"GROGS" IN BRICK MAKING.*

By Professor Baker, School of Mining, Kingston.

I have chosen as the subject of this paper one which I think is of great interest, and also of great importance to clay workers. By "grogs" is meant those substances which are added to strong clays to render them milder and more easily worked. As a rule only one such substance is used by brick makers in this country, and that is sand; but a few others can be used in case sand is scarce, e.g., loam, powdered brick-bats, sawdust, coal screenings, etc. Of course these several grogs have different effects upon the brick or other product to which they have been added, and I wish to discuss briefly a few of the effects of these grogs on our clays in Ontario.

There is a common error among builders and contractors in general concerning the addition of grogs. They believe that the addition of sand or powdered brick to a clay is an adulteration and a detriment to its use as a building material, much as we view the addition of cotton or shoddy to a woollen fabric. This error on the part of brick users, and many brick makers also, is a serious one, for the addition of these grogs is just the reverse of the above. They improve the brick in several ways, as I hope to show you.

Looking at this subject first from the standpoint of the brick maker, you all know well the difficulties that have to be met in working a clay that is too strong or fat, as it is often called. In the first place, such clay is difficult to mine or dig; it sticks to the plows, spades, scrapers or whatever else may be used to dig it. It sticks together so that it can scarcely be picked apart. You all know just how tough a clay bank can be. If, however, there be a certain amount of sand in the clay, it digs so much more easily.

The tempering of a strong, stiff clay is a most difficult thing; it is almost impossible to do it by hand, and if it is done by a pug-mill or other machines, the tough clay will prove a great user of power. About the only way to temper and disintegrate such clay is to dig it in the fall and allow it to lie in a heap over winter, when with frost and wet and dry it will slowly slake and break up to a workable condition. But some of you have not time for this, and should add sand to such clay in your pug-mill, or tempering pit, or to the brick machine itself, if you do not temper in a separate machine.

In the next part of brick making, viz., moulding, sand plays a very important part. It is almost impossible to shift a strong clay from the moulds, such clay will fit the mould so tightly, and it will be so close in grain that it will rub the moulding sand off the moulds and make it almost impossible to shift the brick when made. It is astonishing what an improvement a little sand will make to such a clay in this respect.

In drying either stiff mud or stock brick an addition of sand will make an enormous difference in the rate. Very strong clay will crack and slake, or a dry shell will form, keeping the interior of the brick wet, or the brick will warp and shrink out of shape by unequal drying, and the accompanying air shrinkage. When sand is added it renders the clay leaner or milder; it will not require so much water for moulding, and the grains of sand keep the brick more open, so that the moisture can escape in drying. Again, the sand will not shrink, so that the bricks will keep their shape much better, as only part of the material of which they are made shrinks.

We have seen from the above remarks, certain parts of which must describe conditions which all of you have experience in one respect or other of your industry, that the addition of sand makes clay working much easier in every respect, from the digging of the clay to the burning of the finished product.

But all that we have said is from the standpoint of the brick maker; but what of the brick user? Does the addition of this sand mean a poorer article for builder and contractor? This is the other standpoint from which I wish you to study this question.

Two great classes of strains are put upon brick in building; the one is a tensile strength which would tend to pull bricks apart, the other is a pressure which would tend to crush the brick. The second of these is most important, as it is practically the stress to which bricks are subjected in a building, by the weight placed on them. In order to submit clays to some of these tests, I took several of our Ontario clays and subjected them to these tests, as follows: The raw clay with its own 15% of sand was formed into a briquette, then the percentage of sand was increased to 25 and then again to 33%. These briquettes were made about the shape of the figure 8, the narrow part being one inch wide and the whole briquette is one inch thick, so that at the smallest section, that is, at the place where they will naturally break, the cross section would be one square inch. The weight applied was in pounds so that the results were in lbs. per square inch. The briquettes were all burned in the same muffle furnace, so that all three sets of briquettes were subjected to the same conditions in burning.

TABLE OF CLAY TESTS.

Sample.	15% Sand. No. 1.	No. 2.	Aver.	25% Sand. No. 1.	No. 2.	Aver.	33% Sand. No. 1.	No. 2.	Aver.
A	250	210	230	320	365	342	250	265	257
B	290	325	307	380	350	365	270	290	280
C	300	340	320	350	375	362	326	300	313
D	210	185	197	330	350	340	280	295	287
E	235	270	252	295	310	302	200	230	215
			261			342			270

From the above tests we see that the addition of sand to these clays makes them stronger and better able to resist the pulling strains to which they are subjected. We see here that the best results were obtained when the per cent. of sand is 25, whereas 33% is a little too much. This, of course, simply means that you can get too much even of a good thing, and of course there is a proper increase of sand, which seriously overstepped, becomes a detriment instead of the reverse.

