

Solar System based Water-Oil Separator by Using Multi-Disc

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Abstract — This study focuses on the separation of oil and water to determine the most effective method for recovering oil from the water surface mixture, such as in the case of the Empress Oil spill, with the aim of producing oil-free water. Additionally, it addresses the development of mechanical apparatus designed for the separation of oil from water. An oil and water separator, a type of mechanical equipment utilized in environmental pollution control following oil spillage incidents, aids in the elimination of oil from water surfaces. Through the implementation of polycarbonate materials within the oil separator, industrial mixed water can be rendered free from oil contamination. This device finds application in effluent treatment plants. The paper provides insights into the construction, fabrication processes, assembly, operation, and diverse applications of oil and water separators. While various methods exist for oil removal from water, the disc-type oil skimmer emerges as a commonly preferred choice.

Keywords: Solar System, Water-Oil Separator, Multi-Disc

I. INTRODUCTION

"Solar System Based Water-Oil Separator by using Multi-Disc". The main purpose of the project is to separate and remove oil & other hydro carbons & oil from water, making it suitable for further treatment or discharge. This is crucial in various industries & environmental contexts to protect the environment. We have used two disc, DC motor & other equipments.

In this project we made the device using disc to separate oil & other contaminants that could be harmful for the oceans and environment.

Oil pollution is a big problem in today's world. With China's industrial growth, more oil is being used and transported, leading to untreated oil discharge into water, causing pollution and resource wastage. This polluted water is known as oily wastewater.

Oil skimming works by making oil stick to a material placed in it. This helps separate oil from other impurities because only the oil sticks to the material, not the impurities. Oil skimmers are used in many industries to separate coolants, especially from water. They all use gravity, the stickiness of the surface, and something that's moving to get rid of oil that's floating on top of water. Oil and grease stick to skimming material more than water does, so skimming material like belts or disks can collect oil and grease with very little water.

II. LITERATURE SURVEY

A. Existing System

1) Overview of Oil-water Separation Equipment Technology of Refined Oil:

Shen-Jan (2020) et.al., The emerging environmental issue of concern in contemporary society revolves around oil, a

significant industrial raw material and household commodity. As China's industrial sector advances, so does the scale of oil extraction and maritime transport. However, the discharge of various types of oil, including lubricants, emulsified oil, and edible oil, into water without adequate treatment leads to environmental pollution and resource wastage. This resulting oily water is commonly referred to as oily wastewater. Several methods exist for treating oily wastewater, such as ultrafiltration, biological processes, and flocculation. Among these, gravity separation proves effective in removing both floating and dispersed oil from oily wastewater, thus accomplishing initial oil removal.

2) Fabrication of oil water separator machine in oil industries:

Shubham Sawant (2018) et.al., The oil and water separator stands out as the initial and arguably the most critical wastewater treatment stage in the majority of petroleum refineries. Over the years, refineries have explored various technologies or treatment methods as potential alternatives to the oil and water separator. However, most refineries ultimately opt for, or revert to, the oil and water separator as their preferred technology for the primary separation of oil and solids in wastewater. A properly designed oil and water separator primarily functions to eliminate significant quantities of oil and suspended solids from refinery wastewater before subsequent treatment stages. This typically involves a secondary oil/water separator for further refining and advanced treatment methods to remove dissolved organic compounds. While biological treatment is commonly employed, other treatment technologies have also been utilized.

B. Components Used

1) DC Motor

A 12-volt direct current (DC) motor is a type of electric motor that operates on a 12-volt power supply, providing direct current to the motor's coils to generate rotational motion. These motors are commonly used in various applications such as automotive, robotics, small appliances, and projects due to their versatility and ease of use. They come in different sizes, configurations, and power ratings to suit different requirements.

2) Shaft

The shaft of a motor refers to the rotating component that transfers power from the motor to source to a battery or can complement it by rod-shaped part extending from the motor body that rotates when the motor is powered. The shaft typically protrudes from both ends of the motor and is designed to connect with external components such as gears, pulleys, or other mechanical devices to transmit rotational motion or torque. It's an essential part of the motor assembly, enabling the motor to perform its intended function.

