Philosophy of Implementing Digestion System in Dihydrate PA Technology

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Jordan Phosphate Mines Company

1- JPMC Currently operates three open mines:

- **Al-Hasssa**
- **Al-Abiad and**
- **Eshidiya**

Producing around 7 million TM phosphate

2- Aqaba Industrial Complex

- SA	Monsanato Four Beds – double Conversion	4500
- PA	Dihydrate Prayon Mark IV Process	1310
- DAP	Gulf Process , Badger INC	2400
- ALF3		50 Ton/day

Joint Ventures

The Indo -Jordan Chemical Company (IJC)

A production capacity of 225.000 MTPY of P_2O_5

The Jordan - Japan NPK Plant

For the purpose of producing NPK and DAP fertilizers

A production capacity of 200.000 MTPY of P_2O_5

JPMC's Capital has reached 100 Million US$ in 2001

The strategies of JPMC are:

At mines:

-To increase phosphate production to 8 Mt in 2008

-To use natural gas

Phosphate Rock - high grades

- Soon will be depleted on the international market

From the international experience

- 29% P_2O_5 content is admissible
- should not be less than 28.5% P_2O_5 (BPL 62.27%)

Lower grades 65 % BPL

Lead to :

Higher specific consumptions of Phosphate and SA as well,

- Consequently, more heat will be generated
- Higher content of impurities

- Which impact directly on:

P_2O_5 recovery Slurry filtration rate

To overcome the problems cause by phosphates qualities

Technology

PA producers

- must develops and

- Advance existing equipments

- New process technologies must be more

Flexible with

Filter surface areas **Reaction volumes**

Management

A direct loss of production
Can be reduced to minimum if :

70-72% BPL

Annual Production

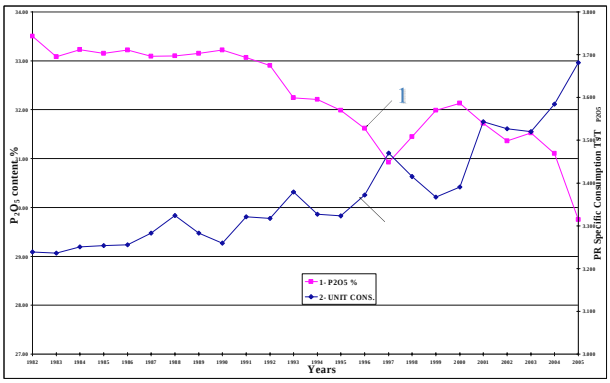
65-66% BPL

-The plant is well managed
- Increased on stream factor
- Reduce unscheduled shutdowns

- A steady operation helps in achieving consistently

High productivity **Efficiencies**

Fig.-1 P2O5 Content & Specific Consumption of Phosphate treated at Aqaba Plant during 1982-2005

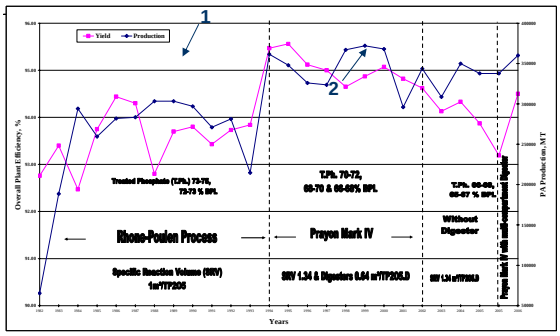


Specific consumptions have been increased to :

Phosphate - 15 %

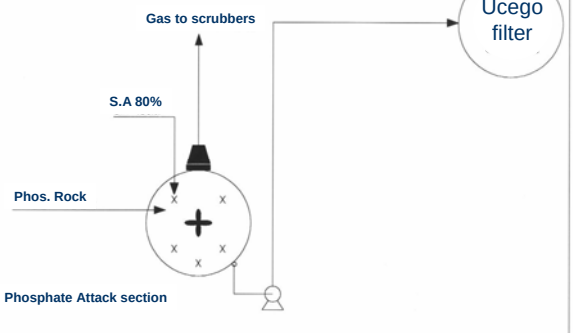
SA - 7.5% per t P2O5 produced

Fig.-3 PA Yearly Production and P2O5 Yield of Aqaba PA plant
1- Production, 2- Yield.



