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KEMENTERIAN PENDIDIKAN TINGGI



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OLEOTRAP: Oil Filter for Drains

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ABSTRACT

Various initiatives, including recycling centres and public awareness campaigns, have been introduced to lessen the discharge of oil into national sewage systems. However, persistent Fat, Oil, and Grease (FOG) accumulation continues to cause long-term drain clogging, particularly at the household level. This innovation aims to develop a practical, low-cost filtration mechanism that captures oil at the source before it enters drainage systems. The product features a two-stage filtration design comprising a stainless-steel mesh layer for coarse particle retention and an oil adsorption keratin-based fibrous layer. Waste cat fur and human hair were collected, washed, dried, and needle-felted into round porous felted discs, which were then enclosed within a mesh and into a flow-stabilising base with vertical channels for water drainage. Experimental testing using oil-water mixtures demonstrated that both materials effectively adsorbed visible oil while allowing water flow. Quantitative analysis revealed that at a density of 0.08 g/cm^3 , cat fur achieved a high adsorption of 63 mL at 80 mL oil input, outperforming human hair by approximately 25%. Furthermore, density variation showed that lower-density cat fur (0.05 g/cm^3) displayed the highest adsorption ability (79 mL), while higher densities reduced performance by 20%. For human hair, adsorption increased with increasing density. These findings reveal the importance of structural porosity in optimising adsorption performance. Overall, the developed mechanism shows strong potential as a sustainable, low-cost household solution for FOG management, with promising scalability and commercial applicability in domestic and small-scale food preparation settings, fulfilling SDG 12 and SDG 14.

Keywords: keratin-based fibres, oil filtration, FOG

1. INTRODUCTION

The mismanagement of used cooking oil from households, street vendors, and small-scale food establishments remains a significant and growing environmental challenge. Commonly, used cooking oil and liquid wastes are discharged directly into kitchen sinks without prior treatment. This allows fats, oils, and grease (FOG) to enter drainage systems, where they gradually accumulate along pipe walls. Over time, this cumulative deposition leads to severe blockages, sewer overflows, and infrastructure damage, resulting in increased maintenance costs and operational inefficiencies for municipal wastewater systems (Omidvar et al., 2023). Aside from the damage mentioned, the environmental impact of FOG pollution is equally critical. When oil-contaminated wastewater flows into

rivers and marine ecosystems, it creates surface films that blocks oxygen transfer, interrupts aquatic life, and worsens water quality (Ahmed et al., 2026). This leads to long-term ecological imbalance and disturbs biodiversity. The existed centralized grease traps and oil recovery systems, such solutions are often costly and space-intensive to be adopted to households and small-scale food operators. Consequently, there is a need for an affordable and user-friendly solution that can effectively reduce oil pollution before it reaches the sewer system.

The OLEOTRAP system offers a compact and modular oil filtration solution designed specifically for small scale drain applications. A key innovation of OLEOTRAP lies in its use of waste-derived natural materials, human hair and cat fur, as the filtration layers. These materials are high in keratin, feature hydrophobic layers, and display highly porous microstructures, enabling them to adsorb oil while naturally repelling water (Sathinathan & Kiew, 2021). OLEOTRAP is designed to provide a practical, low-cost, and environmentally sustainable solution that empowers individuals and small businesses to contribute in reducing pollutions. By addressing the issue at the source of contamination, the system promotes better wastewater management practices and supports the protection of aquatic ecosystems.

2. METHODOLOGY

The study employed an experimental approach to evaluate the oil adsorption performance of human hair and cat fur. Waste hair and fur were collected and thoroughly cleaned to remove impurities. The materials were then dried overnight and processed using a needle-felting technique to form compact round felted discs of varying densities. Each felted disc was prepared with a uniform diameter of 7 cm and a thickness of 1.5 cm, then, weighed to determine its density. For the oil adsorption testing, the filtration setup was tested with mixtures of oil and water at a fixed ratio (1:4), simulating typical kitchen wastewater conditions. The prepared felted discs were placed within a two-stage modular prototype filter housing, where the stainless-steel coarse filter mesh was set as stage 1 and felted discs was fit as stage 2. In the testing, the oil-water mixture was passed through the developed system under gravity. To assess the oil adsorption performance, multiple trials were conducted for each felted disc type and density. The amount of oil adsorbed was measured after each run, allowing for comparison across different material compositions.

3. RESULTS AND DISCUSSION

The results demonstrate that both human hair and cat fur show strong oil adsorption abilities, confirming their suitability as natural filtration materials. The oil adsorption performance of the felted discs displays clear differences between cat fur and human hair at a density of 0.08 g/cm^3 (Figure 1).

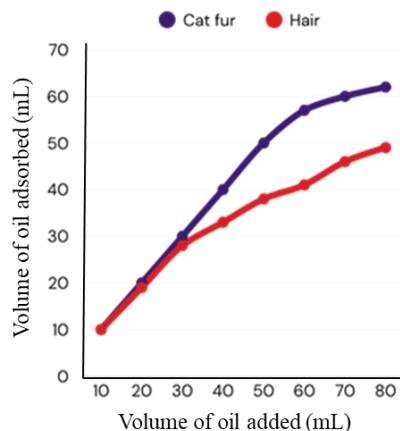


Figure 1. Oil Adsorption Ability between Cat Fur and Human Hair with Density of 0.08 g/cm³.

