The reaction proceeds according to the equation:

$$2Ca_3(PO_4)_2 + 6SiO_2 + 10C = 6CaSiO_3 + P_4 + 10CO.$$

The reaction product is *white phosphorus* (P_4). Due to the presence of impurities, technical phosphorus is yellow; therefore, in industry it is called *yellow phosphorus*.

Phosphorus is used for the production of basic phosphate fertilizers: superphosphate and phosphate rock. All phosphate fertilizers are amorphous substances, whitish-gray or yellowish in color.

Oxygen acids of phosphorus are products of hydration of phosphoric anhydride. There are *orthophosphoric acid* (commonly called *phosphoric acid*) and *condensed phosphoric acids*. The most studied and important are *orthophosphoric acid* H_3PO_4, formed when P_4O_{10} (or P_2O_5) is dissolved in water.

Phosphoric acids

Orthophosphoric acid is colorless hygroscopic crystals with density of 1.87 g/cm^3 and melting $T_{melting}$ = 42.35°C, $H_3PO_4 \cdot 0.5\ H_2O$ crystal hydrate with melting $T_{melting}$ = 29.32°C is known. Density of commonly used 85% H_3PO_4 at 25°C is 1.685 g/cm^3, viscosity at 20°C = $47 \cdot 10^{-3}$ ml· sec/ m^2, specific heat capacity in the temperature range 20-120°C – 2,064.1 J/kg·K (0.493 cal/g·°C).

With water, orthophosphoric acid is mixed in any ratio.

Dissociation constants at 25°C are: $K_1 = 7 \cdot 10^{-3}$, $K_2 = 8 \cdot 10^{-8}$, $K_3 = 4 \cdot 10^{-13}$.

Orthophosphoric acid is a tribasic acid, of medium strength. It forms three rows of salts-phosphates. When acid solutions are heated, their dehydration occurs with the formation of condensed phosphoric acids.

In industry, orthophosphoric acid is obtained by *extraction (sulfuric acid)* or *thermal methods*.

The extraction method consists in the decomposition of natural phosphates sulfuric and phosphoric acids by reaction:

$$Ca_5(PO_4)_3F + 5H_2SO_4 + nH_3PO_4 = (n+3)\ H_3PO_4 + 5CaSO_4 + HF$$

Further, the separation of the formed acid and insoluble $CaSO_4$ on the filters takes place.

The thermal method is based on the combustion of phosphorus to phosphoric anhydride and hydration of the latter to acid:

$$P_4 + 5O_2 = P_4O_{10}$$

$$P_4O_{10} + 6H_2O = 4H_3PO_4.$$

Industrial orthophosphoric acid is the most important intermediate for the production of phosphoric and complex fertilizers and technical phosphates. It is also widely used for phosphating metals, as a catalyst in organic synthesis. Food phosphoric acid is used for the preparation of soft drinks, medicines, dental cements, etc.

Condensed phosphoric acids are obtained by dehydration of orthophosphoric acids, hydration of phosphoric anhydride with an appropriate amount of water, and by ion exchange from the corresponding condensed phosphates. It is used mainly for the production of highly concentrated phosphorus fertilizers, as catalysts in the production of petroleum products and in organic synthesis, for the production of various polyphosphates.

Condensed (polymeric) phosphoric acids are divided into:

- *polyphosphoric with linear structure of phosphate anion* of gneral formula $H_{n+2}P_nO_{3n+1}$;
- *metaphosphoric with cyclic structure of phosphate anion* of gneral formula $(HPO_3)_n$;
- *ultraphosphoric acids having a branched, reticular structure*.