**H2S removal using cellular concrete waste as filtering material**

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**Highlights**

* - H2S removal using cellular concrete waste was investigated.
* - This material is efficient for removing H2S in abiotic conditions.
* - H2S reacts with CaCO3 in wet conditions to form gypsum.
* - At EBRT = 56 s, a maximum elimination capacity of 7.8 g m-3 h-1 was obtained.

**1. Introduction**

Cellular concrete is a building material mainly made up of calcium oxide (CaO), iron oxide (Fe2O3), alumina (Al2O3), silicon dioxide (SiO2) and sulfur trioxide (SO3). Such a waste material could appear as a cheap and eco-friendly solution for the removal of H2S in air or biogas at industrial scale. However, interactions between cellular concrete components and H2S are not yet fully understood, nor are the operating conditions to reach the optimum recovery. The aim of this study was therefore to determine the physical reactions that occur between H2S and the main components of cellular concrete. For this purpose, the removal of H2S in air was experimentally study in three abiotic filters filled with: (i) waste of cellular concrete, (ii) expanded schist, and (iii) a mixture of expanded schist and cellular concrete waste. Thereby, the difference in composition between cellular concrete and expanded schist could allow the identification of major components involved in the removal of H2S.

**2. Methods**

The experimental set up consisted of 3 PVC cylindrical columns (internal diameter 100 mm) filled with a volume of 7.8 L of material (1 m height). Filter “BF1” was filled with a mixture of cellular concrete waste and expanded schist (54%/46% weight, corresponding respectively to 65%/35% in volume). Filters “BF2” and “BF3” were filled with 100% expanded schist and 100% cellular concrete waste, respectively. Materials were sieved and fractions exceeding 10 mm and less than 5 mm were removed. For each column, a stream of H2S (99.7% purity) was diluted in the air generated using a regulated fan before entering the column. If necessary, the air flow was bubbled through a humidification system. The H2S concentration was measured all along the column, which was equipped with 9 sampling ports located at 0, 5, 20, 40, 50, 60, 80, 90, 95 and 100 cm from the bottom.

The polluted gas was firstly flowed through the packing filters in dry conditions, i.e without the humidification system, at a constant airflow (0.5 m3 h-1 corresponding to an Empty Bed Residence Time EBRT of 56 s) and inlet H2S concentration (CGin = 50 ppm). H2S filtration was afterwards investigated in wet conditions for various operating conditions over 4 months (H2S concentrations CGin varying from 50 to 500 ppmv; EBRT from 7 to 56 s).

**3. Results and discussion**

In dry conditions, H2S removal efficiency was relatively low. At EBRT = 56 s, removal efficiency RE = 18% was obtained for filters using cellular concrete waste whereas no removal was recorded for expanded schist. In wet conditions (EBRT = 56 s and CGin = 50 ppm) , H2S removal efficiency was on average 47% and 4% for filters filled with cellular concrete waste and expanded schist, respectively, whereas 28% was obtained for the filter filled with the mixture of cellular concrete waste and expanded schist. Overall, for these operating conditions, 130 mg of H2S was captured by 1 g of cellular concrete waste during the 4 months of experiment. As better removal efficiencies were recorded in wet conditions, results can be explained by the appearance of CaCO3, formed according to reactions that occur naturally in concrete surface in wet conditions. In wet conditions, the influence of inlet H2S concentration on RE is reported in Figure 1. The drop in RE were significant for inlet concentrations up to 200 ppm and moderate for higher concentrations. These results confirm the potential advantage of using cellular concrete waste as a first stage in treatment of gaseous H2S effluents.



**Figure 1.** Removal efficiency vs H2S concentration at the inlet of filters in wet conditions at EBRT = 56 s (blue diamond: cellular concrete waste; green triangle: mixture of cellular concrete waste and expanded schist; red square: expanded schist).

**4. Conclusions**

The ability of cellular concrete waste to remove H2S was highlighted, mainly due to reactions occurring in wet conditions between H2S and calcium carbonate leading to gypsum formation. A maximum elimination capacity of 7.8 g m-3 h-1 was calculated. As a result, H2S filtration using cellular concrete waste could be carried out beneficially as the humidification step of biofiltration systems. Additionally, this mode of filtration could be used as a first step treatment to remove H2S from biogas.