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Effect of current strength on electrocoagulation using Al-Fe electrodes in COD and TSS removal of domestic wastewater

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Abstract. Domestic wastewater is wastewater from household activities such as kitchens, baths, laundry, and water closets. Domestic wastewater contains parameters that can cause environmental pollution, so it needs to be treated. One of the domestic waste treatment technologies is electrocoagulation. Electrocoagulation is a continuous coagulation process using direct electric current through electrochemical events. The purpose of this study was to determine the effect of current on electrocoagulation using Al-Fe electrodes in reducing contaminant levels of domestic wastewater (COD and TSS). The electrode configuration used in this study was Al-Fe, with a variation of the current strength used was 1 A, 2 A, 3 A. The electrocoagulation process was carried out continuously with a contact time of 12 minutes. The sampling process was replicated at 12 minutes, 17 minutes, 22 minutes, 27 minutes, 32 minutes, 37 minutes and 42 minutes. The instrument used in this study was an electrocoagulation reactor with dimensions of 6 cm x 10 cm x 18 cm with Al and Fe electrode configurations. Treatment of domestic waste using electrocoagulation and filtration technology can remove COD parameters in the Al-Fe electrode configuration with a current of 2 A and sampling at 27 minutes with an efficiency of 95%. The most optimum removal of TSS parameters of 94% was obtained in the Al-Fe electrode configuration with a current of 2 A and taking samples at 37 minutes.

1. Introduction

Water is an essential element for human life because almost all human life necessary and activities use water. Used water for human activities is called wastewater. Wastewater can be produced from household or industrial activities. Domestic wastewater is wastewater produced from households like cooking, bathing, washing, and water closet [1]. The characteristic wastewater, like grey water and black water, are containing Total Suspended Solid (TSS), Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), smelly, colored, protein, fat, and detergent [2].

Electrocoagulation is an electrochemical method for water treatment, where an anode occurs in the release of active coagulant in the form of metal ions (aluminum or iron) into a solution. Meanwhile, in the cathode, an electrolysis reaction occurs in the form of hydrogen gas release [3]. Research by Ni'am et al. (2017) shows that the study uses Al and Fe electrodes using different voltage, current strength, and time-proven to reduce COD concentrations by 65% -76% and TSS concentrations reduced by 85% [4].

Recent advances in the stabilization of expansive soils using waste materials: A review

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Abstract. The increasing population necessitates infrastructural development, and these civil engineering infrastructures are constructed on soils. Highways, buildings, bridges, railways, and dams need a strong foundation; however, some soils are not suitable for making a strong foundation. An example is expansive or reactive soils. Expansive soils are subjected to volumetric changes, thus the biggest challenge that geotechnical engineers encounter in the field. In an attempt to make these poor soils more appropriate for use in engineering projects, different stabilization techniques are used. However, well-established stabilizers like cement, lime, and bitumen are associated with environmental challenges. This has attracted the attention of the researchers to look for environmentally friendly and sustainable stabilizers. The current study provides a review of the recent trends in improving the geotechnical properties of expansive soils using waste materials, focusing on their efficacy, the optimum percentage, and research gaps. Wastes considered in this study include waste tires, sawdust, and sawdust ash, and fly ash. The review utilized research articles extracted from different databases, such as Science Direct, Google Scholar, Scopus, Web of Science, and Google. This work could give the geotechnical engineers and independent researchers insight into the recent soil stabilization trends that could lead to sustainable development.

1. Introduction

Various soils are used during the construction of civil engineering structures. However, some soils are suitable, while others are unsuitable for civil engineering purposes [1]. One example of unsuitable soils that cause severe damage to engineering structures' foundations includes expansive clay [2]. These soils experience massive volume changes due to their high affinity to water. Expansive soils have a record of swelling during the wet season and shrinking during the dry season, and the cause of these behaviors could be the presence of a mineral with an enlarging matrix [1], [3], [4]. In most parts of the world, soils with desirable properties are transported from quarries that are at times far from the construction project site. This raises the construction costs of the project in terms of excavation and transportation costs, and for that matter, there is a need for shifting to locally available stabilization materials.

The history of expansive subgrade soil stabilization can be traced way back to the 1950s, and since then, researchers continued looking for better and sustainable ways of soil stabilization [5]. Dubose [6] experimented using a compaction method to control heaving in clay soils. In 1958, Jones conducted laboratory studies on improving the geotechnical properties of reactive clay soils using hydrated lime

Numerical simulation of detailed airflow distribution in newly developed photosynthesis chamber

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Abstract. Predictive numerical simulation of airflow uniformity in canopy plants could provide a suitable environment for plant growth. A numerical investigation of airflow in a photosynthesis chamber was conducted using the Computational Fluid Dynamics (CFD) model. This research-validated the numerical model with measurements performed in a bare bottom open chamber. The chamber has bottom openings with three exhaust fans on the roof. After model validation, airflow patterns and their uniformity were evaluated in different fan arrangements and doubled air volume rates. The obtained results showed that a more uniform airflow distribution was observed with increasing the fan's air volume rate (0.0187, 0.0172, and 0.0177 m^3s^{-1}), particularly fan in the middle position and diagonally position inside the plant with coefficients of variation of 14.36%, 9.3% and 10%, respectively. Moreover, increasing the fan's air volume rate and moving the fan positions to the middle and diagonally can significantly help produce uniform air velocity distribution inside the plant.

