

Phosphoric fertilizers and phosphoric raw materials

The average phosphorus content in the earth's crust is less than 0.1% (or 0.25% P_2O_5). The highest concentrations of P_2O_5 are observed in igneous alkaline and basic rocks.

Apatite $Ca_5[PO_4]_3F(Cl, OH)$ is a compound with volcanic origin. Depending on the content, fluorine, chlorine, and hydroxylapatite are released.

Phosphorites are sedimentary rocks, a significant part of which are phosphates and numerous inclusions of other minerals (quartz, glauconite, calcite, clay minerals, etc.). The content of impurity elements is often observed: *U, Tr, Sr*, less often *V, Ti, Zr*, etc.:

- Simple superphosphate ($Ca(H_2PO_4)_2 \cdot H_2O$)- 19-21% P_2O_5 .
- Double superphosphate ($Ca(H_2PO_4)_2 \cdot H_2O$) – 42-50% P_2O_5 .
- Phosphorite flour ($Ca_3(PO_4)_2 \cdot CaF_2$)- 19-30% P_2O_5 . Phosphorus in it is in a form inaccessible to plants and can be applicable only on acidic soils.
- Precipitate ($CaHPO_4 \cdot 2H_2O$)- 46-48% P_2O_5 .

Methods for producing phosphate fertilizers:

- mechanical (grinding);
- thermal decomposition;
- chemical decomposition.

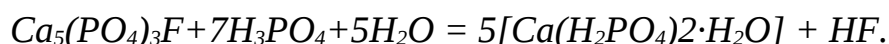
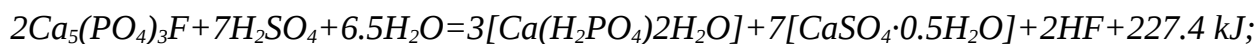
Methods of production of double superphosphate:

- Chamber method using continuous superphosphate chambers and holding the product for ripening in the warehouse. For the decomposition of phosphates, thermal or extraction acid with a concentration of 50-58% P_2O_5 is used.

- Chamber-flow method using similar chambers, but without the operation of warehouse maturation. To decompose phosphates, an extraction acid with a concentration of 47-49% is used.

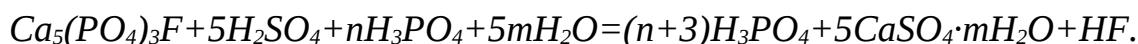
- Flow (tubeless) method using unpaired acid concentration of 30% P_2O_5 .

Production of double superphosphate:



Production of phosphoric acid by extraction

Sulfuric acid decomposition of calcium phosphate is a heterogeneous irreversible process occurring in the "solid-liquid" system and described by the equation:



Conditions for the extraction method for the production of phosphoric acid:

- the dihydrate method is carried out at 70-80° C, a concentration of P_2O_5 in the liquid phase of 25-32%, a heat of reaction of 384.4 kJ/mol;

- the hemihydrate method is carried out at 95-100°C, the concentration of P_2O_5 in the liquid phase is 38-48%, the heat of reaction is 371.0 kJ/mol.