Enhancing Water Quality: A Rainwater and Reclaimed Water Sediment Filtration System

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ABSTRACT

This research explores the development of a novel water filtration system. Using a mix of online and direct surveys, the study reveals strong support for addressing water supply challenges in specific areas of the campus. It introduces an innovative approach centered on recycling excess water and rainwater, which has broad applications beyond the campus, benefiting both humans and the environment. Preliminary results highlight the importance of implementing this "Every Drip Filtration System" on campus, emphasizing its potential to conserve water. Furthermore, the study underscores the universal value of water recycling and offers a versatile solution for daily living. In conclusion, this research holds immense promise for public and private sectors, advocating for water conservation and alternative water sources, benefiting both society and the environment.

Keywords: Water, Filtration System, Rainwater Recycling, Water Conservation, Arduino

INTRODUCTION

Worldwide, there are an estimated 2.3 billion people living in water-scarce and stressed areas. The water in these areas may contain harmful pathogens, such as bacteria, that can have a negative effect on human health [8].

Water, as vital as the air we breathe, is an indispensable element of human survival [1]. However, our journey through history reveals a recurring challenge – the purification of water. This narrative transcends mere adversity; it is a testament to humanity's resolute spirit in securing a lifeline for our existence [1]. Across epochs, water-related predicaments have relentlessly tested our ingenuity, and each time, innovation has risen to the occasion.

Today, the scope of our predicament is impossible to ignore. As the global population burgeons, so does the demand for water, magnifying a litany of water-related crises [1]. Each year, the number of water consumers' surges, and the repercussions are felt worldwide [2]. Access to clean, safe water becomes precarious for some, permeating our daily lives with associated challenges. Within this pressing context, ingenious minds strive to develop solutions that not only ensure our survival but also alleviate mounting water woes.

At the heart of this endeavor lies water filtration, a beacon of hope. It promises to recycle water and purify contaminated sources, offering a lifeline to parched communities [1]. Remote regions and distant provinces often bear the brunt of water scarcity, making this technology crucial [3]. Forward-thinking institutions like

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Super Markets (SM) have already embraced water recycling as a practical solution to reduce water consumption, particularly in restroom facilities.

Filtration is one of the core processes in water treatment. The term refers to the removal, mainly by physical action, of suspended solids as the suspension flows through a bed packed by granular media [6]. Filtration is the removal of suspended and colloidal particles present in an aqueous suspension that drains through a porous medium [7].

This narrative brings us to the province of Bulacan, where a unique opportunity awaits. Here, we aspire to implement a comprehensive water filtration system capable of reshaping our water consumption patterns dramatically. This visionary system, currently under development, seeks to reclaim bathroom and sink wastewater while harvesting precious rainwater. As envisioned, every respondents and staff will actively participate in water conservation [9]. The outcome will be recycled water [10], specifically designated for toilet flushing, ushering in an era of conscientious water stewardship. The rewards extend beyond utility cost savings; they encompass a profound contribution to our environment's preservation.

This research seeks to confront head-on the formidable water-related challenges that plague our world. It underscores the significance of our actions today in shaping the water landscape of tomorrow.

METHODOLOGY

The study is dedicated to the development of an innovative water filtration device. This system incorporates a range of materials, including Activated Charcoal, Fine and Coarse Silica Sand, Gravel, Filter Foam, and Filter screen, each chosen for its unique ability to effectively eliminate even the smallest particles and bacteria from water, rendering it clean and reusable [4].

The creation of a prototype device for this endeavour serves as a tangible demonstration of the project's potential. It showcases the transformation of untreated water into clear and clean water as it passes through the filtration device. Additionally, the inclusion of a Total Dissolved Solids (TDS) meter allows for precise quantification of remaining small particles in the filtered water [5].

The methodology of this research encompasses several crucial steps. First, the selection of the area as the research site serves to evaluate the water efficiency of its restroom facilities. The research aims to involve 50 diverse respondents, encompassing varying genders and occupations. To ensure an unbiased selection, the study employs stratified sampling techniques, which also involve participants in recruiting other potential subjects [4]. Participants include respondents from Bulacan and staff who regularly utilize the campus's restroom facilities.

