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PRELIMINARY REPORT
on the
CERAMIC IMPORTANCE
of
CLAY AND SHALE DEPOSITS OF ALBERTA

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Introduction.

This summary report was written in order to supply certain information which may be of value to those interested in the development of Alberta's clay resources. Topics relative to the utilization of clay deposits are discussed and include: definition of clay and shale, mode of occurrence, classification of clays and shales, properties of clays to be considered in ceramics, and the kinds of clays used in ceramics. Alberta's clay manufacturing industry is dealt with under headings: list of manufacturers of clay products, and list of known workable deposits.

Some notes on the non-ceramic clay materials, bentonite, and fuller's earth, are included.

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Summary and Conclusions.

Deposits of low grade clays, i.e. those suitable for the manufacture of common brick, hollow tile, drain tile, and such are plentiful in Alberta. These clays may be shales belonging to certain older rock formations of fresh water origin such as Kootenay, Blairmore, Belly River, Edmonton, and Paskapoo; or they may be obtained from river terraces or glacial lakes, in which case they are unconsolidated and are of fairly recent deposition. The use of these low grade clays was widespread 25 or more years ago, but the number of manufacturing plants has declined in recent years to 8, of which 5 are located in Medicine Hat and Redcliff.

Apparently the clay manufacturing industry has centered in Medicine Hat and Redcliff because of the cheapness and convenience of natural gas.

However, the discovery of many other gas fields throughout Alberta suggests the possibility of the opening of new plants closer to market, should suitable clay be found in proximity to these gas fields.

No high grade clays such as kaolin, ball clay, stoneware, and sewer-pipe clay have yet been discovered in Alberta. The clay manufacturers of whiteware and stoneware in Medicine Hat import their raw materials from Saskatchewan, Eastern Canada, and United States. The Saskatchewan clays are mined at Willows and Eastend, and are taken from the Whitemud formation. This rock formation extends into Alberta, being found near the top of the Cypress Hills which lie about thirty miles southeast of Medicine Hat. Beds of white and white-weathering clays also occur in it in Alberta. As far as can be ascertained no search for high grade clays has been made in the Alberta section of the Cypress Hills. It appears that such a search is well warranted.

Definition of Clay and Shales

Clay is an earthy material which is plastic when wet, i.e. it can be molded to any shape. When dried it retains this shape; and moreover, if heated to a red heat or higher, it becomes permanently hard. Clay is a mixture of mineral particles ranging in size from sand grains to those that are microscopic. Some of the minerals are in a state of alteration. In addition colloidal material is present and this constituent probably gives clay its property of plasticity.

Shale is a clay which has been consolidated by heat or pressure or both to form hard rock. It does not crumble (or slake) when placed in water as does clay. Shale is often plastic when ground up and if so may be used for the same purposes as clay.

Mode of Occurrence of Clay and Shale.

Shale is usually part of bedrock, and hence is found outcropping where the overlying materials have been removed principally by the erosive action of streams, glaciers, and wind. Shales laid bare in this manner are commonly found in stream banks and exposed hills. Earth movements have been responsible for bringing shales to an exposed position in foothills and mountain regions.

Clay is often a surface material which in recent times has been deposited on bedrock by water, glaciers, wind etc. It covers larger areas of the earth's surface than shale, but it is often contaminated with pebbles and other deleterious materials which render it unfit for use in ceramics.[1] Sometimes clay occurs as bedrock; and if suited, it can be used in ceramics without crushing. This clay has either been formed from shale by weathering, or else has never been consolidated into shale.

Clays which have been transported by water or other agencies are very widespread in Alberta, and have been used in many places for making tile, and common and hollow brick; but at present only a few plants utilize them.

Classification of Clays and Shale According to Origin.

On this basis, clays and shales are divided into three main groups, residual, colluvial and transported.

