2.38	0	screened, 32 m.
20	2.2	2.10	2.10	2.10	4.55	0	0	screened, 32 mesh
21	2.0	1.95	1.95	1.95	2.50	0	0	screened, 32 mesh
22	2.0	1.90	1.90		5.00	0	(crumbled)	unscreened
23	2.0	1.90	1.90		5.00	0	(crumbled)	screened, 32 mesh
24	2.1	2.00	2.00	2.00	4.75	0	0	unscreened
3A	2.1	2.05	2.05	?	2.38	0	?	screened, 32 mesh
7A	2.0	1.95	1.95	?	2.38	0	?	screened, 32 mesh

The following report was made on the results by Mr. Art Glover:

C O P Y

TERRITORY OF ALASKA
DEPARTMENT OF MINES
June 10, 1947 I 8298 - 8311

Mr. Irving Mck. Reed
Fairbanks, Alaska/

Dear Irving:

Following please find our report covering the rough testing performed on your 14 samples of possible brick raw materials.

	Fired Hardness (1050 degrees C.)
1	soft
2	soft
3A	near steel hard
4	softer than steel
6	softer than steel
7A	near steel hard
9	soft
18	very soft
19	softer than steel
20	softer than steel
21	softer than steel
22	very soft
23	soft
24	softer than steel

PREFIRED STRENGTH

As submitted these samples had all been air-dried and prefired in a home electric range oven. Examination of the samples upon receipt yielded the following data concerning "green strength". (The low-temperature prefiring probably served to increase this strength above that of the air-dried materials).

Samples numbered 1, 2, 6, 9, 18, and 22, were too weak to permit normal handling, such as would be required in commercial manufacture. Numbers 19 and 24 were marginal

in this respect.

Samples 3A, 4, 7A, 20, 21, and 23, possessed sufficient strength to warrant considering them as possibly acceptable.

FIRED STRENGTH

No facilities were at hand for determining the modulus of rupture. In my opinion, all of these including the best (3A, 4, 7A, 19, 20, 21) probably fall somewhat below the figure for a good grade of common brick. Continued study and experimentation with mixtures and firing manipulations would, however, probably develop adequate strength.

Yours very truly,
ART GLOVER
Assayer-in-charge

Specimens No. 3A and 7A were considered promising enough to warrant investigation by a competent laboratory in Ohio. Therefore on May 30 and 31, 75 pounds of material was secured from Locality No. 7 (gravel pit near Salchaket Lake) and from Locality No. 3 (Moose Creek Butte). On June 12 the sacked samples were shipped to T. V. Garve, 314 King Avenue, Columbus 7, Ohio.

As Locality No. 3 is in a Government road reserve whose boundaries are not marked, it was necessary to go east at least 1/2 mile to clear the reserve. Therefore on June 12, 1947, a 40-acre placer location (Brickbat Association Claim) was staked on the eastern side of the summit of Moose Creek Buute as an examination of the ground showed the same type of material extended that far. A copy of the certificate of location is appended to this report.

After receiving the report from the laboratory in Ohio on material from Localities No. 3 and No. 7, it was decided to stake claims covering Locality No. 7. However, since this locality is within the area of Salchaket Townsite, legal opinion obtained in Fairbanks is that no mining claim may be located covering Locality No. 7. The local Bureau of Land Management office was of the opinion that the land could not be bought from the townsite trustee as it had not been surveyed into lots by the Government cadastral engineers. It was then decided to locate claims outside of the Salchaket Townsite boundary but as near to Locality No. 7 as possible. Therefore on July 23, 1947, two 40-acre association placer locations were made adjacent to the west boundary of Salchaket Townsite comprising the Terra Cotta Association Claim and the Kaolin Association Claim or the $SW\frac{1}{4}$ $NW\frac{1}{4}$ Sec. 2 and the $SE\frac{1}{4}$ $NE\frac{1}{4}$ Sec. 3, T. 6 S., R 4 E., F.M., respectively. Copies of the certificates of location of these 2 claims are appended to this report.

As the surface of these two claims is covered by a heavy growth of trees and moss, augur holes were drilled in numerous places just inside the boundaries of the claims. Frozen ground was encountered in each hole from 1 foot to 18 inches down from the surface of the moss. However in the augur hole near the middle of the east line of the Terra Cotta and also in the augur holes near the southeast and southwest corners of the same claim and near the middle of the east line of the Kaolin Association, a distinct reddish discoloration of the black muck was noted at the bottom of the holes, possibly indicating the near proximity of reddish material similar to that at Locality No. 7.

At Locality No. 3 on the Brickbat Association, augur holes were drilled with the following results:

Hole No.	Location	Depth	Results
1	10' north of S.E. corner	18"	Bottom of hole in disintegrated bedrock. Subsoil the same as Specimen 3A
2	about middle of east line	3 feet	Bottom of hole on frozen ground, subsoil the same as specimen No. 3A
3	10 ft. east of N.W. corner	4 ft.	Bottom of hole limit of augur, subsoil the same as Specimen 3A
4	10 ft. east of N.W. corner	4 ft.	Bottom of hole limit of augur; subsoil the same as Specimen No. 3A
5	20 ft. east of S.W. corner	2 ft.	Bottom of hole on frozen ground; subsoil black muck with last 2 inches same as Specimen No. 3A.

G E O L O G Y

Moose Creek Butte (Locality No. 3) appears to be a dioritic intrusion which has been highly metamorphosed so that in places it resembles ordinary schist. This material being slightly harder than the ordinary schistose country rock has not been eroded down to the same level as the rest of the Tanana lowland. The subsoil on the butte is apparently derived from the disintegration in place of the altered dioritic rock. On the south and southeastern side of the butte, Moose Creek has cut the butte to a steep blufflike slope. It is thought that such subsoil derived from the bedrock of the butte as lay on the slope would have been washed away by Moose Creek or buried beneath an unknown depth of pleistocene outwash gravels. The Brickbat Association was therefor located on the northern and northwestern slopes of the butte.

At Locality No. 7 the hill west of Salchaket Lake flattens out to the north into the Salcha River valley in a series of low, ill-defined benches from 1/2 to 1½ miles wide. Locality No. 7 is situated on the highest of these benches and apparently extends from that place westward along the foot of the north slope of the aforementioned hill. It is thought that from the color of the subsoil and the presence of small angular pieces of quartz in it, that this material originated by the disintegration of altered intrusions in the northern slopes of the above hill and is probably of pre-pleistocene or interglacial age.

RECOMMENDATIONS

About 1 mile of easily built road over good ground would make the material in the Brickbat Association available. No trouble is anticipated from frost as such frozen ground as is present would thaw after being stripped of brush and overburden. The subsoil could be excavated and loaded by power shovels. It is recommended that at least 6 4-inch drill holes be sunk on the claim by an ordinary light prospecting placer drill before work is started in order to determine the depth of the deposit.

On the Terra Cotta and Kaolin Associations there is a heavy overburden of scrub trees and moss overlying a frozen subsoil. In order to be certain of the nature and extent of the subsurface deposit, a line of at least 10 4-inch drill holes should be sunk in an east-west direction across these claims. Access can be had to the claims by means of a short 1/2 mile and very easily built road from the Richardson Highway. The surface can be stripped by bulldozer and the muck overburden removed on thawing by the same means, or by means of water pumped from Waterlily Lake at the northeast corner of the Terra Cotta Association. After the removal of the insulating vegetative muck overburden, the underlying subsoil will probably thaw enough for loading by power shovel.

(Signed)
Irving Reed
Registered Mining Engineer

C O P Y

Mr. Robert S. Sanford, Acting Chief,
U.S. Bureau of Mines,
P.O. Box 2990
Juneau, Alaska

Box 474
Fairbanks, Alaska
Jan 28, 1947

Dear Mr. Sanford:

I have some clients who are enquiring about brick clays in the vicinity of Fairbanks. Would you please mail me any data the Bureau of Mines has on brick clays in the Fourth Division and also any possible cement rocks. I would like also to get any bulletin the Department of Mines may have on brick clays and bricks; also cement rocks and cement. This is a subject that is a little bit out of the ordinary for the engineers of Alaska. We will have to look to you for guidance in the matter. I am very anxious to see some sort of brick-making or cement plant started in the Interior, since building materials are so scarce, and so terribly costly.

Very truly yours,
Irving M. Reed

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

Box 2990,
Juneau, Alaska
Feb. 6, 1947

Mr. Irving M. Reed,
Box 474
Fairbanks, Alaska

Dear Mr. Reed:

Reference is made to your letter of January 28 concerning brick clays and the possibility or cement manufacture in the vicinity of Fairbanks.

We have no record of any reports on structural materials in the Interior of Alaska. It has been suggested that the Bureau of Mines make such an investigation but, to date, no funds have been made available for this work.

