

10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20

For many years the great fertilizer industry has suffered heavy losses financially in fines imposed upon them by the various states which protect the consumer against under-analysis. Such fines often bring the total losses above the net gain for the fiscal year and as a result many fertilizer companies are often forced into the hands of receivers. Some of the larger companies are often forced to curtail or close down the factories as a result of these losses.

**THE SAMPLING OF FERTILIZERS**

Submitted to the  
Department of Chemistry  
of

Virginia Polytechnic Institute  
as a partial requirement for  
the Degree of Master of Science  
in  
Applied Chemistry

The above statistics do not

the fertilizer people and the state

with the need of more competent chem

any such uncalculated losses. It has

the factory had to take young men who are hardly through with high

school training and place them in the laboratory as assistant

chemists. These men are soon interested with all the analytical

work of the company. The samplers have still less knowledge of

the importance of their work. The author knows of many instances

in which the sampling was done by boys and men who could hardly

For many years the great fertilizer industry has suffered heavy losses financially in fines imposed upon them by the various states which protect the consumers against under-analysis. Such fines often bring the total losses above the net gain for the fiscal year and as a result the smaller fertilizer companies are often forced into the hands of the receivers. Some of the larger companies are often forced to curtail or close down the factories as a result of such losses.

During the manufacturing season of 1920 the audit of one of the largest fertilizer companies in the United States showed a loss of \$20,000 as a result of low analysis fertilizers shipped to farmers in one state alone. Another company suffered a loss of \$10,000 in the same state.

The above statistics do not mean a commercial war between the fertilizer people and the state authorities, but clearly bring forth the need of more competent chemists and samplers to prevent any such uncalled for losses. It has always been the custom for the factory head to take young men who are hardly through with high school training and place them in the laboratory as assistant chemists. These men are soon intrusted with all the analytical work of the company. The samplers have still less knowledge of the importance of their work. The author knows of many instances in which the sampling was done by boys and men who could hardly

read and write. With such men in charge of one of the most important phases in the fertilizer industry there is little wonder that such gross errors with damaging results often occur. It is not the object of the author to criticize the various fertilizer companies as to their methods of analysis, but to offer a few suggestions as to what has proved to be the best way in which to take and prepare samples.

CAUSES OF ERRORS IN SAMPLES: (1) Drawn by incompetent samplers; (2) Using "thief" that has not been thoroughly emptied, thus getting a mixture of two fertilizers or two or more stock materials which often means a higher per cent of material is found in the laboratory than the bags actually contain.

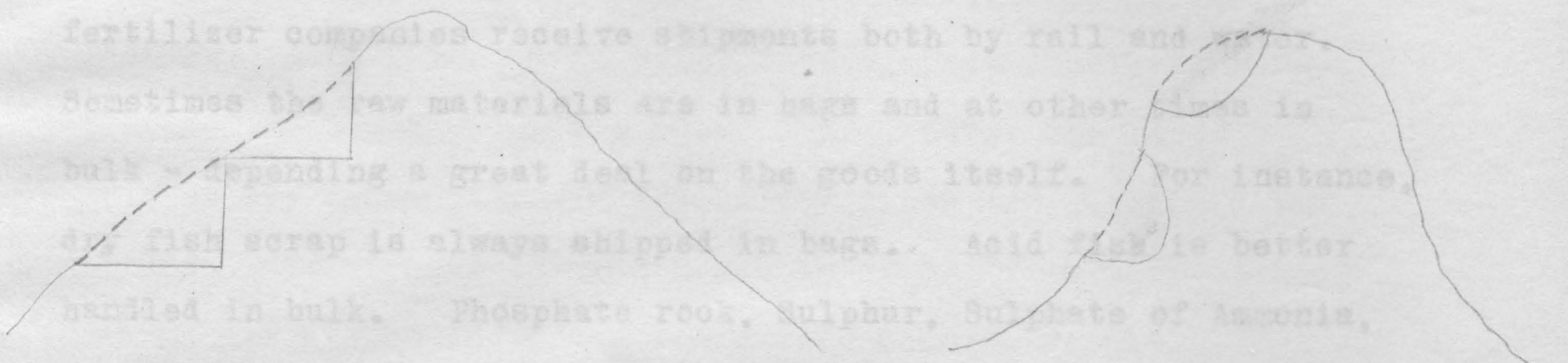
The thief is not thrust deep enough into the bags and is often thrust through the middle of the bag instead of being dragged from corner to corner. Unless the fertilizer is a homogeneous mixture the sample will not be accurate. Very often, however, a faulty sample is the result of carelessness on the part of the baggers or foreman. The "batch" or mixture of some particular fertilizer, say 8% Phosphoric Acid, 2% Nitrogen, and 2% Potash, overruns the desired tonnage for shipment and is left in the "hopper" to fill in another shipment. Now if the next shipment should consist of 10% Phosphoric Acid, 4% Nitrogen, and 4% Potash, the first bags will not yield this per cent because of the presence

chemist did not have sufficient knowledge of his work to make of the "8-2-2" fertilizer. When the mixture of these two fertilizers more than fills one 167-pound bag the risk of a fire is very evident. It is up to the sampler to see that no such fertilizer leaves the factory and to the foreman of the mill that the hoppers are clean before new orders are filled.

