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OPTIMIZING ENERGY CONSUMPTION AND PRODUCTION RECOVERY IN THE WORLD'S LARGEST TRAIN PHOSPHORIC ACID PLANT

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1 - SUMMARY

This is a description of Davy McKee's design of the world's largest single train phosphoric acid plant for IMC at their New Wales operation in Central Florida, USA. The plant was designed for the same capacity as the first two trains built by Davy McKee for IMC in 1975, with a substantial reduction in energy consumption. The plant was designed using the new "Mark IV" Prayon Attack Tank System, and Davy McKee Wet Rock Grinding and Pond Water Recycle System. The lower energy consumption goal was achieved with the added benefit of higher production efficiency and product quality.

2 - INTRODUCTION

Between 1962 to 1975, Davy McKee in Lakeland designed, engineered, constructed, and commissioned 42 Prayon wet process dihydrate phosphoric acid plants with individual capacities ranging from 120 to 1150 MTPD P_2O_5. The performance of all of these plants exceeds the original design parameters.

Although there are differences between the plant designs of the 70's and 60's, due to the continuous improvement in technology and equipment developments, these improvements were oriented to the capability of :

a. Designing larger plants
b. Reducing maintenance costs
c. Improving plant reliability
d. Processing lower grades of rock

In the mid 1970's, with the oil shortage and continuously rising energy costs, Davy McKee Lakeland, together with Society Industrielle de Prayon S.A., took a more energy efficient approach in their plant design while maintaining the same high quality standards of performance of the past decade. Thus the new generation of Prayon's plant "The Mark IV" was developed in 1978.

The main innovations introduced were :

1. New attack tank compartment size and configuration together with new agitator designs that improved agitation and at the same time reduced agitation power requirements.

2. New low level flash cooler and slurry recirculation system, where all slurry is recirculated through the flash coolers at an increased flow rate, and the internal recirculation pumps are eliminated.

   This new system reduces the ΔT across the flash cooler to 2°C, eliminating almost completely scale build-up in the system.

As a result of the new low level flash cooler arrangement, it was possible to accomplish this higher slurry recirculation flow through the flash cooler with a large reduction in pumping horsepower.

The higher slurry recirculation flow, together with the improved agitation, reduces solid build-up in the attack tank itself. This, together with the reduced scaling in the flash cooler, improves plant operating factors and reduces maintenance costs.

3. Use of vacuum pumps instead of steam jets in the flash cooler vacuum system.

With this modification, we are using a more efficient vacuum source, thus allowing more high pressure steam to be converted to electricity in a turbogenerator.

These above innovations together with the already existing Davy McKee's wet rock grinding system and in-plant pond water reuse system, made possible the efficient design of the largest single train phosphoric acid plant in the world for International Minerals and Chemical Corporation at New Wales, Florida.

The IMC New Wales plant was designed to produce 1452 MTPD P_2O_5 as 28 % P_2O_5 filter product acid using IMC 67 BPL wet ground phosphate rock and 93 % sulfuric acid as raw materials. The phosphoric acid plant consists of Prayon's Mark IV attack tank system and a filtration system consisting of a Bird-Prayon 30D filter with a 30E central valve. Because the main innovations as explained before are in the attack tank section, only this portion of the plant will be described.

3 - PROCESS DESCRIPTION (Refer to Figures 1 and 2)

The IMC third train Phosphoric Acid plant has a design capacity of 1452 MTPD of P_2O_5 as 28 % P_2O_5 acid.

The basic raw materials for the phosphoric acid plant are 67 BPL wet ground phosphate rock and 93 % sulfuric acid.

The process consists of reacting wet ground phosphate rock (5 % + 35 mesh) with sulfuric acid at a temperature and phosphoric acid concentration such that calcium sulfate dihydrate (gypsum, $CaSO_4 \cdot 2H_2O$) is precipitated. Phosphoric acid is produced at a strength of about 28 % P_2O_5 and is separated from the gypsum on a Bird-Prayon filter.

Reaction occurs in an eight compartment tank. Compartments 1 through 6 are collectively called the reaction section ; compartments 7 and 8 are called the digestion section. The phosphate rock is introduced into the attack tank from the rock grinding area as a 68 % solids slurry. The rock slurry can flow into either or both compartments No. 1 and No. 2 of the attack tank.

