

Development of a unit known as a skimmer to collect oil and derivatives with water in refineries Case Study

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Abstract

As it is known that oil pollution constitutes a danger and threat to human, animal and plant life And that the world is harnessing all its potential to fight it and reduce its emissions and many reasons, And from these causes that affect the environment are the collection basin for oil and its derivatives, and the cooling water in oil process causes pollution to the marine environment, suggesting that the water coming out of this basin is not entirely purified, On the other hand, the pollution affects the air, which is that the assembly of these components is outdoors, So we worked on our study to provide all possible solutions, including the development of skimmer itself, Or add another unit to separate water from oil and its derivatives before entering the open basin.

Keywords: skimmer - refinery water treatment.

Introduction

Oil refining is also known to be a mechanism in which crude oil within the oil refinery is converted into petroleum products, o be used later as a fuel for transportation, heating, paving roads, electricity generation, and raw materials for making chemicals, Refining breaks down crude oil and separates its main components, which are later converted into new petroleum products[1].

usually, hydrocarbon compounds are the main component of crude oil, and their percentage varies between 50% - 97%, depending on the type of crude oil and the method of its extraction, while organic substances such as nitrogen, oxygen, and sulfur make up about 6%-10% of it, as for minerals such as copper, nickel, vanadium, and iron, they constitute no more than 1% of crude oil[2,3].

The problem with crude oil is that there are hundreds of different types of hydrocarbons mixed together, Therefore, in order to access useful oil products, these materials must be separated from each other, To achieve this, the oil must go through several stages of processing after extraction.

It is then converted into products and if the products do not meet the specifications they are passed through a tube to a large basin known as the assembly basin, Even crude oil itself is passed into this basin if the water is not separated from it in a manner that conforms to specifications, Here's the problem as converting it into this basin causes environmental air pollution, as well as environmental pollution of seawater, As the water in it will return to the sea again mixed with hydrocarbons[4,5,6].

The environmental impact of its neglect:

It is also known that oil pollution is the release of gas, liquid or solid elements, compounds, or mixtures originating from oil to the

elements of the environment, that are air, water, and soil, causing a change in the presence of these elements[7,8].

Pollution of the seas and oceans with oil leads to a series of real and extremely serious disasters, including what can be observed, confined and controlled from the beginning of the pollution and within several days and months from which it cannot be counted and controlled because its serious effects do not appear until several years later and we cannot control them[9,10].

The damage of oil pollution is distributed to all forms of life, Human beings, marine, and wild organisms, birds, and plants, And it eventually leads to the death and extinction of millions of marine organisms of all races, types, and sizes, to the disruption of most navigational services, to the destruction of tourism by polluting water and beaches, to damage to water desalination plants, the arrival of some chemicals from oil into drinking water, and a significant decrease in fishing productivity, t also destroys plant beings as well as damages thousands of species of birds, where oil kills birds by killing them into marine life, such as larvae on which they depend for their food, as well as by contaminating the birds themselves with oil when hunting them[11].

In addition to the more pernicious effects of access to human food, where petroleum compounds are collected and stored in marine organisms such as fish and other shells, crustaceans, and shrimp, it reaches us, humans, through the food chain when humans eat it. Dangerous and stable oil compounds are also transmitted to humans through the food chain, where they are stored in the livers and fats of marine animals, these compounds have far-reaching adverse effects that do not appear on the human body until several years later[12].

In the Arab world, the problem of pollution of beaches and seas has become a serious threat to human and economic activity, affecting those interested in environmental affairs, as more than half of the Arab population lives along with coastal and marine areas and thus depends on seawater in the areas of tourism, fishing and desalination of seawater as a result of the scarcity of fresh water in addition to the use of the sea as a source of food and mineral extraction, The seas overlooking the Arab world (The Mediterranean, the Red Sea, the Arabian Gulf) are considered to be among the most polluted because they are semi-closed seas as their waters are renewed only after about 100 years or more, in addition to the intensity of traffic and the use of these seas as reservoirs of other pollutants such as garbage and sewage.



Figure 1: show the extent of environmental pollution in seawater due to mixing with crude oil

Results and Discussion:

There are several ways to address this problem and we will talk about the most important ways in which we have developed:

Belt:

It is made up of polyurethane material. The width of the belt is 100mm. The length of the belt is 1500mm. It is immersed in dusty particles up to 100mm. It withstands high temperatures up to 180oF



Bearing:

It is made up of cast iron. It is coated with an aluminum coating. The main function of the bearing is to rotate or hold the shaft. Each shaft contains 2 bearings at its end. The inner diameter is 45mm & the Outer diameter is 59mm.

Table (1): Specifications of the skimmers developed in most refineries

S.NO	PARTS	SPECIFICATION
1	Shaft	EN 19 Rod. Magnetic rod. Hard material.
2	Belt	Polyurethane material. Lenth1500mm.Width-100mm.Temperature-180F
3	Bearing	Cast iron. Aluminum coated.
4	Supporting Frame	Made of mild steel. Lenth300mm.Width-240mm

Supporting Frame:

It is made up of mild steel. The length and width of the frame are 300mm and 240mm. It supports the shaft, bearing, and belt. The full weight of experimentation is balanced by a supporting frame. and the belt, where the motor is also fixed on the frame.