A. Residual clays are those that have been formed in place by the weathering of the underlying bedrock. In this type weathering has usually proceeded from the surface downwards, so that there will be a gradual transition from clay at the surface to unaltered bedrock below. Occasionally alteration has been caused by ascending gases and vapours issuing from the earth, in which case alteration from bedrock to clay proceeds from below. In a residual clay, sand is usually disseminated in it, since there is no opportunity for sorting action of any kind as opposed to deposits laid down by water and wind.

Residual clays fall into several groups, chief of which are:

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1. Ceramics is the art of making whiteware, pottery, tiles, bricks etc. of baked clay.

1. Kaolins or China Clays. These are white-burning, and have been derived from feldspar-rich igneous and metamorphic rocks. The mineral feldspars upon decaying produced the kaolin, and there must have been insufficient iron present to lend a red colour to the burned ware. Kaolins may occur in veins in which case the parent rock was an igneous dike; or they may occur in a blanket deposit, which has resulted from the alteration of extensive areas of igneous rock.

There are no known deposits of kaolin in Alberta, and about the only place where they might be expected is in the Precambrian Shield in the northeastern part of the province, since practically all the igneous rocks that occur in Alberta lie in that corner. Furthermore, this kind of deposit is rare in Canada, although some occurrences are known in Quebec and British Columbia. More kaolin deposits may have been present in pre-glacial times, but they were scoured off by the several advances of the continental ice-sheets; and moreover, some which may have survived these scourings may be now concealed by the covering of glacial drift which conceals much of the bedrock in Canada.

2. Red-burning Residuals. These are derived from the decay of several types of rock such as granite, from the disintegration of some shales, and sometimes they occur as the insoluble residue from the solution of limestone. Enough iron is present to cause these clays to burn red. There are no known deposits in Alberta.

B. Colluvial Clays.

These are residual deposits that have been transported only a very short distance by the washing action of rain and melting snow. They usually form at the base of a steep slope. They are an unimportant group, and have not been found in this province.

C. Transported Clays and Shales.

These are formed from the disintegration and decay of bedrock; but, as the name suggests, the particles have been carried from the place of origin by agencies such as water and wind. The velocity of the Transporting medium, be it water or wind, determines the size of particle that can be moved along; therefore, as the velocity decreases, the larger particles are dropped. Hence for example, a stream exercises a certain sorting power over the material deposited and tends to deposit pebbles of a certain size in one place, sand grains of a certain size together, etc. Shale particles are among the finest of transported materials, consequently they may be deposited long distances from the source of supply.

Transported clays and shales differ from residual shales in being sorted, in having a banding or stratification and in often bearing no resemblance to the bedrock underneath.

Transported clays and shales are of several kinds depending on the conditions of deposition. These are (1) marine clays and shales, (2) lacustrine clays, (3) estuarine clays and shales, (4) flood-plain clays and shales, (5) boulder clays, (6) aeolian clays. These types are briefly described below:

(1) Marine Shales. These were laid down in the quiet water of the sea some distance from shore. They have generally great lateral extent and considerable thickness. Beds of marine shale are abundantly exposed in Alberta and some belong to the rocks of Fernie, Colorado, Pakowki, and Bearpaw ages.

Some tests have been made to determine the value of these marine shales in the ceramic industry; but they rank low in this regard. As far as is known, no marine shale has been utilized in Alberta for this purpose. Colorado shales of the Turner Valley area were tested but proved to be of less value than shales of other ages which occurred in that area.

Marine shale of Colorado age is used in the manufacture of cement at Exshaw.

(2) Lacustrine clays are those which have been deposited in lakes, swamps, muskegs, and sloughs. These deposits often show alternating beds of silt, mud, and clay. They vary widely in size from deposits in sloughs to

those laid down in glacial lakes, some of the latter being many miles in extent. Lacustrine deposits are usually quite plastic and impure, but frequently they are suitable for making common brick and earthenware. They are rarely refractory.[2]

Glacial lakes once covered considerable areas of Alberta, and consequently glacial lake clays are common. They are used in Medicine Hat Brick and Tile Co. Ltd. plant for making brick and hollow building tile.

