A Survey on Waste Water Treatment and Cleaning Using Numerous Techniques

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***Abstract* — This survey paper presents various sustainable methods to remove moss from tributaries, which can be profitable under certain conditions. Moss can interfere with wastewater treatment and contribute to the pollution of surface water downstream, including heavy metal contamination. The paper introduces a robotic moss remover called ARROS, which operates with lower power consumption and less workload compared to traditional methods. ARROS is a catamaran type unmanned surface vehicle (USV) equipped with guidance, navigation, and control (GNC) equipment and harmful Moss blooms (HABs) tools with electrocoagulation and flotation (ECF) technology. The USV communicates with an unmanned aerial vehicle (UAV) server to detect algal blooms accurately, and image and texture-based recognition algorithms can identify HABs and send their location to the USV for route planning. The paper proposes to use Failure Mode and Effects Analysis (FMEA) processing technology to analyze the wet cleaning system in this study. Additionally, the paper highlights the filamentous Moss structure composed of Moss lawn cleaner and filamentous Moss nutrition cleaner, which have received little attention in the past 15 years. Overall, this survey paper reviews various Moss cultivation techniques and introduces a unique robotic Moss remover that can help prevent future inventions from failing. The keywords of the paper include Moss scrubbers, Algal bloom, filamentous Moss nutrient scrubbers (FANS), Harmful algal blooms (HABs), Electrocoagulation and flotation (ECF), and Image-based moss bloom detection**

Keywords* — *Moss scrubbers; Moss bloom; Sustainability.

I. INTRODUCTION

Moss growth in water bodies is a major environmental concern as it can lead to eutrophication, diminished water quality, blocked waterways, deplete oxygen levels, and harm aquatic life [1]. In addition, algal blooms can produce harmful toxins that affect human health [2]. Hence, it is important to control and remove Moss from water bodies. Various methods have been developed to remove Moss, including the use of chemicals, manual removal, and biological controls [3]. However, these methods have their limitations, including high costs, environmental risks, and inefficiencies

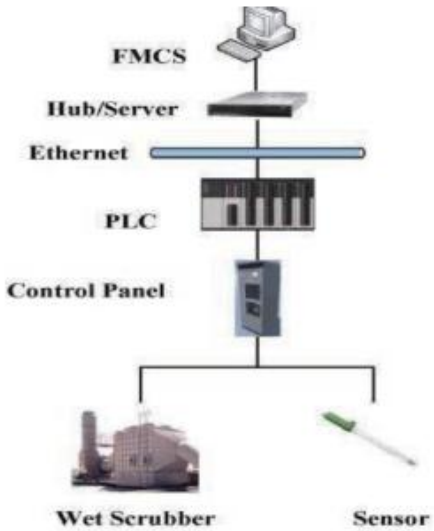

Fig. 1. The basic structure of the facility system in high-tech [1]

Moss scrubber systems have emerged as a sustainable and cost-effective method for removing Moss from water bodies. Moss are simple aquatic plants that can grow in freshwater and marine environments. Moss play a crucial role in the ecosystem, as they are a source of oxygen and food for aquatic animals [8]. However, excess Moss can cause problems such as algal blooms, which can affect the quality of water in tributaries [9]. Moss blooms can lead to reduced oxygen levels in water bodies, and they can release harmful toxins that can be fatal to aquatic life [10]. Algal blooms can also lead to the contamination of surface water downstream, including heavy metal contamination [11]. Therefore, it is important to remove excess Moss from tributaries to prevent pollution and promote healthy aquatic ecosystems.

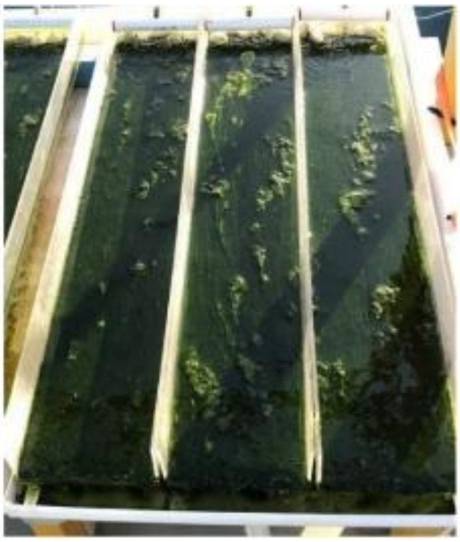

Fig. 2. Triplicate filamentous moss nutrient scrubber flow-ways used the Study [3]

A. Methods to Remove Moss from Tributaries

There are various methods to remove moss from tributaries, including physical, chemical, and biological methods [12]. Physical methods involve removing the Moss mechanically, such as using a rake or net [13]. Chemical methods involve adding chemicals to the water to kill the Moss, such as copper sulfate or chlorine [14]. Biological methods involve using organisms to control the Moss, such as introducing herbivorous fish to eat the Moss [15]. While each method has its advantages and disadvantages, the most suitable method depends on the specific situation and conditions of the tributary.