Sulfuric acid (93 % H_2SO_4) is supplied at battery limits under pressure. The acid is metered and then enters the mixing tees feeding No. 2 and/or No. 3 attack tank compartments. A small flow can be metered to compartment No. 7 if the excess concentration of H_2SO_4 is low in the digestion tanks. The flow split depends on operating experience.

Recycled phosphoric acid (No. 2 filtrate) from the filtration circuit is pumped to the attack tank. The No. 2 filtrate is level controlled and flow recorded to the mixing tees feeding the No. 2 and/or No. 3 compartment of the attack tank. In addition, a sludge stream from the 40 % P_2O_5 clarification tank can be pumped to the No. 1 compartment.

In the attack tank, phosphoric acid containing 38-40 % gypsum solids slurry circulates successively from compartment No. 1 to No. 5 ; the circulation is provided by the flash cooler pumps. Slurry is lifted by vacuum from compartment No. 5 to two parallel low level flash coolers. After being cooled by evaporation, the slurry is pumped back to the attack tank compartment No. 6. The slurry exits compartment No. 6 in two different directions : filter feed overflows to the digestion compartments No. 7 and 8 and is then pumped to the filter ; the rest of the slurry recirculates back to the No. 1 compartment of the attack tank. The ratio of recirculation flow to filter feed flow is approximately 32 : 1 at design conditions. This high recirculation rate ensures good dispersion of reactants, e.g., uniform distribution of free sulfate in the attack slurry.

Attack tank slurry temperature is maintained by the two parallel flash coolers previously mentioned. Most of the heat of reaction and heat of dilution of H_2SO_4 is removed by evaporation of water from the slurry under vacuum. Control of the quantity of heat removed is done by adjustment of the absolute pressure in the flash coolers.

The purpose of No. 7 and 8 digestion compartments is to give gentle agitation and adequate retention time. This ensures that crystallization of gypsum and fluosilicates is as complete as possible by eliminating supersaturation of the slurry.

A variable speed filter feed pump supplies reaction slurry from compartment No. 8 to the filter for separation of gypsum and recovery of phosphoric acid. The aged slurry is filtered on the Bird-Prayon tilting pan filter. The filter cake is given two countercurrent washes. Four separate acid strengths leave the filter and are collected as three filtrates in the filtrate seal tank :

a. 28 % P_2O_5 acid from the No. 1 filtrate section of the filter is collected in one of the filtrate seal tank compartments. From here it is pumped to the first stage evaporator feed tank.

b. Acids from the cloudy port filtrate and No. 2 filtrate sections of the filter are collected and mixed in a second filtrate seal tank compartment. From here it is pumped as 20 % P_2O_5 recycle acid to the mixing tees discharging to the attack tank.

c. Acids from the No. 3 filtrate section, cake dry section, and cell dry section are collected and mixed in a third filtrate seal tank compartment. From here the acid (7 % P_2O_5) is pumped back to the filter and used as wash in the No. 2 filtrate section.

Each filter pan inverts and the cake is blown off the cloth by air from the cake discharge blower. The filter cloth is then washed with recycled pond water. The cake is discharged and sluiced in the gypsum hopper with recycled pond water (from No. 2 hotwell). The gypsum slurry flows by gravity from the hopper to a pumping station from where it is pumped to the gypsum pond.

A horizontal cross flow packed scrubber is provided to remove fluorine from the vapors vented from the attack tank, digestion tank, filter, filtrate seal tank, and barometric condenser seal tank. Pond water is the scrubbing medium. The pond water flow is designed so that the fluorine content of the exhaust vapors is reduced to an acceptable level.

4 - ATTACK TANK SYSTEM DESCRIPTION

4.1. - Attack Tank Design

The IMC Attack Tank is an eight compartment carbon brick lined rectangular concrete vessel. Total liquid volume is 2000 m^3, 1400 m^3 in the reaction section (compartments No. 1 through 6) and 600 m^3 in the digestion section (compartments No. 7 and 8).

4.2. - Flash Cooling System

The flash cooling system consists of two 8 m diameter low level flash coolers in parallel. A Morris 1200 mm diameter axial flow pump installed in each flash cooler discharge downleg provides a total recirculation flow through the attack tank and flash cooling system of 19,900 m^3/hr. This high recirculation rate not only insures a low scale build-up in the attack tank and flash cooler system, but also provides a flow pattern in the attack tank whereby short circuiting is not possible, as in the case of a single tank system which relies on agitation to prevent short circuiting.