(3) Estuarine Clays and Shales. These are clays which were deposited by rivers in their estuaries often in sufficient quantities to build up deltas. They nearly always contain lenses of sand or sandy material which were brought down during periods of high water when the velocity of the stream was greater. Some coal or other carbonaceous material may be present in the shales, as deltas often develop swamps in which vegetable matter could accumulate to form thick beds. In addition, plant fragments are commonly disseminated throughout clays and shales of this type. This latter feature is sometimes a serious drawback to their use in the manufacture of clay products; for, upon firing, the vegetable matter burns out rendering the burned article very porous. Estuarine shales occur in Alberta in the Foremost formation, which outcrops widely in Southern Alberta, but no use has been made of them in ceramics.

(4) Flood-Plain or River Terrace Clays and Shales. As the name suggests, these are clays which have been built up by streams overflowing their banks. Clays of this nature tend to be silty and sandy, and may have some plant material either bedded or disseminated in them. They are sometimes used in the manufacture of common brick, hollow tile, and clay products of that nature.

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2. Refractory clays are those which fuse (melt) only at high temperatures. Most refractory clays are white or buff burning, hence are important constituents in whiteware and stoneware.

Several brick plants using terrace clays once operated on North Saskatchewan river flats in Edmonton but at present only one is in operation.

Shales of this type occur in the Blairmore, Belly River, Whitemud, and Paskapoo formations in Alberta, and have been used in manufacturing common brick and tile. Plants at Medicine Hat and Redcliff use shales of Belly River age; clay plants formerly operating at Calgary and Sandstone used Paskapoo shales. Kootenay shales were at one time used at Blairmore in brick manufacture.

These shales often contain large hard concretions; and also almost always occur interbedded with hard sandstone. As both concretions and sandstone are hard to break down they are usually segregated and discarded. This extra handling adds considerably to the cost of materials used.

The white-burning clays of Southern Saskatchewan, which are used extensively in the clay products plants of Medicine Hat, had their origin in flood-plain deposits which contained many sand beds rich in feldspar. The feldspar upon weathering (decaying) has yielded the valuable clays. These deposits are contained in the Whitemud formation. This formation also occurs in Alberta, being found in the Cypress Hills which lie about 30 miles southeast of Medicine Hat. The size and quality of these deposits on the Alberta side of the boundary have not been studied in any detail from the standpoint of ceramics.

(5) Boulder Clays. These are clays that have been laid down by advancing glaciers. Since there is very little sorting action, the clay usually contains pebbles and other materials which make it unsuitable raw material for clay products. Since all Alberta, excepting higher mountains and hills, has been glaciated, glacial deposits chiefly in the form of boulder clay and lake clays, cover much of the surface area. However, no boulder clays have found application in the clay industry in this province.

(6) Aeolian Clays. These are clays that are composed of windborne particles. There are no recognized aeolian clays in Alberta, though in some

parts sand dunes have grown as a result of wind action. Aeolian clays are used in some parts of the world for brickmaking.

Properties of Clays to be Considered in Ceramics.

The chemical composition of clay is variable since it is a mixture of minerals, but the following are the elements usually present: silicon, aluminum, iron, calcium, magnesium, sodium, potassium, oxygen and hydrogen. However, the chemical properties of any clay give little information regarding its burning properties, and hence they are of so little value that they are not considered further.

On the other hand, physical properties give real information with respect to possible uses of the clay or shale. These physical properties are determined by certain standardized tests applied to the clay before and after burning. Principal physical properties are plasticity, texture, tensile strength, shrinkage, porosity, specific gravity, fusibility, colour, slaking and absorption. These are briefly described below.

1. Plasticity. This is the property of a water-wetted clay to change form under pressure without rupture, and to retain this form when pressure is removed. Enough water is added to the dry clay to make it plastic, a procedure called "tempering" the clay. A clay may require from 20% to 40% of its own weight in water in order to temper it.

