



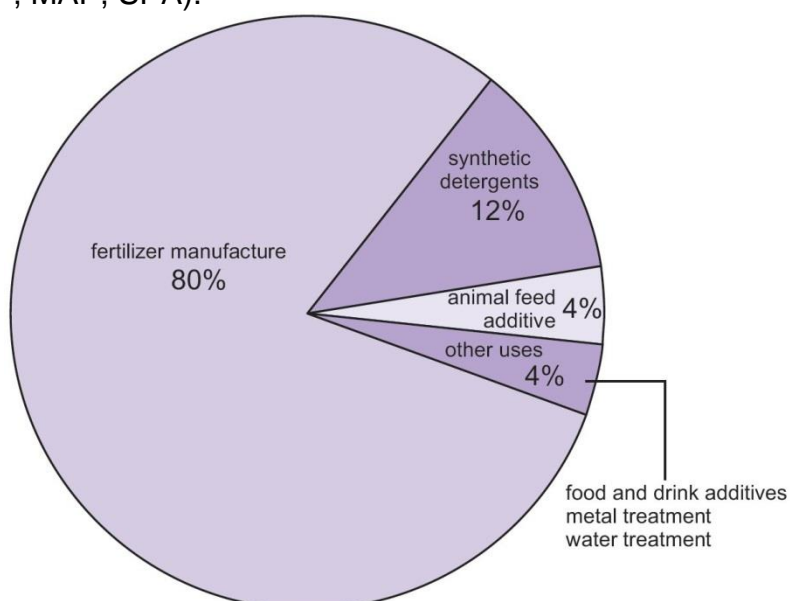
SAFI Application Sheet

Application / Segment :	Phosphoric acid plants
Location :	Jordan, Saudi Arabia, Tunisia, Morocco
Date :	05/10/2016
Written by :	Guillaume CHARTRES

Introduction

Phosphoric acid is a mineral (inorganic) acid having the chemical formula H_3PO_4 . In addition to being a chemical reagent, phosphoric acid has a wide variety of uses, including as a rust inhibitor, food additive, dental and orthop(a)edic etchant, electrolyte, flux, dispersing agent, industrial etchant, fertilizer feedstock, and component of home cleaning products.

By far the largest use of phosphoric acid is the manufacture of phosphates for use as fertilizers (DAP, MAP, SPA).



Phosphoric acid (H_3PO_4) can be produced by 3 main commercial methods: wet process, thermal process and dry kiln process. Wet process is by far the most common route and is the one described in this application sheet.



Application

In a wet process facility (see figure 1), phosphoric acid is produced by reacting 93% sulfuric acid (H_2SO_4) with naturally occurring phosphate rock acid in a series of well-stirred reactors. This results in phosphoric acid and calcium sulfate or gypsum (CaSO_4) plus other insoluble impurities. Water is added and the gypsum is removed by filtration along with other insoluble materials (e.g. silica). Fluoride, as H_2SiF_6 , is removed at a further stage by evaporation.

The initial phosphoric acid solution may contain 23–33% P_2O_5 (32–46% H_3PO_4). P_2O_5 transforms into Phosphoric acid with hydration. The initial weak solution can be concentrated by the evaporation of water to produce *commercial-* or *merchant-grade* phosphoric acid, which contains about 54–62% P_2O_5 (75–85% H_3PO_4). Further evaporation of water yields *superphosphoric acid* with a P_2O_5 concentration above 70%

