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1. INTRODUCTION

1.1. Summary

Phosphoric Acid is one of a kind plant. The feedstock, phosphate rock, has a primarily sedimentary and igneous origin, thus bringing in all the variations connected with life. The entire process depends on the available quantity of Sulfuric Acid and the generated energy to have autonomous production plant. It also produces significant quantities of phosphogypsum and Fluosilicic Acid - a by-product with little added value and lots of implications on permitting and environmental performances.

This paper sketches the importance of integrating the Phosphoric Acid plant (PAP) as a complex by leveraging practical examples and material and energy balances.
Improper design and integration of the sulfuric acid production (SAP) unit (the energy producer) with phosphoric acid (the energy consumer) often jeopardizes or reduces the performance of entire Phosphoric Acid complexes and increases OPEX. On the contrary, sulfuric acid can bring in robustness and energy savings under the conditions that its design considering all phosphoric acid plant needs along with the requirements of all the other units comprising the complex.. Proper control of concentrations and operating parameters in both units allows enhanced P_2O_5 recovery and reliability without affecting CAPEX and OPEX.
Furthermore, the Fluosilicic Acid Waste stream may become a valuable source of additional income from sales of Hydrofluoric Acid or Aluminium Trifluoride at a lower cost than the traditional fluorspar to HF route.

To accomplish that, once again, the designer must ensure proper design of the FSA recovery section and accurate control of water balance across PAP, SAP, and Anhydrous Hydrofluoric Acid units.

Finally, this paper provides a glimpse into a new process solution to purify phosphogypsum and convert it into salable products.

Desmet Ballestra can positively optimize a PAP+SAP complex thanks to the unique availability under a single point of responsibility of SAP technology from MECS® technologies, PAP technology from PRAYON, and Hydrofluoric Acid Technology from Desmet Ballestra's subsidiary BUSS Chemtech.