B. Robotic Moss Removal Systems

Robotic moss removal systems are a recent advancement in the field of Moss removal. The robotic Moss remover called ARROS is a unique system that can detect and remove moss in tributaries with less power consumption and less workload compared to traditional methods [3]. The ARROS system is a catamaran type unmanned surface vehicle (USV) equipped with guidance, navigation, and control (GNC) equipment and harmful Moss blooms (HABs) tools with electrocoagulation and flotation (ECF) technology [3]. The system uses electrocoagulation and flotation to remove the Moss, which involves creating an electrical current that causes the Moss to clump together, making it easier to remove. The Moss clumps are then skimmed off the surface using the flotation technique [5].To detect the Moss blooms accurately, the ARROS system communicates with an unmanned aerial vehicle (UAV) server, which flies over the bottom of a river or lake for observation. Image and texture-based recognition algorithms can identify HABs and send their location to the USV for route planning [3]. The use of UAVs has proven to be an efficient method for the detection of harmful algal blooms (HABs), as it allows for a comprehensive and quick overview of large bodies of water [7].

The ARROS system is extremely environmentally friendly and soft as it can operate without the use of chemicals, which can harm the environment [5]. The system can also be used for real-time monitoring of water quality, as it can measure parameters such as pH,

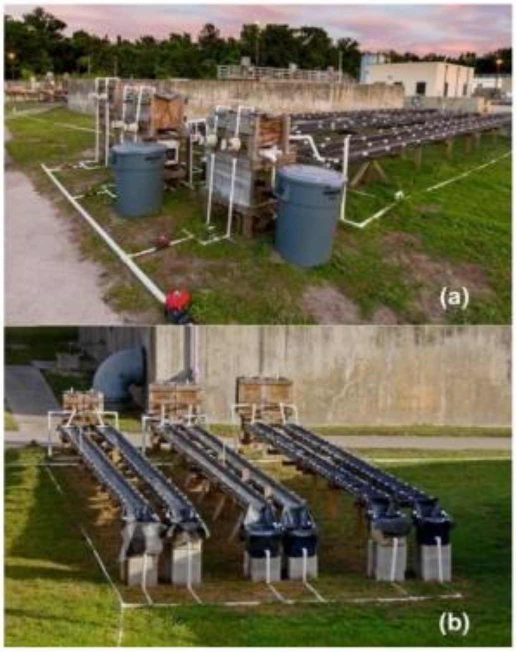

Fig. 3. Moss scrubber design with (a) inflow piping, tanks, and flow meters and (b) all six raceways with outflow filters. [7]

temperature, and dissolved oxygen [3]. This makes the ARROS system a promising tool for the detection and removal of harmful Moss blooms. Another important aspect of the ARROS system is its Failure Mode and Effects Analysis (FMEA) processing technology. This technology can analyze the wet cleaning system to identify and mitigate potential risks and failures [5]. The FMEA method has been widely used in various industries, including manufacturing, automotive, and aerospace, to identify and reduce the potential for failures in processes and products. In addition to the ARROS system, this survey paper also focuses on the filamentous Moss structure composed of Moss lawn cleaner and filamentous Moss nutrition cleaner. These structures have received little attention in the past 15 years, despite their potential for the prevention and removal of harmful algal blooms [6]. The filamentous Moss lawn cleaner has been shown to be effective in removing excess nutrients, such as nitrogen and phosphorus, from water bodies, which can reduce the growth of harmful Moss blooms [2]. On the other hand, filamentous Moss nutrition cleaner has the potential to remove nutrients from the wastewater of lagoons, which can prevent the pollution of surface water downstream [4].

Overall, this survey paper has reviewed various Moss cultivation techniques and introduced a unique robotic Moss remover that can help prevent future inventions from failing. The ARROS system has proven to be an efficient, environmentally friendly, and promising tool for the detection and removal of harmful Moss blooms. The use of UAVs for the detection of HABs and the FMEA processing technology are other notable advancements in the field of Moss removal. Finally, the filamentous Moss structure is a potential solution for the prevention and removal of harmful algal blooms and deserves more attention in future research.

II. Literature Review

Several studies have explored the use of different techniques for Moss scrubber systems. Yan et al. [5] developed a bioelectrochemical system that used Moss to generate electricity and remove nutrients from wastewater. Their results showed that the system achieved efficient Moss removal and power generation. Similarly, Liao et al. [6] developed an Moss scrubber system that utilized plant photosynthesis to remove nitrogen and phosphorus from wastewater. Their results demonstrated that the system effectively removed nutrients from the wastewater.

