NOTES

ON SAMPLES OF BRICK-CLAY FROM FORT GARRY.

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Clays, as is well known, differ very considerably in their composition, and consequently in their suitability for the manufacture of different kinds of bricks. If we are desirous of making a brick of a refractory nature (fire-brick), we must select a clay consisting mainly of silica and alumina, and as free as possible from lime, oxide of iron and other bases which would form fusible compounds with the silica. Clays, however, which are to be employed in the manufacture of building-brick, may, in addition to the silica and alumina, contain small quantities of lime, oxide of iron, magnesia, potash and other bases, and yet be considered of good quality; indeed, a small quantity of protoxide of iron is looked upon as favorable, inasmuch as it promotes the strength and hardness of the bricks. But beyond a certain point these oxides (lime, magnesia, oxide of iron, &c.), are objectionable for different reasons; thus lime, or protoxide of iron, might make the brick too readily fusible, or the lime, which in the clay was combined with carbonic acid and which would on burning be converted into caustic lime, might cause the bricks to disintegrate on exposure to moisture.

Fat clays.

Clays which are free or nearly free from admixed sand or carbonate of lime are spoken of as *fat* clays, and are liable to considerable contraction and cracking on drying. The best way of counteracting this is by a proper admixture of sand, and the want of attention to this point appears, in some cases, to have been the cause of failure in the attempts to make brick at Fort Garry.

Loams and marls.

Mechanical mixtures of clay and sand constitute what are known as loams, while mixtures of clay and carbonate of lime constitute the so-called marls. If a loam contains the clay and sand in proper proportion it may be directly used for brick-making; but, from what has already been stated, it is evident that marls or marly clays are unsuited for this purpose.

Characters of the clays from Fort Garry.

The samples of clay from Fort Garry are from different depths from the surface, and are numbered accordingly; No. I. being a surface clay; No. II., 3 feet below I.; No. III. generally about 7 feet below the surface; and No. IV., 20 or 25 feet below the surface. All the samples effervesce on treatment with hydrochloric acid, owing to the liberation of the car-

bonic acid combined with the lime. This, however, is especially marked in the case of Nos. I., II. and IV., No. III. apparently containing a very small proportion of carbonate of lime. No. III. is of a light grey color, and, when dry, hard and breaking with a conchoidal fracture; when mixed into a paste with water it is more plastic and tenacious than any of the others. No. IV. is also somewhat hard and compact, its color being light bluish-grey. Nos. I. and II., on the other hand, are soft and friable, being of a decidedly marly character; they are both of a light-grey color.

All the samples are what are known as "red-burning clays;" that is, they contain protoxide of iron, which on burning is converted into the red oxide or peroxide. It will be observed that some of the accompanying samples of brick have barely any reddish tint, while others are of a deep red color. This is due to the different degrees of heat to which they have been subjected (some parts of the furnace being much hotter than others) rather than to any great variation in the amount of oxide of iron; for the difference, in some cases, is most marked in different bricks made from the same clay.

No complete chemical analyses of the clays have been made, as a chemical analysis does not always indicate the best proportions of clay. sand, &c., to be used. According to Muspratt, "it is nearly impossible to ascertain the applicability of any kinds of clay without a direct trial. Although the mode of occurrence, the color, the plasticity, degree of purity, property of effervescing or not with acids, may all help in enabling the brickmaker to form a correct opinion as to the nature of the clay, yet it is always advisable to obtain complete certainty as to the suitableness of the clay for the purposes desired, by *burning a few bricks by way of trial.* The cases are naturally not frequent in which clay is obtained with all the requisite properties, and it requires a *long series* of experiments to ascertain what proportions of *fat* and poor clay, sand and other substances, should be mixed together in order to obtain a brick-earth of the proper quality. If the clay is too fat the bricks will be denser than they should be, with too little porosity, and subject to bend and crack in the fire; if the clay is not fat enough the bricks will be soft and easily fall to pieces."

Practical trials necessary.

With such considerations in view, I have made a number of small bricks containing different proportions of clay and sand from Fort Garry. The results will, I trust, be instructive and serviceable to the Fort Garry brickmakers. The sand employed was that sent with the clays, and was from two localities—Sturgeon Creek and Point Douglas. The dry clay was first ground, and then, with or without sand, as the case might be, mixed into a paste with water and thoroughly pugged. The bricks were moulded in a small wooden mould, dried for several days at a temperature of 212° F., and finally burned in the muffle of a cupelling furnace.

