DAP PLANT OPTIMIZATION

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No matter the industry, every company is looking for ways to reduce costs and increase profits. In the manufacture of diammonium phosphate fertilizer (DAP), there are many methods available to cut costs which are not being utilized as much as they should. This paper will focus on various design options that yield a high rate of return on investment. The design options that will be investigated are as follows:

- Granulator Pipe Reactor in conjunction with a Preneutralizer
- Dual Mole Scrubbing
- Recycling Dedust Gas to the Combustion Chamber
- Ammonia Vaporization using Tail Gas Scrubber Liquor
- Ammonia Air Chiller

These options result in a reduction of fuel consumption in the Dryer, a reduction of citrate insoluble P_2O_5, and reduction in the amount of strong phosphoric acid needed which increases the amount of power that can be generated from sulfuric acid production. Each one of these options will be compared against a base case that does not contain any of these options to determine the rate of return of investment for each. Then a final case including all of the design options will be compared against the base case.

EXECUTIVE SUMMARY

A high level of contingency has been added to all costs found in this paper to provide confidence in the estimates. The estimates use a U.S. Gulf Coast basis and costs in other locations will be different. Even with such a high cost added, each design option still proves to be economical. All savings mentioned applies to what Jacobs determined to be a typical plant, and the actual savings will vary from plant to plant. Three and six months were given as possible plant downtimes to make modifications, careful planning can reduce this downtime by half. No information found in this paper should be considered as a competitive bid.

Application of all the DAP Pant optimization techniques discussed in this paper produces a 10.4% increase in profits in a given year compared to a base case where none of these techniques are used. This is assuming a gross profit margin of 25% before any modifications are made regardless of the size of the fertilizer plant. The design options that will be discussed in this paper are listed below:

- Granulator Pipe Reactor in conjunction with a Preneutralizer
- Dual Mole Scrubbing
- Recycling Dedust Gas to the Combustion Chamber
- Ammonia Vaporization using Tail Gas Scrubber Liquor
- Ammonia Air Chiller

The capital expenditure of all five options for a given plant size along with the annual savings, the rate of return on investment, and payback period is given in Table 1. A U.S. Gulf Coast basis was used in the determination of all costs in this paper.

Table 1: Economics of all Five Design Options

Rate	Cost (Millions of $)	Annual Savings (Millions of $)	Rate of Return	Payback Period
35 stph	6.7	2.3	34%	35 months
65 stph	10.4	4.5	43%	28 months
100 stph	13.5	6.8	50%	24 months
130 stph	15.9	9.0	57%	21 months

For a 130 stph (short ton per hour) plant the rate of return is 57% which comes to a payback period of approximately 21 months.

Table 1 applies to a new facility, but for a revamp a loss of profit from plant downtime must be considered as well. In the case of a plant revamp, 3 months of downtime may be needed to make modifications to an existing plant without an increase in production capacity. It is Jacobs recommendation that if a plant is to be revamped that it should also be modified to maximize the production rate. A 50% increase in production rate may require 6 months of downtime and production will be made back in a year. A 65.5% increase in profits can be expected from a 50% increase in capacity that also incorporates all the design options discussed in this paper. The cost of a revamp, on a U.S. Gulf Coast Basis, for a 50% increase in capacity along with the savings, rate of return, and payback period is given in Table 2. Costs at different locations may be expected to vary. The costs associated with a 50% increase in production include upgrading solids handling equipment, ductwork, and piping, new Combustion Chamber, modification of the Scrubbers, Dryer and Granulator.

Table 2: Economics of all Five Design Options Coupled with a 50% Increase in Capacity

Old Rate	New Rate	Cost (Millions of $)	Annual Savings (Millions of $)	Rate of Return	Payback Period
35 stph	53 stph	17	15.6	92%	13 months
65 stph	98 stph	26	31.3	120%	10 months
100 stph	150 stph	33	46.9	142%	8 months
130 stph	195 stph	39	62.5	160%	7 months

INTRODUCTION

No matter the industry, every company is looking for ways to reduce costs and increase profits. In the manufacture of diammonium phosphate fertilizer (DAP), there are many methods available to cut costs which are not being utilized as much as they should. This paper will focus on various design options that yield a high rate of return on investment. The design options that will be investigated are as follows:

- Granulator Pipe Reactor in conjunction with a Preneutralizer
- Dual Mole Scrubbing
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These options result in a reduction of fuel consumption in the Dryer, a reduction of citrate insoluble P_2O_5, and reduction in the amount of strong phosphoric acid needed which increases the amount of power that can be generated from sulfuric acid production. Each one of these options will be compared against a base case that does not contain any of these options to determine the rate of return of investment for each. Then a final case including all of the design options will be compared against the base case.

In the case of a plant revamp the loss of profit from downtime will be considered as well.

All the options described in this paper can also be applied to the production of MAP and ammonium phosphate based NPK’s.