The crushing test, or the ability to withstand weight placed upon it, is still more important to brick users, and some tests of these are also of interest. In these tests small cubes were made one inch to an edge, so that the blocks were one cubic inch, and any face was one square inch. Pressure was then placed on this and gradually increased till the cube crushed. Four tests were made on ordinary red face brick, as sold in general for building, and these required an average of 2,460 lbs. to the square inch to crush them. This figure is given as a standard for ordinary stock brick, and for comparison with the tests given below.

TABLE OF CLAY TESTS.

Sample.	15% Sand. No. 1.	No. 2.	Aver.	25% Sand. No. 1.	No. 2.	Aver.	33% Sand. No. 1.	No. 2.	Aver.
A	3150	2820	2985	3190	3390	3290	2640	3060	2850
B	2900	2580	2790	2990	3375	3182	3400	2760	3080
C	2620	2760	2690	3250	3580	3415	3615	2880	3247
D	3480	2844	3162	3640	4370	4005	2510	2640	2575
E	3710	3410	3560	4360	4720	4540	3390	3570	3480
			3027			3686			3046

Here again we see that the addition of sand improved these products. The small blocks were all burned in the one kiln at one time, so that the conditions were uniform for all. The tests show that 25% of sand is again best, while 33% overstepps the limit and the ability to withstand pressure begins to drop again. You will notice also that the average of tests made on the clays having 15% of sand in them, and this by the way is about the average of our Ontario clays, is about the same as the standard of four tests made on ordinary stock brick as sold in general for building purposes, which shows that these tests were about as fair as could be made. We realize of course that many tests must be made before any general statements can be made, but it seems sufficiently well established when an average of ten tests on a clay with 15% sand in it gives 3,027 lbs. to the square inch, while ordinary stock brick of commerce made from such clay also gives 2,460 lbs., and that ten tests of clay with the sand content increased to 25% gives an average of 3,686 lbs. per square inch, that the addition of sand to clay is a desirable thing. It seems certain at any rate that the addition of 25% of sand, or one shovel of sand to three shovels of clay, is a decided improvement on strong clays, but this per cent. of sand should not be seriously overstepped or the values drop again.

Do not mistake me to mean that every one of you should add 25% to your clay in working; some of you have a sandy clay already, and no doubt you know it and are pleased with the way it works into brick. But others, and a majority at that, have a strong clay difficult to handle and work up—do not hesitate to use sand. It will not hurt the color of your brick unless there be limestone in it, and this is very rarely the case.

If you suspect limestone in your sand, put a little of it into a glass tumbler or a bottle, then pour in a little acid of any kind, and warm it slightly by placing it in a little warm water. If there is any limestone in your sand you will see a brisk effervescence or bubbling coming off the sand. If your clay burns to white brick or buff brick, this will not hurt them, but if your clay burns to red brick, avoid any sand or loam that shows limestone, for this will tend to spoil the color of the brick by making them light in color, or even spotted.

The addition of combustible grogs, e.g., sawdust or coal screenings, is for a different purpose entirely, and this is a subject which has not been considered very much in this country. In Europe such grogs have been used to a considerable extent. Coal, e.g., is powdered and mixed in the raw clay, when the kilns are burned this fine coal dust burns also and helps to distribute the heat throughout the kiln and aids in the burning. The particles of clay fuse slightly and knit to each other, and a more or less porous brick results.

Considerable use is now made of coarser materials as grogs, e.g., coarser coal or sawdust is commonly used. This is used in the manufacture of porous bricks, terra cotta lumber, and fire-proofing.

The aim of the architect and contractor now is to erect a building that will be fireproof and yet not too heavy. This is now accomplished by making the main structure or shape with iron and filling in with terra cotta lumber or fire-proofing. To make this we may use any kind of clay, as the color of the product does not signify, provided it is strong and light. The clay is pugged thoroughly with coarse sawdust, the blocks of any desired shape are made, as in the stiff mud process, by varying the die they are dried like tile, after which they

*Lecture delivered before the Association of Canadian Clay Products Manufacturers.