

ECONOMICS AND BENEFITS OF CONVERTING FROM ANHYDROUS AMMONIA TO AMMONIUM HYDROXIDE FOR NO_x CONTROL AT THE COMMERCE REFUSE TO ENERGY FACILITY

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QUESTIONS AND COMMENTS

1. Describe the nozzle design-materials of construction, dimensions and supplier(s).
2. Did you compare the cost for urea versus ammonium hydroxide before proceeding with the modification?
3. How many nozzles are used at any one time and under what condition are they used?
4. Have you measured the ammonia concentration in the stack and what is the ammonia slip?
5. What ammonia emissions limits apply to this plant?
6. What is the rate of change on NO_x? That is - how fast does the ammonia system have to react?
7. Have you experienced any boiler wall corrosion around the nozzles?
8. What is the injection pressure at the nozzles?

AUTHORS' REPLY

1. The nozzles are 316 stainless steel, are 3/8" diameter x 1" long and are supplied by Bete.
2. Yes. The cost of the chemicals are similar, however, the urea system is patented and uses an expensive retractable nozzle.
3. We installed four nozzles each at three levels in the furnace, however, we currently only use two at each level. We found the flow was so low that four nozzles would not atomize the ammonium properly. As we found with the anhydrous ammonia, the temperature window at

which the ammonium is effective is very broad and therefore, the top two levels have the same removal efficiency. The bottom level is used during startup and low load.

4. In the nine years of operating the original anhydrous ammonia system, we measured the ammonia in the stack several times and were able to develop a correlation between stack NO_x and ammonia flow to minimize ammonia in the stack but to still get the removal needed. A curve was developed and the computer controls ammonia flow based on the stack NO_x measured.

This same curve was found to be just as effective with the ammonium hydroxide system. Although ammonia level in the stack has not been measured with the new system, a detached ammonia chloride plume is not visible.

5. None.

6. NO_x can change from 100 ppm to 200 ppm within a minute and it does this several times per day. Smaller spikes are more frequent.

Since Commerce has a NO_x limit to meet every 15 minutes, response time was important in the design. The pump flows 160 lb/hr and the recirculation valve controls flow to the nozzles on average at 23 lb/hr. With a NO_x spike, the valve can close within seconds which causes the flow to the nozzles to increase to 160 lb/hr.

The control room operator may also elect to start the standby pump which would increase the nozzle flow to 320 lb/hr. Note, however, that since the pump can only put out 240 psig and each nozzles can only flow about

38 lb/hr at 240 psig (see question 8 below), the operator must open all three injection levels and open several nozzles manually to get to 320 lb/hr. The maximum flow of the original anhydrous ammonia system was 100 lb/hr.

7. None in the 11 months it has been in operation. Long term corrosion is a concern, however, and we will continue to measure the tube thickness each year near the nozzles and look for signs of damage.

8. Each nozzle can flow 10 lb/hr at 15 psig and 40 lb/hr at 260 psig.