THE JACOBS SLURRY PROCESS

Dry Section

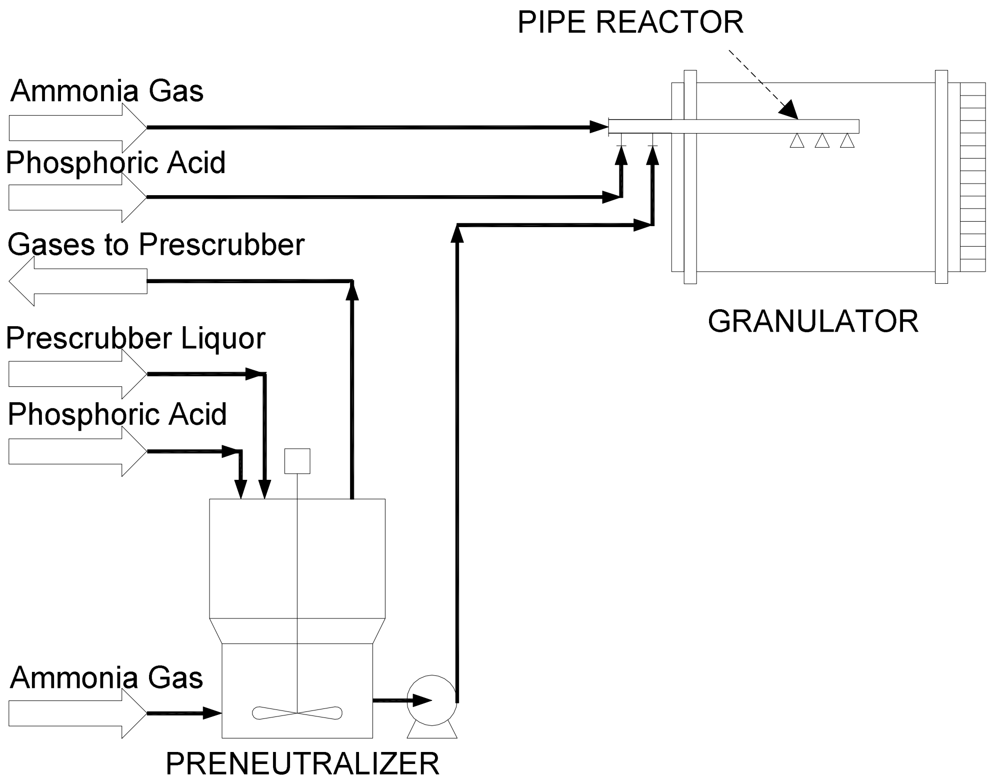
A simplified process flow diagram for the Dry Section of the Jacobs Slurry Process can be seen on page 14. Phosphoric acid, gaseous ammonia, and scrubber liquor enter into the Preneutralizer where it is controlled at a specific gravity of 1.53 and a mole ratio of 1.5, which corresponds to a moisture content in the slurry of 18%. The mole ratio is the number of moles of nitrogen divided by the number of moles of phosphorous. The Preneutralizer is maintained at a mole ratio of 1.5 to ensure maximum solubility of the slurry. The ammonium phosphate slurry is pumped from the Preneutralizer to the Pipe Reactor where it is combined with strong phosphoric acid, and gaseous ammonia and sprayed onto the bed of the Rotary Granulator at a mole ratio of 1.5 and a moisture of 10%. Underneath the bed in the Granulator is the Ammonia Sparger that supplies liquid ammonia to raise the mole ratio of the fertilizer up to the desired value. The material leaves the Granulator and enters into the Rotary Dryer where the DAP is dried, using hot gases leaving the Combustion Chamber, to a moisture of 1.0-1.5% or even lower if needed. After exiting the Dryer the material enters into the Primary Elevator to be distributed over the Oversize Screens. The Oversize Screens are double deck screens where the oversize is sent to the chain mills, the undersize falls onto the Recycle Belt along with the crushed material, and the product size material is sent to the Product Screen Elevator for distribution on the Product Screens. The purpose of the Product Screens is to remove the remaining fines that were not removed by the Oversize Screens. The fines fall onto the Recycle Belt and the on spec material enters into the Fluidized Bed Cooler or is recycled for control of the recycle ratio. The air entering into the Fluidized Bed Cooler can be chilled using the Ammonia Air Chiller which will be discussed later. Once leaving the Fluidized Bed Cooler the material enters into the Product Elevator and is distributed onto the Polishing Screens. The on spec material then enters into the Coating Drum and is then conveyed to the storage building.

The gases leaving the Dryer, Product Cooler, and Dedust system are each sent through a separate set of cyclones. After the dedust gas exits the cyclones it is sent through a Baghouse to be sent to the Combustion Chamber. If this method of recycling dedust gases is not in place then the gases are sent to the RG Scrubber. The gases leaving the Dryer Cyclones go to the Dryer Scrubber and the gases leaving the Cooler Cyclones go the Tail Gas Scrubber.

Wet Section

A simplified process flow diagram for the Wet Section of the Jacobs Slurry Process can be seen on page 15. Ammonia laden gases exiting the Preneutralizer and Granulator first enter into the Prescrubber where they are scrubbed with a liquor at a mole ratio of 1.4 where 60-70% of the ammonia is absorbed. Once exiting the Prescrubber the gases enter into the Reactor Granulator Scrubber (RG Scrubber) where the gases are scrubbed with a liquor at a mole ratio of 0.7. The gases exiting the Dryer go through a cluster of cyclones and enter into the Dryer Scrubber where the gases are scrubbed with the same liquor that is used in the RG Scrubber. The liquor that is used in the RG Scrubber and the Dryer Scrubber is circulated from the Scrubber Tank. Gases from the RG Scrubber and Dryer Scrubber along with the gases that exit the Cooler Cyclones enter into the Tail Gas Scrubber and then exit into the atmosphere. The circulating liquor in the Tail Gas Scrubber is sent through a kettle type heat exchanger to vaporize ammonia.

