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Experimental study of droplet biofilter packed with green sphagnum to clean air from volatile organic compounds

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Abstract

Chemical industries are the main producers of such products as upstream petroleum, solvents and paints and other have the biggest influence on discharging volatile organic compounds (VOC) in to the environment.
Research of biofilter packed with green sphagnum load to eliminate pollutant xylene was made. Filter load as a material has good capabilities to absorb water. The main task of this research is the experimental study of a drop biofilter packed with green sphagnum to eliminate volatile organic compound (VOC).

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1. Introduction

Volatile organic compounds include variety of chemicals that are emitted by a wide array of products. The main sources of volatile organic compounds that could be found in households are organic chemical products that are ingredients in: paints, paint strippers, solvents, wood preservatives, aerosol sprays, cleansers and disinfectants, moth repellents and air fresheners, hobby supplies, pesticides, building materials, furnishings, office equipment, graphics

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and craft materials [1, 2]. As volatile organic compounds are used in household chemical products, they are used in the manufacturing and in production processes as: solvent thinners, degreasers, cleaners, lubricants, and liquid fuels.

To avoid toxic and health threatening compounds in environmental and indoor air, people are creating many different contamination treatment technologies. Various types of technologies been made to find the best to evaluate possibility of cleaning the air contaminated with volatile organic compounds. Two types of VOC controlling techniques can be separated: recovery and destruction. Some techniques are better in cleaning efficiency, but requires high maintenance, or have a big cost [3]. But just one technique was mentioned as a non-hazardous with no requirements for big initial investment – bio-filtration. So from environmental and economic side it is the best technique to use for VOC control.

2. Biofiltration

Biofiltration uses microorganisms fixed to a porous medium to break down pollutants present in an air stream [4]. The microorganisms grow in a biofilm on the surface of a medium particles [5, 6].

The filter bed-medium consists of relatively inert substances (compost, peat, etc.) which ensure large surface attachment areas and additional nutrient supply. As the air passes through the bed, the contaminants in the air phase sorb into the biofilm and onto the filter medium, where they are biodegraded [3].

Biofilter has 7 main parameters that are considered to be the most important [7−9]:

- Microorganisms – degradation process is well known to be involved with microorganisms including bacteria, actinomycete and fungi;
- Filter construction and sizing. The type of construction and installation of biofiltration equipment for a given application will depend primarily on the availability of space relative to the required filter volume;
- Filter material. In order to have a biofilter to operate efficiently, the filter material must meet several requirements;
- Raw-gas conditioning − since biofilters can be poisoned by the presence of off-gas constituents that are toxic to microorganisms because of their chemical nature and/or by excessive concentration, a characterization of type and quantity of all off-gas constituents should always be conducted prior to the design of a filter;
- Moisture control − maintaining optimal moisture content in the filter material is the major operational requirement for a biofilter;
- Control of pH. Since most microorganisms prefer a specific pH range, changes in the pH of the filter material will strongly affect their activity;
- Back pressure and energy consumption. In a biofilter, (electrical) energy is predominantly needed by the blower to overcome the filters back pressure and to a lesser degree, by the humidifier.

When all of these parameters considering the maintenance and monitoring that are important too are being considered as to achieve good efficiency in biofiltration processes.