"SULFURIC ACID, PHOSPHORIC ACID AND DAP INNOVATIONS AT NEW WALES"

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ABSTRACT

The recent 50% expansion of International Minerals & Chemical Corporation's New Wales Phosphate Chemical Complex provided the opportunity to utilize several energy saving ideas. Among them are:

1.) Increased steam production from the Sulfuric Acid Plants

2.) Electrical co-generation

3.) Wetrock grinding of phosphate rock

4.) High attack tank/flash cooler recirculation with reduced power usage in the Phosphoric Acid Plant

5.) Eliminate steam jet ejectors in the Phosphoric Acid Plant attack circuit

6.) Reuse of heated pond water in the Phosphoric Acid Plant

7.) Increased insulation in the Diammonium Phosphate Plant

8.) Use of a bag collector on the DAP cooler.

INTRODUCTION

The New Wales Operations of International Minerals and Chemical Corporation, located in Polk County, Florida, is the world's largest facility for the production of phosphoric acid and phosphate-based fertilizer and animal feed ingredients. In fiscal year 1980-81, the complex produced 1,021,000 tons of phosphoric acid (P_2O_5).

The complex has since been expanded by 50%, to a rated capacity of 1,500,000 tons per year P_2O_5. All new production units have been successfully tested at design conditions. Several units, including the Phosphoric Acid Plant and the Diammonium Phosphate Plant, have been shut down as a result of the current depressed market condition.

In 1978, New Wales began an intensive review of its energy usage. Its first effort to reduce energy consumption was the partial conversion from dryrock to wetrock grinding. From a base year of 1978-79, the energy usage per ton dropped 11% in 1980-81. We forecast a 28% reduction at rated capacity, with the facilities currently installed. In addition we expect to implement more changes which could reduce energy consumption by 58% from the base year.

SULFURIC ACID PLANTS

The New Wales Sulfuric Acid Plant consists of five Monsanto Enviro-Chem double absorption plants - each able to produce 2500 tons per day in a clean condition. Three plants were started-up in 1975; two new plants were started-up in 1981. The new units have demonstrated 2800 tons per day capacity when clean, but are not being run at that rate now.

The major process difference between the original units and the new units is related to steam production and co-generation of electricity.

Larger economizers and superheaters have been installed in order to remove more waste heat from the Interpass Absorption Tower (IPAT) inlet gas and the Final Absorption Tower (FAT) inlet gas. The IPAT inlet runs 401°F now versus 430-460°F on the original plants. The FAT inlet runs 270°F now versus 370°F on the original plants. The removal of this additional waste heat results in an additional 7% steam generation in the new plants. All of the steam can be superheated to 600°F, if necessary, to operate the various turbines and the new turbogenerator.

Prior to the design of the new plants, it was an industry rule-of-thumb that these inlet gas steams should not drop below 430°F and 370°F, because dew point problems would result. In fact, the IPAT economizers on the original plants do experience some dew point condensation, even at the higher temperature. The cause of the condensation is not so much a function of the gas temperature as it is of the boiler feed water inlet temperature. Raising the water inlet temperature by 20-50°F has a significant effect on eliminating tube-wall condensation.

Monsanto and New Wales personnel developed a scheme that permitted higher water inlet temperatures to the IPAT economizer, which has a higher dew point than the FAT economizer. The solution was simple - feed the water through the FAT economizer before entering the IPAT economizer. Although this seems very straight-forward, this is not the scheme being used on the original plants.

As a result of this change, tube-wall condensation potential virtually disappeared. We were able to increase the size of the economizers to an economic optimum - based on steam recovery values. For an additional cost of about $1,000,000, we were able to generate about $1,500,000/yr in steam, valued at $5.00/1000 lbs. We hesitated to go lower than the 401°F and 270°F gas temperatures, and even provided bypass capability to maintain the higher temperatures if dew point problems developed.

Our experience to-date indicates <u>no condensation what-so-ever,</u> barring any steam leaks in the system. We are presently evaluating the installation of equipment to go even lower on the original plants.

New Wales has also installed an 8 megawatt turbogenerator for the two new units. This unit operates with 575 psig, 600°F inlet steam and 55 psig saturated exhaust. It operated quite reliably for 4-5 months until major damage was sustained during an instrumentation upset in January, 1982. The unit is being repaired and upgraded to 10.4 megawatts, and is expected to be back on line in June.

We are presently evaluating the installation of a 30-35 megawatt turbogenerator for the original plants, to be installed in conjunction with other energy retrofit proposals.

In addition to these relatively major improvements in the new Sulfuric Acid Plants, it is worth noting that Brinks low pressure drop Type ES mist eliminators are being used in the IPAT and FAT, in place of the older design Brinks Type HE units. These easily meet mist emission standards while keeping the pressure drop reasonable.

