CASE STUDY

eROI℠ by Ecolab

Precleaning, In-System Neutralization and Cold Passivation Process Delivers Significant Savings for Fertilizer Plants in India

ANNUAL SAVINGS

WATER

Water savings of 72,900 m^3

$9,125

WASTE

Treatment of 54,200 m^3 effluent that was generated during the process

$13,516

ASSETS

Cost savings from not constructing temporary lagoon

$2,000,000

TOTAL VALUE DELIVERED

$2,022,681

BACKGROUND

Between 2003 and 2020, grain production in India increased 69% from 175 to 296 million tons per year.[1] This growth rate, achieved with much more modest increases in acreage under cultivation, depended on local availability of fertilizer. Urea (CO(NH2)2) delivers more nitrogen to the soil per ton of material than any other solid nitrogenous fertilizer. Local manufacturing of this highly efficient fertilizer is key to continued growth of domestic agricultural production.

In 2018, as part of the government's Aatmanirbhar Bharat (Self-Reliant India) initiative, construction commenced on ammonia and urea production facilities in the states of Bihar in eastern India. The plants were designed to produce 2,200 tons per day of ammonia and 3,850 tons per day of urea close to where the fertilizers would be used.

SITUATION

When steel mills ship mild steel components, they apply corrosion inhibitors to protect them in shipping. These preservatives must be removed before putting the system in service. The components also contain "mill scale," thin, brittle flakes that form during heat treatment of the steel. Mill scale also forms during welding when high temperature in the presence of air oxidizes the surface. Left untreated, mild steel components containing mill scale corrode readily and mill scale can move through the system, obstructing flow or depositing on heat transfer surfaces, reducing efficiency and contributing to more corrosion.

Mechanical, operational and chemical limitations made initial cleaning and passivation of the system challenging. Cleaning and passivation would require about 72,900 m^3 [19.3 million gallons] of fresh water, but during construction access to fresh water was limited. The first step of the process, acid pickling, required reducing the recirculating water pH to 4.0, rendering the water unacceptable for discharge. Initial plans called for construction of a reservoir where the low pH water could be stored and the pH subsequently elevated to 7.1 – 7.5 for the second phase of the process, in-system neutralization.[2]

Working with their local Nalco Water representatives, the engineering team at the two facilities developed a plan to clean and passivate the newly constructed cooling water system, using available water resources and eliminate the need for the lagoon, the cost of which was estimated at $2 million.

NALCO Water
An Ecolab Company

SOLUTION

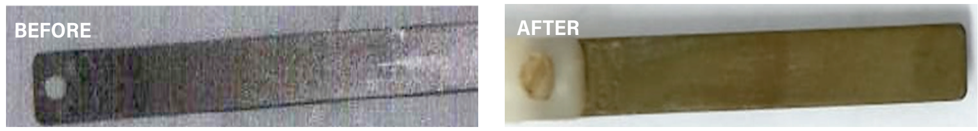
The team of site engineers and Nalco Water started the acid pickling step by recirculating pH 4.0 water through the system to remove the mill scale present in the system[3]. For the next step, in-system neutralization, the team slowly added soda ash to increase the pH from 4.0 to 7.5 while the water recirculated. This eliminated the need for the lagoon. To protect the system from fouling and scaling during this step, a program of iron dispersants, calcium sulfate inhibitors, and silica dispersants were added to the system[4].

The in-system neutralization was closely monitored to ensure safety and effectiveness[5]. In the end, the very experienced team coupled a blend of high stress chemistry with innovative feed, control, and monitoring technology to minimize risks and ensure success. The process was completed using only the available water resources. The need for the lagoon had been eliminated and the resulting recirculating water was safe for discharge back to the environment[6].

The final step — cold passivation of the system — required recirculation of treated fresh water through the system for 96 hours[7]. Corrosion coupons were installed to verify the passivation layer and, after the coupon layer was verified, the system was blown down[8].

RESULTS

Ammonia Cooling Water System



Urea Cooling Water System

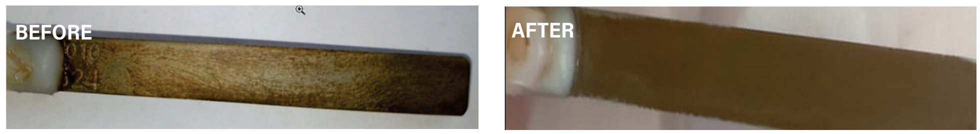


Figure 1. Emulsion breaker dosage rate and number of trylines with clear water before and after the trial.

Corrosion coupon analysis, shown above, verified the efficacy of the pretreatment program. Eliminating the need for the lagoon to neutralize the acidic pickling solution saved the project team construction time, treatment costs and $2 million in construction costs. The innovative chemical treatment program created by the team also reduced the water usage by 72,900 m^3 [19.3 million gallons] compared to traditional methods. The water and discharge savings were estimated at an additional $22,641[9].

CONCLUSION

The precleaning, in-system neutralization, and cold passivation process was successful. Both the Ammonia and Urea systems are protected and ready for a successful start up and a long life. The project team reduced capital expenditures and avoided stressing their limited water resources. Today, the two new plants are producing critical fertilizers to better serve the local agricultural region.

1 India's Fertilizer Under Pressure | World Fertilizer

2 Acid pickling would be completed during the winter without a heat load on the system. The water temperature would be 6-8°C [43 – 46°F].

3 1100 – 1500 ppm of inhibited sulfuric acid was added to maintain a pH of 4.0 throughout this step

4 Soda Ash raised the pH, shifting the system from 250 ppm acidity to 60 ppm alkalinity. Nalco 3DT121 was added at 175 ppm for general Total Suspended Solids (TSS), sulfate, and iron dispersion. Nalco 1393 was added at 80 ppm for calcium sulfate inhibition. Nalco 3DT157 was added at 35 ppm as a silica dispersant.

5 Monitoring included pH, turbidity. titratable acidity, titratable alkalinity, iron, sulfate, silica, residual polymer, calcium, and magnesium

6 Nalco Water's Ultrion 133L was added to the effluent as it was being drained.

7 NALPREP IV was used for the cold passivation step

8 During blowdown, the water was treated with FeCl3 and NaOH.

9 Water savings is $9,125 and the disposal savings is $13,516.

Nalco Water, an Ecolab Company

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