Some Facts on
Phosphate

Phosphate rock is a naturally-occurring material used in almost all phosphate (P) fertilizer production. The most important rock deposits are sedimentary materials, laid down in beds under the ocean and later lifted up into land masses.

KNOWN world reserves of phosphate rock approach 100 billion tons. About half this can be economically recovered under today's conditions. This tonnage represents enough phosphate to meet present consumption rates for hundreds of years. As the economics change, even greater amounts can be recovered.

U.S. deposits (phosphorite) are found in Florida, North Carolina, Tennessee, Idaho, Montana, Utah and Wyoming. They represent about 30 percent of the world's known reserves. More than three fourths of the U.S. production comes from Florida and North Carolina, with the remainder coming from the western states and Tennessee.

Almost all phosphate rock is mined by strip mining. It usually contains about 15 percent P_2O_5 and must be upgraded to be used for fertilizer. Upgrading, in a process called *beneficiation*, removes much of the clay and other impurities, and raises the P_2O_5 content to 30 to 35 percent.

Following beneficiation, the rock phosphate is finely ground. Although it can be applied directly as rock phosphate fertilizer, the P in it is slowly released and seldom benefits crops during the first two or three years after application. *Most of the rock phosphate is treated to make the P more soluble.*

Fertilizer phosphates are classified as either **acid-treated** or **thermal-processed**. Acid-treated P is by far the most prevalent. Sulphuric and phosphoric acids are commonly used in producing acid-treated phosphate fertilizers.

Sulphuric acid is produced from elemental sulphur (S) or from sulphur dioxide. More than 60 percent of industrial sulphuric acid is used to produce fertilizers. Treating rock phosphate with concentrated sulphuric acid produces a mixture of *phosphoric acid* and *gypsum*. Filtration removes the gypsum, leaving "green" or "wet-process" phosphoric acid containing about 54 percent P_2O_5.

Wet-process acid can be further concentrated to form **superphosphoric acid**. In this process, water is driven off and molecules with two or more P atoms are formed. Such molecules are called **polyphosphates**.

Acid-Treated Phosphate Fertilizer Materials

Normal superphosphate (20 percent P_2O_5) is made by treating rock phosphate with a measured amount of lower concentration sulphuric acid.

Concentrated superphosphate (triple superphosphate; 46 percent P_2O_5) comes from reacting wet-process phosphoric acid with rock phosphate.

Ammonium phosphates are produced by ammoniating phosphoric acid. Monoammonium phosphate (MAP) contains 10 to 12 percent N and 48 to 55 percent P_2O_5; diammonium phosphate (DAP) contains

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18 percent N and 46 percent P_2O_5 (18-46-0). The difference is determined by controlling the amount of added ammonia.

Ammonium polyphosphates are usually fluid sources of P produced by ammoniating superphosphoric acid. Polyphosphate content ranges from 40 to 70 percent. Analysis of polyphosphate liquid fertilizers ranges from 10-34-0 to 11-37-0.

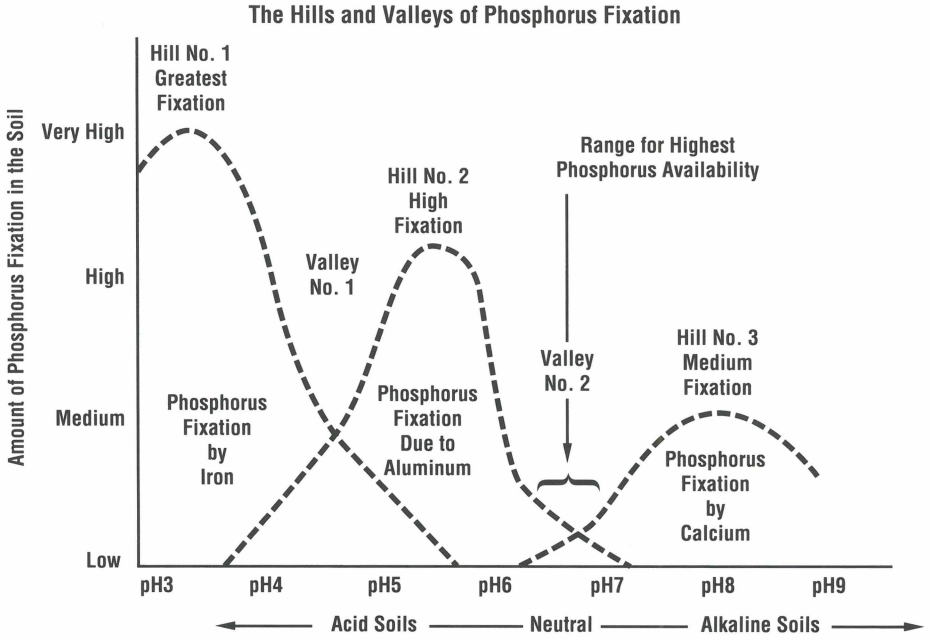
Nitrophosphates are made by reacting rock phosphate with nitric acid. Some sulphuric or phosphoric acid may be used along with the nitric acid to make the material more water soluble. Most nitrophosphates are used in Europe.

Ammoniated superphosphates are made by reacting normal or triple superphosphate with ammonia. They are available in different fertilizer grades and water solubilities. The water soluble P content is variable, influenced by *phosphate source, degree of ammoniation, content of impurities, moisture content, speed of drying, etc.*

Thermal Phosphoric Acid

Thermal phosphoric acid is produced by first producing elemental P through the reduction of phosphate rock with coke in an electric arc furnace. Elemental phosphorus is oxidized to P_2O_5 which is subsequently reacted with water to form **furnace grade phosphoric acid** (H_3PO_4).

Thermal acid is much purer than wet-process H_3PO_4. Its use in fertilizer manufacture is sometimes preferred for the production of liquid fertilizers because of its purity. *Agronomically, products derived from furnace grade phosphoric acid and those produced from merchant grade phosphoric acid are identical.* ■



SOIL REACTION (pH) greatly influences the solubility of different P compounds in the soil. Solubility indicates how available the P is, or how fixed or "tied up" it becomes in the soil. The more soluble or available forms exist in the 5.5 to 7.0 range. This makes a sound liming program essential on very acid soils. Lowering the pH of alkaline soils to improve availability is not very practical.