INDUSTRIAL PRODUCTION OF AMMONIA FERTILIZER USING CYANOBACTERIA

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**PROCESS DESCRIPTION**

The ammonia production plant (Figure 1) features a circulating process, with cyanobacteria, medium, and air continually being recycled in the plant. Production of ammonia starts in the photobioreactor system (green), which is a series of connected clear vertical pipes that houses cyanobacteria in a culture medium. The aeration/pump repeating units are indicated by the blue brackets (Figure 1). Aeration occurs every 10 pipes, and then a pump sends the fluids through to the next aeration pipe. This unit is repeated 1504 times per centrifuge unit and 1504 times after the last centrifuge unit. The centrifuge repeating units are indicated by the red brackets and include the aeration/pump repeating units (Figure 1). Per module, the centrifuge repeating unit is repeated 18 times. As a cyanobacteria travel along the photobioreactor they produce ammonia, and at the end of the reactor they are sent to a membrane system for an initial separation.

The membrane system (orange) first separates out all of the cyanobacteria from the ammonia-laden culture medium, and then heats up the medium before running it over a membrane specific for ammonia extraction. Ammonia diffuses over the membrane into a strong flow of air, which is then diverted away to the separation system. The now ammonia free medium is cooled back down to culture temperature, reinoculated with the cyanobacteria, and is then recycled back into the photobioreactor system.

The ammonia and air then moves to the separation system (blue) where it is first compressed and then cooled. Then, the gaseous mixture encounters a set of 4 absorbers made up of a magnesium chloride and silica gel absorbent. Ammonia is selectively absorbed and the leftover air is recycled back into the membrane system. The section is designed so that one absorber is always desorbing while the others are either absorbing ammonia, heating to desorption conditions, or cooling back down for absorption. This way the process is still considered continuous. The anhydrous ammonia leaving the absorber is cooled and compressed to a liquid, and is then ready for storage and transportation.

**REFERENCES**

1. AICHE 2019-2020 Student Design Competition Problem Statement & Rules