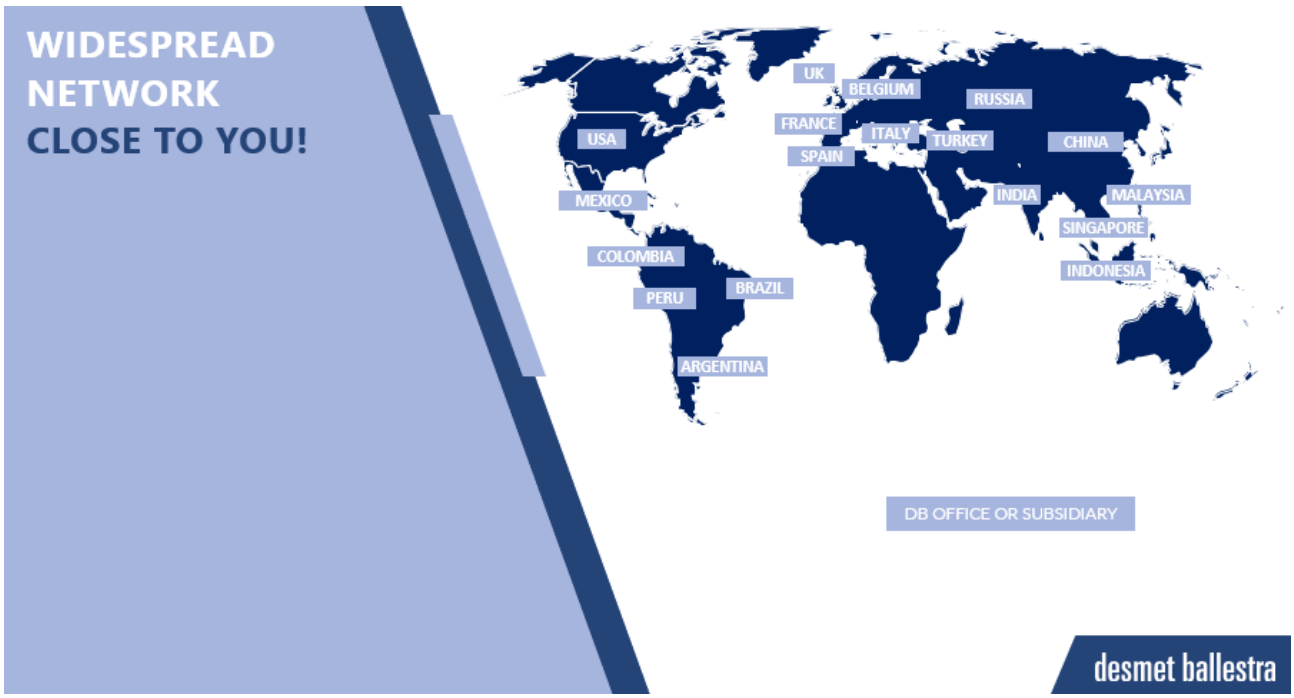
2. BRIEF INTRODUCTION OF THE AUTHORS

2.1. Desmet Ballestra Italy

Desmet Ballestra S.p.A, Italy (DBI) is part of the international Desmet Ballestra group, resulting from the merging of Desmet (based in Belgium, founded in 1946) and Ballestra (based in Italy, founded in 1960).
DBI is a process engineering company with proprietary technologies in many organic and inorganic chemical industry areas.
DBI has within the Chemical Division a range of unique skills and long track experience in the design & supply of several plants, including:

- Sulphuric Acid Production units, as permanent licensed contractor of MECS® Technologies
- Phosphoric Acid Production units, as permanent licensed contractor of Prayon Technologies,
- N-P-K granulated compounds, MAP, DAP, AS, ASN, SSP and TSP and the like
- Ammonium Nitrate, Calcium Nitrate, Sodium Silicate, Potassium Sulphate, Zeolites, and the like

DBI international network enables delivering projects worldwide, keeping in due consideration local market and environmental requirements.



2.2. Buss ChemTech

Buss Chem Tech (BCT), a well-established technology provider located in Pratteln, Switzerland, has a long history in the field of fluorine chemistry in addition to competence in various gas-liquid reaction technologies and phosgeneation technology.
BCT recently joined Desmet Ballestra S.p.A. integrating the respective competencies in inorganic acids , and offering a comprehensive solution for the full phosphate value chain.
(https://www.buss-ct.com/)

2.3. Prayon Technologies

Prayon Technologies – as the licensing division of Prayon SA – has the widest portfolio of technologies related to phosphorus chemistry available on the market. With more than 130 reference plants worldwide, the dedicated team of process experts designs robust solutions for the producers combined with an innovative touch relevant to the needs of today and tomorrow.

Through a solid partnership with Desmet Ballestra, Prayon Technologies provides process services until the plant commissioning, acceptance and beyond, focused on achieving the guarantees and keep the performances in the long run.
(https://technologies.prayon.com/)