There are a number of limestone outcrops near Fairbanks, particularly in the Goldstream Valley. If you can find, at your Public Library, a copy of U.S. Geological Survey Bulletin No. 525, A Geologic Reconnaissance of the Fairbanks Quadrangle, Alaska, with maps, you will be able to locate and investigate these places.

Clay is also reported near Fairbanks but, like the limestone, there is no record of quality. One deposit is reported to be at the Healy River Mine but probably there are others nearer Fairbanks.

The Territorial Department of Mines does not have any bulletins on these subjects but suggest that you contact Art Glover, Territorial Assay Office, College, Alaska, for any information he may have.

The Bureau of Mines has an Information Circular No. 6155, Clay, which contains much information on examining, testing, classification of clays and manufacture of clay products which might be of interest to you. This may be obtained by writing to: Mr. George Cresswell, Publications Distribution Section, Bureau of Mines, Washington 25, D.C.

Very truly yours,
Marvin L. Nelson, for
Robert S. Sanford, Actg. Chief,
Alaska Division, Mining Branch

C O P Y

Mr. George Sunborg, Mgr.,
Alaska Development Board,
Juneau, Alaska

Box 474
Fairbanks, Alaska
Jan. 28, 1947

Dear Mr. Sunborg:

There are some parties here in Fairbanks that seem to be very much interested in starting a brick-making plant. They have asked me to get some data on this and particularly, if they should start a plant, what competition they would have from Anchorage. Of course, if there is going to be too much competition, a plant here is out. I hate to put them to the expense of making a trip to Anchorage and possibly there, not getting the data I should want. I know you are in touch with all the development in the Territory.

Will you please let me know what the development is in brick-making in Anchorage, that is: number of kilns they now have, future plans, etc. size and location of their brick deposits and any other data you think might be of use to me in deciding for these men so they will not unnecessarily risk their money. I am very anxious of course to get a plant started here, as I think it would do the town a great benefit. However, if it is not feasible, I do not want these men to lose money where it might be invested to good advantage otherwise.

Thanking you in advance, I am,

Very truly yours,
Irving M. Reed

ALASKA DEVELOPMENT BOARD
Juneau, Alaska
P.O. Box 50

Feb. 15, 1947

Mr. Irving M. Reed
Box 474
Fairbanks, Alaska

Dear Mr. Reed:

It is only now that I am able to answer your letter of January 28, relative to a brick making plant proposed for Fairbanks. I have just returned here from an absence of several weeks in the States.

I am very much interested to learn that some of you Fairbanks people are thinking about starting a brick making plant. You ask about competition which might be furnished from Anchorage. This office knows of two brick making establishments now being built or enlarged at Anchorage. One is quite small with, I think, only a single kiln. The other is planning installation of at least six tunnel kilns and of going into brick manufacturing on a large scale. I understand that contracts with the Army have either been signed or promised both of these plants. The larger of them contemplates manufacturing brick to sell at Anchorage at around $35.00 a thousand.

Caly suitable for brick making exists widely in the Anchorage vicinity. One of the deposits now being worked is near Pt. Woronzoff. The other is on the Fort Richardson spur of the Alaska Railroad about a mile and a half from Anchorage.

We do not have available here in the office the tariffs of the Alaska Railroad which give the local rate on the transporting of brick from Anchorage to Fairbanks. However, I am sure the rate is probably so high that there is little liklihood that competition would be furnished from Anchorage, in the event brick could be manufactured

at Fairbanks at anything like comparable costs. I might add that I see no reason why it should not be.

This office is anxious to assist this enterprise in every way we can. I would appreciate being placed in touch with the people contemplating establishing a plant there.

Sincerely yours,

George Sundborg

C O P Y

Box 474
Fairbanks, Alaska
Feb. 12, 1947

Mr. George Cresswell,
Publications Distribution Section,
Bureau of Mines,
Washington 25, D.C.

Dear Sir:

Will you please mail me Information Circular # 6155, Clay, which contains information on examining, testing, and classification of clays and manufacture of clay projects.

Thanking you, I am

Very truly yours,
Irving M. Reed
Registered Mining Engineer

Box 474
Fairbanks, Alaska
April 19, 1947

Mr. J. J. Delaney,
Assistant General Manager,
Alaska Railroad
Anchorage, Alaska

Dear Sir:

A group here in Fairbanks is incorporating to manufacture brick for local consumption. We wish to secure a lease on railroad property of 4 acres at Fairbanks. Said 4 acres is in that area north of the main tract, east of the Ladd Field wye, and west of the F.E. Company spur.

Will you please let us know now we will go about securing this lease for the above 4 acres. We would like to start the proceedings immediately as we have arranged for financing and the shipping in of the requisite machinery. We plan to get started manufacturing brick this coming summer.

Thank you in advance for any information you may be able to give us in this matter, I am

Very truly yours,
Irving Reed

UNITED STATES DEPARTMENT OF THE INTERIOR
THE ALASKA RAILROAD

Anchorage, Alaska
April 26, 1947

Mr. Irving Reed
Box 474
Fairbanks, Alaska

Dear Sir:

Reference your letter of April 19, 1947, requesting lease on four acres of ground at Fairbanks, west of the F.E. Company spur.

All of the Alaska Railroad's property on the west side of the F.E. spur has been leased.

Very truly yours,
J. P. Johnson
General Manager

C O P Y

CERTIFICATE OF LOCATION OF PLACER MINING CLAIM

This is to certify that the undersigned qualified under the laws of the United States to locate placer mining ground in the Territory of Alaska, has located an association placer mining claim on the right limit of Moose Creek, a tributary of Chena River, in the Fairbanks Mining and Recording District, Territory of Alaska, containing approximately forty acres and particularly described as follows, to-wit:

(a) The name or number of said claim is Brickbat Association claim,

(b) The names of the locators thereof are Delmar R. Frazier and Irving Reed.

(c) The date of discovery and posting of the location notice was the twelfth day of June, 1947.

(d) Said claim is approximately 1320 feet in length, and 1320 feet in width.

(e) A particular description of the boundaries of said claim is as follows: Beginning at the initial post, which is situated on the right limit of Moose Creek about 200 feet east of the summit of Moose Creek Butte and about 1 mile east of the east end of the Piledriver Slough dike extending thence in a N. 36 degrees E. direction, approximately 1320 feet to Post No. 2; thence in a N. 54 degrees W. direction, approximately 1320 feet, to Post No. 3; thence in a southwesterly direction, approximately 1320 feet, to Post No. 4; thence in a southwasterly direction approximately 1320 feet to the initial post and place of beginning.

(f) Said claim is a bench claim, situate at Discovery on the right limit of said creek.

(g) Brick clay was discovered on said claim on the 31st day of May, 1947.

Delmar R. Frazier
Irving Reed Locators

Eleanor Stoy Reed
Witness to Location

By Irving Reed, Agent

C O P Y

CERTIFICATE OF LOCATION OF PLACER MINING CLAIM

This is to certify that the undersigned qualified under the laws of the United States to locate placer mining ground in the Territory of Alaska, has located an association placer mining claim on Salcha River, a tributary of Tanana River in the Fairbanks Mining and Recording District, Territory of Alaska, containing approximately forty acres, and particularly described as follows, to-wit:

(a) The name or number of said claim is Terra Cotta Association Claim.

(b) The names of the locators thereof are Delmar R. Frazier and Irving Reed.

(c) The date of discovery and of posting of the location notice was the 23rd day of July, 1947.

(d) Said claim is approximately 1320 feet in length, and 1320 feet in width.

(e) A particular description of the boundaries of said claim is as follows: Beginning at the initial post, which is situated at the southeast corner and is identical with the 1/16 Sec. Cor. on the south boundary of the N.W. 1/4 of Sec. 2, T. 6 S., R. 4 E., this claim being the SW¼ of the NW¼ of Sec. 2, T. 6 S., R 4 E.,F.M.

(f) Said claim is a bench claim, situate below Discovery on the left limit of said River.

(g) Brick clay was discovered on said claim on the 23rd day of July 1947.

Delmar R. Frazier

Irving Reed

Locators

Eugene E. Smith

Witness to Location:

By Irving Reed, Agent

C O P Y

CERTIFICATE OF LOCATION OF PLACER MINING CLAIM

This is to certify that the undersigned qualified under the laws of the United States to locate placer mining ground in the Territory of Alaska, has located an association placer mining claim on Salcha River, a tributary of Tanana River, in the Fairbanks Mining and Recording District, Territory of Alaska, containing approximately forty acres, and particularly described as follows, to-wit:

(a) The name of number of said claim is Kaolin Association Claim.

(b) The names of the locators thereof are Delmar R. Frazier and Irving Reed.

(c) The date of discovery and posting of the location notice was the 24th day of July, 1947.

(d) Said claim is approximately 1320 feet in length, and 1320 feet in width.

(e) A particular description of the boundaries of said claim is as follows: Beginning at the initial post, which is situated at the southeastern corner which is identical with the 1/4 sec. Cor. between Sections 2 and 3, T. 6 S., R. 4 E. Said claim being the S.E. 1/4 of the N.E. 1/4 of Sec. 3, T. 6 S., R. 4 E., F. M.