Another source of trouble arises when the sampler takes a sample from large piles of material. In many cases he will take samples from the outer portions of the pile and will not bother with the high percentage ingredients which would seep through to a depth of several inches or feet in some cases. He will often fill the sample bucket with large lumps of the material and leave the smaller particles instead of taking a uniform sample of both. The larger particles will invariably yield a larger per cent of nitrogen and water contents than the smaller ones. In some instances the potash yield will be greater. It is evident that such neglect will give an improper analysis of the bulk of fertilizer.

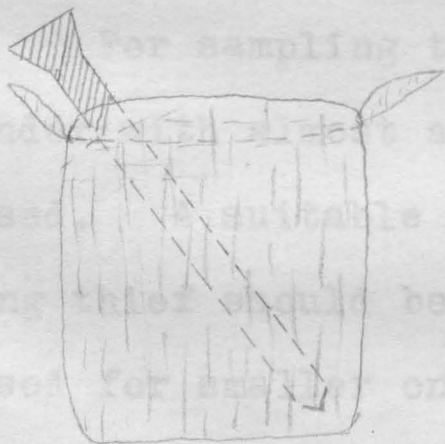
Still another source of error is brought about by using open buckets. The contents of the bucket are exposed to the dust of the mills and in many instances the entire analysis will be changed. Very often the sampler will leave the bucket in such a position that materials from the overhead carriages or elevators will fall on top of a drawn sample and the result is evident. The work of a thoroughly competent sampler would be for naught if the

chemist did not have sufficient knowledge of his work to make a correct analysis or in preparing the sample for analysis.

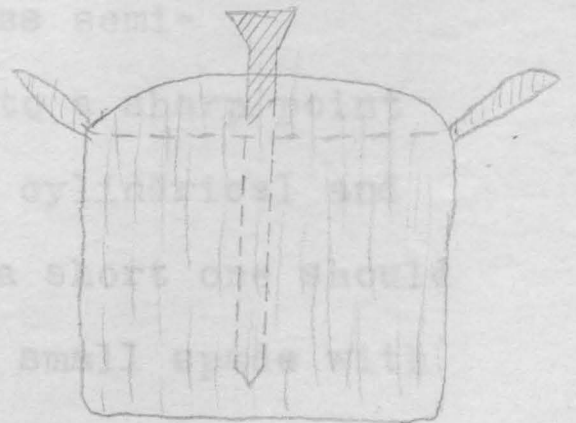


Correct method of digging holes for samples in large piles of stock, etc.

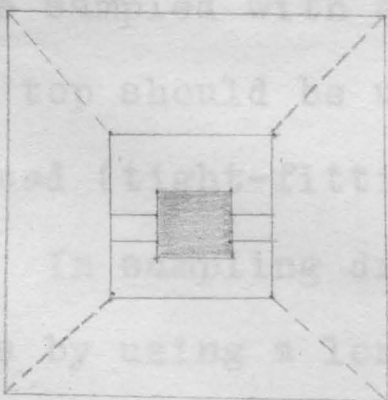
Incorrect method



Correct method for thrusting "thief in bag for sample



Incorrect



Wood box 12" x 10" x 4" for catching samples Looking down thru hopper.

of fish, often containing percentages of Nitrogen, cannot be removed with the

## RAW MATERIALS: -

The sampling of the various raw materials depends a great deal upon the way in which the goods is shipped. The largest fertilizer companies receive shipments both by rail and water. Sometimes the raw materials are in bags and at other times in bulk - depending a great deal on the goods itself. For instance, dry fish scrap is always shipped in bags. Acid fish is better handled in bulk. Phosphate rock, Sulphur, Sulphate of Ammonia, and sheep manure, are usually shipped in bulk, while tankage, Nitrate of Soda, and high grade Potash Salts are shipped in bags.

For sampling the "thief" or a clean brass semi-cylinder with almost all of one side filed off to a sharp point is used. A suitable handle is attached to the cylindrical and a long thief should be used for large bags and a short one should be used for smaller ones. For bulk sampling a small spade with a sharp and clean edge should be used. It is often necessary to use a pick or adz, and in a few cases the bulk material can best be sampled with a thief. For all methods a clean bucket with a top should be used. The quartered samples should be kept in closed (tight-fitting) tin cans or glass jars.

