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Composition of Polystyrene Containers with Extracted Betanin as Remover of Oil Spill

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Abstract: The work included the creation of a new adsorbent polymeric composite known as Polystyrene Betanin Composite (PSBC) which was prepared using the waste polystyrene and betanin from beets. The composite Polystyrene Betanin Composite (PSBC) serves as an ongoing work included the creation of a new adsorbent polymeric composite known as PSBC which was prepared using the waste polystyrene and betanin from beets. The composite PSBC serves as a cleaning for oil spills. The composite PSBC a highly effective remover for cleaning up oil spills from water. Then studied the effect of various ratios (0.1, 0.2, 0.3, 0.4, 0.5, and 0.6 wt%) of PSBC composite at a constant time to enhance the ability of PSBC composite as an oil spill absorption was studied. It can be seen, a high oil absorption capacity (2.484 g/g) at a ratio of 0.6. Furthermore, the impact of extending the time for the oil spill to absorb was studied, the best period was 105 minutes. After that, the crude oil was recovered from the sorbent material PSBC by dissolving the sample (sorbent materials laden with crude oil) in gasoline. Finally, through the experimental results of this study depict, the new composite PSBC can be considered a good crude oil spill remover and a good material for recovering crude oil after spillage in rivers and oceans.

Keywords: Beetroot, Crude Oil, Oil stains, Polymer, Sorbent materials.

Introduction

Oil is a valuable resource in today's global economy and needs to be transported from production sites to various locations around the world through both ocean and inland shipping. In the route of transportation, the hazard of oil spillage over the water body takes place because of damages or by means of way of deliberate motion through wartime that causes severe environmental pollutants (Qiu *et al*., 2020; Zamparas *et al*., 2020; Fan *et al*., 2022). An oil spill is the discharge of a liquid petroleum hydrocarbon into the surroundings, specifically in marine regions, however, spills may additionally occur on land. Oil spills also can be due to releases of crude oil offshore structures, drilling rigs, and wells, further to spills of subtle petroleum merchandise (Ramirez *et al*., 2013; Gong *et al*., 2014; Tayeb *et al*., 2019). Oil spills can happen in marine areas as well as on land, often caused by releases from offshore structures, drilling rigs, wells, and refined

petroleum products. Analyzing and assessing oil spills is an important aspect of managing such incidents, with laboratory analysis providing valuable information about the oil's origin, weathering, and degradation (Kamarudin *et al*., 2020). With a sample of the delivered oil, the degree of weathering and the quantity of evaporation or biodegradation may be decided for the spilled oil. The properties of a super sorbent for oil spill cleanup include oleophilic and hydrophobicity, high oil sorption potential, low water pickup (immoderate oil, water selectivity, and high buoyancy) (Zhang *et al*., 2013; Wen *et al*., 2017). These sorbent materials can be classified into three main categories: inorganic mineral product, natural herbal product, and synthetic herbal products (Viju *et al*., 2019). The present work takes depict a look at the purpose recycling of waste polystyrene and the use of the modern modified polymer for oil spill cleanup. The cutting-edge examination dreams of Preparation a composite of waste polystyrene and betanin extracted from the beetroot and then assessing it as sorbent material used for oil spill cleanup.

Materials & Methods

The beetroot was obtained from a local store, and waste polystyrene was also utilized in the current investigation. Other materials and solvents are supplied by the Aldrich Company.

Preparation methods of sorbent materials

Extraction from betanin the beetroot

500g of freshly cut beetroot was dried for two hours at 50°C in the oven to eliminate any moisture. Beetroot that had been dried was then pulverized into a powder. A 500 mL solution of 10% sodium hydroxide in water was used to extract the powder over reflux for 24 hours. The betanin compound was then washed with distillation water, dried in an oven at 60°C for 24 hours, and then the crude extract was filtered. Next, the betanin compound was acidified by 2% HCl solution to pH= 3-4 (Piperopoulos *et al*., 2020; Zhang *et al*., 2022)

Preparation composite of polystyrene and betanin

By dissolving waste polystyrene in Dichloromethane as a solvent and adding betanin to the solution at ratios of 0.1, 0.2, 0.3, 0.4, 0.5, and 0.6 wt%, the composites were formed at all these ratios separately. The solution was then agitated at 1200 rpm for 30 minutes. Pouring the slurry onto petri dishes, and it was then dried in a vacuum oven. The composite was dried, crushed into powder, and given the designation PSBC (Polystyrene Betanin Composite).

Preparing oil spill

One gram of crude oil was added to 50 mL of water in a glass beaker, and the mixture was stirred for five minutes to make the crude oil homogeneous on the water's surface (Zhang *et al*., 2018; Zhuang *et al.,* 2020) as illustrated in fig (1).

Fig. (1): crude oil in water (oil spill).

The general sorption processes in the current investigation include absorption. The following equation yields the oil uptake (g)

for sorbent materials (Patowary *et al*., 2014; Zheng e*t al*., 2014):

Oil up take = Mo- Ms ……1

The oil sorption capacities for these sorbent materials obtained from the following equation.

$$Q = \frac{Mo-Ms}{\text{Ms}} \text{.....2}$$

Where Q is the oil sorption capacity (g/g), Mo is the total mass of the wet sorbent after the oil had been in contact with it for 10 seconds, and Ms is the mass of the sorbent before sorption (g).

Results & Discussion

Evaluation of PSBC composite as adsorbent materials for crude oil spill

The American Society for Testing and Materials (ASTM) F726-06 standard procedure was used to conduct the oil spill cleanup tests (Zheng *et al*., 2014; Zhang *et al*., 2018). 0.5 g of PSBT compound was added to the oil spill and stirred for 5 minutes to allow the surface to become homogeneous (Fig. 2). The mixture was taken out after an hour and placed on filter paper to catch any surplus crude oil before being weighed (Fig. 3). The weight ratio between the absorbed oil and the initial dry materials was used to compute oil absorbency (g/g).