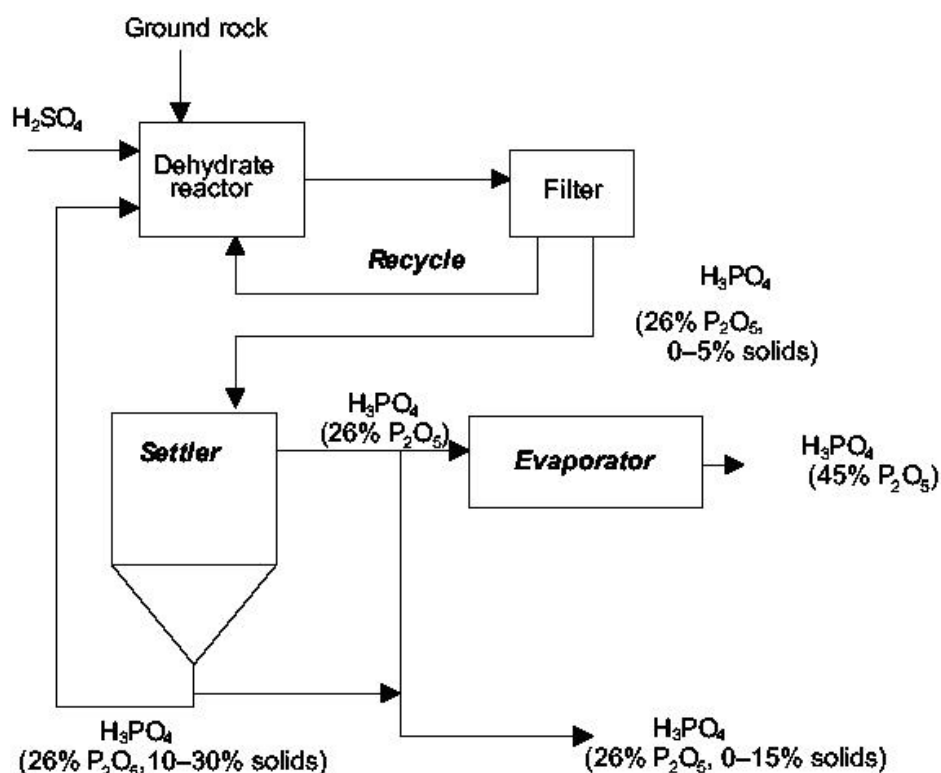


Figure 1: Wet process of production of phosphoric acid



2/ Applications and SAFI solutions:

Application 1: Phosphoric acid line, gypsum filtration



A phosphoric acid plant in Jordan: in the photo phosphate rock is brought from the mine and crushed before the wet process.



Origin of the phosphate rock: sand = highly abrasive





In the beginning of the wet process, there is so much particles of gypsum and silica in the fluid that rubber lined membrane valves are used.



But the rubber suffers from the abrasion and then phosphoric acid attacks the metal.

In the process, the more gypsum and silica are washed, the less there is abrasion, but the more the concentration of phosphoric acid grows. At some point, the use of thermoplastic valves is a good solution to resist both the abrasion and the corrosion:





SAFI replaces Saunders diaphragm valve DN150 DIN standard 3202 F1 in the following service conditions:

- Phosphoric acid line 32%-35% concentration
- Ambient T°
- Gypse concentration of 5%,
- 3 bars max

The difficulty here is to find the application where gypsum concentration is not too high and very often a test is required.

The SAFI valves is also modified for this application:

- GRPP body
- PVDF sphere with an evacuation hole
- PVDF stem
- Modified PTFE seats



Thermoplastics have a good resistance both to chemicals attacks and to abrasion. In terms of abrasion resistance, the results of the taber test proves its capacity to resist to abrasion:

Materials	Abrasive Disk	Weight Loss [mg/1000 rev.]
Solef® PVDF homopolymers	CS-10	5-10
	CS-17	7-10
Solef® 21508 and 31508	CS-10	5-8
PA 6	CS-10	5
	CS-17	4-8
ECTFE	CS-10	13
	CS-17	25
PP (homopolymers)	CS-10	15-20
	CS-17	18-28
304 stainless steel	CS-10	50
PTFE	CS-10	500-1,000

Application 2: **Fluorosilicic acid plant**

Fluorosilicic acid is an important by-product from the production of phosphoric acid. It can be neutralised with sodium hydroxide to form sodium hexafluorosilicate. The acid is also used to make [aluminium fluoride](#), used in turn in the manufacture of aluminium.



Fluorosilicic acid is mixt with gypsum and is processed with PPH diaphragm valves that can handle the slurry.



Application 3: **Sulfuric acid plant**

A sulfuric acid plant is normally located next to the phosphoric acid plant. The sulfuric acid plant is normally a hot process where no thermoplastic valves can be used. Storage and transport of sulfuric acid is normally the only place where thermoplastic can be used. For more information check sulfuric acid plant application sheet.

Application 4: **industrial water**

As explained above, the production of phosphoric acid needs a great quantity of industrial water. Very often this water is collected from the sea and is cleaned from marine life and salt.

For more information refer to applications sheets:

- Sea water collection points
- Desalination plants application sheets

3/ SAFI references

- Jordan phosphate mine (Jordan)
- Office cherifien des phosphates (Morocco)
- Maaden (Saudi Arabia)