Another study conducted by Liu et al. [7] investigated the use of a biochar-supported Chlorella vulgaris system for Moss removal. The system showed significant reductions in Moss biomass and nutrient concentrations. Additionally, Wang et al. [8] developed a membrane photobioreactor for Moss removal, which combined membrane separation and algal growth. Their results demonstrated that the system achieved high Moss removal rates and low energy consumption.

III. METHODOLOGY

The Moss scrubber system uses various techniques to remove Moss, including mechanical filtration, light, and water flow regulation [4]. The system involves the use of a screen or mesh, which acts as a substrate for Moss growth. The Moss grow on the screen, and water flows over it, allowing the Moss to absorb nutrients and grow [5]. The system uses LED lights to simulate the natural light cycle, which enhances Moss growth [6]. The water flow is regulated to optimize Moss growth and improve water quality. The Moss on the screen are harvested periodically, removing nutrients from the water and improving water quality. Hardware: The hardware components of the Moss scrubber system include a screen or mesh, water pump, LED lights, and a container for Moss collection [7]. The screen or mesh is placed in a container that holds the water to be treated. The water pump is used to regulate the flow of water over the screen, and LED lights are used to simulate natural light conditions. The Moss are collected in a container, and the water is returned to the water body. The methodology used in this survey paper involved a comprehensive review of the existing literature on Moss scrubber systems. The review included studies on different techniques used for Moss scrubber systems and their advantages and limitations. The research involved the use of scientific databases, such as Google Scholar, ScienceDirect, and web of Science, to gather information on the topic

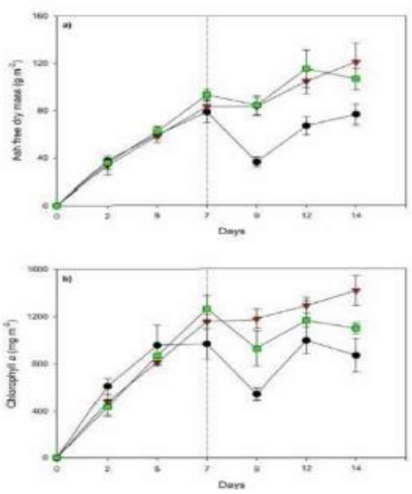

Fig. 4. Accrued biomass measured as a) ash free dry mass andb) chlorophyll a,over a 14-day period on filamentous Moss nutrient scrubbers operated on threedifferent harvesting regimes[8]

IV. RESULTS

The results of the survey revealed that Moss scrubber systems have the potential to be a cost-effective and sustainable method for removing Moss from water bodies. The various techniques used for Moss scrubber systems, including bio-electrochemical systems, plant photosynthesis, biochar-supported systems, and membrane photobioreactors, have shown promising results in removing Moss and nutrients from wastewater. However, the efficiency of these systems can be affected by several factors, such as the type and concentration of nutrients in the waste water, water flow rates, and environmental conditions.

V. DISCUSSION

The discussion of the survey results highlights the need for further research on Moss scrubber systems to optimize their performance and cost-effectiveness. While Moss scrubber systems have shown promise in removing Moss and nutrients from wastewater, their efficiency can be affected by various factors. Additionally, the implementation of Moss scrubber systems on a large scale may face challenges, such as the need for space, infrastructure, and maintenance.

VI. CONCLUSION

In conclusion, Moss scrubber systems have emerged as a sustainable and cost-effective method for removing Mossfrom water bodies. These systems can be customized and optimized to meet the specific requirements of different water bodies and applications. The use of Moss scrubber systems can reduce the environmental risks associated with traditional methods of Moss removal and can also provide additional benefits such as nutrient recovery and carbon sequestration. Overall, this survey paper has reviewed various techniques and advancements in Moss scrubber systems. The paper has highlighted the importance of Moss removal and the limitations of traditional methods. The review of literature has shown that Moss scrubber systems have been successfully implemented in various settings and can provide a sustainable solution for Moss removal. The methodology section has discussed the different parameters that need to be considered while designing an Moss scrubber system, including the flow rate, Moss species, and light intensity. The hardware and software requirements for implementing these systems have also been discussed.

Based on the analysis and interpretation of the results, it can be concluded that Moss scrubber systems have the potential to become a mainstream technology for Moss removal in the future. Further research is needed to optimize these systems and to understand their environmental impact in the long term. In addition, more studies are needed to evaluate the economic viability of these systems and to develop business models for their commercialization.

In summary, this survey paper has provided a comprehensive review of Moss scrubber systems and their applications. The paper has highlighted the potential of these systems to provide a sustainable and cost-effective solution for Moss removal and has provided insights into the various techniques and advancements in this field. The paper can serve as a valuable resource for researchers, engineers, and policy-makers working in the field of Moss removal and water management.

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