PIPE REACTOR USED IN CONJUNCTION WITH A PRENEUTRALIZER



The purpose of the Pipe Reactor is to supply ammonium phosphate slurry at a low moisture content thereby reducing fuel requirements in the drying step. The Pipe Reactor mixes high strength phosphoric acid, gaseous anhydrous ammonia, and reactor slurry from the Preneutralizer and sprays it onto the bed of the Granulator. The reason the Pipe Reactor can operate at such a low moisture is because of the high temperature and pressure which keeps the slurry fluid. Under atmosphere pressure the slurry reaches a minimum moisture content of 18% and in the Pipe Reactor it can be as low as 10%. The moisture content in the Pipe Reactor is reduced by vaporizing water from the high heat of reaction of phosphoric acid and ammonia.

Another reason why the Pipe Reactor is economical is because it reduces citrate insoluble P_2O_5. Citrate insoluble P_2O_5 increases with increased retention time, and since the retention time of a Pipe Reactor is very low there is virtually no citrate insoluble P_2O_5 produced in the Pipe Reactor. The average citrate insoluble P_2O_5 can be reduced by 0.2% when a Pipe Reactor is used.

The Preneutralizer mixes phosphoric acid, ammonia, and scrubber liquor to be sent to the Pipe Reactor or directly to the Granulator. The phosphoric acid and scrubber liquor are fed through the top of the reactor while the gaseous anhydrous ammonia is fed through spargers located at the bottom.

Jacobs uses the reduced retention time Preneutralizer where the diameter at the bottom of the tank is smaller than the top. The advantage of this design is that the citrate insoluble losses are decreased while still maintaining the liquid level necessary to absorb ammonia and to not entrain liquid in the exiting gas. The citrate insoluble losses increase with increased retention time so it is necessary to minimize the liquid volume in the Preneutralizer. The Preneutralizer is much simpler to operate than the Pipe Reactor and when used in conjunction with the Pipe Reactor it gives the plant a stable baseline and increased controllability.

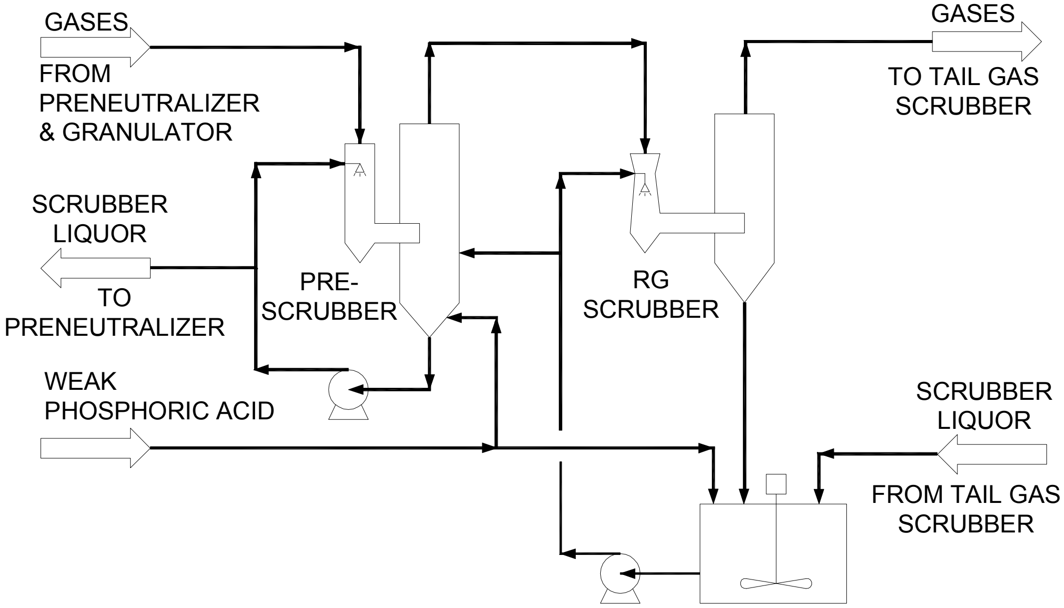
Using a Preneutralizer reduces the amount of water that is vaporized in the Granulator by the Pipe Reactor. If less water is vaporized in the Granulator then less air is needed to keep the gas leaving the Granulator below the saturation point. For a 130 stph plant, the required airflow in the Granulator when a Pipe Reactor and Preneutralizer are installed is 44,000 ACFM and when there is only a Pipe Reactor present is 88,000 ACFM. This reduced airflow reduces the size of the Granulator, Prescrubber, RG Scrubber, RG Fan, Scrubber Pump and the Tail Gas Scrubber and Pump. The overall capital to install a Preneutralizer is less than the capital needed to upgrade all the equipment previously mentioned.

