being frequently present in effloresced condition. Attempts have been made to manufacture pure alkali from this, but up to the present time without marked success (see in this connection an article by Professor Lunge, *Ztschr. angew. Chem.*, January, 1893). During the present year a new company has begun operations in Wyoming and has already achieved results which point to success in the future. Magnesium sulphate is also found in quantity in parts of Wyoming, but the absence of good railroad facilities renders all these deposits of little value at the present time. As coal seems to be found in abundance in the vicinity of some of these beds their development is one of the certainties of the future.

SOME EXPERIMENTS ON SAMPLING BY QUARTATION.

By P. W. Shimer and S. K. Reifsnyder.

FOR reducing the bulk of a coarsely crushed sample of ore on the laboratory sampling table preparatory to still finer crushing, it is customary to mix, spread out, and quartate the sample once or oftener. In order to determine the degree of accuracy obtainable by this procedure, as well as to discover, if possible, the best way to manage the details of mixing and quartation, the following experiments were made upon a mixture of 500 grams lead shot just large enough to be retained by a ten mesh sieve: 500 grams magnetic iron ore of a size between ten mesh and twenty mesh and 500 grams of crushed glass passed through a twenty mesh sieve, but from which the finest powder had been removed by washing with water. By reason of the different sizes, shapes, and specific gravities of the elements of this mixture it is a very difficult one to sample.

It was conceived, therefore, that any inaccuracy in the results of sampling would be prominently brought out and that any method that would give good results on this mixture, could be confidently used on the less difficult mixtures occurring naturally in ores. The mixture of 500 grams each of shot, magnetite, and glass was first separated by sifting, with the result that it was found to be possible to recover the exact amount ($33\frac{1}{3}$ per cent.) of each from the mixture. 500 grams of each were again

mixed on a large paper, using forty motions of the paper. The mixture was then spread out with a spatula and quartated, in the usual manner, with the following results:

	No. 1.	No. 2.
Shot	33.8 per cent.	33.1 per cent.
Ore	34.1 " "	32.3 " "
Glass	32.2 " "	34.6 " "

Each of these parts was then mixed, spread out, quartated, sifted, and weighed as before and the process was continued until each constituent of the mixture had been reduced to sixty grams; the results, grouped together, were as follows:

Shot (per cent.)	38.6	28.7	37.7	39.5	28.4	29.0	34.7	31.8	31.7
Ore " "	32.0	36.0	33.7	31.6	37.1	34.5	31.6	32.9	32.9
Glass " "	39.4	35.3	28.6	28.8	34.5	36.5	33.7	35.3	35.3

Shot (per cent.)	37.5	35.3	28.4
Ore " "	29.8	31.4	34.6
Glass " "	32.7	33.3	37.0

The results seem to vary more widely from the truth the further the sample is reduced by quartation. Having now ascertained how inaccurate the results may be when obtained by the above method, some variations, suggested by the course of the work, were tried. In all the experiments which follow the sampling was not carried beyond the first quartation.

By mixing with forty motions of the paper, spreading out with a spatula, and quartating, the results were:

Shot (per cent.)	34.3	32.4	32.4
Ore " "	32.0	34.6	35.8
Glass " "	33.7	33.0	31.8

To compare with these, three quartations were made by moistening with water, mixing forty times, spreading out with spatula, and quartating. The results were:

Shot (per cent.)	31.8	32.0	31.0
Ore " "	33.7	33.2	34.7
Glass " "	34.5	34.8	34.3

Averaging these results, we have:

	Sampled dry.	Sampled moist.
Shot	33.0	31.6
Ore	34.2	33.9
Glass	32.8	34.5

The slight advantage in favor of the dry mixing was unexpected and led to the suspicion that the spreading out of the sample by means of the spatula was the cause of the trouble. In the next experiments, instead of using the spatula, the sample, after mixing, was simply flattened out by pressure under a small, smooth board. Assuming that the mixture is perfect at the end of the mixing it seemed probable that spreading out with a spatula might destroy the uniformity of the mixture, while, by simply flattening out the sample by means of the board, the relative positions of the particles would remain practically unchanged.

By mixing forty times dry, flattening, and quartating, the results were:

Shot (per cent.)	32.0	35.7	32.9	32.3	32.9
Ore " "	35.0	31.9	33.5	33.7	33.9
Glass " "	32.9	32.4	33.6	34.0	33.1

By mixing forty times moist, flattening, and quartating, the results were:

Shot (per cent.).....	32.9	32.8	31.8
Ore " "	33.5	33.5	34.1
Glass " "	33.6	33.7	34.1

By mixing forty times dry, then forty times moist, flattening, and quartating, the results were:

Shot (per cent.)	33.1	33.5
Ore " "	33.5	33.4
Glass " "	33.4	33.1

The average of the four best dry is: Shot, 32.6; ore, 34.0; glass, 33.4. The average of the four best moist is: Shot, 33.1; ore, 33.5; glass, 33.4. The average of the two mixed forty times dry and forty times moist is: Shot, 33.3; ore, 33.45; glass, 33.25.

From the preceding experiments it appears that there is an advantage in mixing moist, both in accuracy and neatness. Decidedly better results are also obtained when the mixture is simply flattened out with a board instead of being spread out with a spatula. The best results also seem to be obtained when the sample is first mixed dry, then moistened and mixed again, for when dry there is greater freedom of motion among the particles. When, however, the sample is well mixed dry it should

be moistened and mixed again, not only to obtain a still more uniform mixture, but to maintain it during quartation.

