BIOFILMS IN PEAT BIOFILTERS

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1. Introduction

1.1 USE OF PEAT IN WASTE TREATMENT OPERATIONS

As a potential raw material for a variety of uses, peat has been recognized to possess a unique combination of chemical and physical properties, such as absorbency, adsorbency and deodorization, which could be employed in environmental protection applications (McLellan & Rock, 1986; Martin, 1991). Mueller (1972) discussed peat's potential in pollution abatement associated with its capacity to adsorb organic and inorganic matter and its properties as a filter material. The main mechanisms for the attachment of pollution to peat filters are shown in Figure 1.

Recently, the need to dispose of toxic wastes has generated renewed interest in the properties of peat that could be employed towards those aims. Treatment of gaseous effluents has also been highlighted as one of the possible applications for which peat properties are suitable.

1.2 PEAT AS A FILTERING AGENT

In comparing peat with one of the most accepted media for filtration and wastewater treatments, i.e. activated carbon, it has been noted that the surface of the latter is, for the most part, nonpolar. This makes carbon a good adsorbent for organics, but the adsorption of inorganic electrolytes is more difficult (Netzer & Hughes, 1984). The major drawback attributed to the usage of activated carbon is its expense (McLellan & Rock, 1986). In addition to the high surface area (>200 m²/g, 95 %

Figure 1. Main mechanisms for the attachment of pollutants to peat.

porosity of peat, and its adsorption properties, it has the advantage of supporting the formation of biofilms where microbial degradation can occur.

1.3 AIR AND GAS PURIFICATION

Mueller (1972) referred to the high carbon content of dried peat moss, its large surface area to weight ratio and its adsorptive properties. He also mentioned the potential of peat to adsorb odours, by virtue of its physical and chemical structure, in the same way that activated carbon is being used by industry. Pomeroy (1982) discussed the important role of microorganisms in the treatment of odorous air. At the beginning, efforts were confined to chemical and physical methods. Then, the importance of biological methods in pollution control was realized. Smith et al. (1973) showed the importance of microbial action in the capability of soil to degrade SO\textsubscript{2}, H\textsubscript{2}S, CH\textsubscript{3}SH, CO, C\textsubscript{2}H\textsubscript{5} and C\textsubscript{2}H\textsubscript{4}. Furusawa et al. (1984) used a packed bed of fibrous peat as a deodorizing material to remove H\textsubscript{2}S from air in a laboratory-scale column. This removal was mostly due to biological oxidation by indigenous microorganisms in the peat. Wada et al. (1986) determined the characteristics of the H\textsubscript{2}S oxidizing bacteria inhabiting a peat biofilter.

1.4 PEAT AS A SUPPORT FOR MICROORGANISMS

In addition to peat's chemical and physical characteristics, its biological properties should be taken into consideration when analysing its effect in pollution control. It has been long recognized that some of the properties of peat are appropriate for maintaining microorganisms in viable condition. Lochhead & Thexton (1947a,b) found in comparative tests of various powdered materials that peat was superior to other preparations for maintaining viable test bacteria. Jaouich (1975), in his studies on nitrate reduction in peat, reported the role of microorganisms in the denitrification process and the isolation of representative strains of denitrifying Pseudomonas species found in peat. Nichols & Boelter (1982) in their studies on the treatment of secondary sewage effluent with a peat-sand filter bed, found that microbial immobilization in the peat contributed to nitrogen and phosphorus removal.

This presentation reviews and discusses the potential of peat utilization in pollution control, with emphasis on the biodegradative processes that occur with the formation of a biofilm on the surface of the peat fibres. The characteristics of peat as a support for microbial populations will be highlighted. A new theory is presented, suggesting that peat could play the role of an active agent for biological degradation. This role could complement the present use of peat in waste treatment, which is mostly based on its physical and chemical properties. A schematic view of the potential of peat in the removal of pollutants is presented in Figure 2.

2. Materials and Methods

2.1 BIODEGRADATION SYSTEM

Although a bioprocessing module designed for liquid waste treatment has been utilized, this paper will deal with a biofilter unit packed with fibrous peat moss, employed for deodorizing gases (Furusawa et al., 1984). For experiments utilizing gaseous pollutants, hydrogen sulphide gas is generated by the method shown in Figure 3, and initial tests have been conducted with Thiobacillus species, a facultative autotrophic bacterium able to degrade sulphur compounds. It is expected that, in the testing of specific effluents, other microbial strains, adapted for