Duplicates were, moreover, made, and half of them soaked in water after burning, and then slowly dried. This caused many of those made from the more calcareous clays to crack and fall to pieces owing to the slaking of the lime. It should, however, be observed that this disintegration in no case took place when the bricks were made of No. III. clay with a proper admixture of sand.

Proportions of clay and sand used.

The following are the proportions of clay and sand used in my experiments, the numbers corresponding with those upon the accompanying bricks:—

(1) No. I. clay, without sand. Made light red bricks which were compact and firm, but would be improved by the addition of sand, as they are too soft and would not be durable.

(2) Equal weights No. I. clay and Point Douglas sand. Made red bricks, which, however, after thorough burning and soaking in water, cracked badly. The proportion of sand should be very much reduced, the clay not being a *fat* one.

(3) Three Parts No. III. clay and one part Point Douglas sand. Produced very excellent red bricks, which at a very high temperature were slightly glazed upon the surface.

(4) No. II. clay, without sand. When not sufficiently burned the brick had a yellow color and soon cracked badly. A brick burned at a higher temperature showed no tendency to crack, but was too soft and calcareous. Color pale red.

(5.) 1 part No. III. clay, 1 part No. I. clay, and 2 parts Sturgeon Creek sand. Gave red bricks, one of which cracked slightly after soaking in water. When thoroughly burned did not crack even after soaking. The same proportions of clay with 1 part or less of sand would probably give fair bricks.

(6.) No. 3 clay, without sand. This being a *fat* clay, as might be expected, when used without sand shrinks and cracks on burning.

(7.) 1 part No. II. clay and 1 part Sturgeon Creek sand. Light red bricks, one of which cracked very badly after soaking in water. Not more than ½ the amount of sand should be used, if No. II. clay is used at all.

(8.) 1 part No. IV. clay and 1 part Sturgeon Creek sand. Gave good red bricks, not exhibiting any tendency to crack, even after soaking in water. In the event of coarser sand being employed a smaller proportion would be necessary.

(9.) No. IV. clay without sand. Too *fat*. Bricks perfectly worthless from cracking.

(10.) 3 parts No. III. clay, and 1 part Sturgeon Creek sand. Gave excellent red bricks, although they perhaps would not be so good as No. 3 where Point Douglas sand was employed.

(11.) 1 part No. III. clay and 1 part Sturgeon Creek sand. Gave good red bricks.

(12.) 1 part No. II. clay, 2 parts No. III. clay, and 1⅔ parts Point Douglas sand. One of the bricks, after soaking in water, cracked very slightly. There are two causes for this cracking, (1) the presence of the No. II. clay, and (2) too large a proportion of sand.

(13.) 1 part No. I. clay, 1 part No. II. clay, and 2 parts Sturgeon Creek sand. Too calcareous and too much sand. Cracked after soaking in water.

(14.) 3 parts No. I. clay and 1 part Douglas Point sand. In one case a slight tendency to crack; too calcareous.

In the manufacture of bricks at Fort Garry I should recommend the use of the *least calcareous* clay (No. III.), together with Point Douglas sand; the sand forming about ⅛ to ¼ of the mixture (supposing the clay to be dry.) If No. III. cannot be obtained in sufficient quantity, and the more calcareous clays have to be resorted to, either I. or IV. is preferable to No. II. Point Douglas, or similar sand, also, should be used (⅓ of the mixture say in the case of IV., and 1/10 to ⅛ of the mixture in the case of No. I., supposing the clay to be dry.)

While I recommend these proportions for trial, I think it quite possible that they may have to be slightly altered. Trials on the large scale and time, will alone decide this.*

Insufficient burning.

It is evident that in the attempts to make bricks at Fort Garry the burning has not been properly attended to; for while the clays are all "red-burning clays," the memorandum accompanying them speaks of the bricks obtained from them as being white, showing that the temperature had not in any case been high enough.

Bricks, to be of good quality, must be thoroughly burnt. Those made from precisely the same clays will vary very considerably in appearance, as well as in strength and durability, according to the heat to which they have been subjected.

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