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2.4. MECS® Technologies

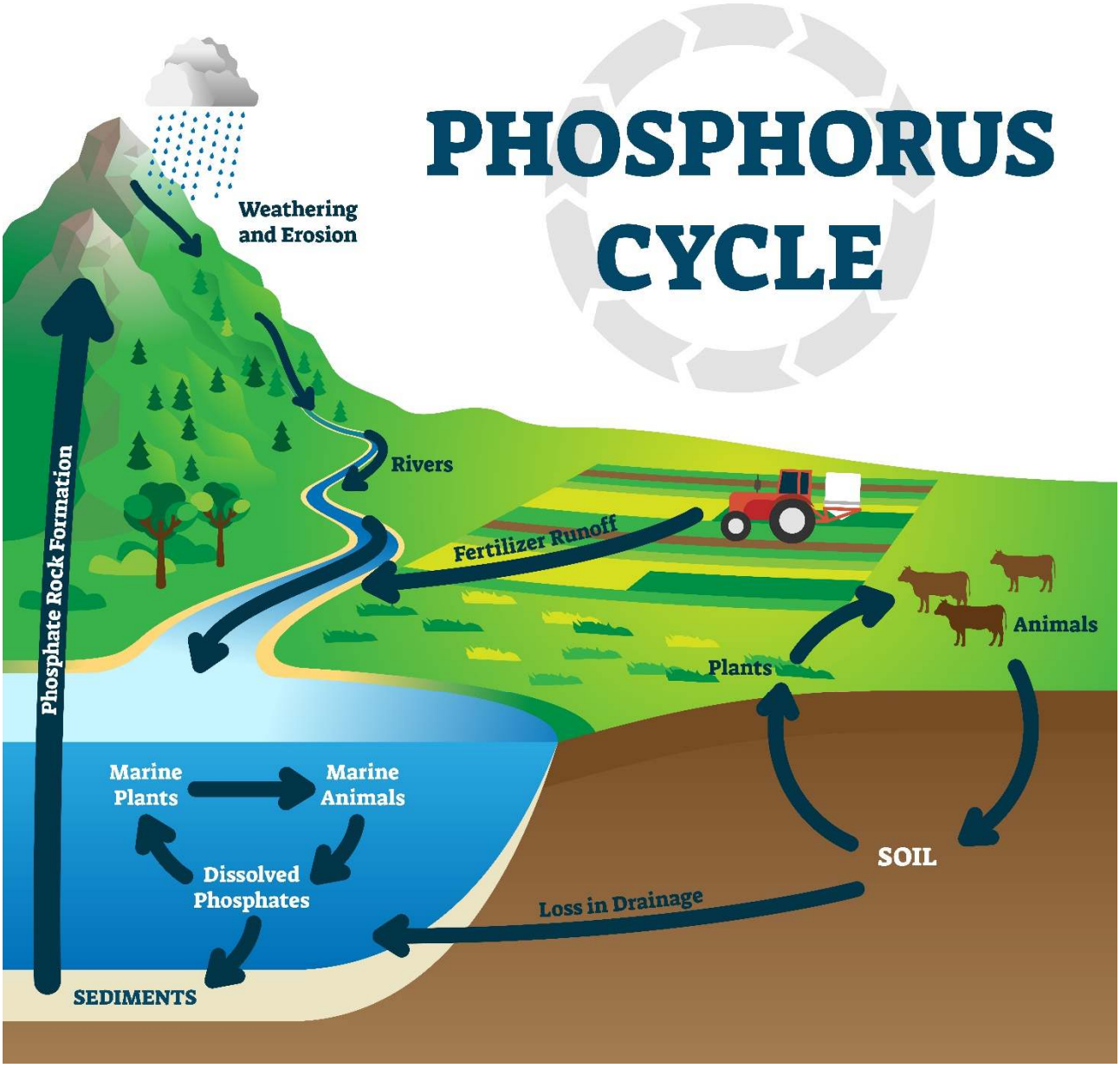
The MECS® sulfuric acid technology has been in use for over 90 years in the phosphate fertilizer, non-ferrous metals (leaching & smelting), oil refining and general chemical industries. MECS® technologies feature breakthrough solutions, many of which have revolutionized the performance, quality and cost-effectiveness of customer operations. They include MECS® heat recovery systems (HRS™), MECS® SolvR® regenerative SO_2 scrubbing and MECS® MAX3™ sulfuric acid production technology. Integrated into these MECS® technologies are proven specialty products such as catalysts, Brink® mist eliminators, DynaWave® scrubbers, ZeCor® corrosion resistant alloy products, and acid coolers all of which are specifically designed for the most demanding operating environments. Licensed and marketed by Elessent Clean Technologies, the MECS® technology is the world-leading sulfuric acid production technology with more than 400 licensed acid plants worldwide since the 1960's. Elessent Clean Technologies is committed to long-term customer satisfaction and support for the life of customer assets.
(MECS.ElessentCT.com)

3. P_2O_5 – SOURCE OF LIFE

Phosphorus is essential for our life. It is vital to the genetical structure building, the production of all cell membranes and energy supply. In the agriculture the phosphorous participates to the formation of the seed and fruits in plants. Our body is using between 0.6 to 0.7g of phosphorous per day (van Rossum 2011). We obtain the phosphorous by consuming plants and animal products, while the plants obtain the phosphorous from the soil.

3.1 Life cycle

The question mark must be raised over most aspects of phosphate exploiting cycle including the sustainability of phosphate resources, the environmental impact of processing phosphate and the health issues associated with the use of phosphate products.
The phosphorous life cycle is presented under inorganic form as a rock. This form is extracted from the mine and then processedd in fertilizer plants to different phosphate-containing products used in the industry and agriculture.
The organic cycle consists of the transfer of phosphorous from the soil to the animals and back to the soil.
The water phosphorous cycle completes this by transferring the phosphorous through the aquatic wildlife.
The first cycle contributes to move the phosphorous from few places where it is highly concentrated to several countries where it is missing.
The organic and water cycles are in direct relation with the population concentration and human behavior.



