

# Banana Tree as Natural Biofilter for Organic Contaminant in Wastewater Treatment

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# Banana Tree as Natural Biofilter for Organic Contaminant in Wastewater Treatment

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**Abstract.** An organic contaminant is one of the environmental issues in the wastewater. Organic contaminants in wastewater may produce toxic chemicals during disinfection. Nowadays, food industries and restaurants are the main contributors to the organic contaminant in the wastewater. Organic contaminant caused the increase of BOD (Biological Oxygen Demand), COD (Chemical Oxygen Demand), TSS (Total Suspended Solid), and decrease DO (Dissolved Oxygen). The purpose of this article is to evaluate the efficiency of removing the organic contaminant from wastewater with natural biofilter from a banana tree. The efficiency of the banana tree was analyzed in terms of decreasing BOD, COD and the content of TSS. The parts of a banana tree that can be removed the organic contaminant from wastewater is its stem. The Banana stem used as natural media biofilter because of its abundant availability in Indonesia. The disadvantages of a banana tree were it can be easily placed by bacteria. Bacteria will develop well on the banana stem because the banana stem is moist enough and consist of much water in it. The banana stem contains cellulose fibers that can be used as media biofilter because of the characteristics of it, such as abundantly available, biodegradable, renewable, cheaper, low abrasive nature, unusual, specific properties, and exhibit excellent mechanical properties. However, the disadvantages of cellulose fibers were low thermal stability, moisture absorption, and poor compatibility.

## 1. Introduction

Environmental problems of developing countries (such as Indonesia) are not only the product of affluence from industries but also a product of poverty, socio-economy, and non-education people [1]. One of the elemental problems that should be considered is an organic contaminant. Unconfined soil infiltration systems have been identified as sources for emerging organic contaminants in aquatic environments, including drinking water source areas [2]. Especially when groundwater is shallow, it can readily exchange with surface water [3]. Thus, not only can organic contaminants pose direct health risks for exposed aquatic organisms, but also indirect risks to humans through ingestion of contaminated drinking water and biota. Therefore, the strategy for removing organic contaminants from wastewater treatment is essential. Many methods have been suggested as a problem solver for waste water treatment [4]. One of the effective methods to remove waste element like an organic contaminant in the wastewater treatment is a natural biofilter.



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Filtration is one of the most critical treatment processes used in water and wastewater treatment. The primary purpose of filtration is to produce effluent of high quality so that it can be reused for various purposes. Any filter with attached biomass on the filter-media can be defined as a biofilter. It can be the trickling filter in the wastewater treatment plant, or horizontal rock filter in a polluted stream, or granular activated carbon (GAC) or sand filter in a water treatment plant. A biofilter has been successfully used for air, water, and wastewater treatment. It was first introduced in England in 1893 as a trickling filter in wastewater treatment, and since then, it has been successfully used for the treatment of domestic and industrial wastewater. Biofilter can be developed using rock or sludge as filter media, using plastic media, or by natural biofilter using part of plants, and vegetables. The basic principle in a biofilter is biodegradation of pollutants by the microorganisms attached to the filter media [5].

Indonesia is a tropical country; the agricultural activity of banana trees are so high. Hence, in this present study Banana tree has been selected as a precursor to creating natural biofilter due to its abundance, low-cost, excellent properties and unique structure. One of the prospective methods to remove waste element such as organic contaminant in the wastewater treatment is a natural biofilter. Usually, cellulose fibers are used for natural biofilter. However, cellulose fibers also have some disadvantages, such as moisture absorption, quality variations, low thermal stability, and poor compatibility with the hydrophobic polymer matrix [6]. One of the cellulose sources is domestic waste relating to fruit and vegetable [7]. For example, banana stems can be used as a cellulose source. Banana stem is mostly available. Thus, this tends to be a waste problem [8] showed that banana stem contained 39.12% of cellulose and 72.71% holocellulose, in which the holocellulose. This paper will analyze the reason for using a banana tree as a natural biofilter for the organic contaminant in wastewater treatment.

## 2. Methodology

Biofilter in primary wastewater is to treat the parameters such as BOD, COD, and SS, etc. The performance of biofilter depends on biomass attached to filter media (banana stem). Other factors that can affect are the filtration rate, filter backwashing techniques, and the organic content of the influent wastewater.

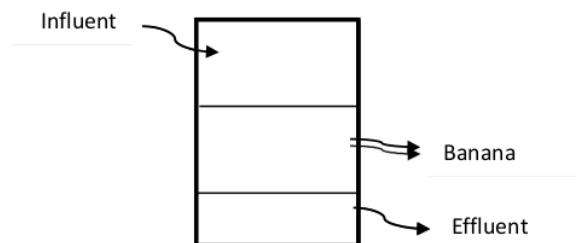


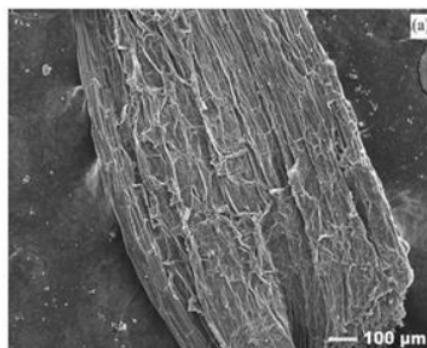
Figure 1. Schematics of the biofiltration for wastewater treatment

The biofilter tank needs one tank when the amount of wastewater is relatively small. Banana stem submerged in wastewater that is flowed continuously through the gap or cavity between the media with the vertical flow. Microorganisms will grow and attached on the surface of banana stem and form a mucous layer called biofilm. The type of biofilter that can remove organic contaminants (BOD, COD, SS, etc.) is anaerobic biofilter.

## 3. Result and discussion

The content of organic contaminant can be dangerous even at low concentrations and may raise regarding if it releases into wastewater. The composition of an organic contaminant in wastewater depends on the type of wastewater, such as wastewater from runoff from fields, industrial, municipal,

hospital, etc. The process that used to remove organic or another contaminant in waste water is wastewater treatment Plants (WWTP). WWTP convert influent of wastewater into an effluent that can be returned to the stream with minimum impact on the environment. The efficiency of the organic contaminant at WWTP is evaluated through measurements of the Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD) and the Total Organic Carbon (TOC), etc. The biofilter can remove organic contaminant with an efficiency of 70,4-84,2% [9].



**Figure 2.** The SEM images of banana fibre [10]

Cellulose is the primary reinforcing ingredient in banana tree cell walls. The presence of this constituent as allied poly-(1,4)-d-glucan molecules in extended chain conformation assembled into nanofibers contributes to the high modulus and tensile strength of the fibers. Microorganisms can be attached on the surface of a banana stem that contains cellulose.

#### 4. Conclusion

Banana Tree, as a natural biofilter for the organic contaminant in wastewater treatment, is presented an overview in this paper. The aim of this review is to evaluate the efficiency of removing the organic contaminant from wastewater with natural biofilter from a banana tree. The efficiency of the banana tree was analyzed in terms of decreasing BOD, COD and the content of TSS. The parts of a banana tree that can be removed the organic contaminant from wastewater is its stem that contains cellulose fibers. Cellulose fibers have characteristics such as abundantly available, biodegradable, renewable, cheaper, low abrasive nature, attractive, specific properties, and exhibit excellent mechanical properties. Therefore, it used as a natural biofilter to remove organic contaminants in wastewater treatment. However, the disadvantages of cellulose fibers were low thermal stability, moisture absorption, and poor compatibility. The banana stem can be used as natural media biofilter because of its abundant availability in Indonesia as a tropical country and the characteristics of cellulose fibre on the banana stem.

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