2. Texture. This is the fineness of the particles comprising the clay. Most clay particles are too small to be seen with the naked eye, but some particles such as sand grains often can be detected. Texture has an important effect on plasticity, shrinkage, porosity, etc.

3. Tensile Strength. This is the resistance that clay offers to breaking after it is air dried. This quality is important in clay, since, after it is molded, the ware is stacked in the kiln and must be strong enough to stand this handling. Tensile strength is expressed in pounds per square inch.

4. Shrinkage. After clay is molded to the required shape the article is usually dried in air before burning in a kiln. Shrinkage in drying is termed air-shrinkage, and that in burning, fire-shrinkage. It is expressed as a percentage. Air-shrinkage may run from 1 to 10%. Excessive shrinkage produces cracks in the ware, hence is to be avoided. Sometimes air-shrinkage is reduced by adding sand.

During burning all clays shrink, for in burning the particles of clay start to fuse, and stick together thus bringing about a decrease in volume. Fusion usually begins at about dull-red heat. The difference between air-shrinkage and total shrinkage is fire-shrinkage.

5. Porosity is the ratio of the volume of pore space in a clay compared to total volume, and is expressed as a percentage. Its importance lies in that it influences the amount of water a clay will absorb, and hence indirectly it is a factor controlling plasticity. Indirectly it also influences air-shrinkage and rate of drying.

Porosity after burning is important too, for pores allow moisture to enter the article; and if porosity is great, the article may be disintegrated by expansion of the water through freezing.

6. Specific Gravity. This is the weight per cubic centimeter. This property is a consideration in that it must be known in order to compute porosity. It also does have some influence on fusibility.

7. Fusibility. Any clay will fuse, i.e. melt, if heated sufficiently. The temperature at which fusion takes place depends on the amount of fluxes in the clay, the size of the clay particles, and the kind of minerals in the clay. Fusion in an air-dried clay ware takes place gradually as the temperature is raised, and this is to be expected since clay is a mixture of minerals, each having its own melting-point. In burning common brick the temperature is raised until the particles are sufficiently heated to fuse together, thereby forming one strong coherent mass. Overheating may bring about loss of shape, cracking,

and other undesirable features. Fusibility is important, for the temperature at which a clay is burnt determines its strenth, colour, porosity, etc. For every clay there is a temperature at which it should be burned to yield maximum results, therefore control of temperature during burning is essential. Several devices are used to measure the high temperatures required to burn clays, but the one commonly used is the Seger cone. Seger cones, 64 in number, are mixtures of clays and fluxes, and so graded that each cone has a higher melting point than the preceding one. Cones are numbered from .022, which has the lowest melting point, viz. 585°C.(1085°F.), to 42 which fuses at 2015.C.(3659.F.). In actual usage several cones in series to include the one melting at the desired temperature are placed in the kiln with the ware to be burned, and in such a position where they can be observed through a peep hole. Thus by observing the melting of the various cones, the temperature can be raised to and kept at the desired level.

Different clay products have different ranges of temperature at which they should be burned to give best results; eg. common brick is usually burned between cone numbers .012 and .01 (840°C to 1110.C), terra cotta between cones .02 to 7 (1095°C to 1210°C). stoneware between 6 and 8 (1190°C to 1225°C), and porecelain 11 to 13 (1285°C to 1350°C).

8. Colour. The blue, grey, and black colours of unburned clay are caused by the iron or carbon compounds present in them. Yellow or red colours are often due to the iron oxide present. As a rule dry clay is lighter in colour than wet clay.

Clays rich in iron burn red, though this colour may be bleached to a cream or yellow if sufficient lime is present. Most clays contain iron, hence upon burning a red colour is commonly produced.

White - and buff - burning clays are lacking or nearly lacking in iron. They are usually kaolinitic and refractory.

