Phosphate extraction for fertilizer production

Reliable and robust valve technology for a vast variety of process technologies in the production of fertilizer.

The fertilizer industry offers farmers a wide range of phosphate fertilizers, most of which are derived from phosphate rock (apatite). Other phosphate sources may be municipal waste treatment residues, and biomass residues. These other phosphate sources are gaining increasing importance as they offer a circular agriculture economy and pose lesser overall environmental impacts.

Various process technologies produce a range of phosphate fertilizer with different chemical composition, each suited for different crop types, soil conditions, agricultural techniques or time of year.

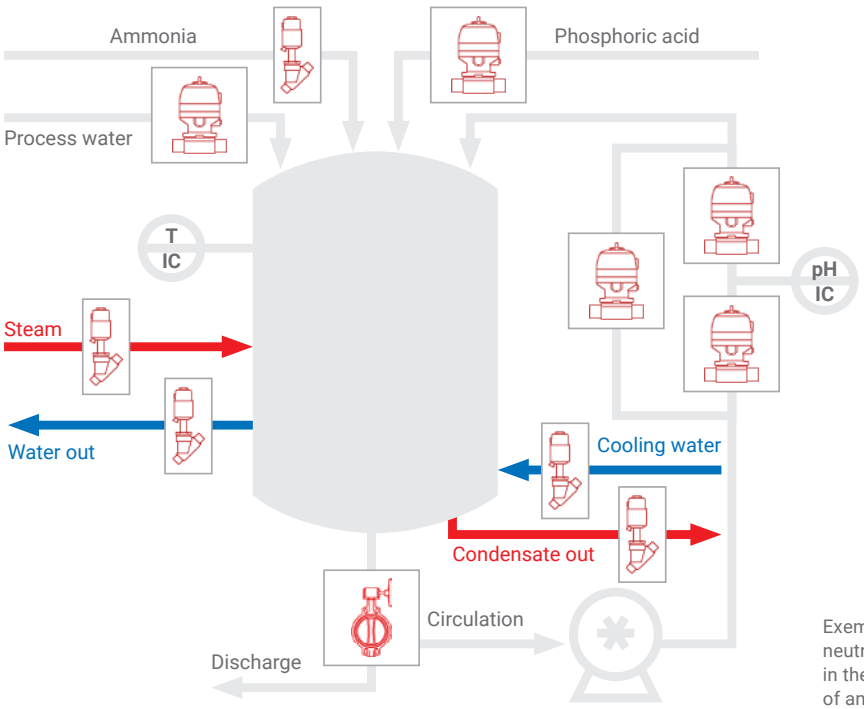
The process equipment used in phosphate production must include reliable and robust components to sustain critical process steps. The vast variety of process technologies encountered in the phosphate industry calls for a broad range of valve solutions.

Conventional fertilizer production from phosphate rock

The production of phosphate fertilizers goes hand in hand with the production of mineral acids. Most important are phosphoric acid (as an intermediate or major product), sulphuric acid (as a major reagent), and nitric acid (as a reagent or additive).

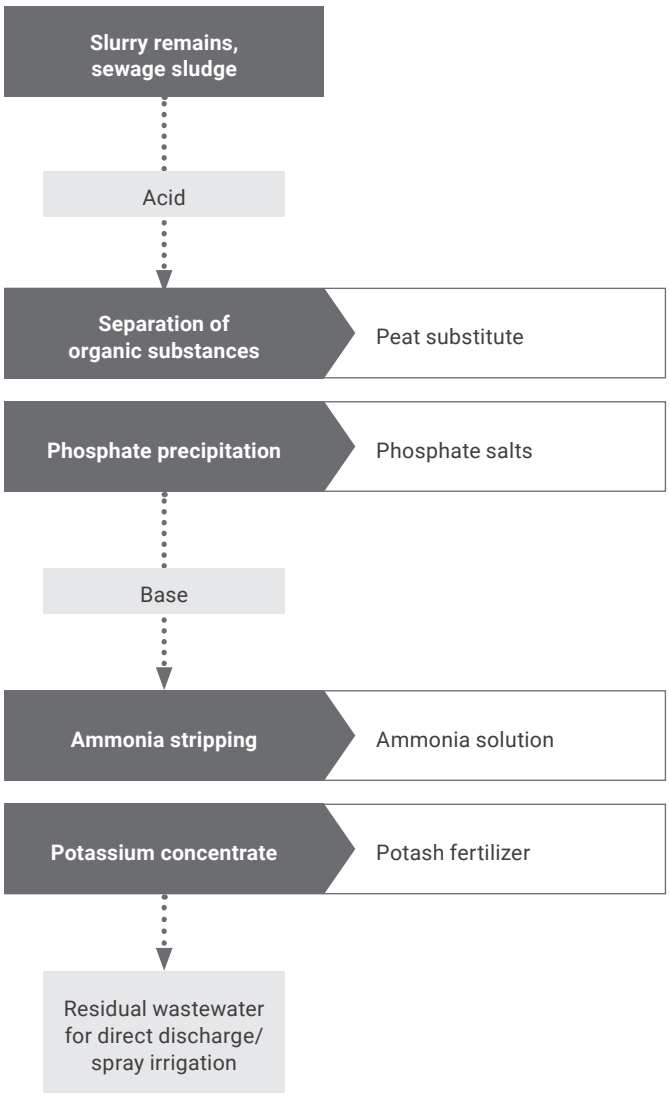
The production of acids and their use in the production process requires special care in the choice of construction material for the process equipment. Although the process equipment and instrumentation are built of metallic materials (often cast iron, steel or stainless steel), internal lining and coating with advanced polymer materials, such as PFA, are required to keep the aggressive acids from attacking the metallic components.