The total installed costs and Rate of Return on Investment of the Pipe Reactor at various production rates are given in Table 3. The Pipe Reactor saves 4.9 lb of fuel oil per ton of DAP which comes to a savings of $1.07/short ton of DAP. Also the Pipe Reactor reduces the amount of citrate insoluble P_2O_5 in the product by 0.2% which has a significant cost savings advantage. A reduction of citrate insoluble P_2O_5 by 0.2% comes to a savings of $3.31/short ton of DAP. This comes to a total savings of $4.38/short ton of DAP. The total installed cost for the Pipe Reactor option includes two high pressure phosphoric acid pumps, piping, and instruments & controls. The rate of return on investment for the Pipe Reactor is higher than any other piece of equipment discussed in this paper.

Table 3: Economics of a Pipe Reactor

Rate	Cost (Millions of $)	Annual Savings (Millions of $)	Rate of Return	Payback Period
35 stph	0.39	1.0	256%	5 months
65 stph	0.65	2.1	323%	4 months
100 stph	0.88	3.1	352%	3 months
130 stph	1.0	4.1	410%	3 months

DUAL MOLE SCRUBBING



Dual Mole Scrubbing is a two stage process where gases from the Preneutralizer and Granulator are scrubbed with a high N/P mole ratio liquor followed by scrubbing at a low mole ratio. The gases first enter the Prescrubber, which operates at a mole ratio of 1.4, where about 60-70% of the ammonia is removed. Next the gases enter into the Reactor Granulator (RG) Scrubber where the rest of ammonia as well as the fluorine are removed and this scrubber operates at a mole ratio of 0.7.

Dual Mole Scrubbing has a greater efficiency than single mole scrubbing. Under ideal conditions single mole scrubbing will have an efficiency of 98% which may not be the case depending on the position and performance of the sprays. Dual Mole Scrubbing operates at an efficiency of 99.7% which produces a savings of 1.65 lb/h of ammonia per short ton of DAP.

Dual Mole Scrubbing requires half the amount phosphoric acid to scrub the gases exiting the Preneutralizer and Granulator. The advantage for using less phosphoric acid in the scrubbing section is as follows:

- Reduction of Citrate Insoluble (C.I.) losses
- Decreased Scrubber Specific Gravity
- Possibly Decreased Fuel Consumption
- Reduced Fluoride Emissions

Single mole scrubbing normally operates at a mole ratio 0.7-0.8 with a much higher specific gravity than Dual Mole Scrubbing. The maximum specific gravity of the scrubber liquor will depend on the impurities in the acid because they have a major affect on the viscosity of the scrubber liquor. A scrubber liquor with a higher specific gravity is more prone to plugging the sprays and will lead to more downtime. If a high specific gravity is not possible due to increased blockages then excess fuel oil is needed to compensate for the extra water that is needed to dilute the scrubber liquor.

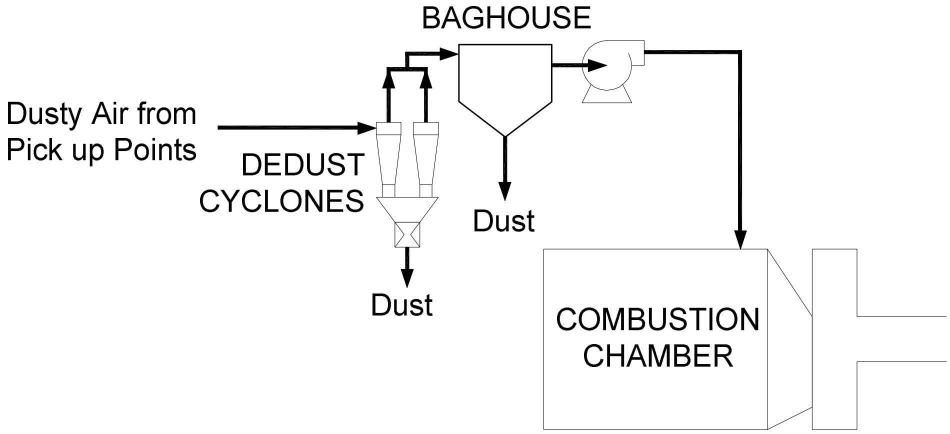
The primary advantage in Dual Mole Scrubbing is not the reduction of ammonia losses or lower fuel consumption but lower citrate insoluble P_2O_5 in the final product. Citrate insoluble P_2O_5 is formed when ammonia and phosphoric acid are in solution in the presence of iron and aluminum impurities. Since the reaction to produce citrate insoluble P_2O_5 is relatively slow compared to producing DAP, a minimum retention time of phosphoric acid will minimize the citrate insoluble P_2O_5. Dual Mole Scrubbing reduces the citrate insoluble P_2O_5 from 0.5% (for the base case) to 0.3% which comes to be a substantial savings. A reduction of 0.2% citrate insoluble P_2O_5 is equal to a savings of $3.31/short ton of DAP.

Dual Mole Scrubbing also reduces the Fluoride emissions from a DAP Plant. With half as much phosphoric acid contacting the gasses in the scrubber, significantly less Fluoride enters the Tail Gas Scrubber, which greatly reduces the overall Fluoride Emissions.