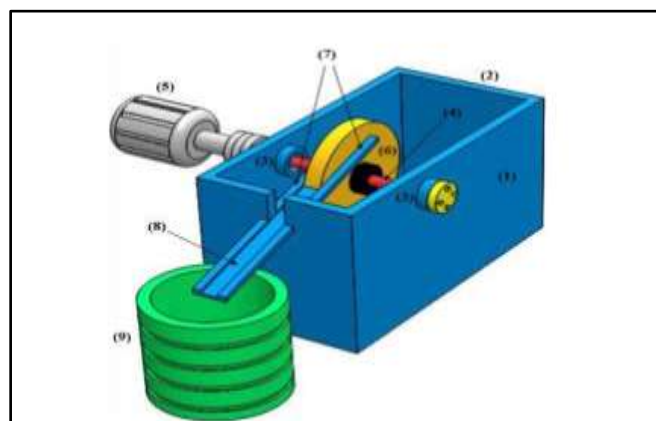


Fig: (2): Schematic diagram of the disk skimmer apparatus. (1) Glass water tank, (2) rigid steel frame, (3) two frictionless bearings, (4) rotating steel shaft, (5) variable speed AC motor, (6) rotating disk skimmer, (7) two flexible rubber scrapers, (8) steel channel, (9) graduated cylinder.

Note: determine the oil recovery rate (ORR) and the oil recovery efficiency (ORE), the volume of the removed mixture (oil and water) during a specific time needed for each disk till it clears out from the water surface in the reservoir is measured. The mixture was left 24 h in a graduated cylinder away from the apparatus to ensure complete separation of water and oil from the mixture. The volume of oil and water is then obtained by measurements using the graduated cylinder.

Table (2): Properties of oils used at 25 °C to test the performance of the disk skimmers

Oil type	Viscosity (cP)	Density (kg/m ³)
SAE 50	381.08	850
Used car engine oil	509	855

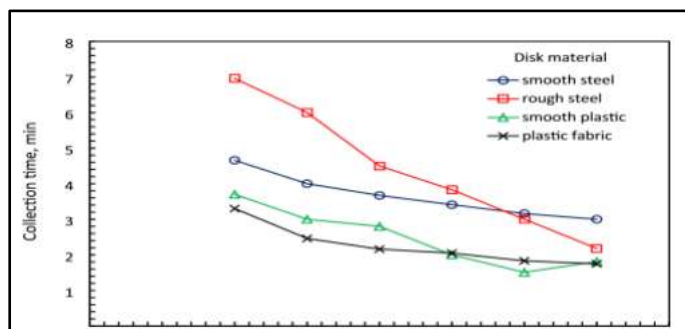
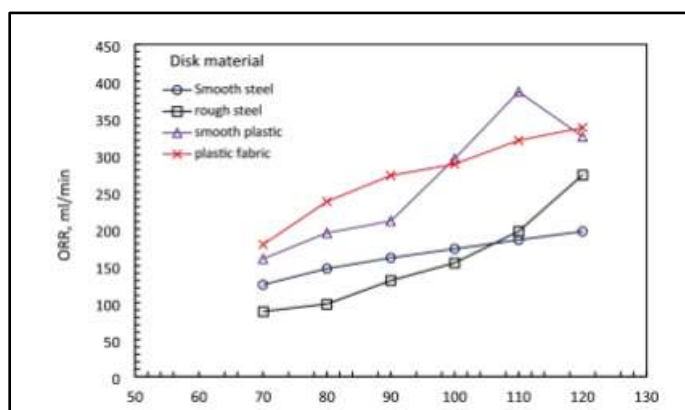


Fig 1. the collection time for SAE 50 oil



2. Effect of disk material on oil recovery rate for SAE 50 oil

Note disk. The smooth steel disk has higher oil recovery efficiency than the rough steel disk at 100 rpm, 1 shows the effect of rpm on the oil recovery rate slight difference in (130/120/110/100/90/80/70) Disk rotation speed, rpm.

Conclusion and recommendations:

It is clear from the foregoing the importance of developing the seawater unit, due to the environmental consequences of negligence in it. Also, we have mentioned that the damage of oil pollution should be distributed to all forms of life, human beings, marine, and wild organisms, birds and plants, And it eventually leads to the death and extinction of millions of marine organisms of all races, types, and sizes, to the disruption of most navigational services, to the destruction of tourism by polluting water and beaches, to damage to water desalination plants, the arrival of some chemicals from oil into drinking water, and a significant decrease in fishing productivity. The recommendations are summarized in one point: The necessary development of this unit should be accelerated depending on the type of refinery it owns for the environment to live in safety.

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