3.2 Resources and reserves

The phosphorous is consumed in all the countries around the world, however the resources are concentrated to only few areas. Few countries control 85 to 90% of the world resources.
Reserves are the supplies of phosphate rock that are available with today's technology and are currently economically producible. According to World Phosphate rock reserves (Jasinki 2013), the total world reserves are in the range of 67.500 million of tons. From this around 50.000 million of tons are in Morocco, the remaining is in China, Algeria, Tunisia, Jordan, Russia, Syria, South Africa, USA and Saudi Arabia.
As a rule, the best rock is mined first as this requires less efforts in terms of energy and processing to produce phosphate fertilizers. This means that the superior reserves diminish quickly and only reserves with low concentration will remain for the coming years. Due to this, the future phosphate will require more advanced technics for the beneficiation and will have higher production cost.

3.3 Challenges

The phosphate production is connected to energy consumption and causes important environmental issues. Energy is necessary from the extraction in the mine, processing the rock, its transformation in phosphoric acid and fertilizers and during the transport and the logistic. The origin of this energy is in the majority from fossil fuel which contributes to the greenhouse gas (GHG) emissions. However, this point could be moderated as the phosphate production contribute to only by 3% compared to the nitrogen production which is at the level of 92.5% (Prud'homme, 2010). Also, Phosphoric Acid wet processes consumes much less energy per ton of P_2O_5 than the thermal route.

Another important constraint to the phosphate is the different wastes during the beneficiation, phosphoric acid production and purification. From one side the phosphate contains different pollutants and some of them can negatively affect the ecosystem and the humans. Cadmium is one of them and its concentration depends on the region and type of phosphate rock. Igneous rock, due to its volcanic origin contains much lower content of Cadmium and heavy metal than sedimentary rock, as a result of the Vulcanic activity, most of the heavy metals are "blown". However its reserves are less important than the sedimentary rock.

On another side, the processing of the phosphate which is done predominantly through the attack of sulfuric acid has as a by- product significant quantity of gypsum. Every ton of phosphoric acid as P_2O_5 produces around 4 to 5 tons of dry gypsum, and the tendency is to increase this quantity as the phosphate rock is with lower phosphate content. The "stacks" of gypsum are of concern as available land is necessary, and particular attention is to be paid with rainwater soil leaching and radio activity.
During the production of the phosphoric acid the emission of fluorine is controlled by capturing it under FSA (Fluorosilicilic Acid). This product is often not valorised and is neutralized and stored with gypsum.

4. P_2O_5 – ONE PRODUCT, SEVERAL CHALENGES

The phosphorus is essential for all living organisms. Phosphorous does not have substitute in food production and cannot be "manufactured", therefore the only way is to extract it from the Earth crust and valorize the organic phosphorous and water cycles. With the scarcity of the available resource, the quality of the phosphate is declining and the economical and industrial equation to feed billion people by improving the crops yield is becoming very complex.
The industrial decision before starting the producing phosphorous fertilizer is of highest importance and this must be analyzed with an integrated approach for the entire production cycle and all parameters must be considered.

4.1 Importance of quality rock

Each phosphate rock is defined by its chemical composition. Most commercial rocks contain fluorapatite $Ca_{10}F_2(PO_4)_6$ as primary source of phosphorus. As a rule, the grade of the commercial

phosphate rock is expressed as its P_2O_5. Depending on the P_2O_5 content (and level of impurities), the phosphate rocks can be classified according to their quality or grade.

One parameter that is considered to classify a rock is the Minor Element Ratio (M.E.R.). It is calculated as the ratio between the sum [$MgO+Fe_2O_3+Al_2O_3$] (in weight %); divided by the P_2O_5 content (in weight %). M.E.R. is a good indicator of the capability of a process to produce a phosphoric acid at a suitable grade for fertilizer applications. Typically, the M.E.R. should be less than 0.08 – 0.10 to enable the use of a rock in a traditional phosphoric acid technology.
Other elements like silica may jeopardize the processability of a rock phosphate. Depending on the form of silica, it may be soluble and increase the acid viscosity or inert and create a layer in the phosphogypsum.

If the rock is classified as low-grade phosphate, traditional phosphoric acid processes may meet the following issues to be assessed through a pilot test:

- Filtration affected by the high viscosity
- Formation of gel at the concentration stage
- Post precipitation and scaling

To tackle that challenge, Prayon offers two unique processes enabling to recover P_2O_5 from low-grade phosphate rocks: the GetMoreP and the Ecophos processes. They consist of a chemical beneficiation with a recovery efficiency far above any traditional beneficiation plant (up to 90%). They produce a DCP of high quality (up to 41% P_2O_5) that can be used as a “super-rock” to feed a traditional phosphoric acid process or as animal feed product.