Another challenging aspect in the production of phosphate fertilizers is the handling of solids. Flowing solids, and media containing fluidized solid particles are abrasive and may cause severe damage to piping and valves. Here, too, coating of the internal surfaces with rubber lining helps prevent damage to the equipment body, allowing it to maintain pressure and tightness in the most critical process positions.



Exemplary process for neutralisation reaction in the production of ammoniumphosphates

Recycled fertilizers from renewable resources



An alternative to produce phosphate fertilizer is, to recycle biological waste like slurry remains or sewage sludge. This approach is a huge trend in Europe, since phosphate minerals are classified as critical raw materials which is running short worldwide in the upcoming years. The rising contamination of ground water with phosphate- and nitrate-salts is another trigger for this approach.

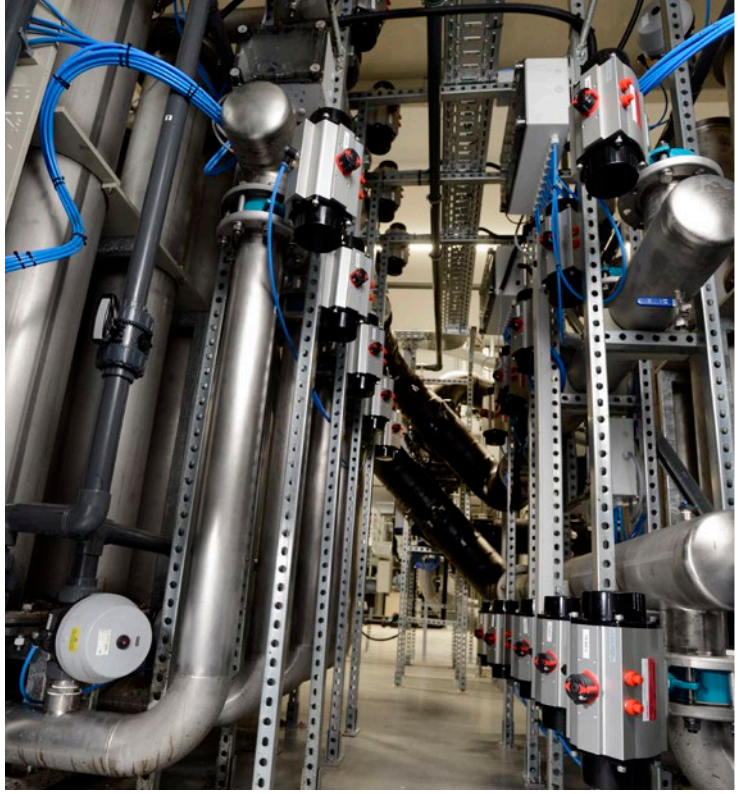
In a general procedure, established by one of our customers, slurry residues and sewage sludge are used to extract phosphate salts which can be used as phosphate fertilizers. Manure or fermentation residues from a biogas plant are fed into the process. These substances do not only contain phosphate salts, but also other substances like nitrogen or potassium compounds which are of importance for the growth of plants.

In several steps with the help of acids and base the phosphate, nitrogen and potassium compounds are extracted from the raw materials and are further processed to fertilizer materials.

GEMÜ valves are involved in several steps of the process. For example, the dosing of acid to extract the phosphate salts is done with the help of GEMÜ R690 plastic diaphragm valves and P600 PVC block manifolds. After this first step of the process solid residues, which can be used as peat substitute, must be separated in a filtration process with support of plastic diaphragm valves (GEMÜ R690) and pneumatically operated butterfly valves GEMÜ R481 Victoria. Other products of GEMÜ which are installed are ball valves, flow meters, pressure retaining valves and check valves.

