REGULATIONS OF ACT 36 OF 1947 FOR AGRICULTURAL LIME 36 :

PART A: CHEMICAL REQUIREMENTS FOR AGRICULTURAL LIME

THIS ARTICLE IS ONE OF TWO ARTICLES WHICH DEALS WITH THE REQUIREMENT OF ACT 36 OF 1947 FOR AGRICULTURAL LIME. PART B (PHYSICAL REQUIREMENTS) WILL APPEAR SUCCESSIVELY.

PE Haumann

Liming products must be able to neutralise soil acidity and are classified in Act 36 of 1947 as agricultural lime with certain requirements.

1. **Basic Chemical Principles :**
   Before dealing with the regulations it is necessary to explain certain chemical aspects:

   1.1 **Quantification of soil acidification:**

   In Table 1.8.1 of the Fertasa Fertilizer Handbook (2016) the acidification of soils with application of ammonia and ammonium containing fertilizers is given according to Sumner(2001)

   According to the table 3,57 to 7,14 kg of pure $CaCO_3$ (100%CCE) is required to neutralise the acidity produced by the application of 1 kg of NH_4^+ depending on the product applied (Sumner, 2001).

   When 100 kg of NH_4^+ per ha is applied 357 to 714 kg pure $CaCO_3$ (100%CCE) per ha may be required to neutralise the produced acidity.

   All quantities of acidification are directly proportional to the amount of nitrate not taken up by the plant and is leached out as basic nitrate salts. Good management of ammonium fertilization can therefore minimise acidification.

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   1.2 **Neutralisation of soil acidity.**

   The chemical equations according to which soil acidity is neutralised, are given in Chapter 4.8.1 of the Fertasa Fertilizer Handbook (2016).

   The following is deduced from the equations:

   $$CaCO_3 + 2H^+ \rightarrow Ca^{2+} + H_2O + CO_2$$

   $CaCO_3$ (100% CCE) neutralises 2 H^+ ions of hydrogen to form water, carbon dioxide gas and a Calcium ion.
   Pure $CaCO_3$ (calcite) has ‘n molecular mass of 100 g (40g for one mole Calsium, 12g for one mole carbon en 48g for three mole Oxygen).
   100 grams of pure $CaCO_3$ is required to neutralise **two** mole H^+.

   50 grams of pure $CaCO_3$ is required to neutralise **one** mole H^+

   Therefore 50 mg of pure $CaCO_3$ (100% CCE) is required to neutralise one mg of H^+.

The relative effectivity of different types of lime is given in Table 4.8.1.1 in chapter 4.8.1 of the Fertasa Fertilizer Handbook.

1.3 **How much acidity is present in the soil?**

The amount of liming product required to neutralise the acidity in one ha 20cm deep sandy loam soil with a bulk density of 1,3ton m^3 is calculated as follows:

Die mass of the soil is 2 600 000 kg

NB!! The amount of soil acidity which has to be neutralised should be determined by a qualified agricultural adviser.!!

For this illustration it is assumed that it is1$cmol_c^{kg-1}$ (This is the same as 1mg per 100g soil)
The total amount per 20cm that has to neutralised is therefore:

2 600 000kg x 10 x1

26 000 000 g = 26 million mg acid/ ha that has to be neutralised.

As determined above is 50mg pure calcium carbonate required to neutralise one mg of acid.
26 million mg of acid has to be neutralised therefore:

26 000 000 x 50 = 1 300 000 000 mg pure $CaCO_3$ required
=1 300 000 g

= 1300 kg pure $CaCO_3$/ha.

= 1.3 ton pure(100% CCE) $CaCO_3$/ha.

2. **Chemical requirement of Wet 36 van 1947 for liming products.**

The regulations for the above Act is available on the Fertasa web page www.fertasa.co.za under "legislations & Regulations.

