Journal of Agriculture and Environmental Sciences
December 2017, Vol. 6, No. 2, pp. 13-15
ISSN: 2334-2404 (Print), 2334-2412 (Online)

Published by American Research Institute for Policy Development
DOI: 10.15640/jaes.v6n2a2
URL: https://doi.org/10.15640/jaes.v6n2a2

Water Quality: Improving Water Quality Utilizing Hemp

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Abstract

Fresh water available for consumption is being contaminated by numerous sources. The world's population and demand for healthy drinking water is rising as well. Current water filtration methods are appropriate by today's standards but what about the future? This study looks at an alternative water filtering media which can be agriculturally grown and be a bio-based filter. The utilization of hemp as a water filter was tested against the standard of current filtration systems of activated charcoal and coconut husks. Filtration cubes built on a $1/10^{th}$ scale of filters currently being used by a municipality were utilized to filter 7 different surface water samples. Pre and post filtration tests determined the E-coli level and the turbidity of the water samples at both stages. The results showed tremendous promise for the ability of hemp to filter out water contaminants.

Keywords: Water quality, hemp, E-coli, turbidity

1. Introduction

Environmental sustainability best practices (ESBP) are a leading edge concept for eliminating the undesired effects of anthropogenic processes. This concept is essential in understanding because ESBP is a direct countermeasure to climate change. There are many ESBP applications in use today, for example, the *Environmental Protection Agency* (EPA), 2015 and others are producing general tactics and disseminating this information to the general public (i.e. low impact development or green infrastructure). Another example of an ESBP approach is incorporating what is known as waste-valorization, which refers tothe process of converting waste materials into more useful products including chemicals, materials, and fuels (Arancon, et al., 2013). Furthermore, due to climate change currently being the greatest environmental threat of our time endangering our health, communities, economy, and national security (National Resources Defense Council, 2015). This study aims to demonstrate the use of hemp as a potential counter balance of the anthropogenic process through improved water filtering utilizinghemp plant material. Specifically addressing *the current drinking water quality issues caused by climate change* (Westerling, 2013).

Using a novel low cost bio based hemp plant for water filtration demonstrates two vital components of creating values of transformation regarding ESBP; 1) the necessity to identify a low-cost bio-based product, (hemp) that has zero waste capacity (100% reuse or recycle capabilities); and 2) improved water filtration performance to address a severe public health threat, which is the quality of drinking-water. "*The quality of drinking water is a powerful environmental factor of health*", per *World Health Organization* 2015.

This investigation of using an unfamiliar, low cost, agricultural, bio based hemp material will address the growing concern of drinking water quality. Utilizing hemp as an alternative water filtering media the following research question and hypothesis were developed.

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Research question(s):

Will activated hemp perform greater than or less than current, high quality water filtering media of activated charcoal and coconut husks?

Null Hypothesis(s):

Activated hemp will not filter water greater than current, high quality water filtering media like activated charcoal and coconut husks for E-coli and turbidity.

2. Methods

Acrylic cubes of one cubic foot size were constructed to equal 1/10th scale size of the water treatment filters used by the city of Richmond, (Kentucky), Water Treatment Plant filtering rooms. The water treatment plant filters had layers of sand, anthracite coal, and gravel. Each layer was two feet in thickness. The thickness of the media layers in the test cubes would be 2.4 inches to maintain the proper ratio to the actual water treatment filters. The 3 scale model 1 cubic foot of acrylic cubes with identical scale model layers of thickness allowed for quality control and consistency. Each of the test cubes were layered with a bottom layer of 5600 mL of gravel. The second layer in each cube was 4500 mL of the specific filtering media for comparison. The top layer was 3000 mL of sand. The dry weight of each material is listed in Table 1:

Table 1: Material Dry Weights

Material	Volume-mL	Weight- grams
Anthracite Coal	80	68.889
Coconut Husks	80	42.891
Hemp	80	13.706
Sand	80	137.28
Pea Gravel	80	120.173

Seven sites of surface water from within Madison County, Kentucky used, one site was used twice although at different dates. These sites consisted of creeks, streams, or lakes. The sites and volume collected are listed in Table 2.

Table 2 Water Sample Collection Sites

Location	Volume
Lake Reba – Dock	6 Liters
Lake Reba – Shore	6 Liters
Taylor Fork Stream	6 Liters
Stratton Sea (x2)	6 Liters
Silver Creek	6 Liters
Wilgreen Lake	6 Liters

Five liters of deionized water was poured into each filter before first filtration performance attempt. This allowed for all layers to become wet, and even water flow through the media layers. The collected water samples were filtered through the 3 different filtering media one location at a time. The filtered water was tested for E-coli and turbidity to ascertain the post filter data for each sample and media type. Measured levels of E coli pre filtration and post filtration were completed using Idexx Colilert Q Tray/2k. Measured levels of Turbidity pre filtration and post filtration were completed using Hach Portable Turbidimeter.

3. Results

Table 3 contains the mean values for E-coli and turbidity summarized data for all 7 water samples for each of the 3 different filtering media. The E-coli count was reduced the most by the activated hemp media followed by the coconut husks and charcoal. A statistical F test was conducted to determine if a significant difference did exist between the 3 media means.

The hemp media was significantly different resulting in removing more E-coli than the other 2 types. The turbidity of the hemp filtered water sample was also significant over the coconut husks and the charcoal media. Based on the research findings the null hypothesis is rejected.

Table 3 Mean E-coli, Turbidity Values

Media	**E-Coli**	**Turbidity**
Activated charcoal	2.73	18.66
Coconut husks	2.70	8.53
Activated hemp	1.77	4.53

4. Conclusion

Activated hemp did filter water greater than current, high quality water filtering media like activated charcoal and coconut husks as measured by reducing the amount E coli from natural surface water samples. The activated hemp also significantly increased the clarity of the water samples as measured by turbidity. Additional applications of these finding ranges from end point user filters to new municipal water treatment systems utilizing hemp. Typically when filter media works for water, it will do the same for air. Air filtration utilizing activated hemp should be considered to reduce air borne pathogens and solids in livestock buildings. Further research on why activated hemp filtering performance is significantly better than currently used, high quality filtering media. One limitation of this study was the amount of water samples tested. Further testing using the 1/10 scale model filters should continue to test the filtering performance of all media types. Additionally if pH hadn't been taken into account for the tests, activated hemp's filtration ability would have been missed.

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