Suitable GEMÜ Solutions

Process step	Process equipment	Characteristics	GEMÜ Type	Features
Crushed rock and powder discharge	Silo bottom	Dry solids, abrasive, low flow speed (normally closed, often pneumatic actuation, powder above the valve at standstill)	GEMÜ R481 GEMÜ D481	Flucast AB/P liner is especially suitable for abrasive dry powders. A rubber lined disc (EPDM or Flucast AB/P) adds protection in case of larger abrasive particles.
	Exhaust filter or cyclone discharge	Dry solids, abrasive, low flow speed (normally open, often manual, dilute gravitational powder flow)	GEMÜ 656	For normally open positions a soft rubber lined full bore valve with an EPDM diaphragm can be used.
Acid lines	Tank top/discharg	Corrosive media, free of solids, large volume flows, broad temperature range	GEMÜ 491	PFA encapsulated disc and TFM™ covered liner material ensure long valve lifetime and environmental protection.
	Dosing lines	Corrosive media, often at room temperature, high switch cycles	GEMÜ 620 GEMÜ 675	PFA lined weir type valves with PTFE/EPDM or PTFE/FKM diaphragms are best suited for fluid control or corrosive media.
Acidic slurries	Overflow discharge lines in acidulation plant (Den, mixer, etc.) Granulation chamber flow control and overflow	Corrosive and abrasive media, slow flow velocity, normally closed position, or periodic actuation	GEMÜ 655 GEMÜ 656	Hard rubber lined full bore valve with a Hypalon, Butyl rubber or EPDM diaphragm (depending on acid concentration).
	Den feed, Acidulation Mixer discharge, Granulation feed	Corrosive and abrasive media, large nominal sizes, normally open position, shut off only for maintenance	For normally open, shut off function for heavy slurry or large solid particles, a gate valve will be more suitable. Available on request.	



Suitable GEMÜ Solutions

Process step	Process equipment	Characteristics	GEMÜ Type	Features
Steam	Steam lines, condensate lines	Shutoff or control, larger nominal diameters, high temperature	GEMÜ 532 GEMÜ R480 GEMÜ D480 GEMÜ 490 GEMÜ R470	Stainless steel/PTFE globe valve is best for steam service. For large DNs a butterfly valve can also be suitable (various liner materials available for steam applications).
	Steam injection, temperature control, granulation control	On/off control function, accuracy and reliability required	GEMÜ 514 GEMÜ 554	Angled seat valves are ideal for steam control and injection applications.
Transport of sewage sludge/ liquid manure/ biodigestables	Reactor feed and discharge	Abrasive and corrosive media, various particle sizes, various flow velocity, moderate temperatures, periodic actuation	GEMÜ R690 GEMÜ 656 GEMÜ D481	Depending on solids content, flow velocity, pH and temperature, weir and full bore diaphragm valve or butterfly valves are possible.
Dosing of acids	Dosing lines to reactor and discharge of products	Corrosive media, high switching cycles, normally closed position, free of solids	GEMÜ R690 GEMÜ R677 GEMÜ 620 GEMÜ 675	PVC or PVDF plastic body or PFA lined weir type valves with PTFE/EPDM or PTFE/FKM diaphragms are best suited for fluid control or corrosive media.
Dosing of alkalines	Dosing lines to reactor	Corrosive media, high switching cycles, normally closed position, free of solid	GEMÜ R690 GEMÜ R677 GEMÜ 620 GEMÜ 675	PVC plastic body or hard rubber lined weir type valves with EPDM diaphragm.
Transport of ashes and solid particles	Granulator or dryer discharge, loading of reactors, reactor discharge	Dry or with low humidity solids, abrasive, low flow speeds	GEMÜ 481 GEMÜ D481	Flucast AB/P liner is especially suitable for abrasive dry powders. A rubber lined disc (EPDM or Flucast AB/P) adds protection in case of larger abrasive particles.
Precipitation agents	Dosing of precipitation agents to reactor	Aggressive media, depending on concentration, also solid dosing possible, normally closed position	GEMÜ R690 GEMÜ R677 GEMÜ M75	PVC or PP plastic body with EPDM or FKM diaphragm.

Butterfly valves, metal

GEMÜ 491 Edessa

GEMÜ R481 Victoria

Weir-type diaphragm valves, metal and plastic

GEMÜ 675

GEMÜ R690

Full bore diaphragm valves, metal

GEMÜ 655

GEMÜ 656

Globe and Seat valves, metal

GEMÜ 536

GEMÜ 554

Measurement and control systems

GEMÜ 805

GEMÜ 554 mit
GEMÜ 1434 µPos

Modular and customized M-Block solutions

GEMÜ P600M

Why GEMÜ

For valve designs in the phosphate industry, GEMÜ offers technically advanced solutions tailored to each process step. With a wide range of valve types, materials and accessories, we supply the complete valves as well as measurement and control systems from a single source.

We provide personal support in more than 50 countries around the world. Whether for the specification of suitable construction materials during planning, assistance in installation or in maintenance cases, our specialists are always at your side to ensure safe and reliable plant operation. Challenge us! For requirements beyond our standard program, we develop customized solutions in close cooperation with our customers.

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