4.2 Sulfuric Acid Production reliable design

Sulfuric acid is an important raw material for the production of phosphate fertilizers. For instance it is used in the attack / reaction of phosphate rock in phosphoric acid production or to carry sulfur compounds in fertilizers such as SSP. On the other hand, Phosphate production is the sector that ranks 1st in the list of sulfuric acid users, followed by mining. In summary sulfuric acid and Phosphate production are closely tied together .
In general terms, sulfuric acid is produced by catalytic oxidation of sulfur dioxide (SO_2) to sulfur trioxide (SO_3), which is subsequently absorbed in water to form sulfuric acid (H_2SO_4). In practice, the SO_3 is absorbed in sulfuric acid which is kept at a controlled concentration (usually 98%) by water addition. There are several different sulfuric acid plant feed sources, the two main sources are elemental sulfur and sulfurous off-gasses.

All sulfuric acid producers are interested in maximizing yield, robustness, and energy production and, therefore, great attention is paid to define the requirements for the selection of the entire process together with the steam turbine and the relevant ancillaries.

Many operating scenarios of the sulfuric acid plant and of the other plants in the complex have been studied to evaluate the different combinations of steam produced, steam consumed, electric power generated and electric power consumed.

Most of the phosphate fertilizer producers include in their complexes a sulfur-burning Sulfuric Acid Production (SAP) unit, not only to have an “in-house” source of H_2SO_4 independent from potential market price variation and industries where the Sulfuric Acid is secondary product. The second

main reason is that a sulfur-burning SAP unit is a valuable source of heat that is generated in the sulfur combustion, $SO_2 \rightarrow SO_3$ conversion and SO_3 absorption.

The heat recovery system allows steam generation by recovering heat from sulfur combustion and SO_2 oxidation. The pressure of the steam can be set in a range from about 30 to 60 barg depening on the specific plant requirements.
An additional steam source can be the SO_3 absoprtion in the case where an HRS™ heat recovery system is included in the SAP unit. The pressure of the steam coming from the HRS™ is in the range of 7-10 barg. Such pressure is e.g. matching the level required in the evaporation section of a Phosphoric Acid Production (PAP) unit. The enhanced heat recovery allows recovery of more than 90% of the heat available from the reactions described above.
Part of the steam is consumed within the SAP unit (e.g. melting section, molten sulfur lines, steam turbine driven motors where applicable) but most is available for export or electric power production through a Steam Turbine Generation (STG) system. In case of STG, the steam production should be above 40 barg considering the requirements of most of the Steam Turbines available in the market.

The Steam Turbine design should be bespoke to consider the specific plant requirements. The selection should evaluate different possibilities:

- Bi-stage or multistage
- Condensing or backpressure
- Possibility of intermediate extractions or injections

Considering:

- the size of the SAP unit
- steam requirements around the SAP unit
- requires superheat recovered by steam generation through boiler(s) and superheater

A SAP unit produces more steam and power than it consumes.
A bypass line can be foreseen and the sulfuric acid plant can operate even if the turbogenerator is off. In such a case there is no electric power production and all the energy needed to allow the operation of the sulfuric acid plant will be taken from the external network.

Vice versa the turbogenerator is also able to back-up the external power supply operating “island mode” and generating exactly the amount of electric power needed for the operation of the sulfuric acid plant and of the other plants of the complex.

In the normal operation state the excess energy produced is exported to the national power distribution network or other users within the complex.

4.3 P2O5 processes and criteria for selection

Referring to §4.1 above, Prayon offers the Ecophos and the GetMoreP processes to deal with the use of low-grade rocks and/or to produce animal feed products.
The Ecophos process is based on the use of diluted Hydrochloric Acid to digest the rock and lead to $CaCl_2$ co-product but that may be complemented with Sulfuric Acid to produce a very pure gypsum suitable for plaster applications. The GetMoreP is based on the use of diluted Sulfuric Acid and provides an easy and simple solution.

Apart from that, Prayon offers five processes to produce phosphoric acid that are characterized by the type and number of crystallization and filtration stage(s).