9. Slaking. Clay when immersed in water crumbles to a powdery mass. This deterioration may take place in a few minutes or it may require several days. This property has a direct effect on the time taken to temper the clay or to wash it.

10. Absorption. This gives an index to the apparent porosity or permeability of the burned clay. It is expressed as a percentage, and is the increase in weight when the object is soaked in water under certain conditions. It is directly affected by shrinkage, for as shrinkage increases, pores close up and porosity will decrease. Too large absorption is not a desirable feature in some wares, such as common brick.

Kinds of Clays Used in Ceramics.

The physical properties of a clay determine the kind of product which can be made from it. Some clays are suitable only for stoneware, some for brick and tile, and some for brick only, etc. Even then the clay must be heated in a certain manner to obtain best results. For example, in brickmaking it should be ascertained first by testing whether best results can be obtained by any one of the soft-mud, stiff-mud, dry-press processes. The following are the principal kinds of clay, along with the products for which they are adapted.

(1) Kaolin is a white residual clay, burning white or nearly so. The term is also improperly applied to certain transported clays of Georgia and South Carolina. They are usually sandy so require washing before use. There are no known deposits in Alberta. Kaolin is used in the manufacture of white-wares such as china, semi-porcelain, porcelain, electrical porcelain, floor and wall tile, white Portland cements, and as a filler in paper, paint, cotton, and rubber.

(2) Ball-clays. They are clays having good plasticity, good working strength, high refractoriness, and burning white or nearly so. They are used

in making white earthenware, porcelain, electric porcelain, and floor and wall tile. Ball clays are found in southern Saskatchewan in the upper part of the Whitemud formation; they are used in the pottery industry in Medicine Hat. Since the Whitemud formation extends into southeastern Alberta, ball clays might be found in this province. As pointed out above, no detailed study from this standpoint has yet been made of Whitemud strata in Alberta.

(3) Fire-clays. In a correct sense fire-clays are those that can withstand a very high temperature without deforming. The term is used loosely, but should be applied to clays having a fusion point above 1605°C. Fire-brick is manufactured from fire-clay. Fire-brick is used to line furnaces where high temperatures are developed, as in metallurgical industries; it is also used in making retorts, locomotive and furnace linings, floor tiles, terra cotta, and paving brick.

Fire-clays are found in southern Saskatchewan in the same geological formation as the ball clays, described above. There are good reasons for believing that they might also occur in Alberta. A one-foot bed of highly refractory clay of fusion-point about 1680°C has been observed in outcrops of this formation, the Whitemud, at the west end of Cypress Hills in Alberta.

(4) Stoneware-clay. This is usually made from a refractory or semi-refractory clay. The clay should have plasticity, good working strength, low shrinkage, and refractoriness sufficient for the ware to hold its shape during burning. This clay is suitable for making crocks, jugs, bowls, and sewer-pipe.

Most of the Whitemud clays which are mined in Saskatchewan are stoneware clays. Remarks regarding the possibility of ball and fire-clays occurring in Alberta are also applicable to stoneware clays.

(5) Terra-cotta Clays. Terra-cotta ware includes vases, teapots, and other articles which are superficially coloured and glazed. Semi-fire clays are generally used, or a mixture of these clays with those of lower grade.

Buff-burning clays are usually selected because they burn hard at the desired temperature.

We have at present no information on the manufacture of terra-cotta ware from Alberta or Saskatchewan clays; but it appears that the ball and stoneware clays could be adapted to this end.

(6) Sewer-pipe Clay. This type of clay must burn without loss of shape, mold easily, and take a salt glaze. The clay may be red-burning shale or a mixture of impure clay and fire-clay.

The stoneware grade of clay from the Whitemud formation in Saskatchewan is used for the manufacture of sewer-pipe in the clay plants at Medicine Hat.

(7) Paving-brick clays. The clay required for paving-brick should be plastic, good working strength, and should burn at a relatively low temperature. These qualities are similar to those required for sewer-pipe.