In sampling dry fish scrap the author always obtained best results by using a long "thief". Part of the sample should be taken with the hand because the larger particles of fish, often containing percentages of Nitrogen, cannot be removed with the

thief. The thief should be forced diagonally from top to bottom through every other bag as they are being unloaded from the boat or train. At the same time a good handful of the larger pieces should be taken. In doing this the arm should be thrust well into the bag through the sewed end. Later the large particles are thoroughly mixed with the fines and quartered for analysis. It is hard to draw a sample of the fish scrap after the bags are stored and often inaccurate samples result.

The acid fish require even more care than the dry scrap. This material is always composed of large lumps, and the matter of drawing a uniform sample is often very difficult. The best results can be obtained by sampling the fish either while loading or unloading the vessel. The author used a small spade with a very sharp edge and removed one spade full for each "Tub" before it was hoisted by derrick from the ship. By using a sharp-edged spade it is easier to cut out a sample with some uniformity.

Phosphate rock, Sulphur, Sulphate of Ammonia, and sheep manure can be sampled with hands and thief. In each case it is best to draw the sample before the materials are unloaded into the storage bins. One handful or thief full should be taken from each tub before it is elevated to the electric carriage. In some cases suitable samples can be obtained by taking a handful from each carriage full; but a more accurate sample is obtained

by taking a handful from the tub. The carriage holds from five to ten tubs - depending upon material. If the materials are conveyed in wheelbarrows, take one handful from each wheelbarrow. Tankage, Nitrate of Soda, and bag lots of Potash Salts should be shipped in a manner similar to that of dry fish. The samples, however, should be drawn entirely with the thief. When the potash salts are of a high grade it is best to take one good thief full from every bag instead of every other one. Care should be taken to penetrate the bag diagonally (top to bottom) from corner to corner. It is often necessary to sharpen the point of the thief in drawing potash samples.

Samples of the raw materials used in making "stock goods" should be taken every other day from the storage bins. This is done by digging suitable holes which shall be described later in the bulk, or by taking "thief" samples from the bagged lots.

STOCK GOODS: - In almost all factories samples of the completed stock are drawn from the storage bin after being unloaded from the carriage. It is much more easy, efficient and accurate to draw samples from the carriage as the completed stock is elevated from the mixer. To do this a thief or a small spade should be used. If using a thief it should be thrust to the bottom of the carriage in several places. If using a spade two or three small spades full should be taken from several points in the carriage. The author has drawn samples both from the bin after the carriage was emptied in bin and from carriage, but always obtained best results from the latter.

However, samples should be drawn from the stock bins at least three times a week. In drawing samples from the bins triangular holes should be dug in the pit at varying points from the bottom to the top. The hole should be from three to four feet deep and the walls should be perpendicular to the base of the pile and the hypothesis of the triangle (hole) should be the slope of the pile.

The hole should be thoroughly cleaned and then the wall opposite the hypothesis should be carefully scraped from top to bottom. After about one-half an inch has been removed from the wall facing the pile, the stock in the hole is thoroughly mixed and transferred to closed buckets by means of small shovels. The wall should be scraped with the shovel. Sometimes it is necessary to employ the use of a pick in order to dig a deep hole. The author often used an adz in digging holes and obtained accurate results. It is customary to draw samples from the filled bags when sampling the completed fertilizers. If the sampler is careful in drawing samples from every other bag very accurate results should be obtained. The sample should be drawn with a thief of suitable length by thrusting it diagonally from top to bottom of the bag. One objection to this method of sampling is the failure to secure samples of all the completed fertilizers when several shipping mills are under operation at one time. It is a rather hard matter for the sampler to get around for all the shipments. The author devised a method by means of which the objection was overcome with fair results. A small

box 12"x10"x4", holding about one-half a sample bucket was placed in the hopper just above the bag trough. The box was held firmly in position at a point in the hopper where it collected a good sample of the fertilizer. The foreman of the mill had the box drawn and transferred to a sample bucket at the end of each shipment of completed goods. The box was thoroughly cleaned before replacing it in the hopper.

All of the sample should be kept in <sup>a</sup>closed bucket with a tight-fitting top. The thief, shovel, and picket should be cleaned after drawing each sample. The sample should be quartered and prepared for analysis as soon as possible after drawing them. The samples often lose some of their moisture content, etc. when confined to the bucket for too long a period. When the samples are small the sample should be quartered on the laboratory table, but when the samples are large the quartering should be done on a clean oil cloth spread on the floor. The quartered samples are then placed in suitable containers for the chemist to grind for analysis.

It has been the sole object of the author to point out a few simple proceedings to follow in order to save the fertilizer industry from conflict with the State, etc. All the proceedings are exactly as carried out by the author and are his own suggestions.

UNIVERSITY OF CALIFORNIA  
LIBRARY  
DIVERSITY