Table 4: Economics of Dual Mole Scrubbing

Rate	Cost (Millions of $)	Annual Savings (Millions of $)	Rate of Return	Payback Period
35 stph	2.0	0.8	39%	31 months
65 stph	3.2	1.6	50%	24 months
100 stph	4.2	2.3	55%	22 months
130 stph	5.0	3.1	62%	19 months

RECYCLING DEDUST GAS TO THE COMBUSTION CHAMBER



Recycling Dedust Gas to the Combustion Chamber takes the heat given off by the DAP throughout the plant and reuses it in the Dryer. There are various dedust pickup points within a DAP plant which mainly come from the belt conveyors, screens, and elevators. Heat is transferred from the DAP to the dedust air which heats the air to about 140°F. The dedust air then enters a cluster of cyclones followed by a baghouse so that it can be recycled to the Combustion Chamber. The dedust system can supply about half of the air required by the Combustion Chamber. Recycling these gases reduces the fuel oil consumption by 1.21 lb/short ton of DAP.

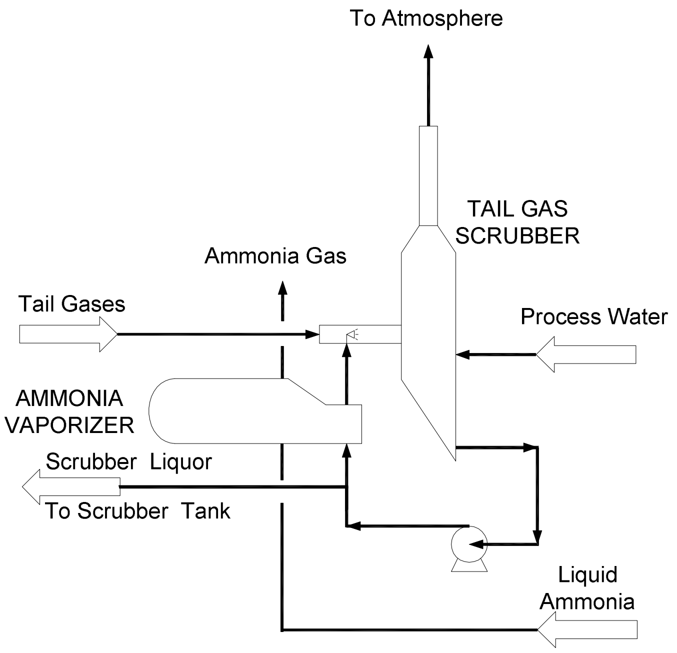
A dedust system which recycles Dedust air compared to a system that does not, contains the same amount of dedust pickup points, ductwork and Cyclones but may not contain a Baghouse which is required to prevent solids from entering the Combustion Chamber. The total installed cost of the Baghouse was weighted against the fuel savings and the following results were obtained.

Table 5: Economics of Recycling Dedust Gas to the Combustion Chamber

Rate	Cost (Millions of $)	Annual Savings (Millions of $)	Rate of Return	Payback Period
35 stph	0.6	0.06	10%	120 months
65 stph	0.9	0.13	14%	85 months
100 stph	1.2	0.19	16%	76 months
130 stph	1.4	0.26	19%	65 months

This design option also reduces the required the size of the RG Scrubber because the dedust gas is recycled to the Dryer which is then scrubbed in the Dryer Scrubber rather than being sent to the RG Scrubber. The recycling of dedust gas can also be applied to the production of MAP, NPK, TSP, SSP, Dicalcium Phosphate, and Monocalcium Phosphate.

AMMONIA VAPORIZATION USING TAIL GAS SCRUBBER LIQUOR



The final stage of scrubbing is in the Tail Gas Scrubber. Tail Gas Scrubber liquor circulates at a temperature of 130-140°C. This circulating liquor can be sent through a kettle type heat exchanger to vaporize ammonia. Heat is drawn out from the gases going through the Tail Gas Scrubber by the circulating scrubber liquor which is then transferred to the ammonia. From the heat used to vaporize the ammonia, 70% of it comes from cooling air and the other 30% comes from condensing water in the tail gas. The condensed water will have be vaporized in the DAP plant so this important fact must be taken into account when calculating the economics of the vaporizer. To vaporize all the ammonia, the vaporizer needs to operate at a lower pressure than what is required at the Pipe Reactor therefore the Tail Gas Scrubber Ammonia Vaporizer can only supply gaseous ammonia to the Preneutralizer.

