

Fabrication Of Oil Skimmer Using Belt Conveyor

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Abstract—The oil skimmer is used to distinguish oil from an aqua and oil mixture. Additionally, it has polluted the coastal areas and created an environment that is exceedingly acidic, alkaline, and salty the purpose of this endeavour is to remove water-borne oil pollution. Waste oil enters waterways in the amount of 706 million gallons each year, polluting the environment. To remove the oil and water, mechanical equipment can be utilized to separate the two. The oil floats on the water since it has less density than water. The water molecules are more attached to each other than oil molecules since they don't mix each other. Here we use the skimming medium as Belt & Metal disk. The skimming medium runs over the surface of water in which oil brought out with little amount of water. So the oil and water can must be separated by absorbent type material called as scrapper.

Keywords — Oil Skimmer, Belt, wiping blade.

INTRODUCTION

Water pollution is caused by toxic substances from farms, cities, industries, and oil spills from ships and oil tankers willingly liquefying into and blending with it. However, oil is not completely mixed with water, and when it spills significantly, it causes water pollution as well as a variety of other problems. Oil spills are not a modern-time incident, and it has been occurring for a long time. During the last decade, the world has witnessed major oil spillage accidents into the ocean, which have had a significant impact on the environment. Apart from that, oil is occasionally spilled as a result of chronic and careless habits in the use of oil industries and oil products. It is estimated that 706 million gallons of waste oil enter the ocean each year, with more than half of that coming from land drainage and waste disposal. When oil is spilled on water, the physical and chemical properties of the oil gradually change. Spilled oil has an unpleasant taste and odour and causes significant environmental damage to water, material life, and the surrounding environment. So, use an oil skimmer, which is a device that separates floating oil from the liquid surface. Oil skimmer are the cheapest and most efficient way to remove surface oil in ocean, washing machines and leakage oils from coolant machinery etc.

I. LITERATURE REVIEW

M.F. Khalil [1] discussed about Oil spill recovery using a rotating drum skimmer covered with a sponge layer was tested experimentally under a variety of operating conditions. The tests were carried out on two different diameter drums. The results show that the sponge-covered surface outperforms the standard steel surface in terms of oil recovery, regardless of the viscosity of the oil collected. When both drums were operated under the same conditions, the sponge covered drum collected 24% more oil than the plain steel drum. M.Pavan Kumar [2] according to him An oil skimmer is a device used to remove floating oil from a liquid Medium. Water molecules are more attached to each other than oil molecules because they do not mix. Belt is used as the skimming medium in this case. The skimming medium runs over the surface of the water, bringing out oil with a small amount of water. M.A.Khodary[3] discussed The effect of disc material and surface roughness on the rate and efficiency of oil recovery. Steel, plastic, and woven fabric were used as materials, and two types of oil were used, SAE50 and Used car engine oil. The rate of oil recovery was discovered to increase with increasing disc rotational speed. Depending on disc rotational speed and disc type, the rate of oil recovery ranged from 88 for SAE50 oil and from 89for used oil. Md.Ansar Khan [4] he discussed about To recover floating oil from the water's surface, a system with a high recovery rate in a dynamic water body is required. We proposed a smart oil skimmer with two circular disc Mechanisms and a user-controlled smartphone IoT (Internet of Things) data monitoring and controlling system in this paper. Raj Maisuriya [5] discussed about the project's goal is to design a belt-type oil skimmer that removes oil effluent from water. Pollution has caused numerous environmental issues. By removing the oil from the water, it becomes oil-free. There are two types of oil skimmer: oleophilic and non-oleophilic. The oleophilic skimmer is distinguished not by its operations, but by the component used to collect oil, which is a belt. It is capable of Removing even a thin floating layer of oil from water. This is primarily due to the belt's synthetic fiber material. The belt in a belt type oil skimmer absorbs the oil from the water and collects it in a storage tank. R.Manivel[6] according to him the basic principle is that separating oil from water using an oil skimmer and coated materials such as Teflon or carbon is more sticky to the oil than water is. Teflon is used as a sticky material in the process of recovering oil from the surface of water, and the main component of the system is the Roller. Sheet metal is used for the roller part. The surface of the roller object is coated with a material similar to Activated carbon, Teflon. The surface of the roller object is coated with a material similar to Activated carbon, Teflon. If the oil becomes stuck on the rolling drum, it will rotate along with the drum. The scrapper attached to the collecting tank scrapes the oil stick on the drum. S.Supriyono [7] discussed about The oil skimmer system consists of a rotary disc that collects oil on the water's surface and two propellers that move the oil skimmer. The rotary disc and propeller are powered by a DC motor linked to a motor driver and an Arduino Mega as a controller. The oil skimmer also has a joystick for adjusting the rotation speed of the rotary disc and controlling the movement of the oil skimmer. According to the testing results, the oil skimmer can take and separate oil on the water's surface at a separation speed. G.Naphade [8] according to him this paper examines the