(f) Said claim is a bench alcim, situate below Discovery on the left limit of said River.

(g) Brick clay was discovered on said claim on the 24th day of July, 1947.

Delmar R. Frazier

Irving Reed

Locators

Eugene E. Smith

By Irving Reed
Agent

Witness to Location:

CLAY TEST REPORT
for Delmar R. Frazier
Fairbanks, Alaska
July 1947

by T. W. Garve
Consulting Engineer
Columbus, Ohio

The Materials

The materials came to us pretty fine and partly crumbly and perfectly dry. Both materials, 3A and 7A, seemed to be much alike but 3A was slightly the darker of the two with a reddish cast whereas 7A had a yellowish cast. Both were badly contaminated with sharp flint pebbles or flint rock fragments, 3A a trifle more so than 7A.

Both materials are closely related and evidently of glacial origin.

Preparation

The material of the 3A bags was thoroughly mixed by itself, and so the material of the 7A bags by itself.

The stones had to be screened out first since they proved to be too hard for ordinary crushing and grinding to render them harmless. The clay was run through a Simpson mixer and then pugged with water and worked through an auger machine for obtaining the necessary test specimens.

Water of Plasticity

The amount of water required to make the clay sufficiently plastic is determined from the test bars by weighing them before and after drying. It is expressed in percentages based on the dry clay.

This amount of water varies greatly with different clays and in our testing work we found values below 20 and above 60 though usually between 20 and 30. We found your water of plasticity to be:

3A	7A
17%	16%

This is low and would indicate a sandy material though it is well to have low water of plasticity in that we do not need to get rid of so much water in the drying.

Lamination

Auger machine laminations are differential flow planes of clay, due to the propelling action of the auger and the retarding action of the die, both in varying degrees. The photograph shows brick from five different clays which we use for classification. No. 1 at the bottom has hardly any lamination while it increases to the excessive case No. 5 on top. These laminations are attributed to the slippage of the clay on itself. In die lamination, seen in the striae near the surface of the bricks and parallel there-to and sweeping around the corners, the friction of the die retards the surface flow of the clay, and the inner mass flows ahead causing slippage of the clay on itself. The auger lamination, shown in the bulging core in 3, 4, and 5 with corresponding cavity in the mating halves, is due to the auger cutting the clay into spiral slices, slicking and twisting them and packing

them into the die. The differential flow through the die draws these slices out into a series of nested cones. Liminations below 3, and often including 3, are usually negligible while 4 and 5 require some corrective to prevent separation of the laminae in the drying or firing.

Your lamination was very low as might be expected from a sandy or lean clay, and it was close to 1, perhaps between 1 and 2.

Machine Behavior

Lamination, though part of machine behavior, was treated in the previous chapter.

Neither material would give a sound bar through the 1" x 1" die in that the edges were badly serrated and the bar would split open. With some pressure against the bar the latter would knit but badly swell at the same time. Since it was impossible to produce test speciments with our regular square inch inch die, we had to substitute a one inch round die which gave no trouble.

In other words, the materials are not readily issued through dies unless the dies are simple and the dies are lubricated. We use dry dies in our testing to bring out the limitations of the material.

Wet Strength

The strength of a clay is a measure of its plasticity. There is no standard test for plasticity and it is only by comparison of the strength of a large number of clays that one can reach a conclusion regarding the relative strength of any particular clay.

Under wet strength of a clay we understand the resistance which the one inch bar offers to breaking. In this test which is very simple and was devised by Ellis Lovejoy and used by him and the writer for amny years, we allow the bar to flow from the die unsupported until it breaks under its own weight. Our wide experience has enabled us to establish the following classification:

1. Weak clays, not suitable for stiff mud products, will break in lengths under 4 inches, depending upon the degree of weakness.

2. Practical stiff mud product clays will break from 4 through 9 inches. The more intricate hollow ware should not break below 6 inches.

3. Strong clays will break between 9 and 12 inches, occasionally above.

Your bars broke at 3 inches which indicated a weak bond or a low wet strength.

By de-airing a clay (all auger machines are now equipped with the de-airing feature) we can greatly increase the wet strength, and many clays that formerly

were suitable for brick only can now often be made into hollow ware by de-airing the clay prior to its issue through the die. In our testing we have found clays that would not break off in hanging from the die instead would curl up on the floor and finally break somewhere around a curve. Other clays again are not so greatly affected, but your clays were affected the least of any we ever tested since it increased the wet strength to 4 inches so that they just made the grade for brick on the auger machine.

Drying Behavior

Our laboratory dryer has been standardized from the many tests carried out on clays whose drying qualities in actual operation were ascertained.

If the bricks come through safely in the first dryer, any ware as brick and regular tile can be dried safely within 24 hours in a commercial waste heat tunnel dryer. If it passes safely through the second, but not first, the ware will be safe in 48 hours drying time. If it passes only the third slow dryer, the ware will require 3 to 6 days for drying.

Both your materials came safely through the first dryer with 24 hours.

Drying Shrinkage

We consider 4% drying shrinkage as normal. Your 3A had 5% and your 7A had 3% which both are satisfactory.

Dry Strength

This determination becomes of importance in the handling of ware from dryer to kiln and in kiln to avoid losses. It is determined by breaking the dry test bars transversely in a breaking machine, and the modulus of rupture is calculated from the usual formula for transverse rupture of a bar supported at each end and loaded in the center.

Fragile clays usually have moduli under 125, good clays have such between 125 and 400, strong clays exceed 400, and occasionally we get as high as 1000 and even higher for special ball clays.

For your materials we found:

3A	7A
288	346

Temperature Determination

The approximate temperatures in firing ceramic ware are determined by means of pyrometric cones which are small slender pyramids of triangular cross section which slowly bend when the softening temperature of the respective cones is reached so that temperature and time factor come into play. The Bureau of Standards has given the following equivalents for the cones which we selected for the firing of your clays:

Cone	Temperature °F
07	1787
05	1886
03	1976
01	2030
2	2075
4	2129
6	2174

Firing Shrinkages

They are obtained by deducting the drying shrinkage from the total shrinkage of the respective trail piece, taken from the kiln during firing.

No. 1	Cone 07	Shrinkage for 3A	1	for 7A	1
2	05		1		1
3	03		3		2
4	01		4		3.3
5	2		5		4.2
6	4		5.5		5
7	6		5.5		5

These shrinkages will be discussed later in connection with the chart attached.

Hardness

The test for hardness of the fired ware is tempered steel. Such test bars which cannot be scratched are counted hard, otherwise soft.

In both your series the hardness starts with the third bar.

Sound

The test bars are struck together or hit by a small hammer to determine their soundness. An open structure will not give the clear ringing sound as a dense piece of fired clay ware will produce.

Your test peices ring true, and the 3A bars have a clearer ring than the 7A bars, evidently due to greater drying and firing shrinkages.

Firing Range

The firing range of a clay is a temperature range within which the fired product is sufficiently hard at its lower limitand still sound and safe at its upper limit. Since it is impossible to obtain uniform temperature conditions in all parts of a commercial kiln, this firing range becomes of prime importance in that its limitations must be sufficiently beyond the limits of the temperature variations of the kiln. In our testing work we consider four cones a minimum.

Absorption

Absorption tests of the fired bars are made to obtain some information relative to the ~~pxm~~ porosity of the ware. Absorption values are reported as per-

centages of the weight of the dry sample, and are obtained by dividing the weight of water absorbed in grams by the weight of the dry piece in grams.

There is no standard nor rigid classification of clay wares based on absorption but a commonly accepted classification for cold climates is as follows:

Vitrified ware - not to exceed 5%
Hard fired building material for facing - 5 to 12
Soft common building material 12 to 20
Above 20 only for inside work

Your absorptions were:

	3A	7A
cone 07	15%	17%
05	14	16
03	10.4	11.7
01	7.8	9.1
2	6.7	7.2
4	1.2	2

Firing Behavior

We divide the firing behavior of clay ware into four stages:

1. Soft or underfired ware, very porous, non-resistant to weather influences, structurally weak and doubtful as a load bearing product.

