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Integrated Management of Industrial Wastewater Treatment and its Reuse Options for Sustainable Developments A Green Technology Concept

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***Abstract* — Water is an essential life-sustaining element of daily life. The water crisis in both quantity and quality apparently becomes inevitable in such a changing world in terms of global environmental changes, the ever-growing population and pressures on global freshwater resources. The water scarcity and misuse of fresh water resources leads to serious concern on the sustainable economic development, food security and protection of the environment in combination with the climate change. The adverse effects that the human race has exerted on water sources have in turn threatened human health either by limiting good hygiene or by impairing drinking water safety. Further, many industries are using large amount of fresh water for the production activities. It is also releasing large volume of wastewater into the environment and causes ecosystem damages. In the concept of environmental and economic sustainability, a proper wastewater management and water reuse system can help to a greater extent in the development of national economy. To cope with the water crisis, innovative approaches to source water management as well as reuse of treated wastewater have been proposed all around the world from a holistic perspective, based on integration of multidisciplinary framework. In the current research, a green technology concept has been introduced to the treatment on industrial wastewater using a novel biocarbon technology. In this research, Hibiscus rosa sinensis L. plant leaves were used for the production of the biocarbon. It is an indigenous medicinal plant, widely available in nature, the leaves have rich carbon content. In this research protocol, three stages were involved. In the first stage, the metal adsorption capacity (pollutant removal), of the biocarbon was evaluated using Cr (VI) ions as model pollutant. The adsorption experiments were carried out in a batch reactor system with pre-determined experimental conditions. In the second stage, leather industry wastewater was subjected for treatment with biocarbon. In the third stage, the treated wastewater was used for the growth of certain plant species in a pilot scale farming land. The current experimental research, leather industry wastewater containing total dissolved solids of 15200 mg/L were introduced in the reactor system, after the equilibrium time of 3hrs; the concentration of TDS in outlet water was 995 mg/L. The color of the leather industry wastewater was reduced to 98.25% and the level of COD was reduced to 98.35% with optimum biocarbon dose of 3.0 g/100mL. In addition, a pilot scale farming practice was carried out in 12 x 12 sq. ft field for the growth of Fodder grass, Sataria clauca and Sorghum. The productivity results show faster growth of the species and 6.8 kg of biomass/sq. ft. The results indicates that, *Hibiscus rosa - sinensis* L. plant leaves biocarbon has excellent adsorption capacity in pollutant removal in the wastewater. Further, the wastewater can be reused for the growth of plants for may farming practice.**

***Keywords* — Integrated water management, wastewater treatment, reuse options, heavy metal removal, biocarbon, adsorption technique**

I. INTRODUCTION

The clean water-food-energy nexus are emerging as an important and dynamic issue for the sustainable development in our society [1. Water stress has become a perennial concern in most cities globally. The quality and quantity of fresh water is of vital concern for mankind and is directly linked with human welfare and inhabitants. Increasing demand for food, fiber and fodder will place great stresses on the land, water, energy and other resources. This is also greatly impacting on climate change.

The population growth, urbanization of new cites and other modernization activities, are ultimately accelerating the demand and supply of fresh water. It is also causing misappropriation of available fresh water resources and leading to grater water scarcity and pollution. Pollutants, such as heavy metals, are serious threats to the environment. They are getting introduced to aquatic streams due to various industrial activities [2], [3].

Water pollution affects human health and ecosystems, as well as aquatic plants and animals. The water pollution associated with heavy metal resulting from industrial and urban activities is a serious global issue due to its high toxicity, low biodegradability, and accumulation in the food chain [4]. The commonly released toxic heavy metals are zinc, thallium, copper,

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