Lime: Its Uses and How to Apply It

Article No. 10 on "Farm Facts Every Boy Should Know"

By TAIT BUTLER

CORRECTLY used, the term "lime" means calcium oxide or burned lime. But the term is loosely used, even by chemists. This is largely responsible for the confusion and difficulties which the average man experiences in estimating the relative values of the different forms of "lime" and also in deciding which he should purchase or use.

It seems remarkable that with each of the four plant foods generally deficient in the soil, the errors of the early chemists should still be permitted to confuse the farmer and others trying to learn something of these important matters. We found that "ammonia" is still used to measure nitrogen; that "phosphoric acid" is used as the measure of phosphorus; that "potash" is used for potassium, and now to complete the list of mistakes, we learn that "lime" is used for calcium. The most remarkable part of the whole thing is that chemists are themselves guilty of the use of these terms, which they know to be erroneous and which do so much to prevent the farmer and the users of fertilizers understanding the subject.

Calcium the Element Needed

IF IN our study of "lime" we keep in mind that it is calcium that is wanted and that this calcium must be in the form of oxide, hydroxide and carbonate, if it is to do the work generally thought to be performed by "lime", there will be less difficulty in avoiding confusion. Now, some will think these terms too hard to remember, but if we are to understand our work we must study such things a little, and three terms like these should not be very hard to remember. To aid in remembering these three forms in which calcium is used, the following statement of the other names used to designate each of these three different forms may be of value:

1. **Oxide:** Calcium oxide, lime, burned lime, quick lime, caustic lime, stone lime, lump lime, builders' lime, shell lime, etc.
2. **Hydroxide:** Calcium hydroxide, slaked lime, water slaked lime, hydrated lime, caustic lime, etc.
3. **Carbonate:** Calcium carbonate, ground limestone, ground oyster shells, shell marl, marl, marble, chalk, shells, carbonate of lime, etc.

These three forms are not equally rich in calcium and are consequently not of equal value and we must, therefore, remember the amount or per cent of calcium in each form. It is calcium we want and calcium that we should buy and pay for, and consequently we must know the per cent of calcium each of these three forms of "lime" contains.

	Per Cent of Calcium
1. Oxide of calcium (CaO).....	71.4
2. Hydroxide of calcium (CaO_2H_2)	54
3. Carbonate of calcium ($CaCO_3$).	40

Now if we keep the foregoing facts in mind, what can be easier than calculating the relative values of these different forms? And yet we find farmers paying $12 a ton for "hydrated lime" when burned lime could probably be obtained for $6 to $8 a ton and ground limestone for $2 or $3 a ton.

For instance, if ground limestone is offered for $2.50 a ton delivered at the farm, what should one pay for a ton of "hydrated lime"? Since pure calcium carbonate (ground limestone) contains 40 per cent calcium and pure calcium hydroxide (hydrated lime) contains 54 per cent of calcium, if we multiply $2.50 by 54 and divide the result by 40 we have the value of the hydrated lime per ton, laid down at the farm—

$$\$2.50 \times 54 \div 40 = \$3.37\frac{1}{2}.$$

In order to assist in learning the relative values of these three forms of calcium compounds, the following tables are given. The first states the relative values in terms of pounds. That is, the number of pounds of the hydroxide and carbonate forms required to equal 1, 100, 500, 1,000 and 2,000 pounds of the oxide form are given. Strictly speaking, it requires 1.322 pounds of hydroxide and 1.785 pounds of carbonate to equal 1 pound of oxide, but in round numbers we use 1.3 pounds of hydroxide and 1.8 pounds of carbonate as equal to 1 pound of oxide.

CALCIUM	The amounts in each column are equivalent or of about equal value.				
Oxide Burned Lime	Lb. 1	Lbs. 100	Lbs. 500	Lbs. 1000	Lbs. 2000
Hydroxide Water slaked Lime	1.3	130	650	1300	2600
Carbonate Ground Limestone	1.8	180	900	1800	3600

The following table shows equal values, expressed in terms of dollars and cents per ton:

Calcium **Oxide** Burned Lime	Calcium **Hydroxide** Water Slaked Lime	Calcium **Carbonate** Ground Limestone
$8.00	$6.05	$4.50
7.00	5.30	3.95
6.00	4.55	3.40
5.00	3.80	2.80
4.00	3.05	2.25

If these three calcium compounds were always pure, an estimate of the value of any sample of any one of them would be easy and a comparison in value of different samples would also be easy; but we do not find calcium oxide (burned lime), calcium hydroxide (hydrated lime — water slaked lime), and calcium carbonate (ground limestone) in pure form as sold on the market, so we may have to compare a sample of calcium oxide (burned lime), 96 per cent pure, with a sample of calcium carbonate (ground limestone), 80 per cent pure, or a sample of calcium hydroxide (hydrated lime, water-slaked lime), 85 per cent pure.

