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Advantages of using animal wool when cleaning contaminated water in car wash

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Advantages of using animal wool when cleaning contaminated water in car wash

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Abstract. Car wash facilities generate wastewater containing significant concentrations of petroleum hydrocarbons, surfactants, suspended solids, and fine particulate matter. The effective treatment of such effluents remains a challenge, particularly for small-scale and decentralized car wash systems. This study highlights the advantages of using animal wool as a natural, keratin-based filtration and adsorption material for cleaning contaminated water in car wash applications. Due to its fibrous morphology and hydrophobic–oleophilic surface characteristics, animal wool demonstrates a strong affinity for oil and grease compounds, enabling efficient hydrocarbon removal. In addition, the porous structure of wool fibers enhances mechanical filtration, leading to a notable reduction in turbidity and total suspended solids. The use of animal wool offers significant environmental benefits, including biodegradability, renewability, and reduced reliance on synthetic sorbents and chemical additives. From an economic perspective, animal wool is a low-cost and locally available material, making it suitable for sustainable and energy-efficient wastewater treatment systems. The findings indicate that animal wool-based filtration can effectively improve water quality and support water reuse in car wash operations, contributing to environmentally responsible water management practices.

INTRODUCTION

The rapid increase in automobile ownership has led to a significant expansion of car wash facilities worldwide. These facilities generate wastewater contaminated with oil, grease, surfactants, fine particulates, and trace heavy metals. Direct discharge of untreated wastewater can result in environmental pollution, soil contamination, and adverse effects on aquatic ecosystems.

Recent studies emphasize the use of bio-based and waste-derived sorbents for sustainable wastewater treatment. Animal wool, a by-product of livestock and the leather industry, is abundant, renewable, and biodegradable [1]. Its keratin fibers exhibit hydrophobic and oleophilic properties, making them ideal for adsorption of hydrocarbons. This study aims to evaluate the efficiency and benefits of using animal wool for preliminary treatment of car wash wastewater, focusing on oil and grease removal, suspended solids reduction, and potential for water reuse.

EXPERIMENTAL RESEARCH

Sorbent Material Preparation. Sheep and cattle wool were collected from local farms. The wool was washed with distilled water to remove dust and impurities, oven-dried at 60 °C, and cut into lengths of 20–30 mm. No chemical modification was applied to preserve natural adsorption properties [2].

Experimental Setup. A laboratory-scale vertical filtration column was constructed with layered animal wool as the main sorbent. Car wash wastewater was collected from a local facility and passed through the filter under gravity-driven conditions. The pilot work was carried out at the car wash facility in Namangan city. During the

testing process, a 3-part water pool was formed to collect the water, and a filter made of animal wool was placed in the process of transfer to each other. A sketch of the same filtering processes is shown below:

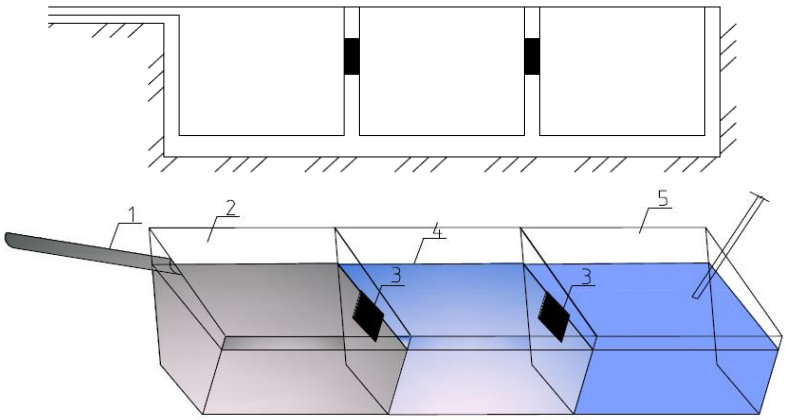

Figure 1. Schematic view of the recommended water storage pool for car washes. 1) polluted water; 2) polluted water pool; 3) filter (from animal wool); 4) semi-filtered water; 5) purified water.

Analytical Procedures

The following parameters were measured before and after filtration [3]:

- Oil and grease concentration (gravimetric method)
- Turbidity (nephelometric method)
- Total suspended solids (TSS)
- p^H
- All analyses were conducted following standard wastewater testing protocols.

RESEARCH RESULTS

A new filter (animal wool) will trap all kinds of alkalis and oils in the water. The turbidity of the water remains in this pool itself at the expense of drowning in the pool itself. As a result of the use of such materials, oils from the machine mechanism come out into the water concrete and are caught in the filter when passing through the pool to each other, and in the next pool, under the influence of this process, the water is brought to a clean state.

Water spraying devices for washing one car DN40 - branded Cacher use 15-20 L of water with a pressure of 9MPA, an average of 20-25 cars are washed in one car in one day, an average of 60-80 cars are washed in the season period, which will be formed in this we calculate the water consumption.

Table 1. Average daily forecast

	Number of cars (units)	**Water consumption (liters)**	**Number of filters (pieces)**
in 1 day	25	500	1
in 1 week	175	3500	7
in 1 month	700	14000	28

Table 2. Average during the season

	Number of cars (units)	Water consumption (liters)	Number of filters (pieces)
in 1 day	70	1400	3
in 1 week	490	9800	20
in 1 month	1960	39200	79

It can be seen from this that an average of 14m3 of water in a month can be recycled and spent on consumption. This leads to a reduction in water consumption coming from the central system. And an unsuitable filter can be used as a waterproofing material on the sides of the foundation at construction sites. This allows the use of waste materials as well. The use of such a system in District, Regional car wash stations will lead to the correct use of consumer water and an acceleration of the working process, and will allow to increase water consumption in other industries.

DISCUSSION

The high efficiency of oil and grease removal is attributed to the hydrophobic and oleophilic nature of keratin fibers. The porous and fibrous structure enhances mechanical filtration, reducing turbidity and suspended solids [4, 5].

Environmental advantages include biodegradability and reduced chemical consumption, while economic benefits arise from low material costs and local availability. Despite the potential for saturation after repeated use, animal wool can be regenerated or replaced at low cost. Integrating animal wool filters as a pre-treatment step can enhance downstream processes such as sand filtration or membrane systems.

CONCLUSIONS

Animal wool is a sustainable and effective material for preliminary treatment of car wash wastewater. It efficiently removes oil, grease, and suspended solids while being environmentally friendly and cost-effective. The findings support its application in decentralized car wash systems and demonstrate potential for water reuse, contributing to sustainable water management practices.

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