2. Hard thus adapted for any building material.

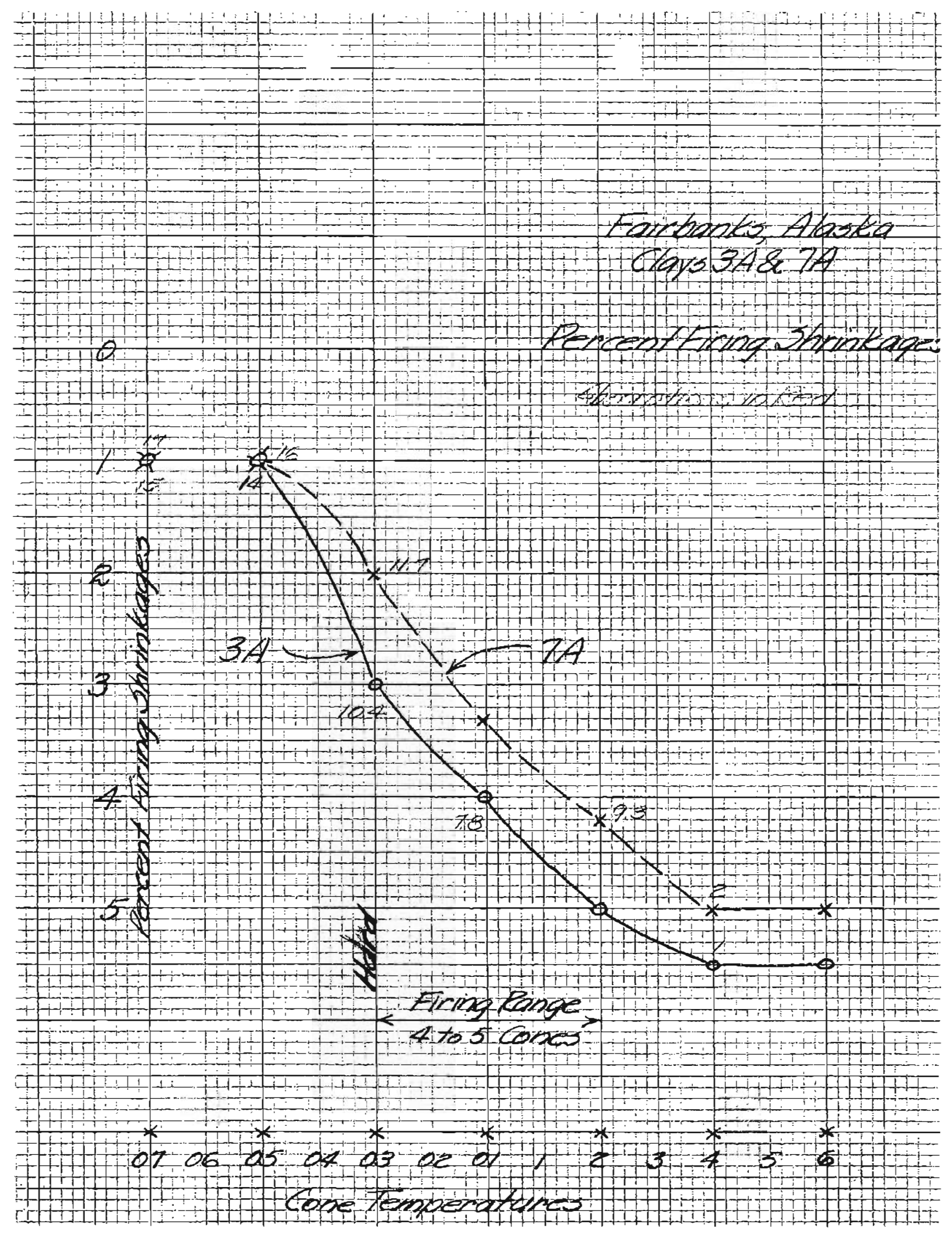
3. Vitirfied, very hard, low porosity. Adapted to building materials, paving brick, floor brick, sewer pipe, etc.

4. Overfired ware which is bloated, distorted, vesicular, usually cindreed and stuck together.

We study the firing behavior by plotting the percent firing shrinkages for the different cone temperatures on cross section paper, and we refer you to the attached curve sheet.

At cone 07 the shrinkage for both materials has advanced to 1% from which temperature on the rate of increase is greatly accelerated to cone 4, with a somewhat greater increase for 3A than 7A.

Since hardness begins with 03 sample, we have marked the firing range from cone 03 to cone 2. This will be within the dark red color range. It is mentioned that our series is darker than normal in that we obtained reducing conditions in our firing which is hard to avoid though in a commercial kiln the colors will be brighter. Furthermore, in a commercial kiln due to the weights imposed, the ware gets somewhat denser at lower temperatures so that we may consider the firing range to commence at cone 04. In any event,


Fairbanks, Alaska
Clays 3A & 7A
Percent Firing Shrinkage
Percent Firing Shrinkages
0
1
2
3
4
5
14
11.7
10.4
7.8
9.3
3A
7A
Firing Range
4 to 5 Cones
07 06 05 04 03 02 01 1 2 3 4 5 6
Cone Temperatures

the firing range is long enough to be on the safe side.

We have entered the absorption values in red ink, and we find the absorptions for 7A a little higher along the line. The only explanation we can advance for the greater absorption of 3A is the fact that its drying shrinkage was greater than that of 7A.

We suggest that you place the test bars, submitted by parcel post, before you in proper order, and you will find the numbers from 1 to 7 scratched in on each piece. The 3A clay bars are marked with three long scratches across each bar whereas the 7A bars are not marked at all except for the seven numbers.

Conclusion

The clays lack plasticity to render them desirable stiff mud auger machine material though it is feasible to produce regular brick with the de-aired clay and lubricated die. We would have to exclude hollow ware.

There is not much we can say against the clay otherwise for the manufacture of brick except the contamination of the clays by the relatively large amount of hard pebbles.

If the clay is dug wet and brought into the factory wet, you would have to install a rotary dryer to get rid of most of the moisture so that the pebbles then may be screened out. This is being done in several Ohio plants where glacial clays are used.

Likely there is a scarcity of good materials in your part of the country and, if so, the material may be used for making brick by the stiff mud process and by the soft mud process in wooden molds; otherwise it might be well to do some more prospecting for better material.

Submitted by:

T. W. Garve

May 11, 1948

Mr. Delbert Frazier
Fairbanks, Alaska

Dear Mr. Frazier:

On behalf of the Department, Mr. Thomas and I wish to thank you for your exceptional courtesy in making available to us the reports of the Fairbanks clay studies, as prepared for you by Mr. Reed and Mr. Garve. In accordance with your request, the information contained will be considered confidential.

This information will prove very helpful to the Department and we thank you agian for your thoughtfulness. Please call on us at any time if there is any assistance we can give you.

Sincerely,

Art Glover
Assayer-in-charge

File:- Fairbanks Precinct.

REPORT ON INVESTIGATION FOR BRICK CLAY

ADJACENT TO FAIRBANKS, ALASKA

by Irving Reed.

In January of 1947, Lt. Col. J. H. Ford and Major Delmar R. Frazier requested the writer to look over the area within a radius of 75 miles of Fairbanks to see if there were any deposits of clay therein suitable for brick-making. As the ground was still snow-covered, it was decided to wait until the latter part of April and May to make investigations in the field. In the meantime letters were written to the Bureau of Mines and to the Alaska Development Board, copies of which are attached. No information whatsoever on clays in the vicinity of Fairbanks was obtained from either of these sources.

In April after looking over several possible factory sites, Mr. T. O. Peyton, Station Agent for the Alaska Railroad, was contacted, plats of railroad land available for leasing examined, and a 4-acre tract of ground adjacent to railroad facilities, chosen for a brickyard. On April 19 a letter was sent to the office of the Alaska Railroad asking about securing a lease on the chosen plot of land. A copy of this letter and the answer received, are attached.

On April 22 a Mr. J. L. Wilson, who claimed to have discovered a large deposit of brick clay along the Alaska Railroad, was contacted, just before he was leaving for Seward Peninsula. An examination of the records in Fairbanks failed to show any recorded clay placer claim locations. On April 24, a trip by train was made to Nenana where a similar examination failed to show any recorded placer claims in his name.

On May 1st, the ground having sufficiently thawed, field trips were started and samples of various alluvial deposits taken.

TABULATION OF LOCALITIES WHERE SAMPLES WERE TAKEN

Locality and Specimen No.	Description of Locality
1	on school lands on Steese Highway, 2½ miles north of Fairbanks(SW¼ Sec.36, T.1N., R.1W.)
2	In road-cut on southern side of Steese Highway on Erickson farm (N½ Sec. 36, T1N, R1W)
3	1/4 mile east of Richardson Highway on south side of Moose Creek Butte
4	At abandoned U.S.A. root cellar on Lazelle road at the foot of the south slope of Meridian Hill.
5	On Elliot Highway about 3 miles north of Scrafford (top of divide between Fox and Vault Creeks)

Locality and Specimen No.	Description of Locality
6	On Richardson Highway at mouth of Little Salcha River
7	On east side of Richardson Highway from north bank of gravel pit 1/2 miles north of the entrance to the Salchaket Lake road. (In Salchaket Towncite, NW¼ NE¼ Sec. 2, T 6 S., R 4 E., F.M.)
8	On west side of Richardson Highway, 1/4 mile south of the entrance to Salchaket Lake road
9	On east side of Richardson Highway about 1/2 mile south of the entrance to Salchaket Lake road
10	On west side of Richardson Highway in granite (diorite) sand barrow pit about 9 miles north of Birch Lake
11	On west side of Richardson Highway in gravel pit about 100 yards south of Birch Lake
12	On east side of Richardson Highway in gravel pit about 1 mile south of Birch Lake
13	At Birch Lake on west side of Richardson Highway on Taylor ground
14	On same side of Richardson Highway and 500 feet south of Specimen No. 10
15	On Farmers Loop road at north fork of Isabella Creek
16	In old field at foot of ridge between Isabella and Goldstream creeks on road running due north past the Fairbanks Golf and Country Club
17	On east side of Farmers Loop road on banks of small creek flowing from Salene Lake
18	At the mouth of the U.S.S.R. & M. Co. Cripple Creek drain down the Chena River from the pumping station.
19	On the north side of Richardson Highway at the site of the old Richardson Lodge (70) miles south of Fairbanks)
20	On the north side of Richardson Highway and the left limit of Gasoline Creek (68 miles south of Fairbanks).

