A method to treat textile dye contained wastewater effluents using natural soil, microbial consortium and aquatic floating plant

Background

Textile based industries account for the majority of the colored waste effluent water and an approximately 50 % from their original dye bath consisting of dyes released from textile industry due to the low level of dye fibre fixation rate (Kalyani et al., 2008). Therefore, around 280 000 tons of textile dyes are discharged into the environment annually, worldwide and adversely account for water and soil pollution. However, synthetic dyes are designed to be resistant for natural degradation processes and persist in the environment for long period of time. Untreated or partially treated textile dye contained effluents finally ended up in aquatic environments as water is the ultimate sink for many types of pollutants. This lead sever problems in the quality and the ecological balance on the receiving water bodies and finally on the groundwater as well. Further, dyes can cause severe health problems such as allergy, skin irritation, cancer and some mutagenic problems on fauna as well as on human health. Disposal of these effluents in concentrated forms create various negative impacts on surface and ground water. Thus, removal of synthetic dyes from textile dye wastewater effluent is vital for long-term ecological balance, environmental health and integrity, as well as on the expansion of textile industry.

This invention generally relates to the wastewater treatment and more particularly to the wastewater containing synthetic textile dyes.

Technical Problem

Various physical and chemical treatment methods such as membrane filtration, ozonation, reverse osmosis, coagulation, flocculation, flocculation, etc, are practiced worldwide to treat textile dye contained effluents. Most of these treatment methods are efficiently remove the color of the synthetic dyes. However, chemical based methods are not environmental friendly and have short life time. Therefore, continuous addition of different polymer contained chemicals is essential. Further, these kind of treatment methods create heavy load of concentrated dyes ass a sludge creating secondary environmental pollution. Treatment of this sludge is challengeable as incineration is the

most preferred method though the cost is high. Further, application of most sophisticated technologies such as reverse osmosis, ozonation, membrane filtration cannot afford by country like Sri Lanka due to the high initiation and maintenance cost. Adsorption into different waste materials such as such as potato waste, recycled alum sludge, sugar cane bagasse, activated carbon and sphagnum peat, zeolites, fly ash, and some ligno-cellulosic materials like natural materials have recorded as the potential dye decolorizing materials by numerous researchers in other parts of the world. However, most waste materials have to activate before the application. Therefore, natural solid materials which do not require prior activations have a growing concern as the low cost alternative adsorbent when designing a wastewater treatment plan. The use of some bacteria, plants, fungi and some algae as biological agents is one of the emerging techniques as it is a low cost, environmentally friendly approach. However, isolation of such species from native environment is challengeable as most species cannot tolerate the toxicity of the dye (Bhattacharyya & Sarma, 2003; Ekanayake & Manage 2017). Moreover, designing a wastewater treatment unit with a single treatment method is not adequate especially due to the application of the wide range of dyes in a single dyeing industry and complexity of the chemical nature of the dye.

Technical Solution

Therefore, the textile dye contained wastewater treatment processes was designed to evaluate the technical feasibility of combination treatment method consists of a natural soil material and an aquatic floating plant to remove textile dyes efficiently. The soil used as a physical adsorption material of textile dyes, is locally available soil that can be applied for wide range of textile dyes used in Sri Lankan textile dyeing industries. Further, soil does not require prior activation and due to the same reason, reduces the initiation and maintenance cost. The adsorbed dye particles do not release back to the environment as a result of environment changes such as pH in the soil. Therefore, removal and disposal of soil can be used in sustainable manner by using as a brick, of filling materials on roads or land filling sites. In the biological treatment unit, microbial consortium~~,~~ comprise with three species of genus Aspergillus which were isolated from textile wastewater effluent sites in Sri Lanka, were employed as they showed ~~and~~ potential to decolorize the synthetic textile dye contained wastewater. The treated effluent by physical and biological treatment units were finally directed to phytoremediation unit consists with aquatic floating plants: water hyacinth and ~~pistia~~ water cabbage to remove the remained dyes if any. Altogether, the whole process was designed to treat the textile dye contained wastewater completely, without using any kind of chemicals.

Advantageous effects

The process described in here is totally environmental friendly when compared to the existing chemical-based treatment methods which create secondary pollution. The initiation and maintenance cost are very low as this process does not required advanced machineries and chemicals which has to be added daily. Replacement of soil is the major concern have to pay attention in maintenance process. The soil is natural available in Sri Lankan wet zone environment and therefore reduce the cost. Disposal can be either to land filling sites or gaining secondary income through making bricks. Further, industries can enhance the social services to the society by providing bricks for un-affordable people to make residents.

Industrial Applicability

The invention can be directly applied to the textile wastewater treatment plants for the industries which are not practicing any treatment processes so-far, especially in small scale industries which cannot afford high cost chemical or mechanical treatment methods. The industries which are currently practiced some treatment methods usually use large cement tanks for chemical treatments, aerations, and for clarifiers. Such treatment units can be modified and use for the preparation of physical and biological treatment units. Further, most industries have aerated lagoons which are not functioned properly. These spaces can dredge and converted to the artificial wetlands by introducing above mentioned aquatic plants.

USJ has already filed the patent for this product.

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