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4E3) A Study on the Application of Rock Wool for H_2S Removal using Lab-scale Biofilter

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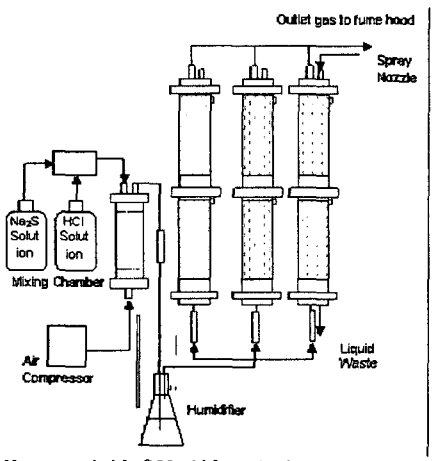
1. Introduction

Among Physico-chemical methods have beenused for the H_2S and other odorous gas treatments, biofiltration has emerged as an effective alternative because of its advantageson efficiency, cost, life applicability and waste product. This process simply utilizes microorganisms attached or immobilized on the surface of packing media to treat malodorous compounds. As for H_2S, microorganisms oxidize this gaseous compound to sulfur element, sulfite or sulfate ion following the reactions:

H_2S HS^- + H^+

HS^- + O_2 + Cells CO_2 + H_2O + S compounds (S, SO_3^{2-}, SO_4^{2-}) + biomass + Heat



The selection of suitable packing materialscan be the most important factor in real applications to achieve high removal efficiencies and sustain effective biofilter performance. And inorganic media-Rock wool was chosen because of many advantageous properties. This study aimed to evaluate the performance of a biofilter packed withrock wool and compare to other biofilters packed with compost and wood chip for the removal of H_2S from a contaminated gas stream. In addition, the effects of NaOH 1N solution neutralize Compost and Lime powder to pH maintaining on rock wool media were evaluated.

2. Materials and methods

A heterotrophic H_2S oxidizer, *Pseudomonas sp*SUL-4 was grown in modified TSA medium at pH 7 then immobilized with packing materials. Gaseous H_2S was produced by mixing HCl and Na_2S in a chamber where a continuous stream of air was directed. The contaminated gas stream was passed through a humidifier prior to introducing to column inlets. Figure beside shows the schematic diagram of the biofilter system

Hydrogen sulfide concentration was measured using H_2S gas detection tubes (Gastec, Tokyo, Japan) and Multi-RAE PLUS multi gas monitor. Gas moisture content and temperature were also regularly measured using SATO thermo-hygrometer SK-110 TRH. Collected percolate water was measured for pH twice a week. Media samples were collected every 5 days from different points of the biofilters and analyzed for water content and microbial counts (CFU).

3. Results and discussions

3. 1 pH maintaining

With the addition of NaOH solution, neutralize compost and lime powder, pH was controlled to neutral. However, with increasing of H_2S inlet concentration, minimal changes in pH were observed in biofilters mediaand the pH of the drained liquids was found to be decreasing due to an accumulation of sulfite and sulfate ions.

3. 2 microbial count

Compost favored the highest microbial growth rate and biomass formation particularly during the high H_2S loading. Inorganic rock wool also housed relatively high microbial count with sufficient weekly nutrient supply. Wood chip, however, had low microbial growth despite lengthening the EBRTto 80 seconds.

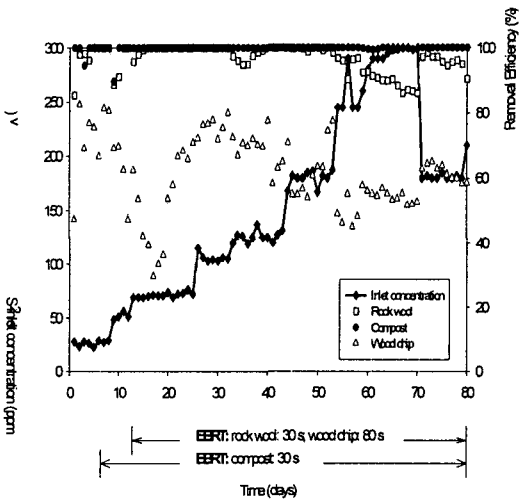
3. 3 Pressure drop

The compost biofilter exhibited the highest pressure drop while Rock wool, though with high porosity adequate for the gas passage, absorbed much water in its light and fibrous intra-structure, resulting to a slight increase in pressure drops during the period of higher water addition. Wood chip packing had low pressure drops due to its high bed porosity.

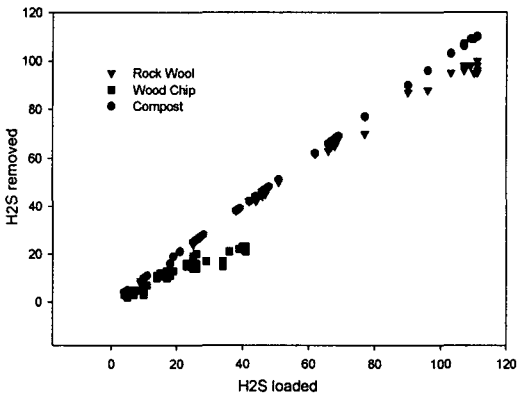
3. 4 Hydrogen sulfide removal

Compost media showed a stable removal efficiency of greater than 99%,while rock wool and wood chip averaged at 96.6 and 61.7%, respectively. The removal efficiencies in the rock wool biofilter were maintained mostly at >99%, but dropped shortly when the inlet concentration was increased initially. The removal efficiency also started to decline when the rock wool biofilter was subjected to an inlet H_2S concentration greater than 250 ppmv..

In addition to the elimination capacity, the pollutant removal pattern along each column can be used as an indicator of biofilter performance.



The H_2S inlet concentration and removal efficiencies throughout the experimental period



Elimination capacities

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