The vacuum system for each flash cooler consists of a barometric condenser and a Nash liquid ring vacuum Pump, V-Belt driven by a 250 hp motor.

4.3. - Attack Tank Agitators

The attack tank agitators were jointly designed by Prayon and Lightnin System Division of Mixing Equipment Corporation. The main improvement to conventional design is the use of variable pitch blade instead of the constant pitch or flat blades. There is one agitator per compartment.

The agitators in compartments No. 1 through 4 have three rows of impellers, four blades variable pitch in the two lower impellers, and a four blades radial type upper impeller. The two lower impellers provide most of the agitation flow, the upper impeller provides the necessary surface agitation for rapid blending of the raw materials and also acts as a mechanical defoamer. Agitator drives are Lightnin Hollow Quill Type with 250 hp motors. Compartments No. 5 and 6 agitators are designed as above, but with only two blades on the upper impeller ; agitator drives are Lightnin Hollow Quill Type with 200 hp motors.

Digestion compartments No. 7 and 8 have single four blade variable pitch impellers. Agitator drives are Lightnin Hollow Quill Type with 75 hp motors.

4.4. - Fume Scrubber System

The attack tank, No. 1 filtrate section of the filter, filtrate seal tank, flash cooler hotwell and evaporator hotwells are all vented through a Davy McKee design cross-flow scrubber, which meets both State of Florida and EPA air pollution regulations. This scrubber system, together with the use of wet rock, produces a very clean and pleasant working environment.

5 - PLANT PERFORMANCE

5.1. - Process Performance

The New Wales plant was operated for six weeks before being shut down last December because of the poor fertilizer market conditions.

The first four weeks were spent in debugging the plant and collecting data for optimizing the operation. In this period, the plant ran consistently at 820 and 1180 MTPD P_2O_5 with P_2O_5 recoveries of 93 to 95 %, based on filter cake losses.

Once the operating parameters were optimized, the plant was run up to 1452 MTPD P_2O_5, while producing 28.1 % P_2O_5 product acid with an average recovery of 95.2 %. During the last four days of operation, because the acid storage tanks were full, the plant rate was brought down to 1090 MTPD P_2O_5, while producing 28.1 % P_2O_5 acid with an average recovery of 97.7 %.

The plant performance during this last two week period is summarized on TABLE 1.

TABLE 1

		Cake Losses		
Plant Rate	Filter Product % P_2O_5	Total P_2O_5	W.S. P_2O_5	C.I. and C.S. P_2O_5
1452 MTPD P_2O_5	28.1	4.8	0.4	4.4
1090 MTPD P_2O_5	28.1	2.3	0.4	1.9

5.2. - Equipment Performance

5.2.1. - Agitators

The new design of attack tank agitators consumed much less power than expected. During the first four weeks of operation, when the plant recoveries were rather low, there was concern that the level of agitation might be insufficient and thereby cause higher P_2O_5 losses. However, the last two weeks of operation indicated that there was enough agitation for the chemical reaction.

After the six weeks of operation, when the attack tank was emptied and inspected, the level of scale build-up was minimal with the exception of underneath the flash cooler suction and discharge downlegs (especially under the suction legs in compartment No. 5) and in compartment No. 7, where it was considered excessive. Modifications to correct these problems are presently planned without additional agitator power input.

These modifications include lengthening the flash cooler suction and discharge downlegs, and reversing the direction of agitation in No. 7 and No. 8 compartments.

Another problem that was experienced with several agitators is erosion along the bottom of the blades near the stabilizers. Since it is believed that the stabilizers are not required, they will be removed.

5.2.2. - Flash Cooling System

This system performed extremely well. At start-up, the flash cooler pumps were found to be surging slightly and the motor ammeters indicated that the flow was higher than design. The pumps were slowed down to meet design flow condition. At this reduced speed and the plant operating at 1452 MTPD P_2O_5, the flash cooler ΔT was 2°C, as designed. The flash coolers were opened for inspection on several occasions and were found to be completely clean. After six weeks of operation the flash coolers, flash cooler pumps, and circulating piping showed no sign of scale build-up, as experienced with the high level flash coolers. However, the flash cooler system, as designed, presented the only major problem encountered in the plant. Because of the flash cooler piping arrangement, the pumps are mounted at a lower level than the main attack tank roof, leaving a very small freeboard when operating at normal liquid level. Due to the wave effect created by the agitators' upper blades, a severe foaming and slurry spillage problem occurred around the pumps. Modifications to seal off the openings and eliminate the spillage are in progress. In a smaller plant, with only a single flash cooler, this problem would not have occurred, because the pump can be mounted at the main roof elevation.