separation of oil and water in order to determine the best solution for oil recovery from water surface mist. Empress the oil spill to create oil-free water. Also included is a contract for the manufacture of mechanical equipment to separate the oil from the water. Water and oil A separator is a piece of mechanical equipment used to control pollution caused by oil spills. An oil separator aids in the removal of the oily component of the mixture. Water escaped from the surface. By eliminating the use of oil in industry When water is misted, it is cleansed of oil pollution. The acrylic material used in the oil separator is primarily to blame for this. Ashwini Dalvi [9] discussed about this project is to develop an oil skimming robot which effectively skims off the oil layer over the water and thus simplifying the task of Cleaning up oceans. Oil skimming aqua robot uses disc Oil skimmer which is used to remove layer of oil over the water surface. This Android application controlled Robot makes use of Bluetooth module which helps to indicate oil level of the collecting container with the help of ultrasonic level sensor and displays real time location of the system via GPS module. Maha Adnan Dawood [10] according to him The experiment of removing oil from the surface of the water was carried out by using a skimming belt under various operating conditions and then determining the empirical correlations of the oil recovery rate under various operating conditions. The oil recovery rate (ORR) and oil recovery efficiency (ORE) are the major parameters that can demonstrate skimming belt execution as predicted by the empirical coefficient of correlation as a function of the above operation conditions. P.P.Jabir [11] discussed about the oil spill increases it result in serious Damage to the environment. About 90%of contaminated Oil can be removed by continuous separation of oil by Skimmer belt. This setup use polyurethane belt, bearings, Supporting L-angle frame and scraper. This work implemented to improve the separation efficiency of the Skimmer belt at manual speed. The belt absorbs the oil from water which can be scooped out and collect in to a vessel by providing piping arrangement. Lokhande M. M [12] according to him In This paper represents the project work carried on development of flat belt type oil skimmer. We have developed a compact mechanism for Collect oil from water with the help of belt in minimum period of time. Collected oil can be reused for many Purposes. This oil skimmer is invented because of low cost, high compatibility, and use for rough. This set up uses the DC motor, polymer belt, pulley, supporting frame, polyurethane blade. V. Malarvizhi [13] discussed about Oil and water separators are mechanical devices used to control pollution caused by oil spills in the environment. The oil separator that was removing the oily surface of the mixing surface leaked water. Oil pollution is eliminated by removing the oil from industrial mixture water. This oil separator is suitable for use in an effluent treatment plant. This paper describes the design, fabrication details, assembly, operation, and applications of an oil and water separator. There are various methods for removing oil from water, but the disc type oil skimmer is the most commonly used and efficient. The Disc after scrapping arrangement, where oil and grease are scraped and collected in a barrel via a pipe. After scraping, the Disc falls back into the water channel. Won-Seok Choi [14] discussed about In this paper, we propose a user-controlled smart phone oil skimmer Monitoring system. IoT (Internet of Things) controller with built-in BLE 4.0. The apparatus The trend of OSHW is IoT hardware (Open Source Hardware). This enables free