(8) Brick-clays. These clays and shales are usually low grade and red-burning. The chief requirements for a clay to make building brick are that it should mold easily, burn at a relatively low temperature, and show a minimum loss of bricks from cracking or warping during burning. Since these requirements are comparatively easily fulfilled, brick-clays have a wide distribution, and vary greatly in origin and age. It has been noted previously that in Alberta bricks have been made from recent flood-plain and glacial clays, Paskapoo, Belly River, and Kootenay shales, the last three having been deposited millions of years ago.

Face brick, i.e. those bricks used on the outside of a building are of a deeper red and of a more uniform shade than bricks which form the inside of the wall or the rear walls. Face bricks are made from a better grade clay than other brick

Brick clays have a wide distribution in Alberta, and at one time brick plants were quite numerous in Alberta. This number has decreased so that in 1946 there were just eight in operation. These plants are discussed in a following section. (p. 15)

(9) Hollow-brick clay. Materials used for this product vary as greatly as with common brick, but the main requisites are that the clay be plastic enough to flow through the die, that it have fair tensile strength, and that it burn hard at a relatively low temperature. These clays are usually red burning.

Several of the clay manufacturing plants in Alberta turn out this product. Hollow brick finds its chief use in the building trade.

(10) Bentonite. This is an especial type of clay formed from the decay of volcanic ash. It occurs in beds from a fraction of an inch up to ten or more feet in thickness. The principal characteristic of bentonite is that it has a soapy feel when wet, and that it generally swells to many times its original volume when immersed in water. It is a common constituent of clays.

Bentonite has a great number of uses; chief of which are; a constituent of the mud used in drilling wells for oil and gas, an adsorbent, a retarder in gypsum plastics, for dewatering oils and gasoline, as a mordant in dyeing, as a bond in molding sand, as a filler in paints, making of cosmetics and soaps, as a water-softening agent.

Bentonite has been observed in Alberta in rocks of various ages, but it is especially abundant in the Bearpaw and Edmonton formations. Thick bentonite deposits have been observed in the badlands surrounding Cypress Hills, in the badlands of the Red Deer river near Drumheller, and near Edson. The Drumheller deposit is the only one being exploited at the present time. This bentonite is used in the oil industry in the preparation of drilling mud. The Edson deposit was opened up a number of years ago and used for manufacturing toiletries. This venture was not successful.

(11) Fuller's Earth. This is a peculiar type of clay that has the property of decolorizing or clarifying (i.e. bleaching) oils and fats. Such earths are also known as active clays; and some clays, not naturally active, may be rendered activable by treatment with acid. They are usuall bentonitic in character, though not all bentonites or bentonitic clays can be made activable by treatment. Fuller's earth probably originated in the alteration of volcanic ash, therefore is related to bentonite in this respect.

The chief use of this clay is for decolorizing oils produced in the petroleum industry; smaller quantities are used in treating vegetable and animal oils; a small amount is used for fulling cloth.

Canada produces none of this material, having to import requirements from the United States. If deposits of fuller's earth were found in Alberta they would possibly find an application in Alberta's growing petroleum industry. There are good prospects of finding fuller's earth in the province as there are numerous beds of bentonite and bentonitic clays; but as far as is known no clays have been systematically sampled and tested for active properties.

Some fulleritic clays have been found in Alberta at Calgary and Drumheller but are of low quality. Clay from the Calgary deposit has been used in the clarification of reclaimed lubricating oils.

Manufacturers of Clay Products in Alberta.

In 1946 there were ten firms in Alberta engaged in the manufacture of clay products. Eight of them turned out such ware as common brick and tile, which require only the lower grade of clays, whereas the other two manufactured stoneware and whiteware, which demand high grade clays. This number represents a considerable decline in operating plants of past years. In 1923 there were eighteen plants in operation. Several factors have contributed to this decline, two of which may be mentioned. One factor is a lessened demand, for the industry was most active during the years when settlement was expanding. The other factor is the centralization of the industry in Medicine Hat and Redcliff, which have the advantage of cheap gas for fuel. Following are the plants currently operating, the products manufactured by each, and the source of raw materials.

