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Design and Development of an Oil Skimmer for Waste Water Treatment

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Abstract: *The oil skimmer is a mechanical device designed to separate floating oil from water based on the difference in density and adhesion properties between oil and water. The main purpose of this project is to design and develop a simple, cost-effective, and efficient oil skimmer system that can remove oil from contaminated water surfaces. The system works by using a rotating mechanism such as a belt or disc that comes in contact with the oil layer. Due to the adhesive property of oil, it sticks to the rotating surface and is then scraped off into a collection container using a scraper mechanism. The developed oil skimmer can be effectively used in small industries, workshops, wastewater treatment plants, and oil spill management operations. It helps reduce environmental pollution and supports sustainable water resource management.*

The project involves the design, fabrication, and testing of the oil skimmer model using suitable materials and mechanical components. Various parameters such as motor speed, belt movement, and oil adhesion characteristics are considered during the design process. The system is developed using commonly available materials and simple fabrication techniques to make it affordable and easy to maintain...

Keywords: Oil removal, oil-water separation, surface skimming, contamination control, fluid purification, coolant maintenance, pollution control, machine efficiency, and environmental protection

I. INTRODUCTION

Oil contamination in water bodies is a major environmental and industrial issue caused by oil spills, industrial discharge, and waste water. It negatively affects aquatic ecosystems, reduces oxygen levels, harms biodiversity, and creates health risks for humans. In industries, the presence of oil in water and coolants decreases efficiency, promotes bacterial growth, produces foul odors, and increases maintenance costs, making effective oil removal essential.An oil Skimmer is a mechanical device designed to remove floating oil and hydrocarbons from the surface of water based on the principle that oil is lighter than water and naturally floats. These devices are widely used in industrie such as petro chemical plants, manufacturing, waste water treatment, and marine spill management. By separating oil efficiently with minimal water loss, oil skimmers help improve water quality, enhance machine life, reduce pollution, and support environmentally sustainable operations.

Recent advancements in oil skimming technology focus on improving efficiency and sustainability through innovative designs like disc-type oil skimmers. Studies comparing materials such as mild steel and acrylic discs show that lightweight and oleophilic materials like acrylic can enhance oil recovery performance. With increasing global concerns about oil spills and environmental damage, oil skimmers provide a cost-effective, eco-friendly solution for oil-water separation and resource recovery.

II. TECHNICAL SPECIFICATIONS

The following table illustrates the technical specifications of oil skimmer machine.

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Table 2.1: Technical Specifications oil skimmer machine

Sr. No.	Category	Specifications
1	Power Source	Electric Motor
2	Motor Power	Single Phase (0.12)HP
3	Oil Skimmer Speed	60 RPM
4	Pulley	Mild Steel , Fiber
5	Frame material	Mild Steel
6	Belt Use	Polyurethane Belt
7	Power Transmission	Belt and pulley

III. LITERATURE REVIEW

Mechanical oil skimmers are widely recognized as effective devices for removing free-floating oil from water surfaces, and numerous studies have examined their design, performance, and optimization. Among the various types, **belt skimmers** are particularly popular due to their simplicity, continuous operation, and low energy consumption. These systems use an oleophilic belt to attract oil, which is then scraped off into a collection container. Research has shown that parameters such as belt material, width, speed, and tension significantly influence recovery efficiency. **Drum and disc skimmers** operate on rotating surfaces, offering larger contact areas and higher oil recovery rates compared to belt skimmers, although they tend to be more complex and costly. Studies have also focused on improving the surface materials and coatings of skimmers, with porous or lyophilic coatings significantly enhancing oil adhesion and collection. Despite their advantages, mechanical skimmers are generally less effective for emulsified or submerged oil layers, and their performance can be affected by environmental conditions such as wave height. Overall, the literature highlights that mechanical skimmers remain crucial for small- to medium-scale applications and initial spill response, with ongoing research aimed at optimizing design parameters, material selection, and operational efficiency to maximize oil recovery.

IV. LITERATURE GAP

Despite extensive research, existing oil skimmer technologies still have several limitations. Conventional types such as weir, oleophilic, and suction skimmers often lose efficiency in real conditions like rough or wavy water and may collect excess water along with oil. They also struggle with emulsified oil and varying oil properties, and there is a lack of reliable performance models to predict their effectiveness under different conditions.

Additionally, many advanced skimmers are costly, require significant maintenance, and have limited capacity for continuous operation, making them less practical for widespread use, especially in developing regions. Most systems also depend on a continuous power supply, which increases operational costs and further limits their use in remote areas.

V. METHODOLOGY

The methodology for the design and development of an oil skimmer for wastewater treatment involves identifying the problem of oil contamination and setting the objective to create an efficient and cost-effective solution, followed by studying existing skimmer types and selecting a suitable design such as a disc-type skimmer. The system is then designed by choosing key components like the rotating disc, motor, shaft, frame, and oil collection unit, along with appropriate materials such as mild steel or acrylic.

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Fig.1.1- Final Product Of Oil Skimmer

Design calculations are carried out to determine important parameters like speed, power, and oil removal capacity. The skimmer is then fabricated and assembled, and an experimental setup is prepared using oil-contaminated water. Performance testing is conducted under different conditions to evaluate efficiency and oil recovery, after which the results are analyzed and improvements are suggested to optimize performance and ensure the system is effective, economical, and suitable for practical use

VI. CONCLUSION

An oil skimmer is an effective and practical solution for removing oil and grease from contaminated water surfaces, contributing significantly to wastewater treatment and environmental protection. It operates on the principle of separating oil based on differences in physical properties such as density and surface tension. Modern oil skimmers, including weir, oleophilic, and suction types, offer improved efficiency, portability, and adaptability for various industrial applications. However, their performance may be affected by factors such as oil type, debris, and environmental conditions. Overall, the design and development of an efficient oil skimmer enhance oil recovery, reduce pollution, and support sustainable water management practices, making it an essential tool in industries and environmental conservation efforts.

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