2.1 **CCE (HCL):**

This property gives an indication of the purity and composition of agricultural lime. The calcium carbonate equivalent (CCE) in strong acid for all liming types must be at least 70% .provision is therefore made for a maximum of 30% impurities such as silica and so forth. It is important that this value is determined by actual excess neutralisation of the product by HCl and back titration with NaOH and not merely a calculation according to Ca and Mg content.

2.2 **Mg- and Ca- content:**

Dolomitic agricultural lime: minimum of 4.3%Mg (15% $MgCO_3$)

Calcitic agricultural lime: less than 4.3%Mg (15% $MgCO_3$) the actual Ca- en Mg-content of the agricultural lime must be registered.

2.3 **Tolerance of laboratory values:**

Laboratories cannot quarantee that their analytical methods can give exact values for analyses. Because of this tolerance levels are taken into consideration. When fertilizers and agricultural lime are sampled and analysed for quality determination, The following is taken into account for chemically compiled products:
The accepted tolerance for 15% in Tabel 17 of the published regulations is given as 0.64%.

therefore a $MgCO_3$ analysis of 14,36 % for dolomitic lime will comply with requirements.. This is equivalent to 4,1% Mg

the accepted tolerance for 70% is given in Tabel 17 as 1.6%.

Therefore a CCE value of 68,4% will comply with the regulatory requirement.

2.4 Resin Value:

A standardised acid resin is used to simulate an acid soil.
An analysis of the CCE resin value of the agricultural lime must accompany an application for registration. This value gives an indication of the relative neutralising value (expressed as Rh-relative resin value as percentage) of a representative agricultural lime compared to pure precipitated calcium carbonate ($CaCO_3$) in an unbuffered caid soil after an incubation time of three months.

There is no required value given for the resin value. The closer it is to the CCE(HCl) value indicates how reactive the lime will be in the soil.

2.5 **Potentially harmful elements:**

Tabel 12 of the regulations lists the following maximum allowable levels for the following elements:: cadmium (20 $mgkg^{-1}$) , chromium (1750 $mgkg^{-1}$), copper750 $mgkg^{-1}$), mercury (10 $mgkg^{-1}$), nickel (200 $mgkg^{-1}$), lead (400 $mgkg^{-1}$), zinc (2750 $mgkg^{-1}$), arsenic (50 $mgkg^{-1}$) and selenium(15 $mgkg^{-1}$).

Tolerance values for these levels are not available, therefore care should be taken that these levels are not exceeded when application for product registration are done .

2.6 Moisture content:

The maximum allowable moisture content for normal agricultural lime is 15% and for microfine agricultural lime 20%.

2.7 **Chemical purity:**

The different types of agricultural lime registered in South Africa are given in discussed in Chapter 4.8.1 of the Fertasa Fertilizer Handbook and will not be dealt with in this article.

When the reactions of the different lime products are considered it is clear that even if they are applied as oxide and hydroxide the reactions indicate that they revert to the carbonate form relatively quickly. Ther can be expected that before this happens the oxides and hydroxides are more active. The rate of neutralisation will diminish as more soil acidity has been neutralised and the formation of carbonates will take place.

Under field conditions over time there will be very little difference in the effectivity between the different forms of agricultural lime in terms of practical value (Barber, 1984). All liming products essentially react in the soil as carbonates and the chemical purity (CCE) is always important.

2.8 Types of agricultural lime.

Liquid lime and granular or pelletised agricultural lime.

It is important to realise that these agricultural lime products can only be carbonates, oxides or hydroxides.
As such it is important that their neutralising values should be expressed in terms of CCE. Equivalent values mean that even though some of these products are regarded as very reactive (extremely fine and nano fine), they cannot be applied at levels of 50 or 400 kilograms per hectare and give the same reaction or better than tons of agricultural lime. See also this discussion in Chapter 4.8.1 of the Fertasa Fertilizer Handbook.

Although the chemical properties of liming products are extremely important, the products are very sparingly soluble in water and in the soil. The crucial influence of fineness of these products will be dealt with in the next article.

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