Alberta Clay Products Co., Ltd., Medicine Hat. This firm manufactures vitreous sewer-pipe, flue lining, hollow tile, drain tile, and brick. Clay for sewer-pipe and flue lining are brought in from Eastend, Saskatchewan, where it is taken from the Whitemud formation. Shale for brick and tile are taken from an outcropping of the Oldman (Belly River) formation about eight miles south-east of Medicine Hat. The shales are a flood-plain deposit, and are mined in a bluff pit, which is reached by railway spur. About 30,000 tons per year are taken from this pit. Natural gas is used for fuel.

Medicine Hat Potteries. This firm is a division of the Alberta Clay Products Co., and produces only whiteware. Materials used are ball clay from the Whitemud formation at Willows, Saskatchewan, ball clay from Kentucky, and kaolin from Georgia. Fuel is natural gas.

Medalta Potteries Ltd., Medicine Hat. This firm manufactures stone-ware, whiteware, and terra-cotta. Materials used are ball clay from Willows, Saskatchewan and Kentucky, stoneware clay from Eastend, Saskatchewan (Whitemud formation), and kaolin from Georgia.

Medicine Hat Brick and Tile Co., Ltd., Medicine Hat. This concern manufactures brick and hollow building tile. Glacial lake clays are used and are obtained at the site of the plant from a bluff pit. Stiff-mud process is used.

Gunderson Brick and Coal Co., Ltd., Redcliff. This firm manufactures brick, drain tile, floor and hollow building tile. Shales from the Oldman formation, a flood-plain type of deposit, are obtained locally. Stiff-mud and pressed-brick processes are used. Fuel is natural gas.

Redcliff Premier Brick Co., Ltd., Redcliff. This company turns out pressed building brick. Shales obtained locally from the Oldman (Belly River) formation are used. Fuel is natural gas.

Redcliff Pressed Brick Co., Ltd., Redcliff. This concern manufactures pressed building brick and floor tiles. Shales obtained locally from the Oldman formation are used.

Acme Brick Co., Edmonton. This firm manufactures brick, building and drain tile. Local clays of recent age are used. Coal is used for fuel.

J. B. Little and Sons, Ltd., Edmonton. This firm turns out only common brick. The soft-mud or sand-mould process is used. Raw material is river terrace clay obtained at the site of the plant which is located on a flat along the North Saskatchewan river. Fuel is natural gas.

Grand Prairie Brick Yard (K.J. Dalen and Sons), Grande Prairie. This firm manufactures common brick. Wood is used for fuel. Clay is mined at the plant site and consists of silty clay of flood-plain origin. The soft-mud process is used; sand for molds is obtained from sand hills a few miles south of Grande Prairie.

Known Workable Clay Deposits in Alberta.

The following list is a summary of information contained in geological reports. It may not be complete since it is possible that all clay deposits and pits have not been recorded.

Location	Township, Range, Meridian	Remarks
Lethbridge	6 - 21 w 4	Shale could be used for brick.
Lundbreck	7 - 2 w 5	Good brick shale present but not used.
Passburg	7 - 3 w 4	Blairmore shales could be used to make excellent brick, drain tile, fire-proofing and perhaps sewer-pipe.