5.2.3. - Fume Scrubber System

The fume scrubber system performed according to design and met both EPA and the State of Florida air pollution regulations.

6 - Conclusions

The IMC New Wales new phosphoric acid plant performed better than expected ; the plant operated up to 1452 MTPD P_2O_5 without reaching its maximum capability. Although there were indications during the last two weeks of the run that plant recoveries were 1 to 2 % higher than the other two Prayon plants built for IMC by Davy McKee in 1975, it is too early to rely on this improvement. The horsepower consumed by the new attack tank system was significantly lower than anticipated and approximately 40 % of the 1975 plants (see Table 2). Based on the IMC operatio even more energy efficiency will be possible in future plants.

TABLE 2

Attack Tank System HP
1452 MTPD P_2O_5

			1975 PLANT		1981 PLANT		FUTURE PROJECTS
			Connected	Consumed	Connected	Consumed	Connected
	(1-4)		4 x 250	4 x 220	4 x 250	4 x 140	4 x 150
Agitators	(5-6)	(5)	1 x 150	1 x 105	2 x 200	2 x 110	2 x 150
		(6)	1 x 75	1 x 70			
	(7-8)		2 x 50	2 x 45	2 x 75	2 x 40	2 x 50
Flash Cooler Pump			2 x 350	2 x 320	2 x 125	2 x 90	2 x 125
Slurry Recirculating Pumps			2 x 50	2 x 45	—	—	—
F.C. Vacuum Pumps			2000^{+}	2000^{+}	2 x 250	2 x 200	2 x 250
Filter Feed Pump			1 x 200	1 x 160	1 x 200	1 x 160	1 x 200
Fume Scrubber Fan*			1/2 x 200	1/2 x 150	1/2 x 200	1/2 x 120	1/2 x 200
TOTAL HP			4425	4110	2600	1660	2050

* Only 50% of fume scrubber dedicated to attack tank.

\+ Equivalent hp that could be generated by steam consumed by vacuum jets.

