The development of floating devices to absorb oil spills at sea

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Abstract

This research studied water quality at Mod Tanoi Beach, Kantang District, Trang Province, from 2017 to the present. The findings showed increasing water temperatures, decreasing pH and dissolved oxygen (DO) levels, and stable salinity, likely due to untreated wastewater discharge and marine transportation. Field studies at two locations—Mod Tanoi Beach community and the area behind the beach—revealed below-standard water quality and significant oil slick contamination.

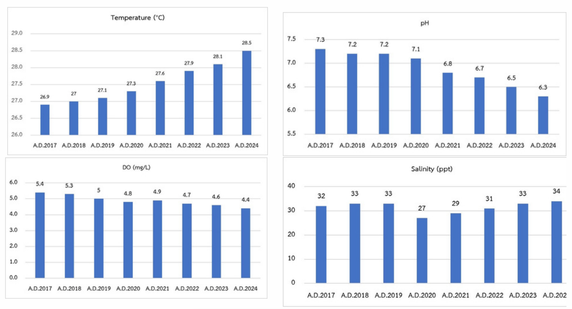
To address this issue, researchers developed a floating oil-absorbing device. The structure, made of rust-resistant coated steel (1.3m × 1.5m × 0.93m), features an HDPE oil absorption tank with external and internal sensors for oil detection, pH, and temperature monitoring. The device operates using solar energy.

Performance testing showed that the filter absorbed oil at 10.92 to 12.05 times its weight. Water quality analysis of the treated water showed a temperature of 28.9–29.3°C, pH levels between 7.0–7.4, DO levels between 4.7–5.1 mg/L, and salinity between 31–33 ppt, all within safe discharge standards.

In conclusion, the floating oil-absorbing device effectively removes oil spills and can help mitigate marine pollution. The device also utilizes natural materials for oil absorption, making it an environmentally friendly solution.

Problem

water quality in 2017-2024



Oil slicks at Mod Tanoi Beach.

"Photograph taken by Wales Online"

Toxic to marine animals.

"Photograph taken by Sean Gardner/Reuters"

Current management

1 Combustion

"Image taken from https://mgronline.com/science/detail/9560000096340"

Air pollution

2 dispersant

"Image taken from https://tos.org/oceanography/article/a-decade-of-gomri-dispersant-science-lessons-learned-and-recommendations-for-the-future"

Oil clumps

"Image taken from https://mgronline.com/south/detail/9660000071185"

Desho grass

"Image taken from https://www.baanlaesuan.com/plants/annual/136573.html/"

- Effectively absorbs oil.
- Does not cause additional pollution
- Utilizes agricultural weeds

Research question

1.Is there a difference in water quality between the two areas?
2.Can the floating oil-absorbing device effectively remove oil spills?
3.Does water quality change after passing through the device?

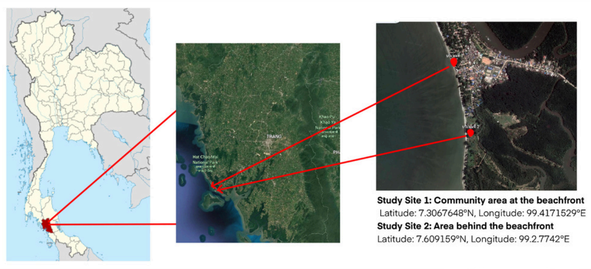
Research hypotheses

1. Water quality differs between the two areas.
2. The device absorbs oil spills.
3. Water quality changes after filtration.

Method

1 Study Site

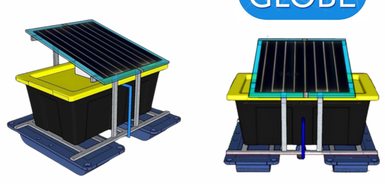
Field study conducted at the front and rear areas of Modtanoy Beach.



2 Data Collection

Measure temperature, pH, DO, and salinity values and enter the data into the GLOBE Data Entry.

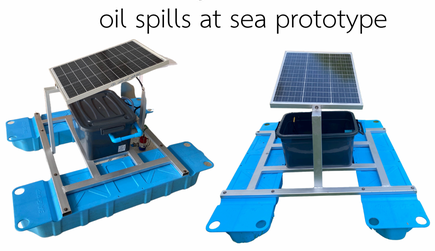
3 Design Methodology for Problem Solving



The floating devices to absorb oil spills at sea prototype

4 Performance testing

Test the device's efficiency and the quality of water after passing through the device.



5 Data analysis

- Analyze the data for temperature, pH, DO, and salinity.
- Compare water quality.

6 Presentation

Research result

Part 1 Water quality in the area Community and after Modtanoy Beach.