Wishing to verify these conclusions in the case of an ore, a sample of crushed iron ore was obtained containing in its coarser portions considerable hornblende and in its finer portions a larger proportion of magnetite. The sample was divided into four sizes by careful sifting.

	Per cent.
Between 4 and 6-mesh sieves	34.69
" 6 " 10-mesh "	18.47
" 10 " 20-mesh "	14.10
Through 20-mesh sieve	32.74

Four hundred grams of each size were taken, mixed dry, and spread out very thin with the spatula before quartation. Instead of twenty-five per cent. of each, we found:

	Per cent.
Over 6-mesh sieve	27.0
" 10-mesh "	25.4
" 20-mesh "	24.5
Through 20-mesh sieve	23.1

Another mixture was made in the same manner, using the spatula, but not spreading out the heap so thin as before.

	Per cent.
Over 6-mesh sieve	25.6
" 10-mesh "	24.8
" 20-mesh "	24.5
Through 20-mesh sieve	25.1

The following were then mixed dry sixty times, flattened by use of the board, and quartated.

	Per cent.	Per cent.	Per cent.
Over 6-mesh sieve	23.6	25.4	25.1
" 10-mesh "	25.7	25.0	25.2
" 20-mesh "	26.3	24.4	25.0
Through 20-mesh sieve	24.4	25.2	24.7

Mixing thirty times dry and thirty times moist, flattened, and quartated:

	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Over 6-mesh sieve	24.5	25.1	24.0	25.7	25.4
" 10-mesh "	25.4	24.9	24.3	25.3	24.8
" 20-mesh "	25.4	25.0	26.1	24.4	24.9
Through 20-mesh sieve	24.7	25.0	25.6	24.6	24.9

By mixing fifty times dry, then fifty times moist, flattening, and quartating, the results were:

	Per cent.
Over 6-mesh sieve	25.8
" 10-mesh "	24.9
" 20-mesh "	24.6
Through 20-mesh sieve	24.7

The average of dry and moist results were:

	Dry. per cent.	Moist. per cent.
Over 6-mesh sieve	24.7	24.9
" 10-mesh "	25.3	24.9
" 20-mesh "	25.2	25.2
Through 20-mesh sieve	24.8	25.0

A few determinations were then made by a method sometimes used. The ore was carefully mixed as before and halved by allowing a small scoop full of the ore to fall over a thin partition. The results of these separations were:

	Dry			Moist.
	Per cent.	Per cent.	Per cent.	Per cent.
Over 6-mesh sieve	25.7	26.0	25.5	24.3
" 10-mesh "	26.6	25.6	26.0	24.7
" 20-mesh "	24.0	24.8	24.9	25.7
Through 20-mesh sieve	23.7	23.6	23.6	25.3

These results are not so good as those obtained by quartation, but here, as before, the moist method has the advantage in accuracy and neatness.

The four sizes were then separately prepared for analysis, the results showing the percentages of metallic iron soluble in hydrochloric acid (magnetite) and insoluble in hydrochloric acid (hornblende) are as follows:

	Per cent. Over 6-mesh.	Per cent. Between 6 and 10-mesh.	Per cent. Between 10 and 20-mesh.	Per cent. Through 20-mesh.
Soluble in HCl	30.30	28.57	27.31	40.25
Insoluble in HCl	8.65	8.85	9.18	6.25
Total metallic iron	38.95	37.42	36.49	46.50

The amount of iron in the different sizes is seen to vary considerably. Knowing the percentage of each grade in the original sample and the percentage of iron in each grade, the percentage of iron in the original sample is readily found to be 40.78. A sample of the mixture experimented on, containing

twenty-five per cent. of each size, should contain by calculation 39.835 per cent. metallic iron. Calculating the amount of iron in the first (dry) sample, which is a very poor one, having been spread out thin with a spatula, we find the sample would yield 39.699 per cent. iron, thus causing an error of 0.136 per cent. While this sampling error is notable, it must be remembered that this error would be increased very much if the quartations were carried further, as was shown by the preliminary work. Taking the average results dry we find an error of 0.022 per cent. Taking the average results moist we find an error of 0.006. The error in the percentage of iron ranges from 0.136 per cent. to 0.006 per cent., the greater error coming from a sample made dry and the least from one made moist. In the average results there is a difference of 0.016 per cent. in favor of moist sampling. This fact agrees with the result of an investigation on the moist sampling (with alcohol) of cast-iron borings published by one of the writers some years ago (*Trans. A. I. M. E.*, **14**, 760). The results may be briefly recapitulated as follows:

(1) It is more accurate to sample moist than to sample dry.

(2) Moist sampling is preferable because of neatness of separation and absence of dust.

(3) It is better to mix dry, then moisten, and mix thoroughly again before quartating.

(4) It is far better to flatten out the sample by simple pressure than to spread it out by means of a spatula.

THE ANALYSIS OF LUBRICATING OILS CONTAINING "BLOWN" RAPE-SEED AND "BLOWN" COTTON-SEED OILS.

BY THOS. B. STILLMAN, PH.D.

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RAPE-SEED oil has long been the standard oil in Europe for lubrication. Its constancy of viscosity at varying temperatures, its non-liability to acidity as compared with other seed oils, and its low cold test, unite in producing the results required of a good lubricant. It, however, is no exception to the rule that vegetable and animal oils suffer partial decomposition when subjected to high temperature produced by friction,