International Journal of Recent Advances in Multidisciplinary Topics
Volume 4, Issue 3, March 2023
https://www.ijramt.com | ISSN (Online): 2582-7839

Development of Needle Punched Non-Woven Fabrics for Filtration Application

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***Abstract*: Using bamboo cloth, polypropylene, cellulose acetate, and activated carbon, needle punching machines were used to create multi-layer nonwoven materials. Four distinct layers each include a varied ratio of textiles, including cellulose, bamboo cloth, and polypropylene. As the top, first middle, second middle, and bottom layers, respectively, acetate and activated carbon were utilized. Due to the density variation and shape factor of the fiber, the fabric's thickness and areal density varied depending on the proportion of each layer. The produced multi-layer nonwoven textiles' obtained filtration efficiency meets the theoretical solid volume fraction. The amount of activated carbon in the bottom layer results in less ion buildup in the water and improved filtration for particles smaller than 0.075 mm. percentage of bamboo fabric. The top layer results in less oil and gum in the water and improved filtering for particles smaller than 30 m. Different ratios of cellulose acetate and polypropylene fibers result in greater air permeability and filtration effectiveness. was greater than the top layer for particles 0.5–20 mm.**

***Keywords*: effluent treatment, bamboo cloth, polypropylene, cellulose acetate, activated carbon.**

1. Introduction

The process of cleaning up industrial or domestic wastewater before it is released into the environment is known as an effluent treatment. Filters are crucial for the treatment of effluent for a number of reasons. Filters are useful for removing solid pollutants from wastewater, including suspended particles, sediments, and debris. This assists in avoiding equipment and pipe blockage, which can result in operational issues and decrease the effectiveness of the treatment procedure. Filters are also capable of removing organic debris from wastewater, including bacteria, viruses, and other microbes. For the sake of maintaining public health and halting the spread of disease, this is crucial.

Environmental protection: By eliminating impurities and pollutants from the effluent before it is released into Environmental filters lessen the negative effects of human activity on natural ecosystems and help to keep the environment

Regulation adherence: The release of wastewater into the environment is subject to stringent rules in many nations. Filters can be used in wastewater treatment to help assure compliance with these rules and prevent paying fines or suffering other consequences for non-compliance Overall, using filters during the effluent treatment process is a crucial step in guaranteeing the safe and responsible management of wastewater, as well as in defending the environment and the general public's health. For a number of reasons, nonwoven textiles are frequently employed in the filtration step of wastewater treatment: High filtration effectiveness: Because nonwoven textiles can produce a lot of filtration surface area, they are very good at absorbing solid particles and pollutants in the effluent. They are extremely effective at removing even the smallest impurities because they can catch particles as small as 1 micron in size.

Low flow resistance: Nonwoven materials provide a low flow resistance, enabling high flow rates and effective filtration. As a result, they can be utilized to filter huge amounts of effluent quickly and effectively without clogging or decreasing the filtration process' effectiveness. Nonwoven materials are extremely resistant to chemicals and heat. They can be used in a variety of wastewater treatment processes because of their resistance to chemicals and high temperatures. They are resistant to heat and strong chemicals, acids, and bases without melting or degrading. They are also resistant to high temperatures. Versatility: By modifying their composition, thickness, and pore size, nonwoven textiles can be made to fit unique filtration needs. This gives them great adaptability to various effluent treatment procedures and enables them to conduct filtration at their best. Nonwoven fabrics, which offer high filtration efficiency, low flow resistance, chemical and heat resistance, and adaptability, provide an all-around highly effective and efficient option for the filtration of wastewater in the effluent treatment process.

2. Materials and Methods

Multi-layer filtration fabric is used in dye effluent treatment These four layers of fabric are produced in bamboo fabric, polypropylene, Charcoal**,** and cellulose acetate and these four layers are stitched together.

Bamboo fabric: It is used for the first layer
(GSM -195g & Thickness - 2.7mm)
Polypropylene fabric: It is used for the second layer
(GSM -191g & Thickness - 2.5mm)
Charcoal: It is used for the third layer
(Charcoal 25% of net weight)

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Cellulose acetate fabric: It is used for the fourth layer (GSM -147g & Thickness - 1.4mm)

