

Fertilizer Production Expertise

HPD[®] Evaporation and Crystallization

WATER TECHNOLOGIES

Fertilizer Expertise

HPD® Evaporation and Crystallization systems from Veolia Water Technologies provide innovative process solutions for large-scale fertilizer production facilities worldwide.

These systems allow production of a wide range of high-quality fertilizer products from natural sources (*mined or solution mined deposits*) or by-product streams from other processes that include:

- Ammonium sulfate
- Ammonium nitrate
- Potassium chloride (MOP)
- Potassium sulfate (SOP)
- Monoammonium phosphate (MAP)
- Diammonium phosphate (DAP)
- Epsom salt: Magnesium sulfate heptahydrate
- Magnesium sulfate monohydrate
- Mono potassium phosphate (MKP)
- Sodium nitrate
- Phosphoric acid *merchant/technical/food/electrical grade*
- Potassium carbonate
- Potassium nitrate
- Calcium phosphate
- Calcium sulfate
- Calcium chloride



KCl Crystallization Plant, Middle East

Fertilizer Project Capabilities

- More than 50 references in fertilizer production and more than 85 years of industrial crystallization experience
- Process Development of customized solutions with extensive laboratory and pilot testing facilities including in-house analytical capabilities
- Materials of construction for corrosive operating environments
- Global turnkey project execution, modularized supply, and process guarantees

Case Study: Research & Development

IC Potash Corp. (ICP) - Sulfate of Potash (SOP)



ICP's Ochoa Mine project (*New Mexico, USA*) is projected to produce approximately 714,000 TPY of Sulfate of Potash (SOP- K_2SO_4) from Polyhalite ore ($K_2SO_4 \cdot MgSO_4 \cdot 2CaSO_4 \cdot 2H_2O$) for more than 50 years.

Veolia was selected to refine, confirm, and validate the overall ICP process utilizing HPD® Evaporation and Crystallization technologies through a series of bench and pilot-scale testing programs performed in Veolia's in-house testing facility.

The scope of the testing extended from the ore leaching to the SOP crystallization process including crystallization/redissolution of leonite ($K_2SO_4 \cdot MgSO_4 \cdot 4H_2O$), and calcium sulfate removal.

As a "first-of-kind" process, the challenge was to develop a cost-effective process to produce a premium potassium sulfate fertilizer. The series of tests proved to be a success as the produced SOP achieved the purity, crystal size, and habit requirements for a fertilizer application.

Based on the results, the testing provided the confidence that a commercial system would perform as designed and met the product quality requirements.