1. Introduction

The response of net photosynthesis to air velocity has become vital in increasing and maintaining airflow uniformity in the plant canopy. Many researchers have conducted air velocity studies in the plant canopy to investigate its influence on plants. For example, Shibuya et al. (2006) experimentally clarified that upward and downward airflows enhanced the CO_2 exchange rate of the canopy and dry masses of the seedlings from 1.4–1.5 and 1.2–1.3 times, respectively, compared with a conventional horizontal airflow [1]. Okayama et al. (2008) reported (that fans set on both sides of the space and opposed fans not set coaxially) could provide more uniform airflow distribution than the conventional airflow pattern (fans set on one side of the room) [2]. It also enhanced the net photosynthetic rate more than that in the traditional airflow pattern with the same energy input. Furukawa (1975) showed that changing the air temperature did not significantly affect airflow rate efficiency on photosynthesis but increasing the light intensity enhanced it significantly [3].

Primary data on adequate air circulation to enhance plant growth in a closed plant culture system (chamber) were obtained by investigating the effects of the current airspeed ranging from 0.01–1.0 ms^{-1}. Researchers also found that the plant canopy's net photosynthetic rate doubled with increased air

Cultivation process of microalgae using wastewater for biodiesel production and wastewater treatment: a review

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Abstract. Combining microalgae cultivation with nutrient removal is a promising technique as it enables renewable energy generation with the additional potential removal of wastewater contaminants in a single process. Performance and total yield of this process are still below the standard for industrialization. Thus, optimization is needed to reach the feasibility and actualize the concept. Cultivation conditions and reactor design play essential roles in the application and feasibility of this process. Both aspects have been developed through the years to enable the industrial application of this concept. Cultivation conditions are usually categorized into trophic conditions in which each situation has its specific function and target of removal. These conditions, however, are also applied in various reactor systems. Closed photobioreactor and open pond are two central systems for the reactor. Two of the most applied reactor models in wastewater are reviewed here to create a broad picture of the algae cultivation process by emphasizing biomass production and considering different aspects.

1. Introduction

Microalgae culture is considered as the future generation of biofuel source with many additional advantages. Among the advantages, nutrient removal and carbon sequestration are on top of the priority list; hence, this technology's benefit in overcoming environmental issues is very favorable [1-3]. Lately, more significant scale applications with numerous technologies vary the possibility of applying many wastewater sources and characteristics.

The microalgae cultivation process with a specific bioreactor design shows essential roles in the application and feasibility of coupling biomass generation with a wastewater treatment system [4]. Among factors that determine the coupling feasibility, light penetration and agitation process are commonly mentioned in this system. Both of operational parameters are mostly affected by the design of the reactor in which the generation of algae biomass is conducted [5]. The agitation and light penetration are essential to ensure high biomass productivity and wastewater recovery [4,6]. Similarly, the *trophic* condition must count as the first consideration since algae can cope with many carbon and energy, including the one in the system of wastewater treatments [7].

Nonetheless, many wastewater applications as sources of nutrients for microalgal growth failed to reach high biomass yield. Some of the applications focused on the strains and co-cultivation microorganisms while the operational conditions were less considered. Failure to identify and construct

Simulation sediment transport in development location of a diesel power plant using Computational Fluid Dynamic (CFD) methods

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Abstract. Research about Sediment Transport is important for the sustainability of coastal buildings. The infrastructure construction of the Halmahera Diesel Power Plant (PLTD) in the coastal area requires water supply as a cooling system. The supply of cooling water can be reduced because of erosion or sedimentation. This study uses CFD modelling of ANSYS FLUENT applications with variations in mass flow rates. The Eulerian-Lagrangian approach is used to predict the rate of erosion and accretion that occur around the place of Halmahera. Methods of Particle Size Distribution (PSD) numerical simulation is uniform. The simulation process results consist of particle mass, erosion, and accretion rate in the seabed. Variations in mass flow rates of 0.05 kg/s, 0.1 kg/s, 0.15 kg/s, 0.2 kg/s, 0.25 kg/s obtained the erosion rate respectively 5.425 x 10^{-7} mm/year, 1.085 x 10^{-6} mm/year, 1.626 x 10^{-6} mm/year, 2.170 x 10^{-6} mm/year, 2.712 x 10^{-6} mm/year. The result of the accretion rate obtained from the variation in mass flow rates is 301.43 mm/year, 602.87 mm/year, 904.30 mm/year, 1205.50 mm/year, 1507.77 mm/year. From this research. The result of simulation to be important to predict the rate of sediment transport for consideration in the development location of construction Halmahera PLTD.

1. Introduction

A natural process that often happens in the coastal area will have resulted in sediment transport. These conditions will result in accretion and erosion. Sedimentation or erosion across the coastline will have impacted the form of coastal buildings (ex: pier, jetty, wave breaker, groin, artificial sea wall, etc.). Halmahera East Ternate island is a specified location for Diesel Power Plant Construction (PLTD). The diesel power plant is usually used for fulfilling the electric in low capacity, new isolated place, village, and industrial needs. The diesel power plant needs a huge water consumption for its cooling system. The lack of water needs for cooling system because of sediment transport, will prevent diesel power plant to work properly [1]. The research uses the data from the temporal change of shoreline that needs expensive cost and longtime research so that simulation needed to be efficient processes [2].

Research about sediment transport conducted by Javaherci and Aliseda (2017) used Discrete Random Walk (DRW) method on simulation to obtain sediment transport rate which marine hydrokinetic turbine