Locality and Specimen No.	Description of Locality
21	On the north side of Richardson Highway at top of cut bank 37 miles south of Fairbanks.
22	On the north side of Richardson Highway at top of cut bank at the mouth of Canyon Creek
23	On the west side of Richardson Highway in gravel pit opposite the head of Canyon Creek and in view of Birch Lake (about 33 miles south of Fairbanks)
24	On the west side of Richardson Highway about 1 mile north of Specimen No 7

The first 17 specimens were made up into 1-inch briquettes, air-dried and then dried in the electric oven to 500 degrees F. On May 14 the briquettes were taken to the Territorial Assay Office at College and fired in an assay furance for 48 hours up to a temperature of 1200 degrees C. None of the samples were satisfactory as most fused under this temperature, except Speciments No. 3 and No. 7. It was felt that these two specimens should be looked into further so more material was obtained from these two localities and numbered speciments 3A and 7A. It was also felt that the heat of firing had been too high during the first firing, so the most promising of the material from the first 17 specimens as well as specimens 18 to 24, inclusive, and specimens 3A and 7A, were made into 2-inch briquettes. The same air-and oven-drying procedure was followed as with the previous 17 specimens and on May 19, 14 briquettes were taken to Mr. Art Glover at the Territorial Assay office at College for firing.

Brick No.	Wet size	Airdry size	Ovendry size	Kilndry size	Airdry % shrink.	Ovendry % shrink.	Kilndry % shrink.	Remarks
1		2.40"	2.35"	2.25"	2.08	2.12	2.25	unscreened
2		2.45	2.45	2.45	0	0	0	unscreened
4		2.00	2.00	2.00	0	0	0	unscreened
6		1.95	1.95	1.90	0	0	2.62	unscreened
9		2.00	2.00	2.00	0	0	0	screened, 32 mesh
18	2.1	2.05	2.05		2.38	0	(crumbled)	unscreened
19	2.1	2.05	2.00	2.00	2.38	2.38	0	screened, 32 m.
20	2.2	2.10	2.10	2.10	4.55	0	0	screened, 32 mesh
21	2.0	1.95	1.95	1.95	2.50	0	0	screened, 32 mesh
22	2.0	1.90	1.90		5.00	0	(crumbled)	unscreened
23	2.0	1.90	1.90		5.00	0	(crumbled)	screened, 32 mesh
24	2.1	2.00	2.00	2.00	4.75	0	0	unscreened
3A	2.1	2.05	2.05	?	2.38	0	?	screened, 32 mesh
7A	2.0	1.95	1.95	?	2.38	0	?	screened, 32 mesh

The following report was made on the results by Mr. Art Glover:

C O P Y

TERRITORY OF ALASKA
DEPARTMENT OF MINES
June 10, 1947 I 8298 - 8311

Mr. Irving Mck. Reed
Fairbanks, Alaska/

Dear Irving:

Following please find our report covering the rough testing performed on your 14 samples of possible brick raw materials.

	Fired Hardness (1050 degrees C.)
1	soft
2	soft
— 3A	near steel hard
4	softer than steel
6	softer than steel
— 7A	near steel hard
9	soft
18	very soft
19	softer than steel
20	softer than steel
21	softer than steel
22	very soft
23	soft
24	softer than steel

PREFIRED STRENGTH

As submitted these samples had all been air-dried and prefired in a home electric range oven. Examination of the samples upon receipt yielded the following data concerning "green strength". (The low-temperature prefiring probably served to increase this strength above that of the air-dried materials).

Samples numbered 1, 2, 6, 9, 18, and 22, were too weak to permit normal handling, such as would be required in commercial manufacture. Numbers 19 and 24 were marginal

in this respect.

Samples 3A, 4, 7A, 20, 21, and 23, possessed sufficient strength to warrant considering them as possibly acceptable.

FIRED STRENGTH

No facilities were at hand for determining the modulus of rupture. In my opinion, all of these including the best (3A, 4, 7A, 19, 20, 21) probably fall somewhat below the figure for a good grade of common brick. Continued study and experimentation with mixtures and firing manipulations would, however, probably develop adequate strength.

Yours very truly,
ART CLOVER
Assayer-in-charge

Recommendations

Specimens No. 3A and 7A were considered promising enough to warrant investigation by a competent laboratory in Ohio. Therefore on May 30 and 31, 75 pounds of material was secured from Locality No. 7 (gravel pit near Salchaket Lake) and from Locality No. 3 (Moose Creek Butte). On June 12 the sacked samples were shipped to T. V. Garve, 314 King Avenue, Columbus 7, Ohio.

As Locality No. 3 is in a Government road reserve whose boundaries are not marked, it was necessary to go east at least 1/2 mile to clear the reserve. Therefore on June 12, 1947, a 40-acre placer location (Brickbat Association Claim) was staked on the eastern side of the summit of Moose Creek Butte as an examination of the ground showed the same type of material extended that far. A copy of the certificate of location is appended to this report.

After receiving the report from the laboratory in Ohio on material from Localities No. 3 and No. 7, it was decided to stake claims covering Locality No. 7. However, since this locality is within the area of Salchaket Townsite, legal opinion obtained in Fairbanks is that no mining claim may be located covering Locality No. 7. The local Bureau of Land Management office was of the opinion that the land could not be bought from the townsite trustee as it had not been surveyed into lots by the Government cadastral engineers. It was then decided to locate claims outside of the Salchaket Townsite boundary but as near to Locality No. 7 as possible. Therefore on July 28, 1947, two 40-acre association placer locations were made adjacent to the west boundary of Salchaket Townsite comprising the Terra Cotta Association Claim and the Kaolin Association Claim or the $SW\frac{1}{4}$ $NW\frac{1}{4}$ Sec. 2 and the $SE\frac{1}{4}$ $NE\frac{1}{4}$ Sec. 3, T. 6 S., R 4 E., F.M., respectively. Copies of the certificates of location of these 2 claims are appended to this report.

As the surface of these two claims is covered by a heavy growth of trees and moss, augur holes were drilled in numerous places just inside the boundaries of the claims. Frozen ground was encountered in each hole from 1 foot to 18 inches down from the surface of the moss. However in the augur hole near the middle of the east line of the Terra Cotta and also in the augur holes near the southeast and southwest corners of the same claim and near the middle of the east line of the Kaolin Association, a distinct reddish discoloration of the black muck was noted at the bottom of the holes, possibly indicating the near proximity of reddish material similar to that at Locality No. 7.

At Locality No. 3 on the Brickbat Association, augur holes were drilled with the following results:

Hole No.	Location	Depth	Results
1	10' north of S.E. corner	18"	Bottom of hole in disintegrated bedrock. Subsoil the same as Specimen 3A
2	about middle of east line	3 feet	Bottom of hole on frozen ground, subsoil the same as specimen No. 3A
3	10 ft. east of N.W. corner	4 ft.	Bottom of hole limit of augur, subsoil the same as Specimen 3A
4	10 ft. east of N.W. corner	4 ft.	Bottom of hole limit of augur; subsoil the same as Specimen No. 3A
5	20 ft. east of S.W. corner	2 ft.	Bottom of hole on frozen ground; subsoil black muck with last 2 inches same as Specimen No. 3A.

G E O L O G Y

Moose Creek Butte (Locality No. 3) appears to be a dioritic intrusion which has been highly metamorphosed so that in places it resembles ordinary schist. This material being slightly harder than the ordinary schistose country rock has not been eroded down to the same level as the rest of the Tanana lowland. The subsoil on the butte is apparently derived from the disintegration in place of the altered dioritic rock. On the south and southeastern side of the butte, Moose Creek has cut the butte to a steep blufflike slope. It is thought that such subsoil derived from the bedrock of the butte as lay on the slope would have been washed away by Moose Creek or buried beneath an unknown depth of pleistocene outwash gravels. The Brickbat Association was therefor located on the northern and northwestern slopes of the butte.