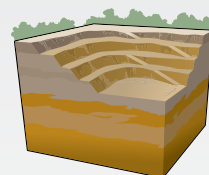
Raw Materials



Natural Gas



Sulfur



Phosphate Rock



Ammonia Plant



Sulfuric Acid Plant



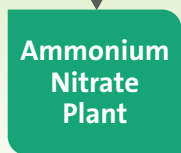
Rock Grinding Plant



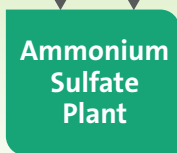
Nitric Acid Plant



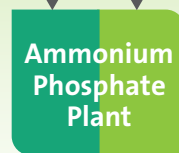
Phosphoric Acid Plant



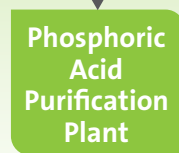
Ammonium Nitrate Plant



Ammonium Sulfate Plant



Ammonium Phosphate Plant

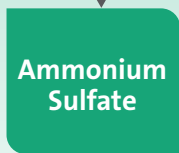


Phosphoric Acid Purification Plant



Ammonium Nitrate

NH_4NO_3
Gr/FI



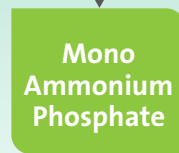
Ammonium Sulfate

$(\text{NH}_4)_2\text{SO}_4$
WSC/Sol



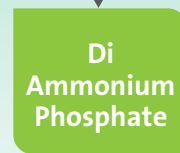
NP Granules

NP
Gr



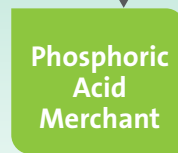
Mono Ammonium Phosphate

MAP
WSC



Di Ammonium Phosphate

DAP
WSC



Phosphoric Acid Merchant

P_2O_5
Sol

Plants

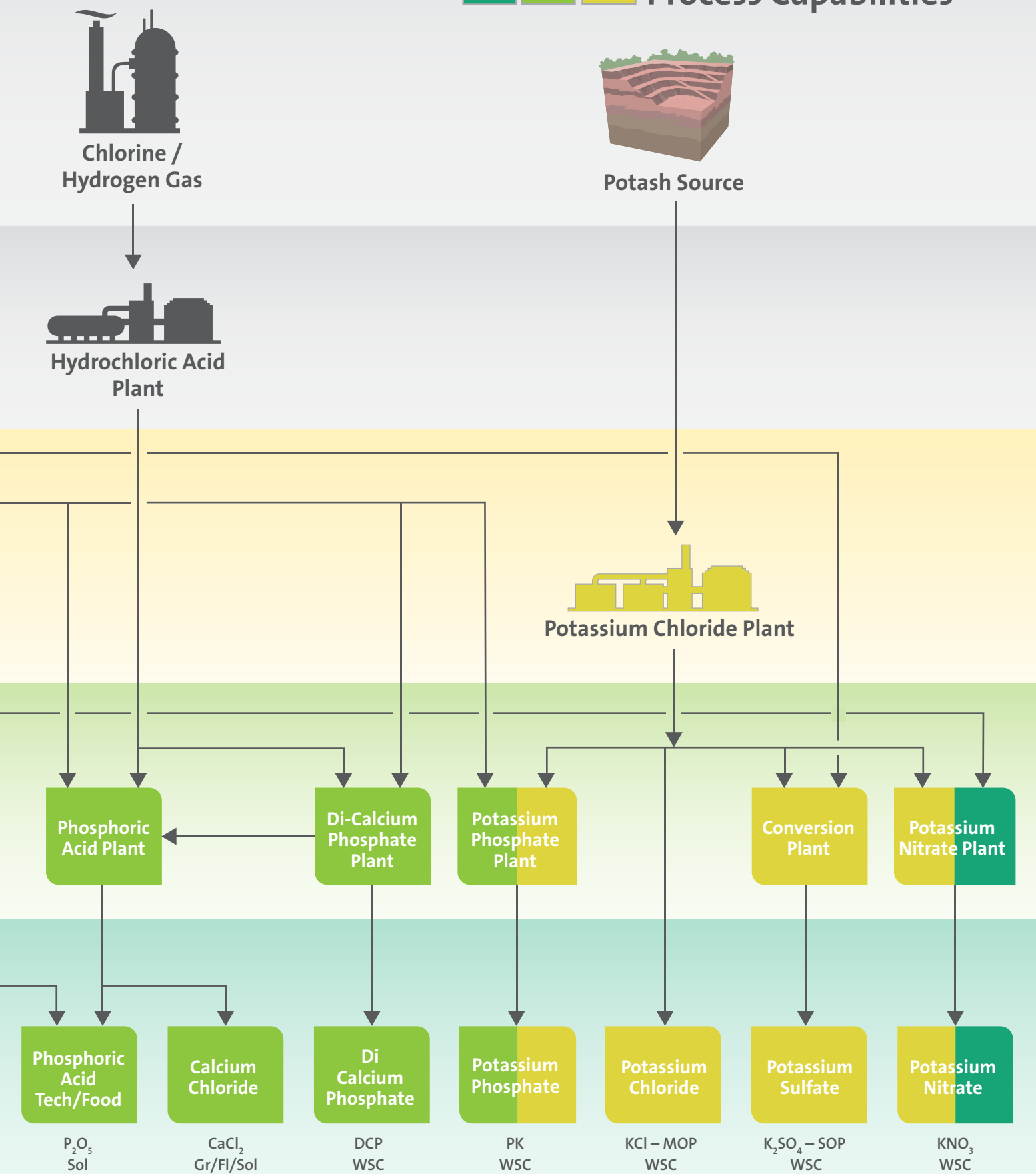
Veolia Technologies

NPK Products

Raffinate



Veolia NPK Fertilizers Process Capabilities



WSC: Water Soluble Crystals - Gr: Granules - Sol: Solution - FI: flakes

HPD® Evaporation and Crystallization Case Studies

- Fertilizer Industry



- **Product:** Ammonium sulfate crystals
- **Project:** Petrobras FAFEN, Brazil
- **Start-up:** 2013
- **Production Capacity:** 875 T/day
- **Feed:** Surplus ammonia (NH_3) from an on-site production facility and sulfuric acid (H_2SO_4) produced as a by-product from a nearby refinery.
- **Scope:** Design and supply of the fully integrated system with process equipment including an HPD® PIC™ (*draft tube baffle*) crystallizer, solid-liquid separation, drying, screening, packaging, and storage.



- **Product:** Monoammonium phosphate crystals (MAP)
- **Location:** Middle East
- **Start-up:** 2004
- **Production Capacity:** 96 T/day
- **Feed:** Ammonia (NH_3) and low-grade phosphoric acid (P_2O_5)
- **Scope:** Turnkey project including feed pretreatment, triple-effect evaporation, vacuum crystallization (HPD® PIC™ *draft tube baffle technology*), drying, and packaging.



- **Product:** Potassium chloride crystals
- **Project:** K+S Potash Canada, Canada
- **Start-up:** 2016
- **Production Capacity:** 2 Million T/year
- **Feed:** Solution mining of sylvinite (KCl / NaCl ore)
- **Scope:** Detailed engineering and supply of major process equipment that included three trains of multiple-effect NaCl evaporators in series and a five-stage train of adiabatic flash, draft tube crystallizers. The vessels that make up the crystallization system range in size up to 30 meters in length, a diameter of nearly 10 meters, and weigh up to 180 tons.

Resourcing the world

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