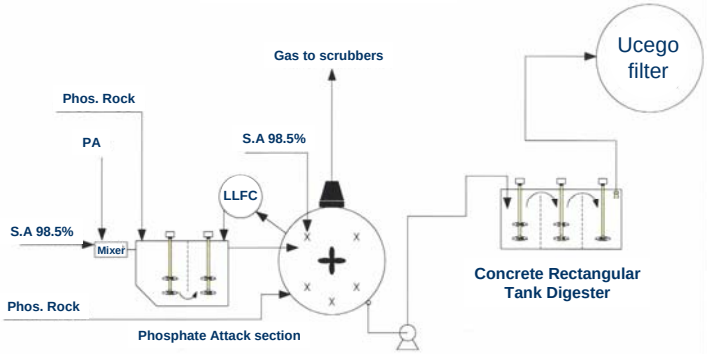
P2O5 production and overall efficiencies of Aqaba PA plant between 1982 and 2005 can be divided in to three periods:

First Period
1982-1993



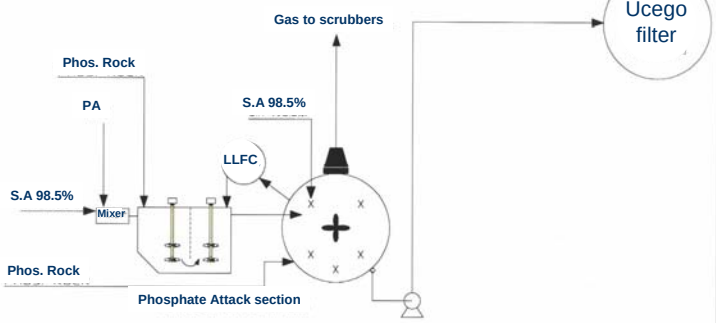
REACTION SYSTEM

Second Period
1994-2001



REACTION SYSTEM

Third Period
2001-2004

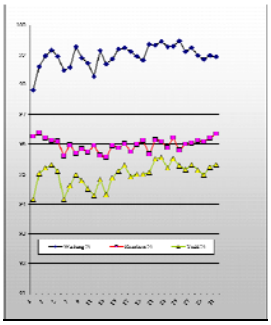


REACTION SYSTEM

Table-1 Production, Yield Criteria of Specific Reaction and Digestion Volumes of PA Dihydrate Processes

	Unit	First Period 1993-1982	Second Period 2001-1994	Third Period 2004-2001
G. Phos. Passing Tyler # 100	%	100	85 – 75	85 – 75
S R V	m^3/mtpd P_2O_5	1	1.34	1.34
S D V	m^3/mtpd P_2O_5	No	0.64	0.68
S F C]Filer area 205 & 208 m^2.[	mtpd P_2O_5/m^2	)Using 73-75% BPL(4.6	)Using-68-70% BPL(6.3	)Using 67-65 & 65 % BPL(5.5
Holding Time	min	170-160	330	230
Scales build up		v. high	No	high
Filter cloth spin time	day	12	25 <	17
Filter acid	%	26 >	28 <	26.5
Limitation Production		Yes	No	Yes
PA slurry condition		High super saturation	De super saturation	Super saturation
Slurry temperature before filtration		High constant temperature	low temperature	High constant temperature
Bottlenecks		Digesters + reaction section	No	Digesters
Production	Ton *10^3	303	375 <	345
Efficiencies Washing Reaction Yield	 % % %	 98.0 95.61 93.70	 98.93 96.35 95.31	 98.17 96.19 94.43

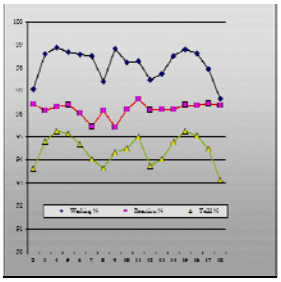
Fig-4 Effect of Reaction & Digestion Systems on the Plant Efficiencies, 1-Gypsum Washing, 2-Reaction 3- Yield % ,



The average efficiencies:

- **washing efficiency 98.93 % (97.81- 99.45%)**
- **Reaction efficiency 96.34% (95.55- 96.38%)**
- **The yield 95.31%**

Fig-5 Performance of PA Plant without Digestion System on Attack- Filtration and overall Plant Efficiencies%



(Without digester): average efficiencies :

- **Washing 98.17 % 96.66 to 98.88%**
- **Reaction 96.19 % 95.43 - 96.63,%**
- **Yield 94.43%**

Typical scales composition of filter grids

Mainly:

- $CaSO_4 \times H_2O$
- Fluorides Compounds such as
- Na
- K
- NaK
- Fluosilicates
- Chukhrovite