At Locality No. 7 the hill west of Salchaket Lake flattens out to the north into the Salcha River valley in a series of low, ill-defined benches from 1/2 to 1½ miles wide. Locality No. 7 is situated on the highest of these benches and apparently extends from that place westward along the foot of the north slope of the aforementioned hill. It is thought that from the color of the subsoil and the presence of small angular pieces of quartz in it, that this material originated by the disintegration of altered intrusions in the northern slopes of the above hill and is probably of pre-pleistocene or interglacial age.

RECOMMENDATIONS

About 1 mile of easily built road over good ground would make the material in the Brickbat Association available. No trouble is anticipated from frost as such frozen ground as is present would thaw after being stripped of brush and overburden. The subsoil could be excavated and loaded by power shovels. It is recommended that at least 6 4-inch drill holes be sunk on the claim by an ordinary light prospecting placer drill before work is started in order to determine the depth of the deposit.

On the Terra Cotta and Kaolin Associations there is a heavy overburden of scrub trees and moss overlying a frozen subsoil. In order to be certain of the nature and extent of the subsurface deposit, a line of at least 10 4-inch drill holes should be sunk in an east-west direction across these claims. Access can be had to the claims by means of a short 1/2 mile and very easily built road from the Richardson Highway. The surface can be stripped by bulldozer and the muck overburden removed on thawing by the same means, or by means of water pumped from Waterlily Lake at the northeast corner of the Terra Cotta Association. After the removal of the insulating vegetative muck overburden, the underlying subsoil will probably thaw enough for loading by power shovel.

(Signed)
Irving Reed
Registered Mining Engineer

C O P Y

Mr. Robert S. Sanford, Acting Chief,
U.S. Bureau of Mines,
P.O. Box 2990
Juneau, Alaska

Box 474
Fairbanks, Alaska
Jan 28, 1947

Dear Mr. Sanford:

I have some clients who are enquiring about brick clays in the vicinity of Fairbanks. Would you please mail me any data the Bureau of Mines has on brick clays in the Fourth Division and also any possible cement rocks. I would like also to get any bulletin the Department of Mines may have on brick clays and bricks; also cement rocks and cement. This is a subject that is a little bit out of the ordinary for the engineers of Alaska. We will have to look to you for guidance in the matter. I am very anxious to see some sort of brick-making or cement plant started in the Interior, since building materials are so scarce and so terribly costly.

Very truly yours,
Irving M. Reed

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

Box 2990,
Juneau, Alaska
Feb. 6, 1947

Mr. Irving M. Reed,
Box 474
Fairbanks, Alaska

Dear Mr. Reed:

Reference is made to your letter of January 28 concerning brick clays and the possibility or cement manufacture in the vicinity of Fairbanks.

We have no record of any reports on structural materials in the Interior of Alaska. It has been suggested that the Bureau of Mines make such an investigation but, to date, no funds have been made available for this work.

There are a number of limestone outcrops near Fairbanks, particularly in the Goldstream Valley. If you can find, at your Public Library, a copy of U.S. Geological Survey Bulletin No. 525, A Geologic Reconnaissance of the Fairbanks Quadrangle, Alaska, with maps, you will be able to locate and investigate these places.

Clay is also reported near Fairbanks but, like the limestone, there is no record of quality. One deposit is reported to be at the Healy River Mine but probably there are others nearer Fairbanks.

The Territorial Department of Mines does not have any bulletins on these subjects but suggest that you contact Art Glover, Territorial Assay Office, College, Alaska, for any information he may have.

The Bureau of Mines has an Information Circular No. 6155, Clay, which contains much information on examining, testing, classification of clays and manufacture of clay products which might be of interest to you. This may be obtained by writing to: Mr. George Cresswell, Publications Distribution Section, Bureau of Mines, Washington 25, D.C.

Very truly yours,
Marvin L. Nelson, for
Robert S. Sanford, Actg. Chief,
Alaska Division, Mining Branch

C O P Y

Mr. George Sunborg, Mgr.,
Alaska Development Board,
Juneau, Alaska

Box 474
Fairbanks, Alaska
Jan. 28, 1947

Dear Mr. Sunborg:

There are some parties here in Fairbanks that seem to be very much interested in starting a brick-making plant. They have asked me to get some data on this and particularly, if they should start a plant, what competition they would have from Anchorage. Of course, if there is going to be too much competition, a plant here is out. I hate to put them to the expense of making a trip to Anchorage and possibly there, not getting the data I should want. I know you are in touch with all the development in the Territory.

Will you please let me know what the development is in brick-making in Anchorage, that is: number of kilns they now have, future plans, etc. size and location of their brick deposits and any other data you think might be of use to me in deciding for these men so they will not unnecessarily risk their money. I am very anxious of course to get a plant started here, as I think it would do the town a great benefit. However, if it is not feasible, I do not want these men to lose money where it might be invested to good advantage otherwise.

Thanking you in advance, I am,

Very truly yours,
Irving M. Reed

ALASKA DEVELOPMENT BOARD
Juneau, Alaska
P.O. Box 50

Feb. 15, 1947

Mr. Irving M. Reed
Box 474
Fairbanks, Alaska

Dear Mr. Reed:

It is only now that I am able to answer your letter of January 28, relative to a brick making plant proposed for Fairbanks. I have just returned here from an absence of several weeks in the States.

I am very much interested to learn that some of you Fairbanks people are thinking about starting a brick making plant. You ask about competition which might be furnished from Anchorage. This office knows of two brick making establishments now being built or enlarged at Anchorage. One is quite small with, I think, only a single kiln. The other is planning installation of at least six tunnel kilns and of going into brick manufacturing on a large scale. I understand that contracts with the Army have either been signed or promised both of these plants. The larger of them contemplates manufacturing brick to sell at Anchorage at around $35.00 a thousand.

Caly suitable for brick making exists widely in the Anchorage vicinity. One of the deposits now being worked is near Pt. Worenzoff. The other is on the Fort Richarison spur of the Alaska Railroad about a mile and a half from Anchorage.

We do not have available here in the office the tariffs of the Alaska Railroad which give the local rate on the transporting of brick from Anchorage to Fairbanks. However, I am sure the rate is probably so high that there is little liklihood that competition would be furnished from Anchorage, in the event brick could be manufactured

at Fairbanks at anything like comparable costs. I might add that I see no reason why it should not be.

This office is anxious to assist this enterprise in every way we can. I would appreciate being placed in touch with the people contemplating establishing a plant there.

Sincerely yours,

George Sundberg

C O P Y

Box 474
Fairbanks, Alaska
Feb. 12, 1947

Mr. George Cresswell,
Publications Distribution Section,
Bureau of Mines,
Washington 25, D.C.

Dear Sir:

Will you please mail me Information Circular # 6155, Clay, which contains information on examining, testing, and classification of clays and manufacture of clay projects.

Thanking you, I am

Very truly yours,
Irving M. Reed
Registered Mining Engineer

Box 474
Fairbanks, Alaska
April 19, 1947

Mr. J. J. Delaney,
Assistant General Manager,
Alaska Railroad
Anchorage, Alaska

Dear Sir:

A group here in Fairbanks is incorporating to manufacture brick for local consumption. We wish to secure a lease on railroad property of 4 acres at Fairbanks. Said 4 acres is in that area north of the main tract, east of the Ladd Field wye, and west of the F.E. Company spur.

Will you please let us know how we will go about securing this lease for the above 4 acres. We would like to start the proceedings immediately as we have arranged for financing and the shipping in of the requisite machinery. We plan to get started manufacturing brick this coming summer.

Thank you in advance for any information you may be able to give us in this matter, I am

Very truly yours,
Irving Reed

UNITED STATES DEPARTMENT OF THE INTERIOR
THE ALASKA RAILROAD

Anchorage, Alaska
April 26, 1947

Mr. Irving Reed
Box 474
Fairbanks, Alaska

Dear Sir:

Reference your letter of April 19, 1947, requesting lease on four acres of ground at Fairbanks, west of the F.E. Company spur.

All of the Alaska Railroad's property on the west side of the F.E. spur has been leased.

Very truly yours,
J. P. Johnson
General Manager

C O P Y

CERTIFICATE OF LOCATION OF PLACER MINING CLAIM

This is to certify that the undersigned qualified under the laws of the United States to locate placer mining ground in the Territory of Alaska, has located an association placer mining claim on the right limit of Moose Creek, a tributary of Chena River, in the Fairbanks Mining and Recording District, Territory of Alaska, containing approximately forty acres and particularly described as follows, to-wit:

(a) The name or number of said claim is Brickbat Association claim,

(b) The names of the locators thereof are Delmar R. Frazier and Irving Reed.

(c) The date of discovery and posting of the location notice was the twelfth day of June, 1947.

(d) Said claim is approximately 1320 feet in length, and 1320 feet in width.