design content for physical artefacts in collaboration with FOSS (Free and Open Source Software). The majority shares and develops Open-source culture as a result of its derivation into an ecosystem. N Widiaksana [15] according to him the experiment was conducted with variation of 27 mm and 55 mm of disc submersion depth or equal to dipped surface area of 31.35 cm² and 88,832 cm². The duration of the test for 3 data is 5 minutes. Based on theoretical calculations, the increase of rotation speed of the disk, the result of spill transport will also be higher. This is proved by the experimental results. The lifting process of oil spill is more effective with low rotation speed, because the result of oil spill transported will be more dominated by oil than water. In this test, the higher the rotation speed of the disk, the higher the water produced. Rashi Yadav [16] according to him disc type oil skimmer can be used to efficiently separate oil from a Water-oil mixture. When compared to the traditionally used disc made of Mild Steel, the disc made of Acrylic is more efficient. The efficiency obtained by using the Acrylic disc was 88%, which is 10% higher than the efficiency obtained by using the mild steel disc. Furthermore, as the disc is immersed deeper, the volume of the recovered mixture increases, but so does the amount of water recovered, reducing efficiency. To maximize efficiency, the disc should be immersed at the optimal depth. A.H.Hammond [17] discussed about This paper discusses the enhancement of weir Skimmer capacity on Spill oil recovery by introducing a tangential water jet along the inside bottom of a Weir chamber. The jet creates a strong, stable vortex inside the weir. The weir skimmer oil recovery rate increased as the water jet flow rate increases, the oil viscosity decreases and film thickness increases. The maximum oil recovery rate was attained when the weir crest was at the same level as the oil/water separation surface. Deploying containment booms to increase oil film thickness and using transfer pumps to increase oil recovery rates are recommended to maximize the enhanced weir skimmer's effectiveness. Thombare Babasaheb [18] according to him the coolant is directed into the collecting tank. When it flows over the surface with the roller, it is drawn towards the drum-belt surface. The upper rollers are actuated by a setscrew to raise or lower them in order to tighten or loosen the belt. It is then collected in a tray and transferred to another tank (container), where pure coolant is recirculated for use in the machine. Abdul Rahman [19] discussed about .An oil skimmer is a device used to remove floating oil from a liquid medium. Because oil has a lower density than water, it floats on it. Water molecules are more attracted to each Other than oil molecules because they do not mix. In this case, the skimming medium is a belt and a metal disc. The skimming medium runs over the surface of the water, bringing out oil with a small amount of water. The primary function of this constructed skimmer is to purify the water of various dirt oils. The collected oil is routed to the collecting chamber via a port. As a result, the oil is collected from the water's surface and separated using the wiping blades attached to the frame. B.Narmada Devi [20] she said that This project leads to simple and effective way of Removing the oil from the surface of water in dynamic bodies like seas, oceans, etc. The understanding and working of the device is simple and can be employed at any place. The normal oil skimmers are mostly employed only in static condition, few which are used in the dynamic conditions skims out excess water along with the oil. To achieve high efficiency and also to avoid removal