PHOSPHATE ROCK GRINDING

The New Wales complex is now totally converted to wetrock grinding. The system consists of two rod mills, preceded by a washer to remove clay from certain dirty pebble rock sources, and two ball mills fed directly from the wetrock storage pile. The rod mills are open-circuit; the ball mills are closed-circuit with cyclones. Power draw on the rod mills is 1500 HP each - 3200 HP on each ball mill. System capacity ranges from 640 dry tons per hour on all pebble to 1000 dry tons per hour on all concentrate.

In an attempt to handle higher pebble/concentrate ratios, we are presently evaluating the addition of screens on the rod mills. It appears that size separation efficiency is better with screens than with cyclones. Apparently large particles can leave the cyclone overflow to storage if those particles have a low apparant specific gravity. We see a range of particle densities from 2.1 to 3.0, with the bulk of the rock near 3.0.

We are currently using 10-20% of our water make-up as gypsum pond water. This serves two purposes. It reduces the amount of pond water lime treatment costs that would be required during the summer months, and it reduces the rock slurry viscosity by 40-50%. The pond water is added to the ball mill cyclone feed tanks. The ball mill pH is about 6.5, while the cyclone circuit pH is about 5.5. We will attempt to use even more pond water in the future.

PHOSPHORIC ACID PLANTS

The New Wales Phosphoric Acid Plant consists of three Davy-McKee/Prayon 912 tons per day P_2O_5 trains - each able to produce 1600 tons per day at capacity. The newest unit utilizes the Prayon Mark IV design, and achieved production rates of 1600 tons per day before being shut down for market conditions.

Innovations in the Third Train include low level flash coolers with vacuum pumps instead of steam jet ejectors, much higher flash cooler circulation rates, elimination of the attack tank internal recycle pumps, high efficiency agitators, and a Bird 30-D filter with a 30-E valve. Reuse of pond water from the second and third stage evaporators for the flash cooler barometric condensers and gypsum sluicing was also incorporated.

The plant was operated for six weeks before being shut-down last December. After about four weeks of debugging, during which time the plant ran consistently between 900-1300 tons per day, the plant was pushed to its maximum capacity of 1600 tons per day.

An initial problem with overall efficiencies 2% lower than the original trains was solved by changing the sulfuric acid/rock/#2 filtrate addition points. The resulting efficiencies were about 2% higher than the original trains. Obviously, it is too early to say that these improved efficiencies will hold, but they were encouraging.

An initial problem with scrubber emissions was solved by changing out packing type and increasing liquid irrigation rates.

A major problem was discovered when the attack tank was emptied. Solids build-up near the flash cooler suction and discharge legs and in the two aging compartments indicated inadequate agitation for the compartment configuration. Modifications are presently planned to solve this problem. We do not anticipate at this time that additional power input will be required, although that is certainly a possibility.

The worst problem we encountered was a foaming and/or spillage problem around the flash cooler discharge pumps. These pumps are located at a low level - about 5' lower than the main roof level of the attack tank. In order to control this spillage, we used 5-15 pounds per ton of defoamer, considerably higher than the original trains. We are presently modifying this area of the attack tank to eliminate this problem.

No problems were encountered with flash cooler capacity. The design temperature drop of 3.6°F at 1600 tons per day was achieved easily.

In summary, it appears that the Third Train is at least equal to the original trains in capacity, efficiency, and scrubber emissions. In addition, the total attack tank system power usage is about 50% of the original trains.

DIAMMONIUM PHOSPHATE PLANTS

The New Wales Diammonium Phosphate (DAP) Facilities include an original D. M. Weatherly TVA-type 50 tons per hour plant, operating at 90 tons per hour, and a new Davy-McKee TVA-type twin DAP Plant. The new plant is designed to produce 70 tons per hour in each unit, and achieved 90 tons per hour before being shut down for market conditions. Capacities and efficiencies of each new unit appear to be equal to the original plant. Scrubber emissions and general plant environment appear to be better.

The two new units are unique, in that they are housed in a single building, and share a common product cooler, product handling system and common control room. Although we were not able to design a single unit for 140 tons per hour, a common product handling system for that rate was no problem.

Major energy improvements in the new DAP Plant include insulation of the two dryers, four cyclones, and major ductwork. The cooler is ventilated to an insulated bag collector, rather than a wet scrubber. The bag collector system, which has a start-up recycle air heater, was very successful.

Each unit's scrubbing system consists of two venturi scrubbers followed by two vertical packed tailgas scrubbers. Emission standards were easily met and no tailgas scrubber pluggage occurred whatsoever.

The only major problem encountered during start-up was poor fuel oil combustion in the dryer burner. This should be corrected by modifying the air inlet ports per the manufacturer's recommendation.

SUMMARY

New Wales is anxious to see the present market situation turn around so that we can put the new facilities to a long-term test.