Calcium Polysulfide as Agricultural Soil Amendment

The Reaction of Calcium Polysulfide in the Soil

Calcium Polysulfide reacts with water (H_2O) and/or carbon dioxide (CO_2), carbonates (HCO_3) and bicarbonates (H_2CO_3) to form hydrogen sulfide (H_2S), calcium carbonate ($CaCO_3$) and elemental sulfur (S) in the soil. The reaction with the carbonates and bicarbonates in the soil solution lower the pH.

$CaSx$	+	**H_2O**	+	**CO_2**	→	**H_2S**	+	**$CaCO_3$**	+	**$4S$**
calcium polysulfide		water		carbon dioxide		hydrogen sulfide		calcium carbonate		elemental sulfur

Elemental sulfur (S) that is formed is a very fine colloidal sulfur that is quickly oxidized to sulfuric acid (H_2SO_4).

$2S$	+	**$3O_2$**	+	**H_2O**	→	**H_2SO_4**
elemental sulfur		oxygen		water		sulfuric acid

The rate of sulfur oxidation in the soil depends upon soil temperature, aeration and soil moisture. Two other factors play a very important role in sulfur oxidation which are the particle size and the degree of distribution in the soil. The average particle size of soil sulfur is approximately 0.018 mm. The average size of the colloidal sulfur in Calcium Polysulfide is approximately 0.0002 mm. The very fine particles of colloidal sulfur in Calcium Polysulfide have a very large surface area, which makes them readily available to the soil organisms for oxidation to sulfuric acid. These fine sized sulfur particles of Calcium Polysulfide are evenly distributed throughout the soil profile by the irrigation water.

How do these reactions affect soil structure?

Throughout the Southwestern United States many soils are calcareous, which means they contain free lime or calcium carbonate ($CaCO_3$). Calcareous soils are generally alkaline with a pH above 7. The free lime is insoluble under these conditions, which makes the calcium unavailable in the soil structure. Sodium will build up in these types of soil because of poor structure and high sodium in irrigation water and the results will be an alkali soil. Alkali soils will have a high pH and poor structure which in turn causes poor water penetration and soil aeration.

Calcium Polysulfide will correct this type of soil condition.

When Calcium Polysulfide is applied to a lime-containing alkali soil, it goes through the reactions necessary to form sulfuric acid, then combines with the calcium carbonate or lime in the soil to form calcium sulfate ($CaSO_4$).

H_2SO_4	+	**$CaCO_3$**	+	**$CaSO_4$**	→	**H_2O**	+	**CO_2**
sulfuric acid		calcium carbonate		calcium sulfate		water		carbon dioxide

The calcium sulfate ($CaSO_4$) is already evenly distributed in the soil profile and as quickly as the reaction occurs the calcium ions (Ca^{++}) replace two sodium ions (Na^{+}) on the soil particles and the sodium ions (Na^{+}) combine with the sulfate ions (SO_4) to form sodium sulfate ($NaSO_4$) which is highly soluble and is leached out of the soil profile.

$CaSO_4$	+	**Na-Soil**	+	**Ca-Soil**
calcium sulfate		sodium soil		calcium soil

The soil becomes friable and aggregated allowing for improved water penetration and aeration of the soil profile.