Process Effectively Strips Hydrogen Sulfide Gas from Wastewater

Hydrogen sulfide is a common component in wastewater treatment plant off-gases (e.g., biogas) and waste gases from certain industrial processes. It is highly toxic and odorous. Therefore, its release into the atmosphere is regulated. In addition, it is very corrosive, which can result in costly damage to equipment and piping systems used in biogas handling. Several technologies exist for removing H_2S from gas streams, but many suffer from drawbacks such as insufficient removals, complexity or high cost.

The simplest means of dealing with H_2S is to burn the biogas in a flare prior to atmospheric release. This typically achieves 95 percent conversion of H_2S to nonodorous sulfur dioxide (SO_2). However, in many cases this level of H_2S reduction is not sufficient to meet stringent air quality requirements. In addition, care must be taken not to exceed sulfur dioxide emission limits (sulfur dioxide, being a greenhouse gas, also is strictly regulated).

In cases where flaring will not reduce the H_2S concentration sufficiently to meet the emission limit, flaring would result in exceeding the SO_2 emission limit or the biogas would be used as a fuel in boilers or electrical generators, other treatment methods must be used. These include iron sponges (and other iron-based absorbents), chemical scrubbers and water scrubbers.

A recently completed research and development project by ADI International, Inc., determined that an iron oxide-based adsorption medium—Media G2— could efficiently and cost-effectively remove H_2S from biogas. This filter product originally was developed to remove arsenic from water supplies down to 2 g/L and was granted a United States patent in March 2001. The company's development engineers who are well experienced in biogas handling systems for anaerobic digesters realized the potential of its iron-based adsorbent to remove H_2S.

In the company's research, a bench-scale version of a Media G2 filter was assembled and a flow of biogas from a small anaerobic digester was passed through it. The filter was able to treat gas with an H_2S concentration as high as 30,000 ppm, reducing this to less that 1 ppm. By varying flow rates and filter configurations, optimum performance was obtained with a gas/medium contact time of 30 to 60 seconds and a linear gas flow velocity of 5 feet/min. It was found that premoistening of the medium was not required as the natural moisture in the biogas effectively moistened the medium. Successful removal of low-level H_2S from a dry air stream also was accomplished.

The absorption capacity of the medium was found to be approximately 40 mg H_2S/gram of medium. Of significance was that Media G2 can be regenerated many times simply by flowing air through the filter column for a period of about eight hours. Over the course of 14 regenerations and reuses, the total adsorption capacity of Media G2 was 540 mg H_2S/gram of medium. The H_2S-saturated medium releases only about 0.1 percent of the adsorbed H_2S into the regeneration air. The medium also has the interesting property of changing color from orange to black as it becomes saturated with H_2S and back to orange as it is regenerated. This is a useful visual indicator of the status of the medium while in operation.

Following the successful lab-scale testing of the medium, a pilot-scale filter containing five liters of Media G2 was constructed and set up at the Canadian Forces Base Gagetown, New Brunswick's waste treatment plant to treat a side stream of gas from the plant's anaerobic digester. Flow through the pilot filter was 3.6 liters/min, 24 hours/day, for more than two months. In that time, the filter treated more than 340,000 liters of biogas without any regeneration and, based on the rate of color change in the medium, appeared to be only ⅓ exhausted. The filter was able to reduce the H_2S from 60–100 ppm down to less than 0.2 ppm at times.

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