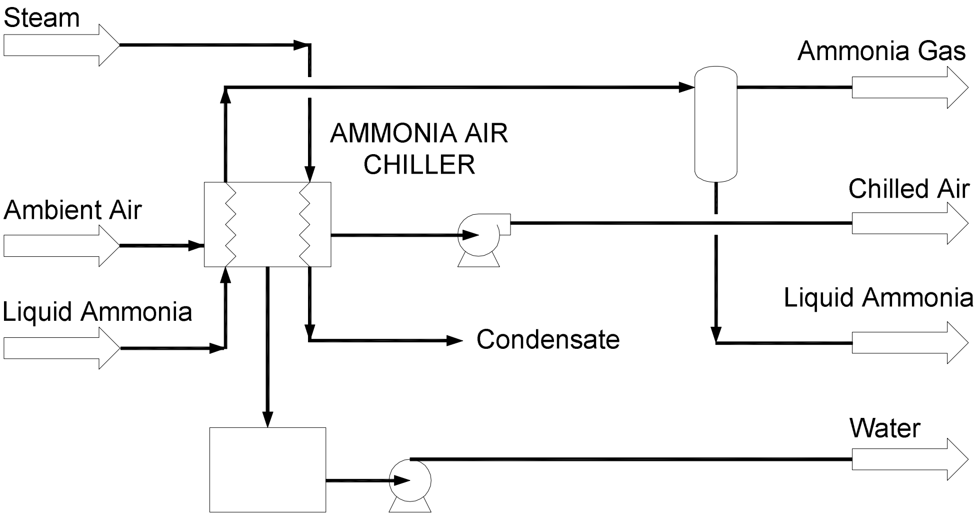
The energy that goes into heating ammonia reduces the fuel oil consumption or is used to evaporate water thereby reducing the amount of strong phosphoric acid needed in the DAP Plant. Since a lower overall phosphoric acid concentration is needed, less steam is needed at the concentration area which can be used for power generation at the Sulfuric Acid Plant.

The total installed cost of the Tail Gas Scrubber Ammonia Vaporizer was compared against the increased profit from increased power production and reduced fuel oil consumption at various rates as can be seen in Table 6.

Table 6: Economics of Ammonia Vaporization using Tail Gas Scrubber Liquor

Rate	Cost (Millions of $)	Annual Savings (Millions of $)	Rate of Return	Payback Period
35 stph	1.0	0.4	38%	32 months
65 stph	1.5	0.8	51%	23 months
100 stph	2.0	1.2	60%	20 months
130 stph	2.3	1.5	65%	18 months

AMMONIA AIR CHILLER



The Ammonia Air Chiller uses air going to the Product Cooler to vaporize ammonia. The Air Chiller is a finned tube heat exchanger with an ammonia coil and a steam coil. The air first passes through the ammonia coil where it is chilled using liquid ammonia. After the ammonia coil the air passes through the steam coil to reheat the air by 5°F to desaturate the air. The heated liquid ammonia is then flashed to produce gaseous ammonia.

The majority of the gaseous anhydrous ammonia required can be supplied by the Ammonia Air Chiller, but the remainder must be produced from another source such as using steam or tail gas scrubber liquor to vaporize ammonia.

The economics of the Ammonia Air Chiller depend on the climate of the region. In cooler climates the amount of ammonia that can be vaporized may not be enough to justify the purchase of this piece of equipment. If the average annual temperature is above 62°F then the use of the Ammonia Air Chiller is without doubt economical. The total installed cost of the Air Chiller was compared against the increased profit from increased power production and reduced fuel oil consumption at various rates as can be seen in Table 7.

Table 7: Economics of an Ammonia Air Chiller

Rate	Cost (Millions of $)	Annual Savings (Millions of $)	Rate of Return	Payback Period
35 stph	2.7	0.4	15%	81 months
65 stph	4.1	0.8	19%	62 months
100 stph	5.2	1.2	23%	52 months
130 stph	6.2	1.6	26%	47 months

FINAL CASE

The final case that will be discussed is a combination of all five options compared against the base case. The Pipe Reactor, Baghouse (for recycling dedust gas), Prescrubber (for Dual Mole Scrubbing), Tail Gas Scrubber Ammonia Vaporizer, and the Ammonia Air Chiller will remain the same size in this case.

Table 8: Economics of all Five Design Options

Rate	Cost (Millions of $)	Annual Savings (Millions of $)	Rate of Return	Payback Period
35 stph	6.7	2.3	34%	35 months
65 stph	10.4	4.5	43%	28 months
100 stph	13.5	6.8	50%	24 months
130 stph	15.9	9.0	57%	21 months

Utilizing all five options will result in a 10.4% increase in profit assuming an initial gross profit margin of 25%.

REVAMP

In the case of a revamp of an existing fertilizer plant, profit losses for an extended shutdown must also be considered. For making all the modifications described in the previous section, 3 months of downtime may be required. The step in the revamp that requires the most time is the modification of the Scrubber System to incorporate Dual Mole Scrubbing which may require the entire 3 months. Using 3 months downtime is a very conservative number, the modifications will most likely take half that time. The rate of return on investment for all the modifications with a loss of profit from a 3 month down added can be seen in Table 9.

Table 9: Economics of all Five Design Options Including Loss Production Time

Rate	Cost (Millions of $)	Loss of Profit (Millions of $)	Annual Savings (Millions of $)	Rate of Return	Payback Period
35 stph	6.7	5.9	2.3	18%	66 months
65 stph	10.4	11.9	4.5	20%	59 months
100 stph	13.5	17.8	6.8	22%	55 months
130 stph	15.9	23.8	9.0	23%	53 months

Jacobs recommends that a revamp of an existing facility should be accompanied by a production increase. The additional time to modify solids handling equipment, piping, and ductwork will increase the downtime to 6 months. A 50% production increase will make back the 6 months of lost production time in one year. Using 6 months downtime is a very conservative number, the modifications will most likely take half that time. The approximate cost, along with the final capacity, annual savings, and rate of return on investment, for a 50% increase in capacity revamp including all the design options described in this paper is given in Table 10.