II. METHODOLOGY OF OIL SKIMMER

A belt skimmer is mounted on tank tops. The unit consists of two pulleys. Care is taken that the bottom pulley is below fluid surface level. The top pulley is connected to a geared drive. An endless flat belt of polyurethane material rotates on the pulley. Fluid flows slowly over the belt leaving the floating oil on the Surface of the belt. The belt scrapes through a pair of nylon scrapers near the top

pulley. The scraped fluid is collected a tank. The separator tank is specially design with adjustable baffles this separates the additional content and diverts it back to the main tank it as shown in fig 1.

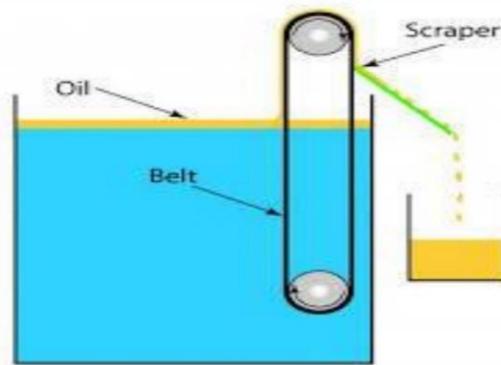


FIG 1 : WORKING PRINCIPLE

Oil skimming is a technique used to remove floating oil from the surface of water bodies, such as lakes, rivers, and oceans. The goal of oil skimming is to minimize the environmental impact of oil spills and prevent harm to wildlife, plants, and human populations. Oil skimming works by using specialized equipment, such as an oil skimmer, to physically remove oil from the surface of the water. The basic principle of oil skimming is to use a device that separates the oil from the water based on their different specific gravities.

Here's how an oil skimmer works:

- **Collection mechanism:** An oil skimmer typically consists of a floating device that has a collection mechanism, such as a belt to collect the oil.
- **Movement:** The oil skimmer is usually propelled through the water by a motor or towed by a boat. As the skimmer moves, the collection mechanism comes into contact with the surface of the water, picking up floating oil as it goes.
- **Separation:** The collected oil is then separated from the water by the skimmer's mechanism and collected in a Storage tank.
- **Disposal:** Once the oil has been collected, it can be disposed of in an environmentally safe manner, such as through a specialized oil recycling facility. Oil skimming can be a highly effective method for removing floating oil from water bodies, but it is important to

Use the right equipment for the job and to follow proper safety procedures to minimize the risk of harm to people And the environment.

SELECTION OF MATERIAL:

The main objective for fabrication of the selection of the Material for different component of the machine.

Selection of the material is depend on the following factor:

- Easily available in market
- Material properties
- Cost of the materials
- Mechanical properties of the material

Mechanical properties of the material are oppose the mechanical forces and load.

Stress : The bending stress act on the shaft. The Disc is mounted at the middle of the shaft. The maximum bending act at the middle.

Strength : The strength of the disc is good. And for sustain the bending stress the bending strength of shaft is Should be more.

III. EXPERIMENTAL SET UP

An oil skimmer belt typically consists of the following components:

BELT: Belt-type oil skimmers use an endless belt of corrosion resistant steel or synthetic medium, which is lowered into the tank or vessel to be skimmed. The belt passes through resilient wiper blades where the oil is Removed from both sides of the medium. Belt machines provide a simple, dependable and cost effective method for removing oil, grease and other hydrocarbons from water. The material used for an oil skimmer belt conveyor component belt can vary, but the most common materials used are Polyurethane, silicone, and neoprene. These materials are chosen for their ability to attract and hold onto Oil, as well as for their durability and resistance to abrasion and damage from exposure to liquids. The specific material used for an oil skimmer belt conveyor component belt will depend on the type and viscosity of the oil being removed, as well as the operating conditions of the conveyor. For example, Polyurethane may be a good choice for removing light to medium-viscosity oils, while silicone may be Better suited for thicker oils.

BATTERY: It is commonly used in home energy storage and is made up of one of three chemical compositions: lead acid, Metal particle, and seawater. Metal particle batteries are usually the best option for an electrical device system, though different battery types are more cost-effective. Electrical energy was converted into mechanical energy using an electric motor. Furthermore, the motor's operation converts force into rotation of the shaft. Wide Operating temperature range operating between -15°C to $+50^{\circ}\text{C}$ when fully charged. 12V 1.3AH Sealed Lead Acid Batteries are maintenance free as shown in fig 2 .