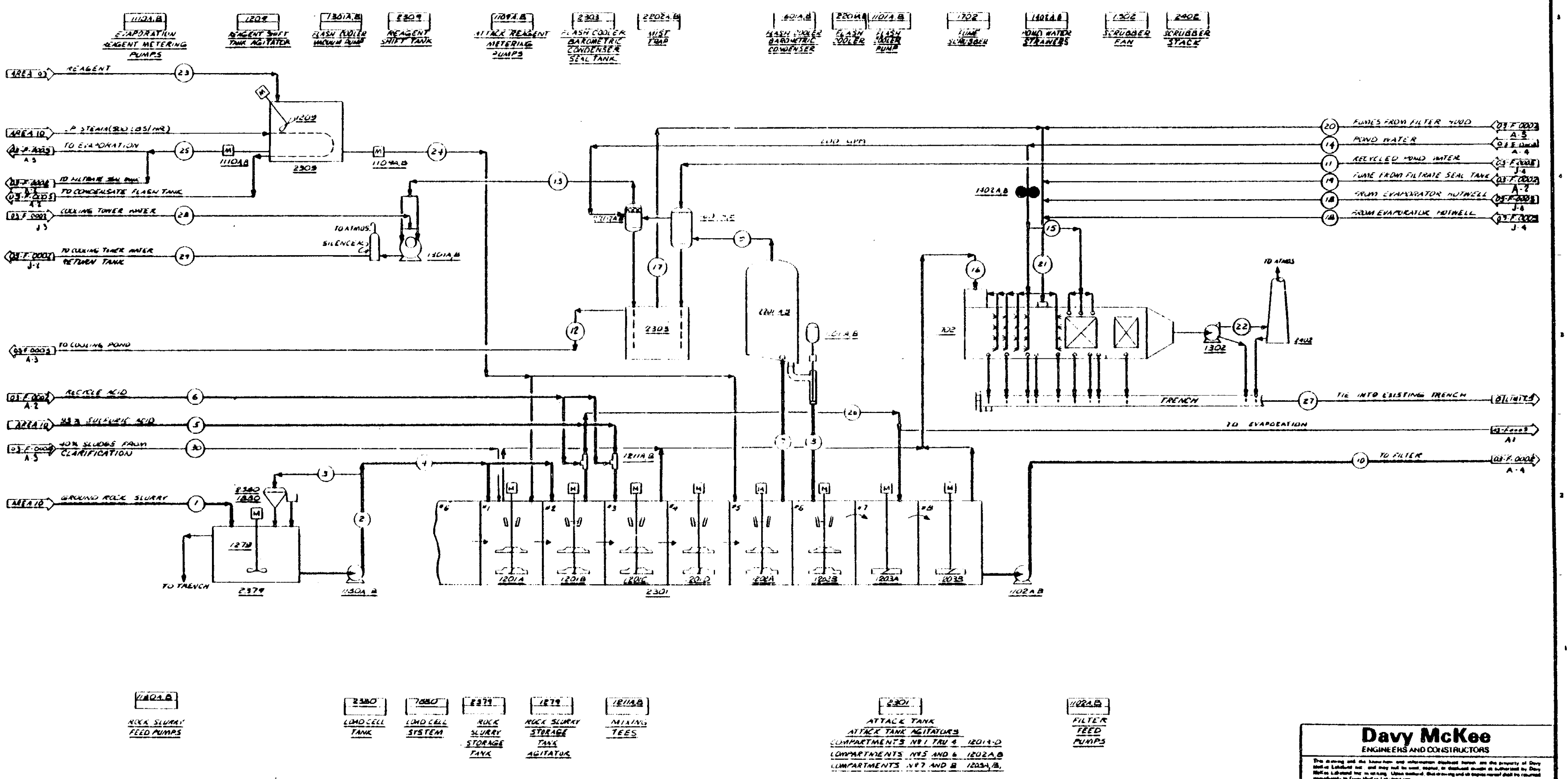

FIG. 1

NO.	TITLE
	REFERENCE DRAWINGS

Davy McKee
ENGINEERS AND CONSTRUCTORS

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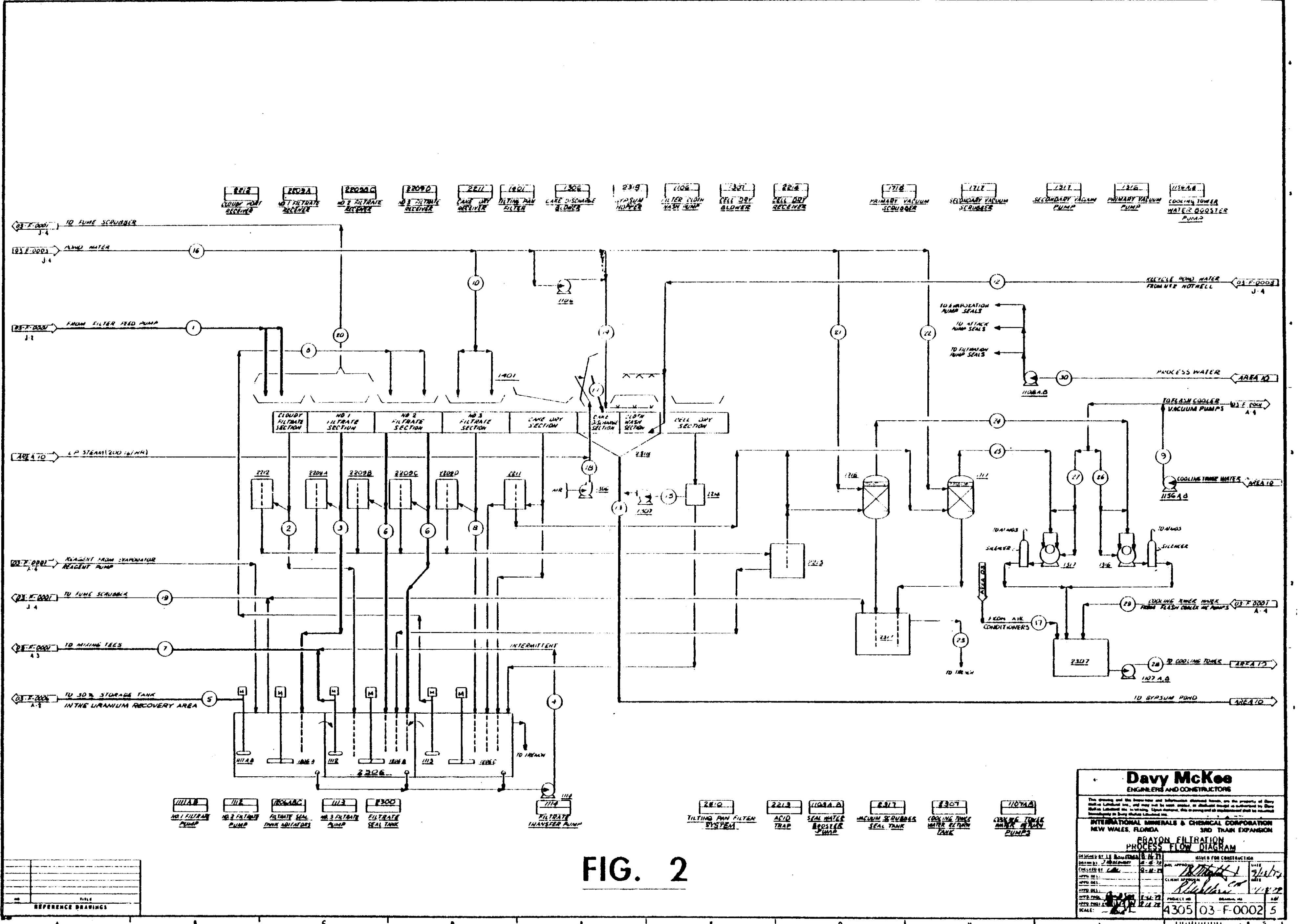
INTERNATIONAL MINERALS & CHEMICAL CORPORATION
NEW WALES, FLORIDA 3RD TRAIN EXPANSION

