Alkaline Soils (above pH 7)

In an acid soil, one with a pH below 7, some of the exchange sites will be occupied by the —acidic|| cation Hydrogen H+. Recall that in the term pH the H stands for Hydrogen. pH is the measure of the ratio of Hydrogen H+ ions to hydroxide OH- ions. A water solution that has more H+ than OH- ions is acid; if there are more OH- ions than H+ ions, it is alkaline. At pH 7, H+ and OH- are equally balanced. This is true regardless of the amount of ions present.

We are talking about replacing or exchanging cations, + charged ions, on the soil colloid. A soil with a pH of 6 will have around 15% of the cation exchange sites occupied by H+ ions. In a soil with a pH of 7, all of the - sites will be filled by cations other than H+. The H+ concentration on the exchange sites is 0.00%.

Balancing the nutrient cations in an acid soil is relatively straightforward: simply replace some of the H+ ions with the nutrient cations that we wish to see. If the soil has a 60% Calcium saturation and we want a 70% Calcium saturation, we add enough Ca++ to raise the saturation 10%. This may need to be done a few times as the process is not 100% efficient but it will work.

A soil with a pH of 8 is a different story. There are no H+ ions to replace; adding more Ca++ will only make the soil more alkaline. What to do? We need to use an acidifier along with the cation base that we wish to replace. That acidifier is Sulfur, either in the form of elemental Sulfur S, or combined with one of our cation nutrients as a sulfate: Calcium sulfate $CaSO_4$, Magnesium sulfate $MgSO_4$, or Potassium sulfate K_2SO_4. Which one we use will depend on the present level of Sulfur in the soil and of course on which element we wish to raise or lower.

Recall from the —Best Guess|| chart on p26 that for most crops we want Sulfur S to be around 50% of actual Phosphorus P. If P (or ideal —target|| P) is 500 ppm, Sulfur should be around 250 ppm. If our soil test says we have only 50 ppm S, then we know that we can add 200 ppm and still be OK. If the soil test says we already have 250ppm S or more, we had better not add any more for now.

In any soil, we simply look at the level of S and the level of the Nutrient cation that we wish to add or change. If the soil is low in Mg and S, we would add Magnesium sulfate; if it is low in K and S we would use Potassium sulfate. If it has plenty of S we would not use the sulfate form, we would use the oxide or carbonate form; this would be much more likely on an acid soil than an alkaline soil.

In an alkaline soil that had too much Magnesium or Potassium or Sodium, our choices would be limited to using either elemental Sulfur S or Calcium sulfate $CaSO_4$, commonly called gypsum. If an alkaline soil already had plenty of Calcium, we would choose pure elemental Sulfur, or 90%S agricultural sulfur.

Alkaline soils can do fine with much higher levels of Calcium than are considered ideal for a more acid soil. 80 to 85% Calcium, 8 to 10% Magnesium, and 2 to 3% Potassium will work fine for soils with a pH of 8 or above. If the Hydrogen+ is not replaced by Calcium++, the consequence would be a soil that would have too many of the other bases, either Mg, K or Na. This has been the observation of Michael A. Kraidy in Latin America, especially in the soils of Peru. Hydrogen+ that would be found in an acid soil would be replaced with the same percentage of Calcium in an alkaline soil. Using our example from above, the pH 6 soil with 15% exchangeable H+, a pH 8 soil might do fine with 15% more Ca++ (85%). Michael is not shy to mention that the best grapes that produce the best wines in the world are produced in the soils of the Dolomitic mountains of France and Italy, where the Calcium saturation of the CEC is over 90%.

[Credit for this original way of amending alkaline soils goes to Michael A Kraidy, farmer and consultant, who uses Albrecht methods on both acid and alkaline soils in most of Latin America, South Africa, USA, and the Philippines for over 25 years. Contact mike@ofarmer.com]

The primary goal is to balance the nutrient cations Ca, Mg, and K in the soil, and if there is too much Sodium Na, to bring its level down by replacing Na; in most cases the Na would be exchanged for Ca, and the primary tool would be gypsum, Calcium sulfate.

This next part, about the uses and properties of gypsum, is adapted from the website of the USA Gypsum company. We think it is very well done, and trust they won't mind our reprinting it and promoting their products.

Agricultural Gypsum Uses (from: http://www.usagypsum.com/agricultural-gypsum.aspx)
Agricultural Gypsum (Calcium Sulfate - $CaSO_4$) is one of those rare materials that performs in all three categories of soil treatment: an amendment, a conditioner, and a fertilizer.
Poor soil structure is a major limiting factor in crop yield. The bottom line to the many benefits of gypsum is higher yield at a minimum cost.

Gypsum Improves Compacted Soil
Gypsum can help break up compacted soil. Soil compaction can be prevented by not plowing or driving machinery on soil when it is too wet. The compaction in many but not all soils can be decreased with gypsum, especially when combined with deep tillage to break up the compaction. Combining gypsum with organic amendments also helps, especially in preventing return of the compactions. (1)

Gypsum Helps Reclaim Sodic Soils
Gypsum is used in the reclamation of sodic soils. Where the exchangeable Sodium percentage (ESP) of sodic soils is too high, it must be decreased for soil improvement and better crop growth. The most economical way is to add gypsum which supplies Calcium. The Calcium replaces the Sodium held on the clay-binding sites. The Sodium can then be leached from the soil as Sodium sulfate to an appropriate sink. The sulfate is the residue from the gypsum. Without gypsum, the soil would not be leachable. Sometimes an ESP of three is too high, but sometimes an ESP of ten or more can be tolerated. (2)