Fig.-7 Tendency of scale formation on the filter Perforated sheets of Aqaba PA plant (Before Linking up the digester)

Fig.-17 Tendency of scale formation on the Filter perforated sheets of Aqaba PA plant, (After linking up the digester)

After 6 months of operation ,

- No more build up of scales are observed
- The old scale is dissolved by Cooling tower acidic water

1- Major bottlenecks of I and III periods are:

- Shortage of reactor retention time
- Absence of digester

Slurry is handled and filtered in a state of high constant temperature,

Caused serious process problems;

- High super saturation of the slurry PA
- Low slurry filtration rate
- Low P_2O_5 recovery
- Low service life of filter cloth cycle
- High scales build up
- High frequency of wash cycle time
- Low of stream factor

2- The concepts of using digestion system are :

-To provide volume separate before filtration stage,

-To allow fully de super saturation of slurry PA liquid phase

History of implementing Digestion system

It was linked with Prayon –Mark III in 1965

-Increasing the reaction volume by 25 %

-Adding a single rectangular concrete tank digester with two agitators

Three carbon steel cylindrical tanks digester is linked with Prayon |mark IV IN 1982

Fig-8 Arrangement of Digestion system
With Prayon Mark-IV Dihydrate Process

Problems of Digestion System of Aqaba PA plant

Three carbon steel rubber lined tanks digester ,

- protected with only 1.5 m carbon bricks in height .

-Began to emerge catastrophic failures only after eight years of operation

The rubber-lined fittings near the baffles areas failed More than two times ,the shell of the second tank got damaged .

Built new concrete rectangular tank digester

The main factors forced to build new concrete tank digester are:

-To ensure -Long-term of operation

- To help using low grades phosphate

- To reduce the P2O5 losses of gypsum

- To stop build up scale formation

Works on site

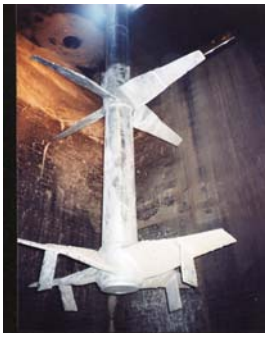
The digester is:

Located in the same previous location of carbon Steel tanks

- flat
- Squared shape
- Divided into three compartments
- Working volume 900 m3
- operating volume 0.68 m3/ tpd P2O5

Agitators

Compartment-A is equipped with Prayon Lightnin Reactor Agitator double impeller agitator



Compartment-B is equipped with Robin patented of axial flow propellers type agitator having double impeller

- Rotation speed has decreased to 38 rpm,
- Diameter of blades has increased to 10%,
- Agitation power reduced from 90 to 72 Kw

Agitators

Compartment-C is equipped with Prayon Lightnin digester agitator, having one impeller high rotation speed.

Processing phosphate grade 65-%BPL with linking up digestion system

Two industrial trials have been conducted

The first group of experiments was conducted
For 9 days test run.

Followed by a 12-days production run

Results are:

Minimum 1000

Maximum 1300

Average 1200 tons P2O5

Maximum filter acid is 26.89 .%

-Efficiencies:

- Washing 98.44 %

-Reaction 96.64%

-Yield 95.13%

BPL = P2O5 * 2.185 on dry basis

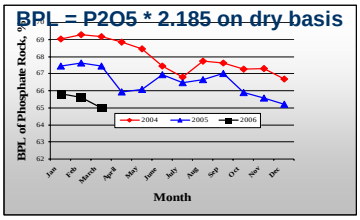


Fig.-16 Average Content of BPL fed into reactor last three years

The period of the second trial was about one month

Average results of efficiencies:

Washing	98.4	97.03 - 99.38 %
Reaction	96.45	96.10 - 96.77%
Overall plant	95.00.%	

Max filter acid was 28.40

In spite of the somewhat lower P2O5,

In general, Jordan Phosphates still remain

One of the world's easier rocks to process WPA production,

Conclusion

1.The first concrete rectangular tank digester with 900 m3 has been in operation at Aqaba PA plant in 2005

2- This tank digester is the best technological solution

- From a process and operating point of view
- From an economic point of view in spite of time consuming for erection
- An initial investment and labor costs are low
- A maintenance cost dramatically has been reduced

3- Agitators are operating at relatively low power consumptions

4- Based on the industrial experimental results

- P_2O_5 recovery increase higher than 0.88 %
- Estimated annual production cost savings amount 0.8 million US $

Thank You

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