Recovery of Nitrogen in Multi-stage Anaerobic Digestion by Nitrification as Acid Source.

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Abstract: Animal wastes can cause environmental pollution when they are not managed appropriately. Manure piles are examples of the animal wastes that release greenhouse gasses such as carbon dioxide, methane and nitrogen which are important contributors to climate change. Anaerobic digesters have been used to eliminate the environmental impacts of animal waste. However, anaerobic digesters are not currently economically feasible, so more research is needed to overcome the main anaerobic digestion system challenges. One of the biggest challenges in anaerobic digesters is the toxicity of high ammonia content. High nitrogen content in animal wastes like manure is toxic to methanogenic organisms and limits biogas yield. Recovery of ammonia from these systems offers the benefit of nutrient recovery and recycle when used in agriculture. Several approaches have been applied to solve the problem of ammonia toxicity in anaerobic digestion system. Dilution with fresh water in the digestion system requires a large amount of water and impacts economics and sustainability negatively. Removing ammonia from anaerobic digestion system is another way that has been used to control the toxicity of ammonia. The traditional way of removing the ammonia is volatilizing the ammonia from the anaerobic digesters then capture it with an acid. The need to use acids is financially burdensome. Therefore, this work aims to assess a new way to capture ammonia in anaerobic digestion system. Whereas traditional methods use acids such as hydrochloric or sulfuric acid to capture ammonia, nitrified solution is used in this work as substitutions of these strong acids to capture the ammonia. Nitrification process is free biological acid forming reaction which also provide an organic fertilizer, nitrate. In this work, a bench-scale of ammonia recovery system is designed which is mainly consisting of two units: packed stripper column and packed absorber column. Ammonium chloride is used as source of nitrogen. The stripper operates at thermophilic temperature (52 C^{o}). The stripping process is done in different pH (8-12). The stripping optimal pH is found to be at 12 as NH_4 is reduced from 1.3 g/L to 0.1 g/L during 150 minutes. The absorber unit is examined in different concertation of HCl at pH range of 2 to 4. The main problem is to maintain the pH at the desired pH values since the pH of the acid increases as ammonia absorbs. The next work focuses on find an acid buffer that helps maintaining the absorber pH at the desired stripping pH.