PRAYON ATTACK
PROCESS FLOW DIAGRAM

DESIGNED BY LE BOUFFARD 8-15-77
DRAWN BY BRASSEUR 8-18-77
CHECKED BY LBL 9-12-77
APPD DEL.
APPD DEL.
APPD DEL.
APPD PROC. 9-6-77
APPD PROJ. 9-12-77
SCALE: — NONE —

ISSUED FOR CONSTRUCTION
DML APPROVAL
DATE 9/2/77
CLIENT APPROVAL
DATE 9/14/77

PROJECT NO.	DRAWING NO.	REV.
4305	03-F-0001	5


2212 CLOUDY PORT RECEIVER
2209A NO 1 FILTRATE RECEIVER
2209C NO 2 FILTRATE RECEIVER
2209D NO 3 FILTRATE RECEIVER
2211 CAKE DRY RECEIVER
1401 TILTING PAN FILTER
1306 CAKE DISCHARGE BLOWER
2318 GYPSUM HOPPER
1106 FILTER CLOTH WASH PUMP
1307 CELL DRY BLOWER
2214 CELL DRY RECEIVER
1718 PRIMARY VACUUM SCRUBBER
1712 SECONDARY VACUUM SCRUBBER
1317 SECONDARY VACUUM PUMP
1316 PRIMARY VACUUM PUMP
1156A,B COOLING TOWER WATER BOOSTER PUMP
03-F-0001 J-4 TO FUME SCRUBBER
03-F-0003 J-4 POND WATER
03-F-0001 J-2 FROM FILTER FEED PUMP
AREA 10 LP STEAM (200 lb/HR)
03-F-0001 J-4 REAGENT FROM EVAPORATOR REAGENT PUMP
03-F-0001 J-4 TO FUME SCRUBBER
03-F-0001 A-3 TO MIXING TEES
03-F-0006 A-2 TO 30% STORAGE TANK IN THE URANIUM RECOVERY AREA
RECYCLE POND WATER FROM NO 2 NOTHELL 03-F-0003 J-4
TO EVAPORATION PUMP SEALS
TO ATTACK PUMP SEALS
TO FILTRATION PUMP SEALS
PROCESS WATER AREA 10
TO FLASH COOLER VACUUM PUMPS 03-F-0001 A-4
COOLING TOWER WATER AREA 10
COOLING TOWER WATER FROM FLASH COOLER VAC PUMPS 03-F-0001 A-4
FROM AIR CONDITIONERS
TO COOLING TOWER AREA 10
TO GYPSUM POND AREA 10
TO TRENCH
INTERMITTENT
AIR
TO ATMOS
SILENCER
CLOUDY FILTRATE SECTION
NO 1 FILTRATE SECTION
NO 2 FILTRATE SECTION
NO 3 FILTRATE SECTION
CAKE DRY SECTION
CAKE DISCHARGE SECTION
CLOTH WASH SECTION
CELL DRY SECTION
2306
2307
2313
2317
1108A,B
1156A,B
1107A,B
1111A,B
1112
1113
1114
1306A
1306B
1306C
1
2
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14
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1111A,B NO.1 FILTRATE PUMP
1112 NO.2 FILTRATE PUMP
1306A,B,C FILTRATE SEAL TANK AGITATORS
1113 NO.3 FILTRATE PUMP
2300 FILTRATE SEAL TANK
1114 FILTRATE TRANSFER PUMP
2310 TILTING PAN FILTER SYSTEM
2213 ACID TRAP
1108A,B SEAL WATER BOOSTER PUMP
2317 VACUUM SCRUBBER SEAL TANK
2307 COOLING TOWER WATER RETURN TANK
1107A,B COOLING TOWER WATER RETURN PUMPS
REFERENCE DRAWINGS
NO
TITLE
A
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I
Davy McKee
ENGINEERS AND CONSTRUCTORS
INTERNATIONAL MINERALS & CHEMICAL CORPORATION
NEW WALES, FLORIDA
3RD TRAIN EXPANSION
PRAYON FILTRATION
PROCESS FLOW DIAGRAM
DESIGNED BY
DRAWN BY
CHECKED BY
APPD DES.
APPD PROJ.
SCALE:
ISSUED FOR CONSTRUCTION
DATE
CLIENT APPROVAL
PROJECT NO
DRAWING NO
REV
4305
03-F-0002
5