Quantitative research results will be derived from meticulous data organization, examination, and analysis of responses gathered from targeted respondents. This involves the active participation of 50 users of the public restrooms at Bulacan, who responded to questionnaires regarding the impact of rain and water filtration systems. Additionally, the research outcomes will include an evaluation and assessment of each survey result by the research team.

The sample size calculation was based on the proportional sampling formula:

$$nh = (Nh/N) * n$$

Where:

nh = sample size using proportionate stratified random sampling

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Nh = total stratum population

N = total population

n = sample size

For this study, the population of Personnel was 98, and the population of for selected areas was 4,488. The resulting sample sizes are as follows:

For chosen respondents:

nh = (98 + 4488) * 40

Number of chosen student respondents = 40

For chosen Personnel respondents:

nh = (98 + 4488) * 10

Number of chosen Personnel respondents = 10

The researchers adopted a quantitative approach and employed survey questionnaires that incorporated descriptive and rating scale elements for data collection. These questionnaires were administered to 50 participants from Bulacan. Their responses were collected to assess the impact of rain and the utilization of water filtering equipment in the campus's public restrooms.

The primary objectives of that research study were to increase awareness of the value of water in everyone's lives, encourage responsible water consumption, and identify potential consequences of consumer behaviour. The researchers surveyed 50 individuals from Bulacan, consisting of 40 respondents from different ages, and ten staff, including security guards and utility workers. The responders to the initial survey were profiled based on their roles, distinguishing between respondents and staff members.

Material for Water Pump

2 pcs ¾ blue Pipe

Male Adaptor

¾ Pipe with ¾ threaded tee

½ Pip e (used for the Pressure)

Pressure Gauge

Pressure Switch

¾ Elbow

¾ Pipe with ¾ Ball Valve

Water Tank

¾ Elbow

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¾ Pipe

¾ Check valve

¾ Reducer

¾ Blue Pipe (connected to the water tank)

¾ Blue Pipe (connected to the water filtration)

Assembly Steps for Water Pump Installation:

Begin by using two male adapters (2 pieces). Attach one male adapter to the upper side and the other to the right side of the water pump.

Utilize two pieces of ¾-inch pipes. Connect one of the ¾-inch pipes to the right side of the water pump; this will serve as the water inlet (Step 1). The second pipe will be connected to the upper part of the water pump and will function as the water outlet (Step 2).

Employ a ¾-inch tee fitting. Attach the tee fitting to the ¾-inch pipe from the water pump's outlet. Subsequently, connect a ¾-inch ball valve to the tee fitting; this valve regulates the water pump's pressure (Step 3).

Integrate another ¾-inch pipe and connect it to the tee fitting, originating from the water pump's outlet (Step 4).

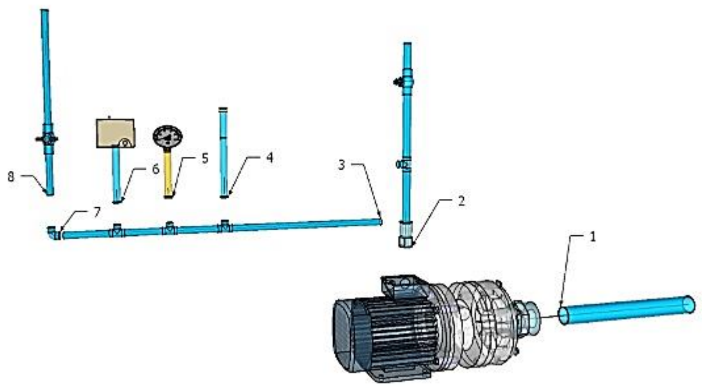
Employ three threaded tees, each measuring ¾-inch. Begin by connecting the first threaded tee to the ¾-inch pipe (Step 4); this tee will link to a ¾-inch pipe, which serves as an alternative to the pressure tank. The second threaded tee will be used to connect a pressure gauge (Step 5), while the third threaded tee will facilitate the connection of a pressure switch (Step 6).