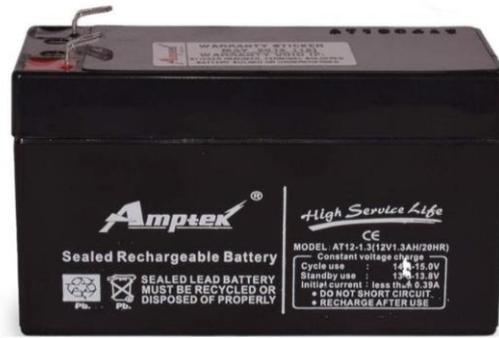


Figure 2: Battery

ROLLERS : The rollers provide support for the conveyor belt. These rollers are mounted on a shaft with a diameter drilled through a hole drilled in each of the two rollers, and these shafts are inserted into the holes made on the frame, which holds the rollers in the required positions and allows the belt to roll over it. To withstand exposure to the oil and other liquids being recovered, the rollers in an oil skimmer belt conveyor are typically made of a durable and corrosion-resistant material, such as stainless steel or plastic. The rollers support the belt and keep it running smoothly, so choose rollers that are the right size and weight for the belt as shown in figure 3.



Figure 3: Rollers

GEAR: Gears, which are mechanical components that transmit power and motion between rotating shafts, are typically used to drive the conveyor belt. Depending on the specific application and conveyor system requirements, the gears used in oil skimmer belt conveyors can be spur gears or helical gears. These gears are typically made of a durable and corrosion-resistant material, such as stainless steel. It is critical to note that regular maintenance of the oil skimmer belt conveyor's gears and other components is critical to ensure their continued operation and to reduce the risk of downtime or mechanical failure. This may entail inspecting the gears on a regular basis for signs of wear or damage, lubricating them to reduce friction as shown in figure 4



Figure 4 : Gears

MOTOR: The belt is driven by a motor, which provides the necessary power to move the belt and transport the collected oil to a storage area. The type of motor used for an oil skimmer belt conveyor can vary depending on the specific requirements of the application. Some common types of motors used in these systems include electric motors, hydraulic motors, and pneumatic motors. DC Motor – 150RPM – 12Volts geared motors are generally a simple DC motor with a gearbox attached to it. This can be used in all-terrain robots and variety of robotic applications. These motors have a 3 mm threaded drill hole in the middle of the shaft thus making it simple to connect it to the wheels or any other mechanical assembly as shown in figure 5.



Figure 5 : Motor

OIL COLLECTING TANK: Oil collector tank will be used to collect and store the oil collected by the oil skimmer during the operation. The separated oil is stored in the tank. Larger the tank, longer the operation can be performed without interruption. The collected oil is then transported to the collection tank, where it is stored for later disposal or processing as shown in figure 6 .



Figure 6 : Collecting Tank

OIL SCRAPER: A scraper is used to extract oil from the belt's surface. This is situated beneath the elevated roller. The oil on the surface of the water adheres to the belt as the belt is dipped into the water with the help of the roller-driven motor. A scraper is attached to provide the least amount of clearance, preventing the Belt from moving freely. The scraper removes the oil from the belt's surface due to the low clearance. The collected oil is placed in the collecting tank. Thus, the scraper, which is considered an important component of the Oil Skimmer, plays an important role in oil extraction.

IV. EXPERIMENTAL PROCEDURE:

An oil skimmer is a device used to remove oil floating on the surface of a liquid, such as a pond, River, or ocean. The oil skimmer typically consists of a belt conveyor, which is a continuous loop of material that moves along a set of rollers. Here is a general outline of the procedure for using an Oil Skimmer with a belt conveyor:

- Preparation: Before starting the skimming process, ensure that the area you are working in is safe and that the oil skimmer is properly set up and connected to a power source.
- Start the belt conveyor: Turn on the motor that drives the belt conveyor. The belt should start moving along the rollers.
- Adjust the speed of the belt conveyor: If necessary, adjust the speed of the belt conveyor so that it is moving at an appropriate speed for the conditions. The speed of the belt conveyor will affect how much oil is removed from the surface of the liquid.

- Lower the skimming unit: Slowly lower the skimming unit into the liquid until it is just below the surface. The skimming unit should be positioned so that it is touching the surface of the liquid and the belt conveyor is partially submerged.
- Start skimming: Once the skimming unit is in place, the belt conveyor will start collecting oil from the surface of the liquid. As the belt moves along the rollers, the oil will adhere to the Surface of the belt.
- Remove the collected oil: As the oil is collected on the surface of the belt, it will eventually reach the end of the conveyor. At this point, the oil can be removed from the belt and disposed of Properly.
- Repeat the process: Repeat the above steps as necessary until you have removed as much oil from the surface of the liquid as you need to.