Table 10: Economics of all Five Design Options with a 50% Capacity Increase

Old Rate	New Rate	Cost (Millions of $)	Annual Savings (Millions of $)	Rate of Return	Payback Period
35 stph	53 stph	17	14.3	84%	14 months
65 stph	98 stph	26	28.5	110%	11 months
100 stph	150 stph	33	42.8	130%	9 months
130 stph	195 stph	39	57.0	146%	8 months

The costs associated with a 50% increase in production include upgrading solids handling equipment, ductwork, and piping, new Combustion Chamber, modification of the Scrubbers, Dryer and Granulator. If the 6 months of downtime is considered as a project cost then the rate of return can be seen in Table 11.

Table 11: Economics of all Five Design Options with a 50% Capacity Increase and 6 Months Loss Production Time Included

Old Rate	New Rate	Cost (Millions of $)	Loss of Profit (Millions of $)	Annual Savings (Millions of $)	Rate of Return	Payback Period
35 stph	53 stph	17	11.8	14.3	50%	24 months
65 stph	98 stph	26	23.8	28.5	57%	21 months
100 stph	150 stph	33	35.6	42.8	62%	19 months
130 stph	195 stph	39	47.5	57.0	66%	18 months

A 50% capacity increase revamp including all the design options described in this paper produces a 65.5% increase in profit assuming an initial gross profit margin of 25%.

CONCLUSIONS

The design options starting with the most economical option based on rate of return on investment and ending with the least is summarized in Table 12. The rate of return on investment given in the table is based on a production rate of 130 stph.

Table 12: Comparison of Design Options Based on Rate of Return

Design Option	Rate of Return
Pipe Reactor	410%
Ammonia Vaporization using Tail Gas Scrubber Liquor	65%
Dual Mole Scrubbing	62%
Ammonia Air Chiller	26%
Recycling Dedust Gases to the Combustion Chamber	19%

The capital expenditure of all five options for a given plant size along with the annual savings and the rate of return on investment is given in Table 13.

Table 13: Economics of all Five Design Options

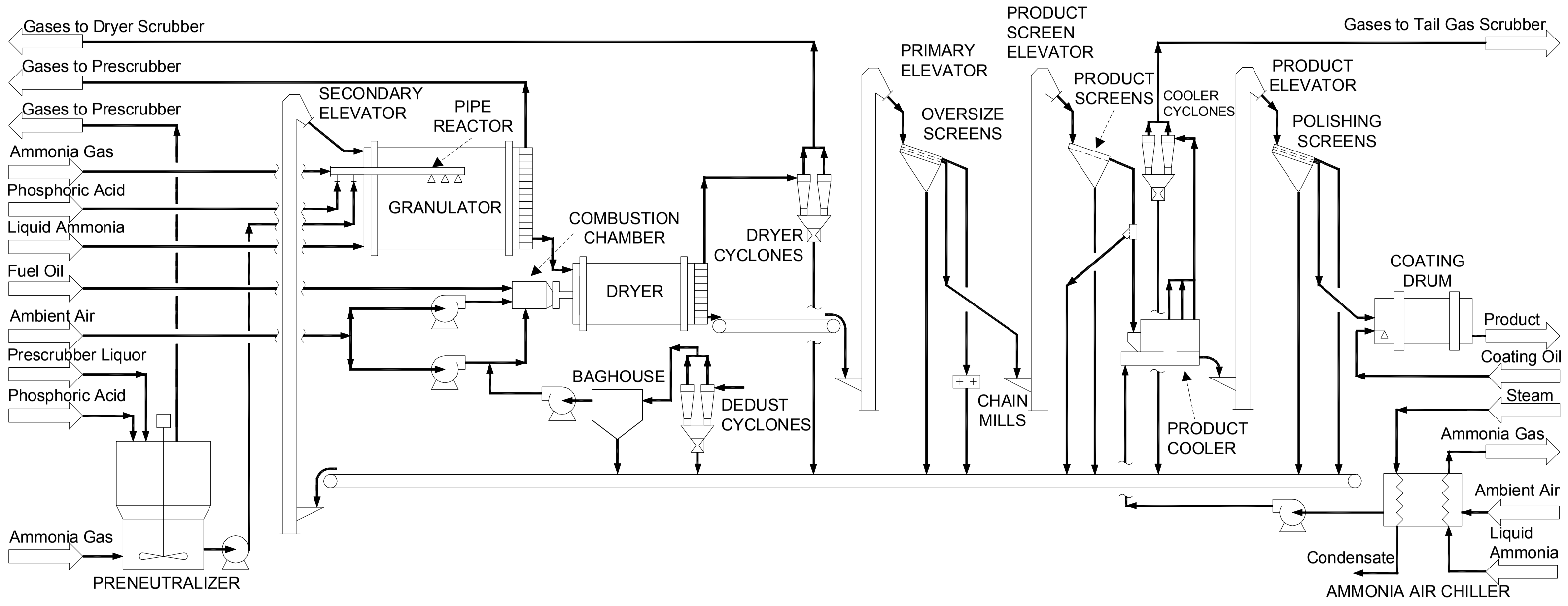
Rate	Cost (Millions of $)	Annual Savings (Millions of $)	Rate of Return	Payback Period
35 stph	6.7	2.3	34%	35 months
65 stph	10.4	4.5	43%	28 months
100 stph	13.5	6.8	50%	24 months
130 stph	15.9	9.0	57%	21 months

The capital expenditure of a 50% increase in production including all five options for a given plant size, along with the annual savings, final capacity and the rate of return on investment, is given in Table 14.