Process Name / Stages	Reaction 1	Filtration 1	Reaction 2	Filtration 2
Dihydrate (**DH**)	DH	DH		
Di-Attack Hemi-Filtration (**DA-HF**)	DH		HH	HH
Central-Prayon (**CPP**)	DH	DH	HH	HH
Hemihydrate (**HH**)	HH	HH		
Hemi-Dihydrate (**HDH**)	HH	HH	DH	DH

Note: DH stands for Dihydrate Calcium Sulfate ($CaSO_4.2H_2O$) and HH stands for Hemihydrate Calcium Sulfate ($CaSO_4$. ½ H_2O).

The selection between those five processes can be done based on the following criteria:

- Phosphogypsum:

Most of the time, the by-product is stacked or discharged. However, it makes sense – especially in the context of circular economy - to use it as a raw material to manufacture plaster or as an additive to cement. This is achieved by Prayon SA in collaboration with local industries for half a century.

Double crystallization processes produce a phosphogypsum quality suitable for further applications due to the higher recovery efficiency (lower P_2O_5 in the gypsum). The processes ending with HH (DA-HF and CPP) produce a self-drying phosphogypsum that means significant energy and cost savings for the end user.

- Phosphate Rock:

When the phosphoric acid producer is also owner of a phosphate mine, the access to low-cost raw material impacts the decision regarding the process to be selected. Indeed, that type of producers is less affected by the loss of 1 ton of P_2O_5 compared to the producer buying a rock on the market.

The latter will look for a high-efficient process to convert each kg of phosphorus available into a valuable product while the former will maybe pay more attention to other criteria.

Amongst the list of processes offered by Prayon, double crystallization are the most efficient ones (up to 98.5% recovery efficiency).

- Sulfuric Acid:

The phosphoric acid producer may buy sulfur or sulfuric acid directly on the market. First option means that Sulfuric Acid plant shall be available with the side effect that energy can be produced and recovered for the industrial complex.

Apart from this, Sulfuric Acid consumption of each process differs in relation to the reaction conditions and recovery efficiency. The minimum consumption will be the Central-Prayon process as the excess sulfate in the reaction is limited in comparison to the other processes. Therefore, the product acid contains a reduced amount of free SO_4.

Standard Sulfuric Acid consumed by a Phosphoric Acid plant is at 98.5% concentration. However, in the frame of the collaboration with Desmet Ballestra (BUSS ChemTech), Sulfuric Acid at lower concentration from HF production plant may be recovered depending on the water balance of the process route that is selected.

- Energy

HH process routes (HH and HDH) produce a higher-concentrated acid at the outlet of the filter (more than 40% P_2O_5). It leads to significant steam saving to evaporate the water until 52% to reach Merchant Grade Acid.

Electricity consumption is higher for double crystallization processes due to the amount of equipment.

- Water

Usually, water reserves are not the first limitation for a future phosphoric acid producer. However, if the plant is in the middle of a desert (for example close to the phosphate mine, that criteria become very critical without groundwater in the area.

In this respect, the HH process is the one consuming less water. It is explained by the crystal water in the phosphogypsum (1/2 molecules instead of 2 in the DH) and the high concentration of P_2O_5 in the acid at the outlet of the filter. Generally, processes ending with HH (DA-HF, CPP, HH) will consume less water than these ending with DH (HDH, DH).

- Operability & Maintenance

Sometimes underestimated, the training of the operators is a mandatory service provided by Prayon. Based on the same educational background, it appears that some plants remain more complex to operate and maintain than the others.
It may be due to the phosphate rock and impurities like Fluorine and Silica that leads to corrosion and abrasion of the equipment. It may be due to the process conditions involving high temperature or handling of unsteady calcium sulfate or phosphoric acid leading scaling and regular clogging of some equipment when the maintenance is not predictive.

- Capital Cost

The investment cost should not be the most significant criteria in the balance for the selection of one phosphoric acid process technology (amongst the five processes described above) as the operational costs will quickly exceed it – except considering very small capacities.

Notwithstanding that, it is obvious that single crystallization processes are CAPEX-wise less expensive than double. The main advantage of the DA-HF process is that it combines most of the advantages of the CPP (considering the hereabove criteria) with only one stage filtration so that the investment cost for that technology is smaller.

