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Comparison of the Biological H_2S Removal Characteristics among Four Inorganic Packing Materials

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Four inorganic packing materials were evaluated in terms of their availability as packing materials of a packed tower deodorization apparatus (biofilter) from the viewpoints of biological H_2S removal characteristics and some physical properties. Among porous ceramics (A), calcinated cristobalite (B), calcinated and formed obsidian (C), granulated and calcinated soil (D), the superiority of these packing materials determined based on the values of nonbiological removal per unit weight or unit volume of packing material, complete removal capacity of H_2S per unit weight of packing material per day or unit volume of packing material per day and pressure drop of the packed bed was in the order of A≃C>D≃B, which is correlated with the maximum water content, porosity, and mean pore diameter.

[Key words: biofilter, hydrogen sulfide, removal capacity, inorganic packing materials]

The applications of biological deodorizing methods have been increasing (1–4) because of their cost effectiveness and simple maintenance (2, 5) compared to chemical and physical methods. Biological deodorizations are divided into two types of system, gas-solid and gas-liquid systems (6). Among the gas-solid systems, a packed tower deodorization system is efficient mainly because this can be constructed in a small construction area and can function sufficiently in urban areas. To reduce the scale of the apparatus, the selection of packing materials is an important factor and many different types of packing materials suited for microbial growth have been actively researched. Some requirements for a good packing material are as follows: (i) high water-holding capacity, (ii) high porosity and large specific surface area, (iii) less compacting nature, (iv) low-pressure drop over a wide range of water content, (v) small change in form in long periods of use, (vi) lightness, (vii) low cost, (viii) appropriate adsorbing ability for malodorous gases and (ix) large buffering capacity for acidic end products. Requirements (iii), (iv), (v), (vi) and (vii) are mainly related to the construction and maintenance of the biological deodorization apparatus, and (i) and (ii) are related to its biological activities. The acidity or basicity of gases may be one of the factors for selecting packing materials. As organic packing materials, soil, compost and peat were shown as good packing materials (7–14) that meet requirements (i), (ii), (vii), (viii) and (ix). Inorganic packing materials, such as perlite (15), porous ceramics (16), activated carbon fiber (17,18) and porous lava (19), are used, because they meet requirements (iii), (iv) and (v). Because comparative study of different packing materials has been rarely conducted under the same condition (20), the evaluation of many packing materials is difficult. In this study, biological H_2S removal characteristics of four inorganic packing materials were evaluated under the same experimental conditions of packing volume, flow conditions and inoculation source. Additionally, the H_2S removal characteristics were discussed in terms of physicochemical properties and microbial distribution on the packing materials.

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MATERIALS AND METHODS

Flow system A gas flow system is shown in Fig. 1. Biofilter columns are made of glass and have a 50 mm inner diameter and 500 mm height. H_2S gas from a gas cylinder was diluted with air from a compressor, then supplied to the biofilter downward after its flow was regulated with a flowmeter to the appropriate value.

Packing materials The chemical components of the inorganic packing materials used are shown in Table 1. True density (g·cm^{-3}), porosity (%), bulk density (g·cm^{-3}), mean pore diameter (μm), pore distribution, pH, and maximum water content (%) were measured as follows.

True density (ρ_s): distilled water was placed into a 100-ml Erlenmeyer flask. A mark was made at the water level inside and the system was weighed [y_1 g]. Fifty ml of distilled water and xg of packing material dried at 100°C overnight were placed in the marked flask, then stirred with a magnetic stirrer and suctioned with an aspi-

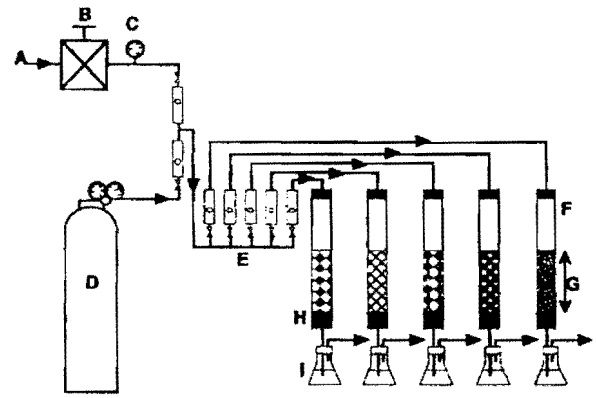

FIG. 1. Schematic of laboratory-scale experimental apparatus. A, Air; B, pressure regulator; C, pressure gauge; D, gas cylinder (H_2S+N_2); E, flow meter; F, glass column (50 mmϕ × 500 mmH, packed height 180 mmH); G, packing material; H, saran net; I, drain water.