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# P2O5 EFFICIENCY IMPROVEMENTS AT CARGILL FERTILIZER INC

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## 1. INTRODUCTION

In a 2-3 year period Cargill Fertilizer Inc,former GARDINIER,put main emphasis on reducing the losses of P2O5, fluoride and sulfate to the cooling pond system/gypsum storage system with the objectives to improve process efficiency as well as the environmental reason to limit the use of the cooling pond to absorb chemical losses.

This article is an overview of the measures that were taken and are partially still underway.

## 2. P2O5 LOSSES TO THE COOLING POND , THE NET LOSSES

Only about 25% of the water soluble P2O5 losses to the gypsum stack and pond proved to be recovered back on the filters into the process.An important statement therefore is once it is lost to the gypsum stack and pond it is basically lost for 75% [This number is for running at 30% reactor acid and no pond water to mills]. The reason is that soluble phosphate combines with calcium coming from the gypsum slurry and deposits on the gypsum stack as DiCalcium Phosphate.

## 3. DAILY PLANT P2O5 BALANCE

An accurate daily plant P2O5 balance resulting in the plant P2O5 yield for that day is a requirement.In our plant the shift superintendents make a balance on a PC every shift to track possible losses.

## 4. IDENTIFICATION OF P2O5 LOSS AREAS

P2O5 balances tell how much and where losses occurred. For loss reduction and management a more local and detailed approach per P2O5 loss area is appropriate.The following loss areas were defined:

Water Soluble Losses
- a. The filter (water soluble) losses
- b. Carry-over losses from the flash coolers
- c. Carry-over losses in filter vacuum condensers
- d. Wash losses from filters,lines,etc.
- e. Accidental spills
- f. Overformulation losses in Dry Products Department plus spills in Dry Products
- g. Evaporator P2O5 carry-over

Water Insoluble Losses
- h. Water Insoluble losses

Above loss areas were individually sampled 2 times per shift and checked for P2O5 to identify problem areas for a period of about 5 months.

All ditches,esspecially the main ditch,were checked. Higher P2O5 values were traced back to the source.

a. Filter Losses

**Where to measure filter losses**

Measuring P2O5 losses based on cake samples from a tilting pan filter will result in lower losses then they really occur.It is difficult to get a representative sample,but more important the main part of the losses comes from acid not drained out of the pans.We are measuring the P2O5 losses based on gypsum slurry samples,taking into account the losses in gypsum and drainage losses.

**Configuration and filter loading**

Cargill Fertilizer operates a Dorrco plant with 30D filter (1780 Sqft) and a PRAYON plant with a 24C filter (950 Sqft). The operation load on the filters was close to 1.0 Ton P2O5 per day per Sqft active filter area.

When reactor parameters are in control a typical 2.0 to 3.0% water soluble P2O5 losses were experienced based on DORRCO/PRAYON plant P2O5 intake at 29.5-30% reactor P2O5 concentration.When slightly out of control losses are running up quickly to 4 -5% or when production rate was not reduced up to 8 - 12% (water soluble only).

b. Carry-over losses from the Flash Coolers

Were typically .2 to .3% losses on DORRCO/PRAYON plant P2O5 intake.

At higher vacuum losses can go up higher.

Vapor velocities have to stay under 5 ft/sec

c. Carry-over in Filter Vacuum Condensers

In our DORRCO plant 30D filter with relative low velocities and good vapor/liquid separation losses were none. At the PRAYON 24C with poor liquid/vapor separation at higher rates .2-.3% losses were experienced (On PRAYON P2O5 intake).

d. Wash Losses from Filters/Lines,etc.

Losses during a filter wash,line washes,etc. fluctuate widely.During a filter outage for wash we could loose up to 5% on DORRCO or PRAYON P2O5 intake (Incl. start up/shutdown losses). Starting a wash always requires the timing decission for switch over of pond water into the product or P2O5 in the ditch.

Manual wash (Switch over) without proper procedures and checking can lead to average 2% losses on plant P2O5 intake

e. Accidental Spills to the Cooling Pond System

Without a proper incident follow-up reporting and corrective action these add up.Without detection devices spills may continue for a longer period.

f. Overformulation Losses in Dry Products

The Triple Superphosphate plant,2 MAP plants and DAP plant experience low P2O5 losses via the scrubbers.
The main loss is here **overformulation.**
Overformulation losses amount .5 - 1.0% on total plant P2O5 intake.

g. Evaporator Carry-over Losses

These are negligible.There is only a problem when there is an incidental high level.

h. Water Insoluble Losses

These are typically 3.5 - 4.0% on plant P2O5 intake. Water insoluble losses are less costly as water soluble (A third of the sulfuric acid use compared to water soluble).

## 5. SITUATION IN 1989

Our situation with respect to above P2O5 loss areas in 1989 was as follows:

The filter losses (water soluble) were 3 - 4% .Peak losses during out of control situations brought a 2% loss up to the 3 - 4% .
The P2O5 losses due to reasons as mentioned under "b through e" were 2 to 3%
The water insoluble losses were 3.5%

Exclusive Dry Products overformulation losses the total plant yield was 89 - 91% .Inclusive 1.0% overformulation losses the yield was 88 - 90% .

## 6. ANALYSIS AND CONCLUSIONS

* The drainage losses in the pans at high filter load (2.5 minute per revolution) were too high.We needed better,faster draining pans or lower filter speed as well as more surface area

The option was more surface area and better draining pans in the

existing filters or a new additional filter.

We implemented an additional 30D filter with BIRD new fast drain pan concept.

With respect to operation we aim to prevent peak losses at the filter by frequently checking the filter losses and consequently adjusting the production rate.

* With respect to carry-over losses to condensers,wash losses and spills a training and education program was organized for the operating crew.
Procedures were written for washing lines.
A spill reporting and analysis program was given highest priority.

Conductivity analysers with continuous trending in the control room were installed to check losses in the ditches to the cooling pond system.

* Several trials have been made to reduce water insoluble losses below 3.5% by increased flash cooler circulation and injection of sulfuric acid at more then one location.

* Critical was our conclusion that phosacid controls with trending of P2O5 losses on ditches could be done most properly by a DCS computer system.
The DCS system on PRAYON/DORRCO and Evaporators was implemented in 1991

## 7. SITUATION IN 1992

Our filter losses were reduced from 3-4% to about 1.0%
Follow-up,trending,procedures,spill reporting and analysis led to a reduction in wash losses and spill reduction of 1-2% .
Overall about 3% improvement was made.
Hardly any improvement was made on water insoluble losses.This remains a target for the coming year.

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