FIG. 2

TA/82/18 Optimizing energy consumption and production recovery in the world's largest train phosphoric acid plant, by M.L. WALTON & C.A. PFLAUM, International Minerals & Chemical Corporation, USA, R.H. CURTIS & J.M. ENRIQUEZ, Davy McKee Corporation, USA

DISCUSSION : (Rapporteur Mr. P. MORAILLON, SICNG, Greece)

Q - Mr. M. GAURON, COFAZ SA, France

1. In Table 1, you indicate total unreacted + cocrystallized P_2O_5 losses at two plant rates. What do the figures 4.4% and 1.9% actually include?

2. Can you indicate the pond water and gas flow rates in the horizontal cross flow scrubber?

A - 1. The figures 4.4% and 1.9% are the filter cake non-water soluble losses at the two different rates. They are expressed as a percentage of the feed P_2O_5.

These figures include the citrate insoluble P_2O_5 (unreacted phosphate rock) plus the citrate soluble P_2O_5 (dicalcium phosphate cocrystallized with the gypsum).

In practice, the total P_2O_5, water soluble P_2O_5, and CaO in the gypsum cake are determined. Phosphate rock and filter product acid are also analyzed for total P_2O_5 and CaO. This enables a P_2O_5 and CaO balance to be made, and hence the total water soluble and P_2O_5 cake losses can be calculated as a percentage of rock feed P_2O_5. The C.S. and C.I. losses are assumed by difference of total and water soluble losses.

2. The design flow rates to the horizontal cross flow scrubber were as follows for a plant capacity of 1452 MTPD P_2O_5:

Pond Water - 568 M^3/hr
Gas Flow - 76,700 M^3/hr

Q - Mr. D.W. LEYSHON, Jacobs Engineering Co, USA

1. Table 1, page 5, shows a very substantial difference in solid solution loss at the two rates reported. Jacobs experience with Dorrco reactors shows a much lower effect of detention (operating rate) on the C.I./C.S. We would suggest the rock feed particle size might have been significantly finer at the lower operating rate. Do you have any rock size data?

2. The Dorrco reactor five day test run done in 1966 (see Slack) reported an average 2.2% insoluble loss P_2O_5 at 31% acid strength, so we do not find the 1.9% you report a large improvement considering the intervening 16 years.

3. Also, the water soluble losses are not consistent. They should be significantly higher at the high rate and we believe repulped gypsum slurry samples rather than pan samples could show this.