Any of these carriers of calcium may have from 2 to 20, or even 30 per cent of matter which is of no value. They may also contain a certain per cent of magnesium oxide, magnesium hydroxide, or magnesium carbonate, as the case may be. On most soils and for the general purposes for which calcium compounds are used, except to supply plant food, these magnesium compounds are of about the same value as the corresponding calcium compounds. On some soils, containing already large amounts of magnesium, any considerable amount of magnesium in the "lime" would be objectionable, but these soils are probably rare in the South. A given amount of this magnesium "lime" acts a little more slowly in correcting acidity in the soil but it corrects a little more acid than the same amount of calcium "lime". It therefore follows that magnesium oxide or carbonate, in any sample of "lime", may generally be counted as equal in value to calcium oxide or carbonate.

But, as stated, any sample of ground limestone, for instance, may contain 10 to 20 per cent of useless material, or something other than calcium or magnesium carbonate. Of course a sample of any carrier of "lime" which is only 80 per cent pure is only worth eight-ninths as much as a sample 90 per cent pure. In other words, if a sample of ground limestone containing 90 per cent of calcium and magnesium carbonates is worth $2.25 a ton, then another sample containing only 80 per cent of calcium and magnesium carbonates would only be worth $2 a ton.

But the best way to compare the values of different samples or grades of "lime" is to calculate the cost of a pound of calcium in each. Those who have studied our articles on finding the number of pounds of plant foods in a ton of fertilizer will have no trouble in calculating the number of pounds of calcium in a ton of any calcium compound. For instance, a sample of ground limestone containing 90 per cent calcium and magnesium carbonates costs laid down at the farm $2.40 a ton, while a sample of burned lime containing 95 per cent of calcium oxide costs $5.50 a ton laid down at the farm. Which is the cheaper?

We must remember that 40 per cent of pure calcium carbonate is calcium, but this sample is only 90 per cent pure; then it is evident that 90 per cent of 40 will give the number of pounds of calcium in 100 pounds of this sample of ground limestone, and 20 times this the number of pounds of calcium in a ton of this ground limestone, and since this costs $2.40, the cost per pound of calcium is ⅓ cent—

$$\$2.40 \div (.90 \times 40 \times 20) = \frac{1}{3} \text{ cent.}$$

Of pure calcium oxide, 71.4 per cent is calcium, but this sample of burned lime was only 95 per cent pure; therefore 95 per cent of 71.4 gives the number of pounds of calcium in 100 pounds of this burned lime (67.83 pounds), and the result multiplied by 20 gives the number of pounds of calcium in one ton of this sample of burned lime (1,356.6 pounds). As the cost was $5.50, then 5.50 divided by 1,356.6 will give the cost of a pound of calcium in this sample of burned lime—

($5.50 \div 1{,}356.6 = .4+$ or $\frac{2}{5}+$ cents).

Since a pound of calcium in the ground limestone costs ⅓ cent and a pound of calcium in the burned lime costs ⅖ cent, it is apparent that this sample of ground limestone at $2.40 a ton laid down at the farm is cheaper than the sample of burned lime at $5.50 a ton, even though the gound limestone was only 90 per cent pure, while the sample of burned lime was 95 per cent pure.

Now this may appear too difficult,—

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KEEP UP THE GOOD WORK, BOYS!

You Have Shown Your Daddies How to Make Big Corn Crops—Now Help in the Big Work of Marketing and Coöperation—This Week's "Success Talk for Boys"

THERE never was any better advice given than that which urged you to "make two blades of grass grow where one grew before." The man who can do that is better morally, physically and in every other way. You boys have done that and more. You have made 40 bushels of corn grow where only 10 bushels grew before, not only because you have increased production on the little land you have planted, but because you have waked up the old farmers, your daddies, and made them take notice and get busy.

PRESIDENT BARRETT

But you have got a bigger work than this before you: You've already increased the yield, now you can help increase the price; your efforts can help the farmer of this country come nearer to getting a fair price for his product than he has ever done before.

Coöperation—that's the point; that's the farmer's big problem. What you have done in increasing production, you can also do in building coöperation. Keep up the good work you have begun, and the reward is yours, not only in the returns which come to you today, but in the splendid impetus which you have given and will give to your country's agricultural growth and betterment,—an impetus that will be felt throughout all the years to come.

C. S. BARRETT,
President Farmers' Educational and Coöperative Union of America.

SONGS OF THE LAZY FARMER

My Neighbor's a Great Hand to Read

MY neighbor's quite a hand to read; he says he learns to sow his seed and plant his corn the modern way, and feed his pigs right every day. He spends his hard earned money, too, whenever time comes to renew, he'd never let his paper go, he likes its plans and idees so. Then after he has fed his teams, he reads of other farmers' schemes, and how they put up clover hay, and make the cows and poultry pay.

Now I won't spend my hard earned dough, I'd rather let my paper go, someday when I am on the street, a pleasant agent I will meet. He'll hand me out a fountain pen or pocket knife or gold watch, then he'll ask me all about the folks and tell me all the latest jokes and promise, for a stamp a week, no other knowledge need I seek, for he will send me without pay, a dozen papers every day. Then when my evening chores are done, I'll read the stories, one by one, and if they ain't so very good, they'll save my wife a lot of wood.