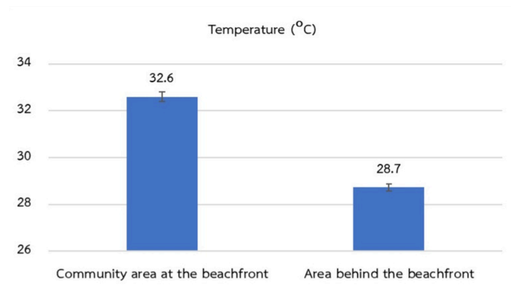


Figure 2 shows the water temperature at the study school location

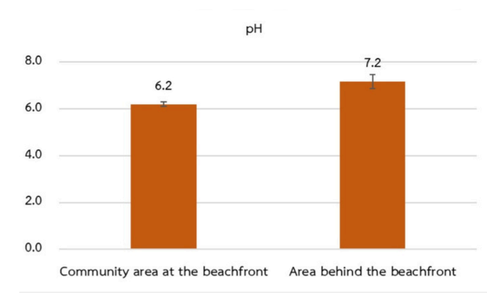


Figure 3 shows the pH of the water at the study school locations

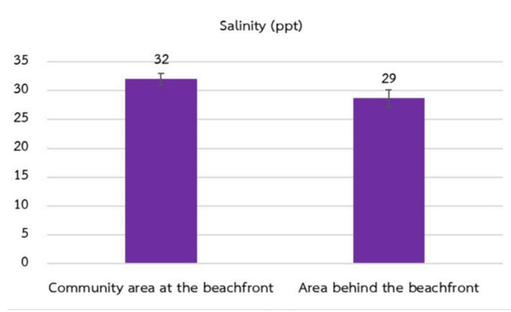


Figure 4 shows the DO of the water at the study school locations

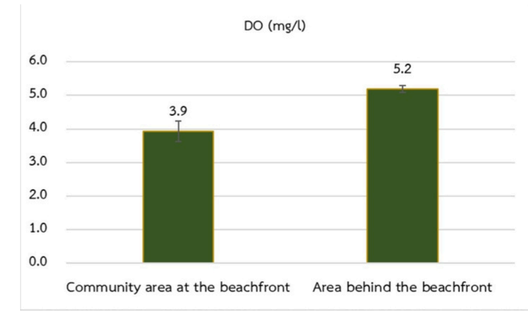
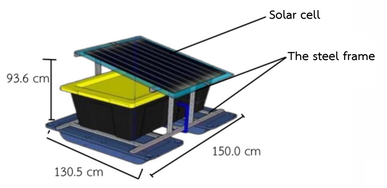
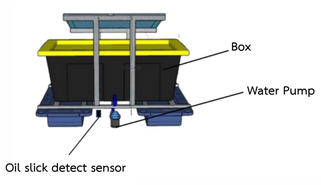


Figure 5 shows the Salinity of the water at the study school locations

Part 2 Design and Construction of the floating Oil-Absorbing Device

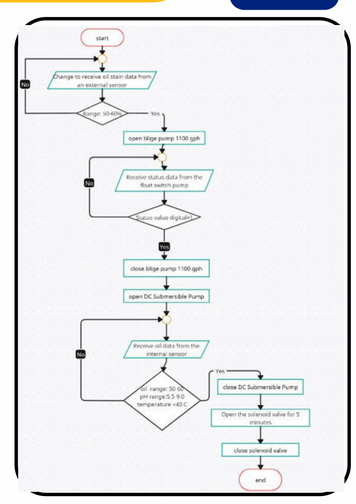
Draft of the floating device.





The floating device when fully completed.

ICT system



Part 3 Performance Testing of the Floating Oil-Absorbing Device

water Quality After Passing Through the floating Oil Absorbtion Device

Table 1: Show water quality after passing through the equipment

Quality	Quality of seawater after passing through the device
Temperature (°C)	29.1±0.2
pH value	7.2±0.2
DO value(mg/L)	4.9±0.2
Salinity value (ppt)	32±1

Standard pH range of 5.5–9.0 allowed for discharge into the sea.

Standard temperature limit of no more than 40°C allowed for discharge into the sea.

Filter made from desho grass capability

Table 2: Oil and water Absorption Capacity of the Filter

Filter weight before absorption (grams)	Filter weight after absorption(grams)	Absorption Capacity (times)
5.00±0.01	65.25±3.90	12.05
10.00±0.01	119.69±1.10	10.97
15.00±0.01	178.75±1.18	10.92

The filter can absorb oil and water 10.92-12.05 times it own weight

Summary and discussion of results

This research successfully developed a floating oil absorption device to address marine oil contamination at Hat Mod Tanoi, Kantang District, Trang Province. The study confirmed that water quality in the area was below environmental standards, with a temperature of 32.6°C, a pH of 6.3, a dissolved oxygen (DO) level of 3.9 mg/L, and a salinity of 32 ppt, indicating significant oil pollution due to untreated wastewater discharge and maritime activities.

The developed device features a natural Kachornchob grass filter with an oil absorption efficiency of 10.92 to 12.05 times its weight, an IoT-based monitoring system, and a solar-powered design for sustainable operation. Water quality analysis after treatment showed that the device successfully restored conditions to meet environmental standards: temperature 28.9–29.3°C (standard: ≤35°C), pH 7.0–7.4 (standard: 5.5–9.0), DO 4.7–5.1 mg/L (standard: ≥5 mg/L), and salinity 31–33 ppt (standard: 30–35 ppt).In conclusion, the floating oil absorption device effectively removes oil spills and improves water quality, ensuring compliance with environmental standards before discharge. Its successful performance and eco-friendly design suggest potential applications in coastal areas, harbors, and other marine environments affected by oil spills.

Benefits

- The buoy can absorb oil spills in the sea.
- It helps reduce marine pollution.
- It helps marine life to thrive and survive.

Suggestions

1. Moving buoy for precise oil absorption.
2. Optimizing internal flow for better filtration.
3. Telegram-based operation alerts.

Acknowledgements

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