(e) A particular description of the boundaries of said claim is as follows: Beginning at the initial post, which is situated on the right limit of Moose Creek about 200 feet east of the summit of Moose Creek Butte and about 1 mile east of the east end of the Piledriver Slough dike extending thence in a N. 36 degrees E. direction, approximately 1320 feet to Post No. 2; thence in a N. 54 degrees W. direction, approximately 1320 feet, to Post No. 3; thence in a southwesterly direction, approximately 1320 feet, to Post No. 4; thence in a southeasterly direction approximately 1320 feet to the initial post and place of beginning.

(f) Said claim is a bench claim, situate at Discovery on the right limit of said creek.

(g) Brick clay was discovered on said claim on the 21st day of May, 1947.

Delmar R. Frazier
Irving Reed Locators

Eleanor Stoy Reed
Witness to Location

By Irving Reed, Agent

C O P Y

CERTIFICATE OF LOCATION OF PLACER MINING CLAIM

This is to certify that the undersigned qualified under the laws of the United States to locate placer mining ground in the Territory of Alaska, has located an association placer mining claim on Salcha River, a tributary of Tanana River in the Fairbanks Mining and Recording District, Territory of Alaska, containing approximately forty acres, and particularly described as follows, to-wit:

(a) The name or number of said claim is Terra Cotta Association Claim.

(b) The names of the locators thereof are Delmar R. Frazier and Irving Reed.

(c) The date of discovery and of posting of the location notice was the 23rd day of July, 1947.

(d) Said claim is approximately 1320 feet in length, and 1320 feet in width.

(e) A particular description of the bounderies of said claim is as follows: Beginning at the initial post, which is situated at the southeast corner and is identical with the 1/16 Sec. Cor. on the south boundary of the N.W. 1/4 of Sec. 2, T. 6 S., R. 4 E., this claim being the SW$\frac{1}{4}$ of the NW$\frac{1}{4}$ of Sec. 2, T. 6 S., R 4 E.,F.M.

(f) Said claim is a bench claim, situate below Discovery on the left limit of said River.

(g) Brick clay was discovered on said claim on the 23rd day of July 1947.

Delmar R. Frazier

Irving Reed

Locators

By Irving Reed, Agent

Eugene E. Smith

Witness to Location:

C O P Y

CERTIFICATE OF LOCATION OF PLACER MINING CLAIM

This is to certify that the undersigned qualified under the laws of the United States to locate placer mining ground in the Territory of Alaska, has located an association placer mining claim on Salcha River, a tributary of Tanana River, in the Fairbanks Mining and Recording District, Territory of Alaska, containing approximately forty acres, and particularly described as follows, to-wit:

(a) The name of number of said claim is Kaolin Association Claim.

(b) The names of the locators thereof are Delmar R. Frazier and Irving Reed.

(c) The date of discovery and posting of the location notice was the 24th day of July, 1947.

(d) Said claim is approximately 1320 feet in length, and 1320 feet in width.

(e) A particular description of the boundaries of said claim is as follows: Beginning at the initial post, which is situated at the southeastern corner which is identical with the 1/4 sec. Cor. between Sections 2 and 3, T. 6 S., R. 4 E. Said claim being the S.E. 1/4 of the N.E. 1/4 of Sec. 3, T. 6 S., R. 4 E., F. M.

(f) Said claim is a bench alcim, situate below Discovery on the left limit of said River.

(g) Brick clay was discovered on said claim on the 24th day of July, 1947.

Delmar R. Frazier

Irving Reed

Locators

Eugene E. Smith

By Irving Reed
Agent

Witness to Location:

CLAY TEST REPORT
for Delmar R. Frazier
Fairbanks, Alaska
July 1947

by T. W. Garve
Consulting Engineer
Columbus, Ohio

The Materials

The materials came to us pretty fine and partly crumbly and perfectly dry. Both materials, 3A and 7A, seemed to be much alike but 3A was slightly the darker of the two with a reddish cast whereas 7A had a yellowish cast. Both were badly contaminated with sharp flint pebbles or flint rock fragments, 3A a trifle more so than 7A.

Both materials are closely related and evidently of glacial origin.

Preparation

The material of the 3A bags was thoroughly mixed by itself, and so the material of the 7A bags by itself.

The stones had to be screened out first since they proved to be too hard for ordinary crushing and grinding to render them harmless. The clay was run through a Simpson mixer and then pugged with water and worked through an auger machine for obtaining the necessary test specimens.

Water of Plasticity

The amount of water required to make the clay sufficiently plastic is determined from the test bars by weighing them before and after drying. It is expressed in percentages based on the dry clay.

This amount of water varies greatly with different clays and in our testing work we found values below 20 and above 60 though usually between 20 and 30. We found your water of plasticity to be:

3A	7A
17%	16%

This is low and would indicate a sandy material though it is well to have low water of plasticity in that we do not need to get rid of so much water in the drying.

Lamination

Auger machine laminations are differential flow planes of clay, due to the propelling action of the auger and the retarding action of the die, both in varying degrees. The photograph shows brick from five different clays which we use for classification. No. 1 at the bottom has hardly any lamination while it increases to the excessive case No. 5 on top. These laminations are attributed to the slippage of the clay on itself. In die lamination, seen in the striae near the surface of the bricks and parallel there-to and sweeping around the corners, the friction of the die retards the surface flow of the clay, and the inner mass flows ahead causing slippage of the clay on itself. The auger lamination, shown in the ~~kiss~~ bulging core in 3, 4, and 5 with corresponding cavity in the mating halves, is due to the auger cutting the clay into spiral slices, slicking and twisting them and packing

them into the die. The differential flow through the die draws these slices out into a series of nested cones. Liminations below 3, and often including 3, are usually negligible while 4 and 5 require some corrective to prevent separation of the laminae in the drying or firing.

Your lamination was very low as might be expected from a sandy or lean clay, and it was close to 1, perhaps between 1 and 2.

Machine Behavior

Lamination, though part of machine behavior, was treated in the previous chapter.

Neither material would give a sound bar through the 1" x 1" die in that the edges were badly serrated and the bar would split open. With some pressure against the bar the latter would knit but badly swell at the same time. Since it was impossible to produce test speciments with our regular square inch inch die, we had to substitute a one inch round die which gave no trouble.

In other words, the materials are not readily issued through dies unless the dies are simple and the dies are lubricated. We use dry dies in our testing to bring out the limitations of the material.

Wet Strength

The strength of a clay is a measure of its plasticity. There is no standard test for plasticity and it is only by comparison of the strength of a large number of clays that one can reach a conclusion regarding the relative strength of any particular clay.

Under wet strength of a clay we understand the resistance which the one inch bar offers to breaking. In this test which is very simple and was devised by Ellis Lovejoy and used by him and the writer for amny years, we allow the bar to flow from the die unsupported until it breaks under its own weight. Our wide experience has enabled us to establish the following classification:

1. Weak clays, not suitable for stiff mud products, will break in lengths under 4 inches, depending upon the degree of weakness.

2. Practical stiff mud product clays will break from 4 through 9 inches. The more intricate hollow ware should not break below 8 inches.

3. Strong clays will break between 9 and 12 inches, occasionally above.

Your bars broke at 3 inches which indicated a weak bond or a low wet strength.

By de-airing a clay (all auger machines are now equipped with the de-airing feature) we can greatly increase the wet strength, and many clays that formerly

were suitable for brick only can now often be made into hollow ware by de-airing the clay prior to its issue through the die. In our testing we have found clays that would not break off in hanging from the die instead would curl up on the floor and finally break somewhere around a curve. Other clays again are not so greatly affected, but your clays were affected the least of any we ever tested since it increased the wet strength to 4 inches so that they just made the grade for brick on the auger machine.

Drying Behavior

Our laboratory dryer has been standardized from the many tests carried out on clays whose drying qualities in actual operation were ascertained.

If the bricks come through safely in the first dryer, any ware as brick and regular tile can be dried safely within 24 hours in a commercial waste heat tunnel dryer. If it passes safely through the second, but not first, the ware will be safe in 48 hours drying time. If it passes only the third slow dryer, the ware will require 3 to 6 days for drying.

Both your materials came safely through the first dryer with 24 hours.

Drying Shrinkage

We consider 4% drying shrinkage as normal. Your 3A had 5% and your 7A had 3% which both are satisfactory.

Dry Strength

This determination becomes of importance in the handling of ware from dryer to kiln and in kiln to avoid losses. It is determined by breaking the dry test bars transversely in a breaking machine, and the modulus of rupture is calculated from the usual formula for transverse rupture of a bar supported at each end and loaded in the center.

Fragile clays usually have moduli under 125, good clays have such between 125 and 400, strong clays exceed 400, and occasionally we get as high as 1000 and even higher for special ball clays.