Add a ¾-inch 45°-degree elbow (Step 7) to the ¾-inch pipe (Step 4).

Connect another ¾-inch pipe (Step 8) with a ¾-inch ball valve to the ¾-inch 45°-degree elbow (Step 7).

Connect the ¾-inch pipe (8) to the water tank (9).

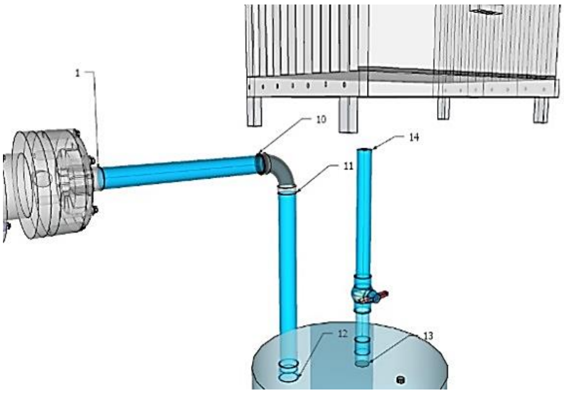
Attach a ¾-inch 45°-degree elbow (10) to the pipe (1) originating from the water pump's inlet.



Extend the assembly by connecting another ¾-inch pipe (11) to the previously attached ¾-inch 45°-degree elbow.

Install a ¾-inch check valve (12) at the lower end of the ¾-inch pipe (11), ensuring it is connected to the water tank, which serves as the storage for filtered water.

Connect another ¾-inch pipe (14) equipped with a ¾-inch ball valve to both the filtration device and the water tank (storage of filtered water) (13).



Link a ¾-inch pipe (15) to an additional water storage unit. This pipe should connect to a ¾-inch 45°-degree elbow. Extend this assembly by adding another ¾-inch pipe and securing it with a ¾-inch ball valve. Finally, connect this pipe to the water filtration device.

RESULT AND DISCUSSION

This comprehensive study employed a dual methodology, comprising online surveys and direct surveys, engaging selected participants representing a diverse cross-section of students and campus personnel. The survey outcomes resoundingly affirmed strong support for the installation of a filtration system within the campus, effectively addressing critical water supply challenges encountered in specific staff and student comfort facilities.

This study's innovative approach centres on the recycling of excess water and rainwater, unveiling its substantial potential in significantly reducing overall water consumption. Beyond the campus, the implications of these findings extend to various settings, including public and private schools, hotels, residential neighbourhoods, and regions grappling with water scarcity or inadequate water supply. This pioneering strategy not only augments the well-being of human populations but also ushers in positive ramifications for animal welfare and the broader environment.

The preliminary survey results from selected respondents underscore the paramount significance of implementing the proposed "Every Drip Filtration System" innovation within Bulacan. Collecting and analyzing feedback and opinions from respondents have illuminated the primary effects of this system within the campus context. By proffering an alternative water supply and fostering water conservation practices within the campus precincts, this research underscores the profound significance and potential transformative impact of a filtration system.

Moreover, the research study investigating the rain and used water filtration system underscores the universal value of recycling. Implementing such a device holds substantial promise, especially in rural areas where water supplies are often limited. A filtration system emerges as an adaptable and versatile solution for daily living, facilitating the recycling of used water and rainwater for diverse purposes, including flushing, cleaning, gardening, and more, contingent upon the quality of the filtered water.

CONCLUSION

In conclusion, the findings of this research study, coupled with the implementation of the project hold immense promise for both public and private sectors. This research project serves as an educational platform, advocating for water recycling, the utilization of filtered water, and the provision of alternative water sources for multifarious applications. While such technology might be prevalent in certain regions, its overarching significance resides in its capacity to curtail water consumption and safeguard this invaluable resource, thereby bestowing profound benefits upon society and the environment at large.

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