



## AVERY VEST

SCHOOL: The University of Iowa  
MAJOR: Chemical Engineering

# CF INDUSTRIES PORT NEAL COMPLEX

SERGEANT BLUFF

### COMPANY PROFILE:

CF Industries, founded in 1946, is the leading global manufacturer and distributor of ammonia fertilizer products. Headquartered in Northbrook, Illinois, the company operates nine manufacturing plants and 23 distribution terminals serving customers across North America, Europe, and other international markets, producing 10.3 million tons of product per year.

The Port Neal facility employs approximately 270 people and operates 24/7, producing solid and liquid ammonia fertilizer, urea liquor, and diesel exhaust fluid (DEF). CF Industries operates with a strong commitment to environmental and product stewardship, manufacturing their products in an efficient and environmentally responsible manner.

### PROJECT BACKGROUND

At CF Industries, the intern focused on assessing the water treatment facilities and identifying opportunities for improvement within the process. Ammonia production consumes water in two forms, steam generation with high purity water and cooling water usage. The intern was assigned with developing a baseline of the utilities and chemical costs per one million gallons of water in both of the site's ammonia plants. In collaboration with several departments, the information gathered identified areas of improvement and cost reductions in both the chemical treatment program and the cooling towers.

### INCENTIVES TO CHANGE

CF Industries seeks to strengthen existing business by investing in clean energy initiatives that focus on significantly reducing the carbon emissions associated with the production of am-

monia. The company looks to invest in projects that optimize their processes and reduce material consumption. The water treatment process and water consumption are areas where the company believes there are opportunities for savings. CF's commitment to the environment strengthens the business in the long term and creates new growth opportunities that support the global energy transition.

### RESULTS

#### Install Reverse Osmosis Unit in Ammonia II

It was determined that the largest cost of water treatment is in making demineralized water. Currently demineralization train throughput is not meeting expectations and is reducing the lifespan and efficiency of the demineralization resin. Investing in filtration before water reaches the demineralization trains will reduce the cost of water treatment and improve the efficiency of both ammonia production facilities. A reverse osmosis unit was recommended and would further remove dissolved solids and impurities by pumping the water through a semi-permeable membrane which blocks out the impurities. The water is then much cleaner and ready to go through the ion trains. This additional filtration will significantly decrease the number of resin regenerations, significantly decreasing the use of caustic soda and sulfuric acid. It will also reduce the amount of resin changes required from every 5 years to 10.

#### FlexPro Treatment Plan in Ammonia II Cooling Towers

The cooling tower controls the level of blow down water based on the conductivity level which is limited by chloride concentration. The plant operates at low levels of chloride to prevent Stress Corrosion Cracking (SCC) which results in excessive water being blown down from the towers. The water usage could





be significantly reduced by changing the chemical treatment program to address the chloride limits on the system. FlexPro, an organic-based corrosion inhibitor, has been suggested as an alternative to the current chemistry program, which will continue to prevent fouling of the system, while also protecting it from SCC at higher concentrations of chlorides. The new chemical program will reduce the chemical treatment cost and show savings in the treatment of water that is saved in the blow down reduction. It also provides environmental benefits as it reduces the use of phosphorus and zinc emissions.

The recommended FlexPro program has been tested in the lab and has shown increased protection against SCC at up to double the current cycles of concentration and could be implemented in the North ammonia plant. If approved, the program will provide water and chemical savings and could be considered in the South plant as well.



#### ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
INSTALL REVERSE OSMOSIS UNIT IN AMMONIA II	\$1,025,655	49,320,000 gallons 1,700,000 lbs. sulfuric acid 2,300,000 lbs. caustic soda	RECOMMENDED
FLEXPRO TREATMENT PLAN IN AMMONIA II COOLING TOWERS	\$173,839	157,000,000 gallons 18,250 lbs. phosphorus	RECOMMENDED