A - 1. Ground rock particle size was not significantly different between the two capacities reported. The design grind was 5% + 35 Tyler mesh. The average grind for the period at 1452 MTPD P_2O_5 was 5.3% + 35 mesh, 45% -200 mesh, and for the period at 1090 MTPD P_2O_5 was 4.8% +35 mesh, 47% -200 mesh.

The increase of non water-soluble cake losses between rates of 1090 to 1452 MTPD P_2O_5 is rather high, but it should be remembered that these are results from a two week period only a month after start-up of the World's largest phosphoric acid plant. There was only limited time to attempt to optimize operation. We expect that after longer periods of stable operation, the difference in P_2O_5 losses between the two capacities will reduce.

2. It should be recognized that non water-soluble losses of 2.2% P_2O_5 are very good for any design of dihydrate plant. Therefore, there is a limit to how much this can be improved without going to a recrystallization route. We do not know if we can maintain the 1.9% C.S. and C.I. P_2O_5 in the future at 1090 MTPD P_2O_5, but if so the benefits are certainly not insignificant. An improvement of 0.3% P_2O_5 at 1090 MTPD P_2O_5 represents annual savings of $ 200,000 for losses valued at $ 200/T P_2O_5.

Since Mr. Leyshon refers to performance of a Dorrco plant in the 1960s we have checked on the details. Unfortunately, Mr. Leyshon in his one paper did not give any data for a modern Dorrco plant, so we cannot see if there has been any improvement in their performance in 16 years.

The plant performance shown in Slack is the same as in the paper "Manufacture of Phosphoric Acid from A.A.C. Black Rock Using the Dorr-Oliver Single Tank Reactor" by Kronseder, Kulp, Leyshon, Jaeggi, presented at TFI Round Table, Washington, D.C., 1965. By extracting data from these two published sources and comparing with the Prayon Mark IV plant operation at IMC, we can produce the following table:

	Dorrco	Prayon Mark IV
Operating Rate STPD P_2O_5	360	1200
Rock Grinding Method	Dry	Wet
Rock Grind-200 Mesh %	65	47
Rock BPL	68	67
Retention time, hrs	7.2	4.8*
+Power Consumption, KWH/ST P_2O_5	70-75	38
Steam, lb/ST P_2O_5	375	-
Non water-soluble Cake Losses, % P_2O_5 Feed	2.2	1.9

*Includes digestion volume (filter feed)

+Attack plus filtration

From the above numbers, it is evident that the Prayon Mark IV performance was obtained with a coarser rock, only two thirds of the retention time, and about half of the power (even ignoring steam) compared to that of Dorrco. Therefore, the whole plant performance has to be considered before assessing whether it is an improvement.

3. On your comment on water soluble P_2O_5 losses at different rates, the numbers reported were obtained from IMC's daily laboratory analyses and we do not have any reason to question them. In our opinion, the results show that we have not reached the maximum filter capacity, especially if you consider that

this filter is equipped with a 30-E central valve and the new Bird-Prayon sloped bottoms pans which increase the filtrates drainage speed.

Q - Mr. E. UUSITALO, Kemira Oy, Finland

In your conclusion, you have notified 40% energy saving compared with phosphoric acid built in 1975. Are you building now after these experiences new mixers also in the old reactors?

A - Although we have not yet replaced the mixers in any of the existing plants with the new design, currently we are conducting studies in several plants to determine the return on investment of such modifications, and we are very optimistic that they will be carried out in the near future.

Q - Mr. P. SMITH, QUIMBRASIL, Brazil

1. Could you please explain the reasons for the use of the 30-E central valve on the 30-D Prayon filter?

2. Would such a high recirculation be advisable for a relatively coarse (60% 100 mesh) igneous phosphate?

A - 1. The new Mark IV Prayon plant at IMC was designed for 1452 MTPD P_2O_5 as 28% acid. The 1975 Mark III plant is able to achieve this capacity as a maximum with a conventional 30D filter and valve. Because of the expected improvement in the reaction section and hence better filterability of the gypsum/phosphoric acid slurry, we were confident that this plant capacity could easily be handled in a Bird-Prayon 30D filter with an active filter area of 175 M^2. However, it was decided to install the central valve of a 30E filter to eliminate the liquid flooding possibility when the plant operates over design capacity.

2. For a relatively coarse igneous rock, because of their lower reactivity, the recirculation rate should be approximately 30 to 70% lower depending on the particular rock and the particle size distribution