It is important to use caution when using an oil skimmer, especially when working near large bodies of Water, to ensure the safety of the operator and to minimize the risk of environmental damage as shown in figure 7 .

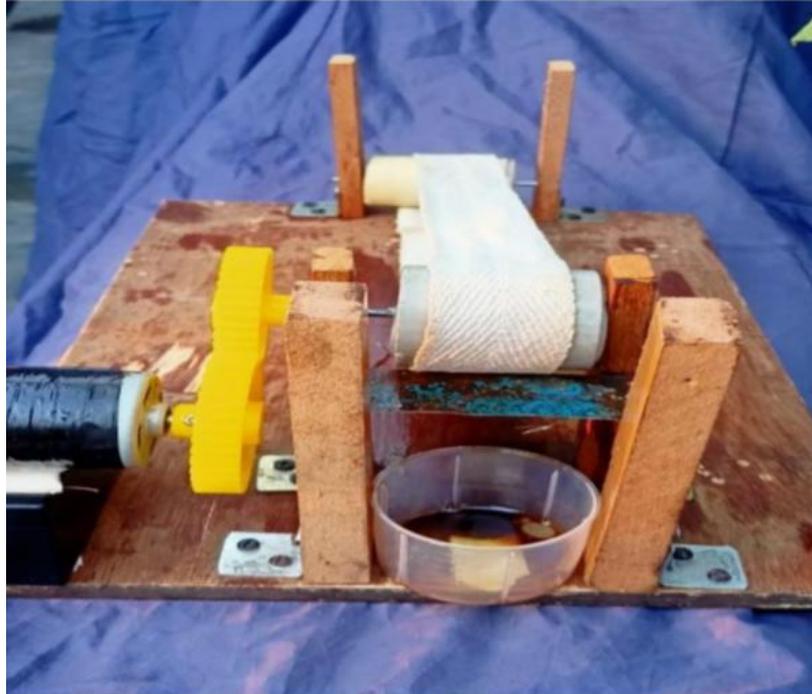


Figure 7 : Experimental setup

V. RESULTS AND DISCUSSION

Specifications:

Gear and pinion specifications

- Gear diameter :50 mm
- Pinion diameter :25mm
- Gear Teeth :30
- Pinion Teeth :25

Motor specifications:

- Type : Dc motor
- Volt : 12V
- Speed : 150rpm

Roller Diameter:

- Diameter 1 :30
- Length 1 :70
- Diameter 2 :40
- Length 2 :70

FORMULA :

Gear velocity ratio= $N2/N1=d1/d2=T1/T2$

$N1$ = Speed of the motor

$N2$ = Speed of the belt

$D1$ = Diameter of roller 1

$D2$ = Diameter of Roller 2

$T1$ = Teeth of gear

$T2$ = Teeth of pinion

Calculation:

Considering the schematic diagram:

$N_1 = 150 \text{ rpm}$, $N_2 = ?$

$D_1 = 30 \text{ mm}$, $D_2 = 40 \text{ mm}$,

$T_1 = 30$, $T_2 = 25$,

$N_2/N_1 = D_1/D_2$

$N_2 = 150 \cdot (30)/(40)$

$N_2 = 110 \text{ rpm}$

Using an oil skimmer belt conveyor is the removal of floating oil or other liquids from the surface of a body of Water or other liquid.

Oil collecting per second = 1ml

Oil collecting per minute = 60ml

Oil collecting per day = $60 \cdot 24$

= 1440ml

= $1440 / 1000$

= 1.44liters

The total oil collection per day is calculated = 1.44 liters.