For your materials we found:

3A	7A
288	346

Temperature Determination

The approximate temperatures in firing ceramic ware are determined by means of pyrometric cones which are small slender pyramids of triangular cross section which slowly bend when the softening temperature of the respective cones is reached so that temperature and time factor come into play. The Bureau of Standards has given the following equivalents for the cones which we selected for the firing of your clays:

Cone	Temperature °F
07	1787
05	1886
03	1976
01	2030
2	2075
4	2129
6	2174

Firing Shrinkages

They are obtained by deducting the drying shrinkage from the total shrinkage of the respective trail piece, taken from the kiln during firing.

No.	Cone	Shrinkage for 3A		for 7A	
1	07		1		1
2	05		1		1
3	03		3		2
4	01		4		3.3
5	2		5		4.2
6	4		5.5		5
7	6		5.5		5

These shrinkages will be discussed later in connection with the chart attached.

Hardness

The test for hardness of the fired ware is tempered steel. Such test bars which cannot be scratched are counted hard, otherwise soft.

In both your series the hardness starts with the third bar.

Sound

The test bars are struck together or hit by a small hammer to determine their soundness. An open structure will not give the clear ringing sound as a dense piece of fired clay ware will produce.

Your test peices ring true, and the 3A bars have a clearer ring than the 7A bars, evidently due to greater drying and firing shrinkages.

Firing Range

The firing range of a clay is a temperature range within which the fired product is sufficiantly hard at its lower limitand still sound and safe at its upper limit. Since it is impossible to obtain uniform temperature conditions in all parts of a commercial kiln, this firing range becomes of prime importance in that its limitations must be sufficiently beyond the limits of the temperature variations of the kiln. In our testing work we consider four cones a minimum.

Absorption

Absorption tests of the fired bars are made to obtain some information relative to the porosity of the ware. Absorption values are reported as per-

centages of the weight of the dry sample, and are obtained by dividing the weight of water absorbed in grams by the weight of the dry piece in grams.

There is no standard nor rigid classification of clay wares based on absorption but a commonly accepted classification for cold climates is as follows:

Vitrified ware - not to exceed 5%
Hard fired building material for facing - 5 to 12
Soft common building material 12 to 20
Above 20 only for inside work

Your absorptions were:

	3A	7A
cone 07	15%	17%
05	14	16
03	10.4	11.7
01	7.8	9.1
2	6.7	7.2
4	1.2	2

Firing Behavior

We divide the firing behavior of clay ware into four stages:

1. Soft or underfired ware, very porous, non-resistant to weather influences, structurally weak and doubtful as a load bearing product.

2. Hard thus adapted for any building material.

3. Vitirfied, very hard, low porosity. Adapted to building materials, paving brick, floor brick, sewer pipe, etc.

4. Overfired ware which is bloated, distorted, vesicular, usually cindered and stuck together.

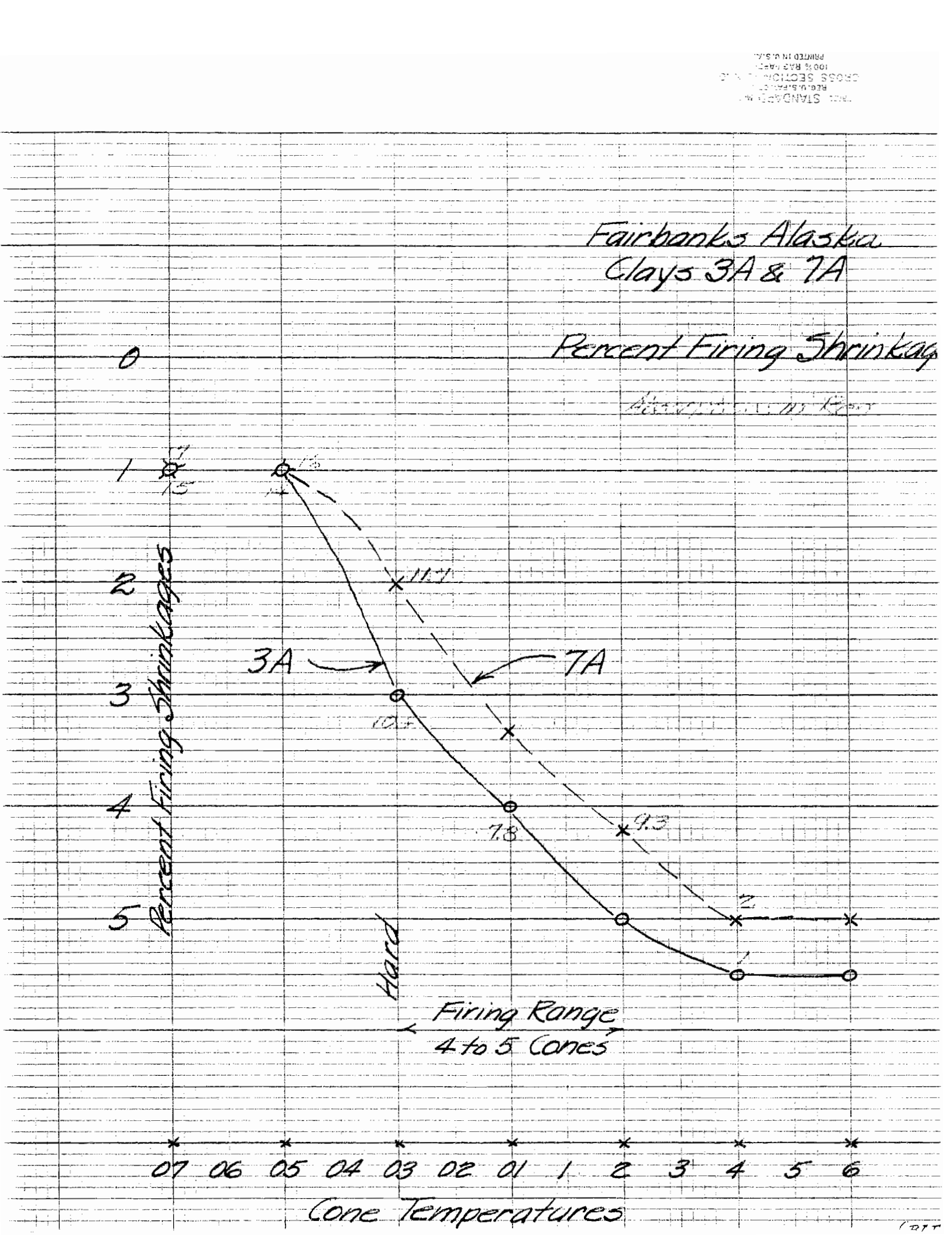
We study the firing behavior by plotting the percent firing shrinkages for the different cone temperatures on cross section paper, and we refer you to the attached curve sheet.

At cone 07 the shrinkage for both materials has advanced to 1% from which temperature on the rate of increase is greatly accelerated to cone 4, with a somewhat greater increase for 3A than 7A.

Since hardness begins with 03 sample, we have marked the firing range from cone 03 to cone 2. This will be within the dark red color range. It is mentioned that our series is darker than normal in that we obtained reducing conditions in our firing which is hard to avoid though in a commercial kiln the colors will be brighter. Furthermore, in a commercial kiln due to the weights imposed, the ware gets somewhat denser at lower temperatures so that we may consider the firing range to commence at cone 04. In any event,

Fairbanks Alaska
Clays 3A & 7A

Percent Firing Shrinkage



the firing range is long enough to be on the safe side.

We have entered the absorption values in red ink, and we find the absorptions for 7A a little higher along the line. The only explanation we can advance for the greater absorption of 3A is the fact that its drying shrinkage was greater than that of 7A.

We suggest that you place the test bars, submitted by parcel post, before you in proper order, and you will find the numbers from 1 to 7 scratched in on each piece. The 3A clay bars are marked with three long scratches across each bar whereas the 7A bars are not marked at all except for the seven numbers.

Conclusion

The clays lack plasticity to render them desirable stiff mud auger machine material though it is feasible to produce regular brick with the de-aired clay and lubricated die. We would have to exclude hollow ware.

There is not much we can say against the clay otherwise for the manufacture of brick except the contamination of the clays by the relatively large amount of hard pebbles.

If the clay is dug wet and brought into the factory wet, you would have to install a rotary dryer to get rid of most of the moisture so that the pebbles then may be screened out. This is being done in several Ohio plants where glacial clays are used.

Likely there is a scarcity of good materials in your part of the country and, if so, the material may be used for making brick by the stiff mud process and by the soft mud process in wooden molds; otherwise it might be well to do some more prospecting for better material.

Submitted by:

T. W. Garve

May 11, 1948

Mr. Delbert Frazier
Fairbanks, Alaska

Dear Mr. Frazier:

On behalf of the Department, Mr. Thomas and I wish to thank you for your exceptional courtesy in making available to us the reports of the Fairbanks clay studies, as prepared for you by Mr. Reed and Mr. Garve. In accordance with your request, the information contained will be considered confidential.

This information will prove very helpful to the Department and we thank you agian for your thoughtfulness. Please call on us at any time if there is any assistance we can give you.

Sincerely,

Art Glover
Assayer-in-charge

MAIL

B. [illegible]