Location	Township, Range, Meridian	Remarks
Blairmore	7 - 4 w 5	Kootenay shale was formerly used for making dry press brick.
Sentinel	7 - 5 w 4	Would make excellent brick and could be used as an ingredient in sewer-pipe.
Coleman	8 - 4 w 5	Shale could be used for low grade brick.
Taber	9 - 16 w 5	Belly River shale could be used in brick-making.
Bow Island	10 - 11 w 4	Clays could be used for common brick.
Monarch	10 - 24 w 4	Surface clays formerly used for brick.
Medicine Hat	12 - 5 w 4	Glacial lake clays and Oldman (Belly River) shales used for making bricks and tile by stiff-mud process.
Redcliff	13 - 6 w 4	Oldman (Belly River) shales used in manufacture of bricks and tile by stiff-mud and pressed brick processes.
Sandstone	21 - 1 w 5	Plants using Paskapoo shales formerly operated.
Sheep Creek	21 - 3 w 5	Shale could be used to make a fine, buff, face-brick by stiff-mud process.
Calgary	24 - 1 w 5	Plants using Paskapoo shales formerly operated making brick.
Seebe	24 - 8 w 5	Wapiabi (Upper Colorado) shale used in manufacture of cement at Exshaw.
Mitford	26 - 4 w 5	Paskapoo shales could produce an excellent brick, not worked.
Cochrane	26 - 4 w 5	River terrace clays formerly utilized in making brick.
Drumheller	29 - 20 w 4	Bentonite used in making drilling mud
Didsbury	31 - 1 w 5	Paskapoo shales would make a fine brick. Some shale contains enough lime to burn a cream colour.
Innisfail	35 - 28 w4	Surface clays formerly used for manufacture of brick.
Red Deer	38 - 27 w 4	Limy river terrace clay formerly produced a good brick.

Stettler	39 - 19 w 4	Glacial clay formerly used to produce small quantity of brick.
Alix	39 - 23 w 4	Clay could be used for brick.
Mirror	40 - 22 w 4	Very good common brick clay.
Wainwright	44 - 6 w 4	Plant once operated using recent clays to make brick.
Gwynne	46 - 23 w 4	Edmonton shales could be used for making brick of fair quality.
Wetaskiwin	46 - 24 w 4	Glacial lake clays formerly used to make brick.
Camrose	47 - 20 w 4	Glacial clay formerly used to make common brick.
Pocahontas	49 - 27 w 5	Cream-burning limy clay could be used for brick.
Vegreville	52 - 14 w 4	Surface clays were formerly used for manufacture of brick.
Edmonton	52 - 24 w 4	River terrace clays used for manufacture of common brick.
Entwistle	53 - 7 w 5	Good brick shale present in Edmonton formation: not used.
McLeod River	53 - 17 w 5	Bentonite formerly used in making toiletries and cosmetics.
Smoky Lake	59 - 17 w 4	Clays of residual origin used at one time in brick making.
Grande Prairie	71 - 6 w 6	Surface clays used for common brick.

The above information has been taken largely from the following reports:

Ries, H. and Keele, J.: "Preliminary Report on Clay and Shale of the Western Provinces;" Geological Surv., Canada, Memoir 24-E (1912).

Ries, H. and Keele, J.: "Report on the Clay and Shale Deposits of the Western Provinces" Part II; Geol. Surv., Canada, Memoir 25 (1913).

Ries. H.: "Clay and Shale Deposits of the Western Provinces", Part III; Geol. Surv., Canada, Memoir 47 (1914).

Ries, H.: "Clay and Shale Deposits of the Western Provinces", Part IV; Geol. Surv., Canada, Memoir 65 (1915).

Keele, J.:"Clay and Shale Deposits of the Western Provinces", Part V; Geol. Surv., Canada, Memoir 66 (1915).

From time to time certain clay deposits are examined; some prove to have commercial possibilities, and others unfortunately do not. Two of the latter type are the Beaverlodge and McMurray deposits. The Beaverlodge clay deposit, a clay that would make a fairly good common brick, is too thin to be economically worked being only 1.5 feet thick. Should larger deposits be found nearby, a profitable clay industry could result. Near McMurray stoneware and sewer-pipe clays were reported, but upon further investigation the clay beds were found to be too thin for the overlying material to be profitably stripped from them.

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