A. Bamboo Fabric

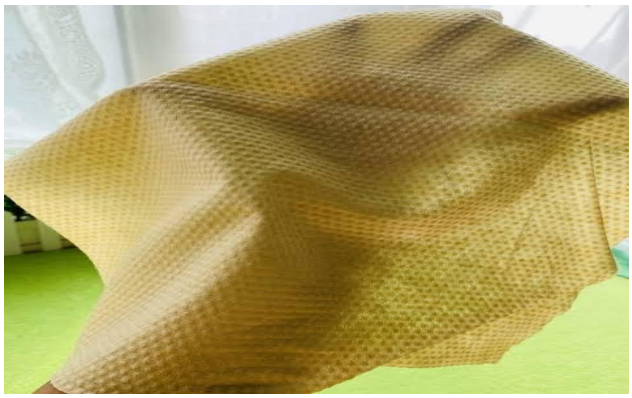

Fig. 1. Bamboo fabric

For a number of reasons, the nonwoven bamboo cloth is becoming more and more attractive for use in effluent treatment procedures. Sustainability: Bamboo is a quick-growing, renewable material that doesn't need fertilizer or pesticides to grow. As a result, using it in effluent treatment procedures is an environmentally favorable decision. Nonwoven bamboo cloth is biodegradable, which means it can decompose harmlessly in the environment over time. As a result, it is a secure and sustainable option for filtration in wastewater treatment procedures. Bamboo is good at capturing and removing bacteria and other microbes from effluent due to its inherent antibacterial characteristics. This increases the overall efficiency of the filtration process and lowers the chance of contamination. High bamboo nonwoven fabric is strong and long-lasting, making it able to endure the rigors of effluent treatment procedures. It can also tolerate heat, chemicals, and other harsh conditions without losing its ability to filter.

Softness and comfort: Nonwoven bamboo fabric has a soft, comforting feel to it, which makes it perfect for skin-contact applications. In effluent treatment procedures where personnel might come into contact with the filtration materials, this can be crucial. Nonwoven bamboo fabric, with its inherent antibacterial qualities, high strength and durability, softness and comfort, offers a sustainable, biodegradable, and efficient alternative for filtration in effluent treatment operations. Depending on the kind and amount of oil in the wastewater, nonwoven bamboo fabric may be a useful filter for effluent treatment. Bamboo cloth has a high capacity for absorption and is good at removing fats and oils from wastewater. The nonwoven fabric's ability to have a high surface area-to-volume ratio can improve filtration effectiveness. However, the qualities of the oil, such as its viscosity, density, and solubility, will determine how well the nonwoven bamboo fabric filters oil. The nonwoven bamboo fabric may not be able to effectively catch oil if it is excessively viscous or has low solubility in water. Moreover, with time, the nonwoven bamboo fabric may absorb oil, decreasing the efficiency of its filtering. To retain the fabric's ability to filter effectively in this situation, it would need to be replaced or regenerated. Overall, nonwoven bamboo fabric can be a good alternative for removing oil from effluent treatment, but how well it does so will depend on the nature of the oil and how well the filtration system is made and operated.

B. Polypropylene Fabric

Fig. 2. Polypropylene fabric

For application in the filtration of wastewater treatment operations, nonwoven polypropylene fabric is a preferred option for various reasons: Chemical resistance: Due to polypropylene's great chemical resistance, it can be used in a variety of effluent treatment procedures. It is the best material to use in corrosive situations since it can endure exposure to strong chemicals, acids, and bases without degrading.

High filtration effectiveness: Nonwoven polypropylene fabric may produce a lot of filtration surface area, which results in high filtration effectiveness. It is very successful at eliminating even the smallest impurities because it can catch particles as small as 0.3 microns. Durability: Nonwoven polypropylene fabric has high tear, puncture, and abrasion resistance due to its strength and durability. This makes it resilient. without sacrificing its ability to filter substances through the rigors of wastewater treatment procedures. Low cost: Nonwoven polypropylene fabric is a popular option for both small- and large-scale applications because it offers an economical filtration solution for effluent treatment systems.

Versatility: Nonwoven polypropylene fabric's composition, thickness, and pore size can all be modified to meet unique filtration needs. This allows for the best filtration performance and makes it very adaptable to various effluent treatment methods. Overall, nonwoven polypropylene fabric provides high filtration effectiveness, chemical resistance, durability, cheap cost, and versatility for the filtering of effluent in the effluent treatment process.

C. Charcoal

Due to its capacity to filter pollutants and toxins from water, charcoal is frequently employed in wastewater treatment operations. Since charcoal is a porous substance with a sizable surface area, it may efficiently absorb and filter out pollutants from the water as it moves through the filter. The most common form of charcoal used in wastewater treatment procedures is activated carbon, which has undergone an oxygen treatment process to create millions of tiny pores between its carbon atoms. The activated carbon may efficiently remove a variety

of organic and inorganic chemicals from water thanks to the pores' vast surface area for the absorption of pollutants and impurities.

Fig. 3. Charcoal

Very efficient at eliminating organic pollutants like pesticides, herbicides, and solvents, which can be challenging to filter out using standard techniques. Chlorine, heavy metals, and other pollutants that could alter the flavor and odor of water can also be eliminated. Aside from being a very effective filter, activated carbon is also a secure and sustainable choice for wastewater treatment procedures. It may be readily disposed of after usage because it is non-toxic and biodegradable.