3) Disc

In the context of a motor or machinery, a disc typically refers to a flat, circular component with a central hole through which a shaft can pass. Discs can serve various purposes depending on the specific application. In other applications, discs may be used for braking, clamping, or as part of a rotational mechanism. They are commonly made from materials such as metal, plastic, or composite materials and are designed to withstand the forces and stresses encountered during operation.

4) PVC Pipes

Poly Vinyl Chloride pipes is used to support the structure for the purpose of floating the structure.

5) Battery

A battery is a device that stores chemical energy and converts it into electrical energy when needed. In the context of a 12-volt DC motor, a battery typically serves as the power source, providing the necessary voltage and current to drive the motor. The battery supplies the motor with electrical energy, which is then converted into mechanical energy to produce rotational motion. Batteries used with 12-volt DC motors are often rechargeable and come in various types such as lead-acid, lithium-ion, nickel-metal hydride, and others, each with its own characteristics and suitability for different applications.

6) Solar Panel

A solar panel is a device that converts sunlight energy into electricity energy through the photovoltaic effect. In the context of a 12-volt DC motor, a solar panel can serve as an alternative power providing a renewable energy source for charging the battery. The solar panel consists of multiple photovoltaic cells made of source to a battery or can complement it by providing a renewable energy source for charging the battery. The solar panel consists of multiple photovoltaic cells made of the connected mechanical system. In the case of a 12-volt DC motor, the shaft is the cylindrical or semiconductor materials, such as silicon, which generate direct current (DC) electricity when exposed to sunlight. This DC electricity can then be used to power the motor directly or charge a battery for later use. Solar panels are commonly used in remote locations, off-grid systems, and environmentally friendly applications to harness solar energy for electrical power generation.

7) Scrapper

It is used to remove the oil from the disc, on the scrapper rubber are provided to purpose of remove oil, from disc.

C. Working

When the DC motor is powered either by the battery or solar panel, it drives the rotor inside the separator. The Rotor Shaft spins rotationally about its axis.

The two circular disc mounted on shaft it spins about its axis. The material of disc is polycarbonet used. The poperty of this material is to stick the oil to the disc.

When the disc revolve in the oil-water mixtue oil is stick to the disc. The Scapper is provided on one side of the disc, it remove the oil from the disc which is stickining the disc.

In this two PVC (Poly Vinyal Chloride) pipes are provided to support all the structure .

Which is to be provided to support and floating on the water surfaces.

The removed oil is collected in one container, which is placed downside of the scrapper.

The oil is removed efficiently. This ecofriendly to the environment, because the dosent's use of any chemical. This is ecofriendly system.

III. EXPERIMENTAL SETUP

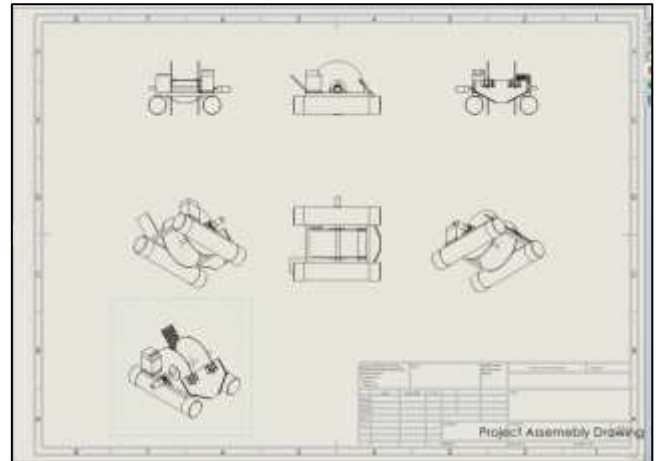


Fig. 1: Drafting of the model.

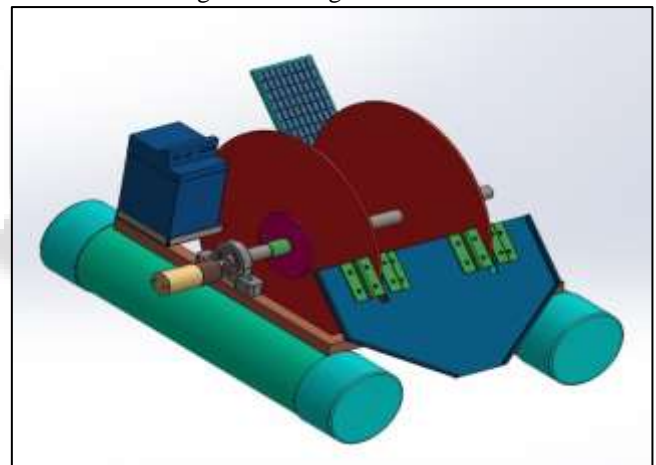


Fig. 2: Oil-Water Separator System.