Table 14: Economics of all Five Design Options with a 50% Capacity Increase

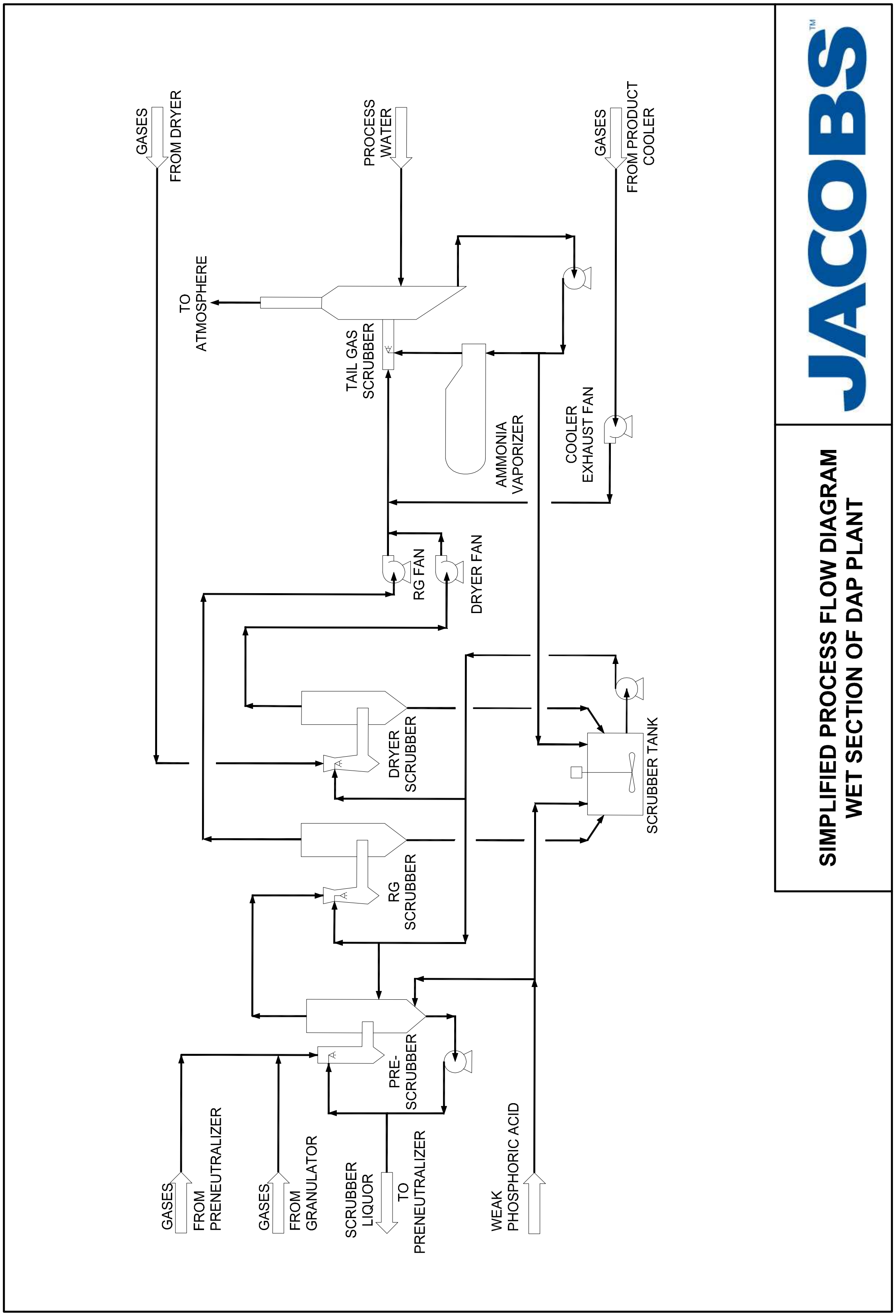
Old Rate	New Rate	Cost (Millions of $)	Annual Savings (Millions of $)	Rate of Return	Payback Period
35 stph	53 stph	17	14.3	84%	14 months
65 stph	98 stph	26	28.5	110%	11 months
100 stph	150 stph	33	42.8	130%	9 months
130 stph	195 stph	39	57.0	146%	8 months

A 10.4% increase in profit can be expected from utilizing all five design options. A 65.5% increase in profit can be expected when all five design options are utilized along with a 50% increase in capacity. Both of the following numbers assume an initial gross profit margin of 25%.



SIMPLIFIED PROCESS FLOW DIAGRAM
DRY SECTION OF DAP PLANT

JACOBS™



SIMPLIFIED PROCESS FLOW DIAGRAM
WET SECTION OF DAP PLANT