PHOSPHORIC ACID PURIFICATION

BY

FILTRATION

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PHOSPHORIC ACID PURIFICATION BY FILTRATION

Wet process phosphoric acid contains soluble and insoluble impurities. The degree of clarification required to prepare the phosphoric acid for downstream utilization depends on the intended end use.

In order to achieve the desired result, it is imperative that one understand the basic chemistry of the phosphoric acid at different concentrations and phosphate rock origins.

Calcium sulfate can be separated from 28, 40, and 54% phosphoric acids, but is best achieved prior to the precipitation of iron and aluminum phosphate that occurs after the acid concentration exceeds 40+% P_2O_5.

Iron and aluminum are normally precipitated and can be removed at the 54% P_2O_5 level. Fluorine and silica are normally removed at the 40% and 54% P_2O_5 levels. Magnesium compounds precipitate and are removed at the 50% to 70% P_2O_5 levels. All of these elements complex with each other at different concentration temperatures.

The insolubility of the elements are effected by the origin of the rock, calcination temperature, fluorine level, oxidation state of the elements, and evaporator conditions. The following are acids at varying concentrations.

40% P_2O_5

	Feed	Product
P_2O_5	40.2	41.1
CaO	3.6	0.3
SO_4	3.2	2.8
Fe_2O_3	0.8	0.9
Al_2O_3	1.2	1.4
MgO	0.5	0.5
F	1.1	0.6
SiO_2	0.5	0.1

54% P_2O_5

	Feed	Product
P_2O_5	52.0	53.0
CaO	1.1	0.1
SO_4	3.7	2.5
Fe_2O_3	1.6	1.4
Al_2O_3	0.6	0.6
MgO	0.3	0.2
F	1.5	0.8
SiO_2	0.3	0.1

70% P_2O_5

	Feed	Product
P_2O_5	68.2	68.7
CaO	0.3	0.1
SO_4	3.9	3.3
Fe_2O_3	1.1	0.7
Al_2O_3	0.8	0.8
MgO	1.2	0.4
F	1.1	0.8
SiO_2	0.4	0.5

The above separation can be achieved by settling tanks equipped with rakes, centrifugation, Lamella Settlers, and filtration. The most effective and complete separation can be achieved by precoat rotary vacuum filtration.

These units are generally used when the nature of the solids are small in size and complete clarification is required in order to prepare the acid flow for high purity end product uses.

Filtration can be a useful tool when impurity levels increase because of declining rock quality. Whether or not your plant uses precoat filtration will be dependent on rock quality and market requirements.

Laboratory size filtration can be made on a pressure filter to determine quality expectations. Pressure filtration is not practical in merchant and super acid concentrations. The finely divided impurities rapidly form an impervious layer over the precoat and flow ceases 20 minutes into the cycle.

The addition of body feed helps sustain flow, but significantly increases costs. The solids volume from the acid is large and filter aid, with its low density, rapidly increases the solids volume. This means more cubic feet of cake space, short filtration cycles, and large size pressure filtration equipment.

There is an exception--30% acid clarification by pressure precoat filtration, which is functional because the solids are of a relatively large particle size and drain well without the use of body feed.

Once quality parameters have been established as satisfactory, the next step is a pilot-sized test on a rotary vacuum precoat filter of 10 square feet area.

These units can successfully handle a wide range of solids, both in concentration and drainage characteristics. In phosphoric acid application, rotary filters can be used at solids levels of 1 to 10%.

Rotary filters offer the adaptability of being able to adjust several operational variables to accommodate variations in the material being filtered. Pressure filtration offers limited flexibility.

Pilot filters can be rented from the major precoat filter manufacturers. The units come skid-mounted with their own vacuum system, but normally the user supplies the precoat mixing and filter feed tank.

To accomplish realistic results, the unit should be installed at the tank farm and operated several days a week for several weeks to establish quality and costs for a wide range of raw material and tank farm operational conditions.

In general, diatomaceous earth filter aids used in rotary vacuum filtration are rather coarse. The large particle size is necessary because of deterioration from fluorine, which is very active under the high temperatures required to reduce acid viscosity.

Scale-up from a 10 square foot pilot unit to a commercial size is quite predictable.

Vendors of both rotary vacuum filters and diatomaceous earth have had to update their skills to cope with the severe requirements of your products.

Most of the large rotary vacuum filters have been used in the corn syrup industry, where specific gravity was 1.05, corrosion minimal, and the solids level about 2.0%.

The high specific gravity of acids being filtered--1.6 to 2.0--led to bearing cap failures in early installations because a 12' x 16' drum was still buoyant after being precoated with 5,000 pounds of diatomaceous earth.

Stress on the knife advance mechanisms and the structural integrity of the knife support have a major impact on filtration rate and precoat efficiency. Before purchasing a commercial unit, this area should be covered thoroughly.

Phosphoric acid purification by filtration is being successfully commercialized at numerous locations in our industry utilizing rotary drum filters manufactured by different suppliers using diatomaceous earth.

We would like to emphasize again that the chemistry of the formation of insoluble elements is the key to selective purification by this technique.