4.4 Environmental issues and protection

The mining, sulfuric acid and phosphoric acid production and handling are related to serious environmental issues and must respect strict environmental norms. Today most of the producers in the fertilizer industry make an important effort to comply and preserve the environment.

During the mining and handling of the raw phosphate many spillages occur, and this create dust and polluted environment to be tackled with. The post mining activities should be planned since the very early project stage. The mine rehabilitation activities need to take local conditions into account.

Sulfuric acid production produces gaseous effluents including SO_2 and SO_3+acid mists. Modern plants can meet the most stringent environmental requirements with proper selection of conversion catalysts, mist eliminators, demisters, and/or scrubbing systems. Additionally, SAP units areconsidered a valuable source of carbon-free" steam and electric power.

The phosphoric acid as already mentioned is the cause of phoshogypsum and FSA byproducts produced with difficult direct industrial applications.

The different sources, project localities, energy management and environmental constraints make the decision extremely complex and requires large knowledge and professional approach for each project case.

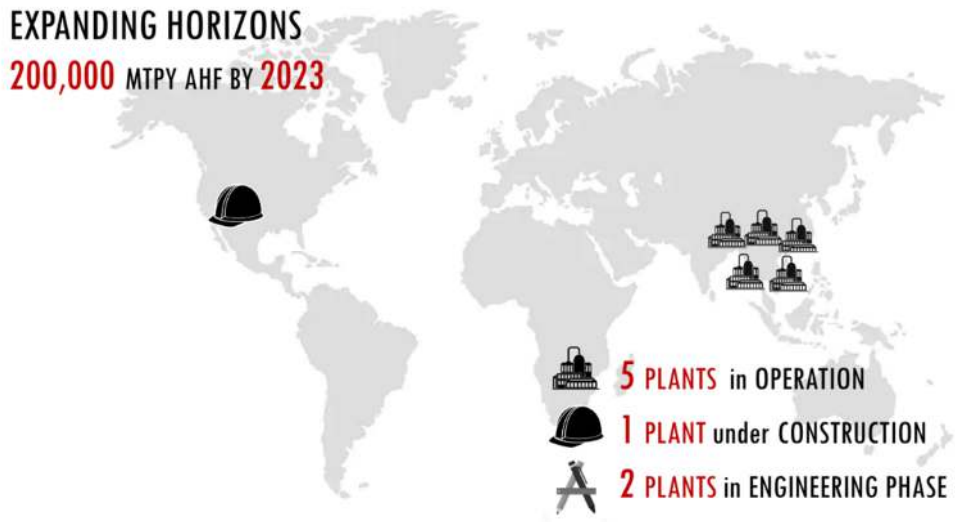
4.5 FSA Valorization

Fluorosilicic Acid to Hydrogen Fluoride: Solution for a more sustainable phosphate industry
Sustainability is becoming more important for the phosphate industry as well as across all industries. The value creation should consider a comprehensive sustainability strategy with ecological, technological, social, and economic aspects.
A perfectly sustainable approach would envisage the conversion of low value products/co-products into value added ones without compromising the aforementioned aspects. One of the co-products of the phosphate industry that could be evaluated from this perspective is fluorosilicic acid (FSA).

A high value-added co-product in a price sensitive industry
The conventional use of FSA is very low compared to overall production capacity. The main application is low bulk density aluminum fluoride (LBD AlF3) for which the market is limited and ever shrinking. Another application is water fluoridation which has limited market size and is controversial due to increasing health awareness in the society. The other application is fluoride salt manufacture; again, with very limited market size.
Buss ChemTech AG (BCT) offers a robust solution to the international phosphate industry to create added value from FSA in a sustainable manner. BCT's technology for manufacturing of Anhydrous Hydrogen Fluoride (AHF) from FSA opens the door to phosphoric acid producers to new markets such as organic and inorganic fluorochemicals like high bulk density aluminum fluoride as a bulk chemical or Lithium hexafluorophosphate as a sophisticated Li-ion battery ingredient . Considering the competitive challenge in the phosphate industry, such a revenue stream from diversity would not only improve the bottom-line but also balance the effects of fluctuations in the core business.

Process Highlights
FSA is fed to a concentration step that raises the acid concentration by absorption of SiF_4 from approx. 18% to 24%-wt. to levels of >45%-wt. Silica is precipitated and will be filtered from the concentrated acid solution.