A. Calculation:

Material = C 45 (mild steel)

Take fos=2

$$\sigma_t = \sigma_b$$

$$= 540/\text{fos}$$

$$= 270 \text{ N/mm}^2$$

$$\sigma_s = 0.5$$

$$\sigma_t = 0.5 \times 270$$

$$= 135 \text{ N/mm}^2$$

1) Force generated by the disc on Shaft:

$$F = m \cdot a$$

Where,

m= mass of the disc=2 kg

a=acceleration due to gravity.

$$F = 2 \cdot 9.81$$

$$F = 19.62 \text{ N}$$

2) Design of shaft.

Calculating Torque required to drive the shaft: $T = F \cdot r \cdot \sin\theta$

$$=19.62*170*\sin(90)$$

$$T=3134.4 \text{ N-mm.}$$

Where,

T=Torque of the shaft, N-mm

F= Force generated by the disc on Shaft, N

r =Radius of the disc, mm

θ =Angle between shaft & disc.

3) Shaft Diameter

$$T = \pi \sigma_s d^3 / 16$$

$$3134.5 = \pi * 135 * d^3 / 16$$

$$D=4\text{mm.}$$

Motor shaft is 6mm and main shaft diameter/bore diameter is $4*5=20\text{mm}$, so our design is safe.

4) Power of Shaft P

$$P = 2\pi NT / 60$$

$$P = 2\pi * 30 * 3134.4 / 60$$

$$= 9.97 \text{ watts}$$

$$P \cong 10 \text{ watts}$$

Where,

N → Rpm of motor shaft = 30

T → Torque transmitted

5) Selection of bearing

For 20mm Shaft diameter we take standard bearing no.6004 / P204 (Pedestal Bearing).

6-Deep groove Ball bearing/ pedestal bearing

0-Extra light

04- $4*5=20\text{mm}$, Bore diameter.

B. Advantages:

- 1) Protects the Environment: It keeps our water clean by removing oil, which helps protect fish and plants in the water.
- 2) Saves Resources: It can save and reuse the oil it removes, so we don't waste it.
- 3) Makes Processes Work Better: In places that treat water, it helps the machines work more efficiently by taking out the oil.
- 4) Easy to Maintain: It's designed to work well and doesn't need a lot of fixing, making it low-maintenance.
- 5) Good for Nature: It doesn't use harmful chemicals, making it a safe and eco-friendly way to clean water.

C. Disadvantages:

- 1) An oil/water separator is effective for substances resembling oil that don't dissolve in water, are hard to blend with water, and have a density close to that of water.
- 2) It might be expensive to set up the system in the beginning.
- 3) Not Perfect: It may not remove all the oil, and a small amount could still be left in the water.
- 4) Application:
- 5) Clean Water for Nature: It helps keep water clean by removing oil, protecting plants and animals.
- 6) Reuse of Oil: It saves and reuses the removed oil, preventing waste and saving resources.
- 7) Better Factories: In places that treat water, it makes machines work better by taking out the oil.
- 8) Easy Maintenance: It's designed to work well with little fixing, making it easy to take care of.

- 9) Safe for the Environment: It doesn't use harmful chemicals, making it a safe and eco-friendly way to clean water.

IV. CONCLUSION

The Solar-Powered Disc-Type Oil Spill Recovery System is a great way to clean up oil spills. It's easy to use, works well, saves money, and helps the environment. This system is better than other methods for cleaning up oil spills. It takes the oil out of the water so the water can be used again.

Using automation and solar power makes it run by itself without needing people to do much. This means it works all the time without stopping. Because it needs less human help, it can clean up oil spills faster and better. By cleaning up oil spills, it helps protect the environment from harm. In short, the Solar-Powered Disc-Type Oil Spill Recovery System is really important for solving the problem of oil spills worldwide.

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