VI. ADVANTAGES OF OIL SKIMMER USING BELT CONVEYOR

Oil skimmer belt conveyors have several advantages, including:

- **Efficient oil removal:** Oil skimmer belt conveyors are designed to effectively remove floating oil from Water surfaces, making them an efficient way to clean up oil spills or prevent oil pollution in industrial processes.
- **Continuous operation:** The belt conveyor in an oil skimmer is a continuous loop, which allows for continuous removal of oil from the water.
- **Versatility:** Oil skimmer belt conveyors can be used in a variety of settings, including harbors, ports, Marinas, and other waterways, as well as in industrial processes.
- **Environmentally friendly:** Oil skimmer belt conveyors are a safe and environmentally friendly way to remove oil from water surfaces, as they do not produce harmful chemicals or other by-products.
- **Cost-effective:** Oil skimmer belt conveyors are relatively cost-effective, as they are relatively simple in design and do not require expensive materials or complex technology to operate.

Overall, oil skimmer belt conveyors are an effective, efficient, and cost-effective way to remove floating oil from water surfaces and prevent oil pollution.

VII. LIMITATIONS OF OIL SKIMMER BELT CONVEYOR:

While oil skimmer belt conveyors are a useful tool for removing floating oil from water surfaces, there are some limitations to consider:

- **Efficiency:** Oil skimmer belt conveyors may not be effective in removing heavily viscous or thick oils, as these oils may not adhere well to the belt.
- **Water conditions:** The efficiency of oil skimmer belt conveyors can be impacted by water conditions, such as rough waves or strong currents, which can make it difficult for the skimmer to effectively remove oil from the water.
- **Limited capacity:** Oil skimmer belt conveyors have a limited capacity for collecting and storing oil, Which may not be sufficient for large oil spills or other high-volume applications.
- **Cost:** While oil skimmer belt conveyors are generally cost-effective, the initial cost of purchasing and installing the system can be significant, especially for larger applications.
- **Weather conditions:** The effectiveness of oil skimmer belt conveyors may be impacted by weather Conditions, such as storms or heavy winds, which can make it difficult to operate the skimmer or transport The collected oil.

Overall, oil skimmer belt conveyors are a useful tool for removing floating oil from water surfaces, but their Effectiveness and efficiency can be impacted by a variety of factors, including the type of oil, water conditions, and weather conditions.

VIII. DISCUSSION

The following are some of the benefits of using an oil skimmer belt conveyor:

- **Environmental protection:** By removing oil from the surface of a body of water, an oil skimmer belt conveyor Helps to protect the environment and prevent pollution.
- **Improved safety:** Floating oil on the surface of a body of water can be a safety hazard, and removing it with an oil Skimmer belt conveyor can help to reduce the risk of accidents and spills.
- **Increased efficiency:** An oil skimmer belt conveyor can remove oil quickly and efficiently, reducing the time and Labour required for manual cleaning.
- **Cost savings:** By removing oil from a body of water, an oil skimmer belt conveyor can help to reduce the cost of Cleaning and disposal of the oil.
- **Compliance with regulations:** In many cases, the removal of oil from a body of water is required by environmental Regulations, and using an oil skimmer belt conveyor.

Overall, the result of using an oil skimmer belt conveyor is a cleaner and safer body of water, reduced Environmental impact, and increased efficiency and cost savings.

IX. Conclusion

We learned from all of the research work that there are some important aspects and points to consider when Designing an oil skimmer. To summaries, an oil skimmer belt conveyor is an extremely useful tool for removing Floating oil or other liquids from the surface of a body of water or other liquid. An oil skimmer belt conveyor Helps to protect the environment, improve safety, and reduce the cost of cleaning and disposal by effectively and Efficiently removing oil. It is critical to select the best oil skimmer belt conveyor for your specific requirements, Taking into account factors such as the size and type of body of water, the amount of oil to be removed, and the location. The slightest changes in the design aspect of the skimmer may cause a huge difference in the oil Recovering efficiency of the skimmer Overall, an oil skimmer belt conveyor is a cost-effective and Environmentally responsible solution for removing floating oil and protecting our water resources .

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