The FSA is then pumped to a reactor where it is contacted with sulfuric acid. HF and SiF_4 form and are separated. The crude HF is condensed and purified, the SiF_4 flows to the concentration step and concentrates the FSA. The diluted sulfuric acid is stripped of residual HF in a stripping column with steam and air and is then recycled back to the phosphoric acid plant. The AHF production plant has to be attached to a phosphoric acid plant to close the loop of sulfuric acid and water.



FSA to HF technology checks all boxes for a sustainable co-product valorization and moreover it also adds an indirect value for environmental protection and to economy by replacing a considerable amount of CaF_2 which would have been mined otherwise.

HF and Derivatives

HF has applications in almost all industries and BCT technology offers high purity product suitable for various applications. BCT's technology portfolio also includes the following HF derivatives; high bulk density (HBD) aluminum fluoride (AlF_3), lithium fluoride (LiF) and lithium hexafluorophosphate ($LiPF_6$).

HBD AlF_3 is used in the production of primary aluminum to lower the bath operating temperature therefore reducing the energy consumption and to replace losses of fluorine and to maintain cryolite (Na_3AlF_6) ratio.

LiF is most widely used as a flux in the production of ceramics, such as enamels, glasses, and glazes. Similarly, it is also used in brazing and welding fluxes and molten salt chemistry in metallurgy. Another area of use is to be the raw material for LiPF6 production.

LiPF6 is an electrolyte ingredient used in lithium ion batteries. Due to the increasing shift towards making total electric or hybrid electric automobiles, the demand for LiPF6 has increased tremendously in the past ten years.

Summary

BCT FSA to HF process promises:

- Exceptional value addition to a by-product and generating new revenue stream
- An annex unit to PA Plant without jeopardizing the PA process
- Environmentally friendly technology
- Nonhazardous by product – amorphous precipitated silica with modest commercial value
- Comparative cost advantage of FSA route vs. conventional method via Fluorspar – competitiveness in new business line

- A byproduct (HF) independent of phosphate business fluctuations -absorbing effect
- Downstream diversification opportunity (AlF3, LiF, LiPF6 etc.)

4.6 Phosphogypsum and possible solutions

The production and the handling of the phosphogypsum is the critical point during the phosphoric acid production. The current environmental constraints make mandatory assessment of all possible treatment and uses of the byproducts.
Several options are currently used with more or less success. The final decision is depending on the environmental constraints, energy cost, capacity and financial equilibrium of the operation.
The most used option is the application as an additive in the cement and plaster industry. The requirements to be respected in terms of radioactive emissions and heavy metals necessitate the use of high-quality phosphate rock and as a rule most of the processes achieving the phosphogypsum purity requirements are from igneous origin.
Industry is using different technics to wash the phosphogypsum in order to meet the cement and plaster requirements. This technic is simple however it rises the question of the water treatment and wastes recovering.
Another option is to convert the phosphogypsum in ammonium sulphate using Merseburg process Sulfate by reacting Gypsum and Ammonium Carbonate.
The process is economically attractive in areas where Sulfur is unavailable or very expensive and within the close vicinity of Ammonia-Urea production complexes. In an existing Ammonia-Urea manufacturing complex, Ammonium and CO_2 gas are both available and can be conveniently used to treat Phosphogypsum to produce Ammonium Sulfate. The process reaction takes place in a series of reactors with a long residence time. There is 95% conversion achievement with gypsum particle size 95% passing a 120 mesh. Even though it is not evident to deal with any phosphogypsum and preliminary works and adjustments are necessary to have stable operation.
The solution for the phosphogipsum use and treatment should be a mix of careful selection of phosphoric acid production technology, ammonium sulphate production, purified gypsum for cement and plaster industry and use as filler and sulfur addition in fertilizer production.

5. CONCLUSION

All future projections confirm the population growth and the need to produce more food. This increase must be achieved under land and water constraints and climate changes.
Fertilizer will be one of the keys to acheive this target.
However, the many parameters and interactions that are to be considered with respect to the production units that composes a fertilizer complex and the entire complexity of project selection and development considering all variables makes the decision extremly difficult.
The necessity of global view from the initial project evaluation steps and particular expertise into the different fertilizer production units will require specific knowledge and experience to gain the confidence of the investors.
DBI, as major player in the field, together with BCT and with its long-term partners PRT and MECS® Technologies owns under the same roof such a capability.