Overall, using charcoal in effluent treatment procedures is a successful and environmentally responsible way to remove pollutants and toxins from water, resulting in a safe and clean source of water for a variety of uses.

D. Cellulose Acetate Fabric

Fig. 4. Cellulose acetate fabric

Due to its distinct qualities, nonwoven cellulose acetate fabric is occasionally utilized in the filtration of effluent treatment procedures. A semi-synthetic substance called cellulose acetate is made from cellulose, a naturally occurring polymer found in plants. For usage in effluent treatment procedures, nonwoven cellulose acetate cloth offers the following benefits:

High purity: Because cellulose acetate is free of additives and other pollutants, it is a high-purity substance that is perfect for usage in industries where purity is important, such as the pharmaceutical or medical industries. porosity: Nonwoven cellulose acetate fabric has a high porosity, allowing water to flow through the filter effectively. High filtration effectiveness and minimal pressure drop are the results, which lower the energy needed to pump water through the filter. Strong chemical resistance: Acids, bases, and organic solvents are not easily broken down by cellulose acetate. Because of this, it can be used in a variety of wastewater treatment procedures where it might be subjected to severe chemicals.

Biodegradable: Cellulose acetate is a substance that degrades naturally and is simple to discard after usage. As a result, it is a green alternative for wastewater treatment procedures.

Overall, nonwoven cellulose acetate fabric's high purity, high porosity, high chemical resistance, and biodegradability make it able to provide high-quality filtration in effluent treatment procedures. However, it might not be appropriate for all applications, and the specific traits of the effluent being treated could affect how effective it is.

3. Conclusion

Before wastewater is released into the environment, filtration is a vital step in the effluent treatment process that helps remove contaminants. The following crucial factors should be taken into account in order to improve outcomes in the filtration of effluent treatment process. The precise features of the effluent, the needed filtering efficiency, and the process circumstances will all influence the choice of filter media. Nonwoven fabrics can be used for filtering made of materials including bamboo, polypropylene, and cellulose acetate, but the best material and GSM/thickness will depend on the particular application. Maintenance of filtration equipment: To ensure that filtration equipment performs at its best, regular maintenance is essential. This include maintaining the apparatus, cleaning and replacing the filter medium as needed. is operating within the limits of its intended operating range.

Checking the effluent's quality on a regular basis will help spot any problems with the filtering system and allow for any

Table 1
Result

Parameters Selected for this Study	Before Effluent Treatment Test	After Effluent Treatment Test
p H	8.7	7.5
Zinc	9.2mg/l	2mg/l
Sulphate	940mg/l	207mg/l
Chemical oxygen demand (COD)	1453mg/l	453mg/l
Turbidity (Nephelometric Turbidity Units)	573NTU	43NTU
Biochemical oxygen demand (BOD)	581mg/l	48mg/l
Chlorides	980mg/l	313mg/l
Total Dissolved Solids (TDS)	2520mg/l	1461mg/l
Total Dissolved Suspended Solids (TSS)	330mg/l	84mg/l

necessary modifications to be made to keep the effluent at the desired level of quality. To guarantee that the effluent discharged into the environment complies with the necessary standards, it is crucial to comply with local regulatory requirements. By adhering to these fundamental principles, it is feasible to improve effluent filter treatment process outcomes and guarantee that the discharged effluent satisfies the necessary quality standards, safeguarding the environment and public health.

References

[1] Rakesh Singh Asiwal and Shweta Singh, "Wastewater treatment by effluent treatment plants."
[2] Richard C. Daniel and Reid A. Peterson, "A brief review of filtration studies for waste treatment at the Hanford site."
[3] Mohan Seneviratne, "Wastewater treatment technologies."
[4] Irwin M. Hutt, "Nonwoven filter media," in Handbook of Nonwoven Filter Media in 2007.
[5] N. Mao, "Nonwoven fabric filters," in Advances in Technical Nonwovens in 2016.
[6] Irwin M. Hutten, "Liquid filter applications," in Handbook of Nonwoven Filter Media in 2007.
[7] World Health Organization. (2017). Guidelines for drinking-water quality. Fourth edition.
[8] United States Environmental Protection Agency. (2011). Wastewater Technology Fact Sheet: Trickling Filter.
[9] A. K. Yadav and A. Bhatnagar, "Fabrication and characterization of a novel hybrid nanofiltration membrane for the removal of contaminants from wastewater," 2021.
[10] Y. Wang, S. Zhang, and X. Hu, X. "Development and characterization of a novel cellulose acetate ultrafiltration membrane modified with graphene oxide," Separation and Purification Technology, 2020.
[11] H. Liu, Y. Liu, and G. Jiang, "Progress in nonwoven fabric-based filtration materials for water treatment," Environmental Science and Pollution Research, 2018.