Both materials show an initial linear increase in oil uptake as the oil volume increased. The oil adsorption performance of the cat fur felted discs significantly and consistently outperforms the human hair felted discs. At 50 mL of oil added, cat fur discs adsorbed nearly 50 mL compared to 38 mL for human hair discs, presenting human hair discs to be 24% less effective than cat fur discs. This trend continues at higher volumes, with cat fur reaching 62 mL at 80 mL of oil added, whereas human hair plateaus at around 50 mL. The higher adsorption ability of cat fur discs may be due to its finer structure and higher surface area. This enhances oil absorption within the felted matrix.

Additionally, the study revealed that the disc density affects its effectiveness. Higher-density discs improved oil absorption due to increased contact surface area, somehow, this may reduce the flow rate if the materials are overly compressed. Hence, an optimal balance between permeability and adsorption capacity is important for actual usage. The effect of material density on oil adsorption capacity is plotted in Figure 2.

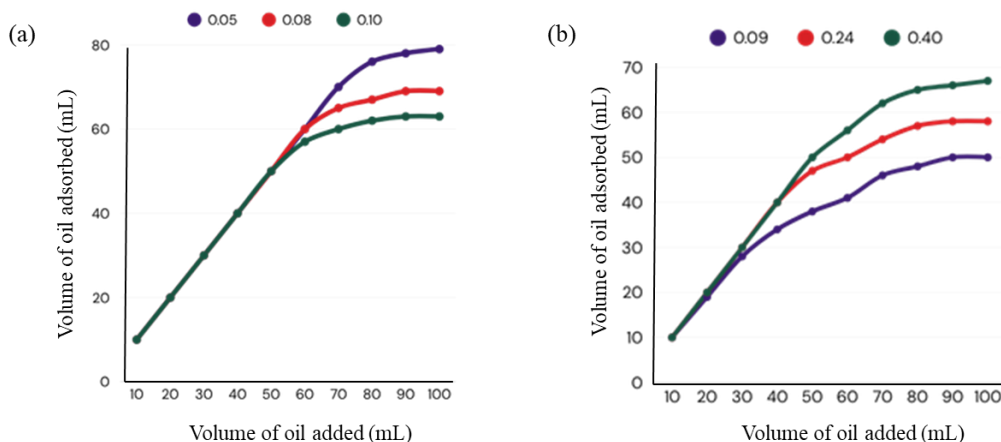


Figure 2. Oil Adsorption ability with Different Densities (g/cm³) for (a) Cat Fur and (b) Human Hair Felted Discs.

For cat fur (Figure 2a), increasing density from 0.05 to 0.10 g/cm³ decreases the oil adsorption performance at higher oil volumes. At 100 mL of oil added, the 0.05 g/cm³

sample was able to adsorb 79 mL, compared to 70 mL (0.08 g/cm^3) and 62 mL (0.10 g/cm^3), showing a reduction of nearly 20% as the disc's density increases. Similar for human hair discs (Figure 2b), the highest disc's density (0.40 g/cm^3) exhibits the highest oil adsorption, outperforming 0.24 g/cm^3 and 0.09 g/cm^3 by approximately 13% and 35%, respectively. These suggest that optimal density plays a significant role in balancing pore structure and capillary action, which influence the oil adsorption efficiency. Overall, the results emphasise the potential of these felted discs, particularly those derived from cat fur, as effective, low-cost household oil filtration materials. Ultimately, the integration of a stainless-steel mesh to filter coarser residues with this felted discs layer improves the whole filtration system and validates the design choice of a two-stage modular system in OLEOTRAP.

4. CONCLUSION

OLEOTRAP demonstrate a practical, low-cost, and environmentally sustainable solution for managing kitchen oil waste at the source. By preventing FOG from passing to the drainage systems, the system helps lessen sewer blockages, lower maintenance costs, and minimise pollution. Its detachable design allows for easy cleaning and replacement. Furthermore, the simplicity of the design ensures accessibility, requiring minimal technical expertise for implementation.

In conclusion, OLEOTRAP effectively demonstrates the usage of natural and low-cost materials, addressing real-world environmental challenges. The system has strong potential for widespread usage in urban and semi-urban communities where improper oil disposal issue needs to be solved. This innovation fulfils SDG 12, which promotes sustainable production patterns and waste reduction, and SDG 14, which aims to conserve marine resources by preventing nutrient and chemical pollution from entering the oceans. Lastly, future work may focus on long-term durability testing, optimisation of filter mechanisms, and integration with current drainage systems.

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REFERENCES

- Ahmed, N., Straub, A. & Ali, M. (2026). Fats, oil, and grease (FOG) in wastewater: sources, mechanisms, control, and removal strategies. *International Journal of Environmental Science and Technology*, 23, 161. <https://doi.org/10.1007/s13762-025-06977-2>
- Omidvar, M., Malayeri, M.R., Farshchi Tabrizi, F., Doroodmand M. (2023). Investigation of used cooking oil on the formation of FOG deposits in sewer line clogging. *Environmental Science and Pollution Research*, 30, 18325-18339. <https://doi.org/10.1007/s11356-022-23480-0>
- Sathinathan, P., & Kiew, P. L. (2021). Regression analysis for the adsorption of oil using human hair as natural adsorbent. *International Journal of Biomass and Renewables*, 10(1), 16-29.