



Triple Super Phosphate

The triple super phosphate (TSP) which is also known as concentrated super phosphate (CSP) is used for fertilizer. The TSP is a solid phosphate fertilizer which is produced by phosphoric acid and phosphate stone. The production usually contains 44 – 46% of phosphoric acid (P_2O_5) that is more than common amount in super phosphate. For ease of using, TSP is usually produced as a granule. (GTSP) which is the powder form of the material (ROP) is also produced but is not directly usable and it could be used when mixed with other fertilizers in NP and NPK form. The most important part of TSP is mono calcium phosphate monohydrate ($CaH_4[PO_4]_2 \cdot H_2O$) which is about 63 to 74 weight percent of TSP. The most concentration of phosphate among phosphate fertilizers is one of the advantages of TSP, which its available P_2O_5 is about 44 to 48% and soluble P_2O_5 in water is about 40 to 45%. Some amount of required P_2O_5 of TSP is prepared by phosphate stone which is cheaper source of phosphate. The amount of P_2O_5 depends on the ratio of CaO and P_2O_5 and impurities of phosphoric acid (another required material to produce TSP) is varied between 25% to 35%. On the other hand, in a certain amount of phosphoric acid, the amount producible of TSP is greater than ammonium phosphate.



TSP is produced by acidification of phosphate stone by phosphoric acid. A small amount of hydrochloric acid, nitric acid and sulfuric acid may be added deliberately or may be there as an impurity. It is not possible to show the reaction of the material and phosphoric acid as a single reaction for complexities and differing compositions. Two basic processes are used in producing TSP. Productions of both processes are chemically similar and physically different. Indeed TSP is produced in the form of granules and powder. To use directly granular type as chemical fertilizer, using the high efficiency compared with powder type, and other mentioned reasons, TSP granule type is produced in the design. In most TSP producing processes, there are a notable amount of fluorine compounds in phosphate stone, and different kinds of flour silicates such as flour silicate sodium phosphoric in the final production as calcium fluoride (CaF_2). Based on experiments, there is about 11 to 50 kilograms different compounds of fluorine in each one tone phosphate stone that about 70 to 80% will remain in the final product. The reactivity of phosphate stone is important in TSP producing. There is less reactivity for some types of phosphate stone because of the apatite structure in front of phosphoric acid, so it is necessary to cut down the size of stone or increasing the required time for reaction as a solution. To optimize the contact between reactants, grinding of the phosphate stone is the first step in both producing processes of TSP powder and granule.



The process of powder type TSP producing is known as ROP, it is similar with normal super phosphate producing process except the acidification step that phosphoric acid makes phosphate stone more acidic. The reaction product is a powder form that can be used in secondary operation of ammonia process to produce chemical fertilizers mixtures of NP and/or NPK. TSP granular type is better and more common to use compared with powder type. ROP process involves four steps:

Grinding : In this step, the phosphate stone is grinded. Mixing Grinded phosphate stone and phosphoric acid enter into a funnel. High concentrate phosphoric acid (45-54%) is used.

Reaction: A slurry flow that rapidly solidifies, leaves mixing funnel to discharge vessel by a conveyor belt, because of gas emitted during the reaction, it will be produced as a very porous solid.

Crushing: At the end of the vessel, the solid TSP is discharged into a crusher and is converted to powder particles.

Curing: Then the produced powder is transferred into storage silos and is kept there from 2 to 5 weeks for some chemical reactions. The curing period is necessary to optimize conversion rate. Then, TSP powder is ready to use (in some cases, the TSP powder converts to TSP granule in a granule making unit). In the granule process, TSP granules, which is used directly or in dry mixing, during the 4 step process is prepared.

Grinding : In this step, the phosphate stone is grinded. Reacting Phosphate stone and phosphoric acid are fed into one or two tanks. The produced slurry flow is pumped to granule making drum.

Drying and curing: The TSP granules are discharged into rotary dryer. The curing reaction is completed by reducing wetness. The curing period is 3 to 5 days. **Screening:** The GTSP is dried, screened and retrieved (mesh is from 6 to 20). Bigger granules are grinded and with smaller granules are returned to the granule making step.