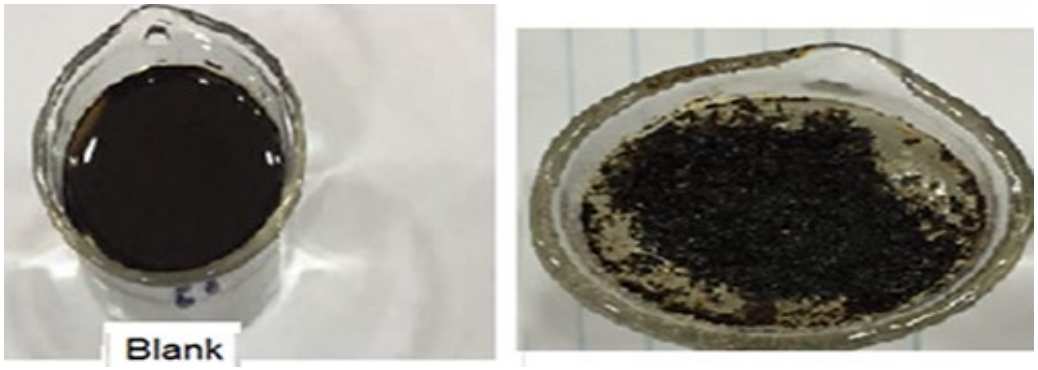

Fig. (2): Evaluation the adsorbent of PSBC composite as oil spill clean-up.

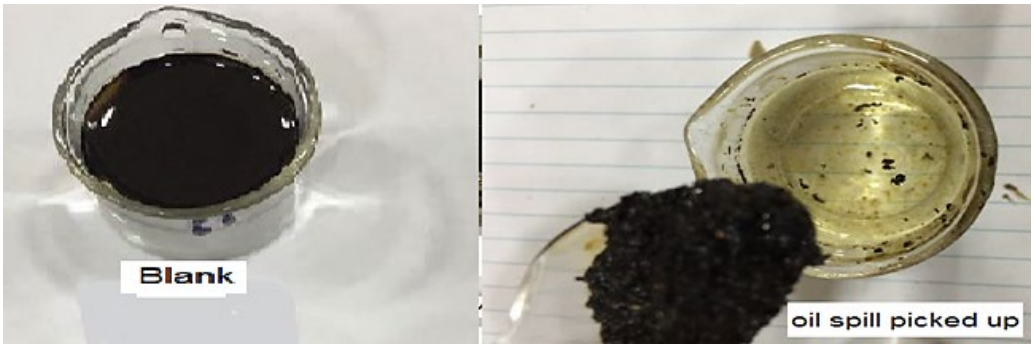

Fig. (3): Oil spill picked up.

Study the effect of increasing the ratio of Betanin on capascity of composite (PSBC) as oil spill up take with constant time

The effect of increasing weight was studied by using different ratios of betanin (0.1, 0.2, 0.3, 0.4, 0.5, and 0.6 wt%) at the constant time (1h) and room temperature. This study carried out at the same procedure above (section 1), as shown in fig. (4); the wet sorbent was removed, and then it was weighed. Every sample with an identical sorption time was measured three times separately, and the average cost was computed for each measurement. The measurements of oil sorption were all carried out at room temperature. Equation (1) was used to compute the oil uptake value, as demonstrated in fig. (5), the oil uptake values rise as the weight of the sorbent material increases. As indicated in the table (1), which obtains the optimal oil uptake values. The oil uptake values are related to the increase in the weight of the sorbent fabric (Zhang *et al*., 2021).

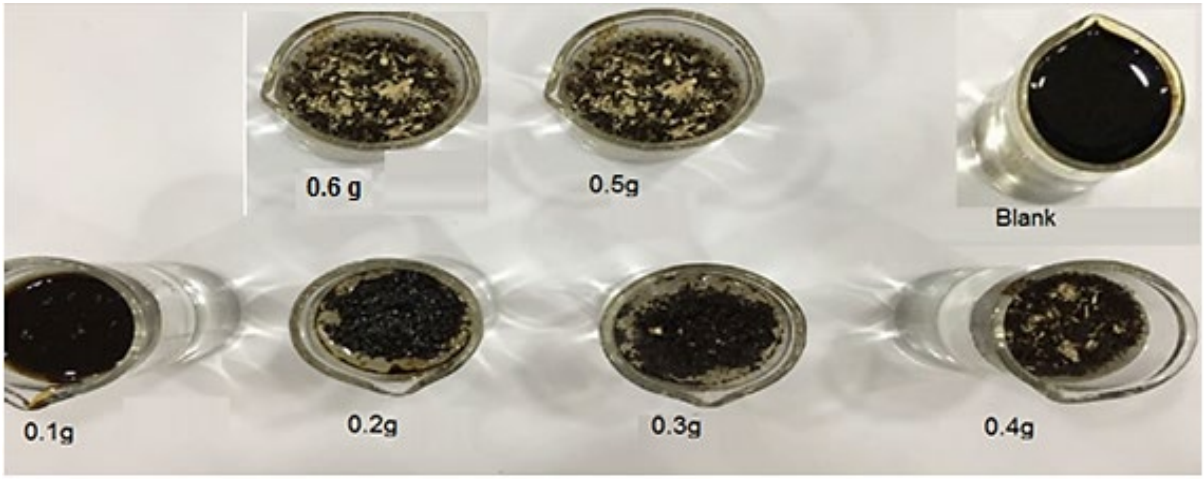

Fig. (4): The effect of increasing ratio of betanin on capacity of PSBC composite as oil spill up.

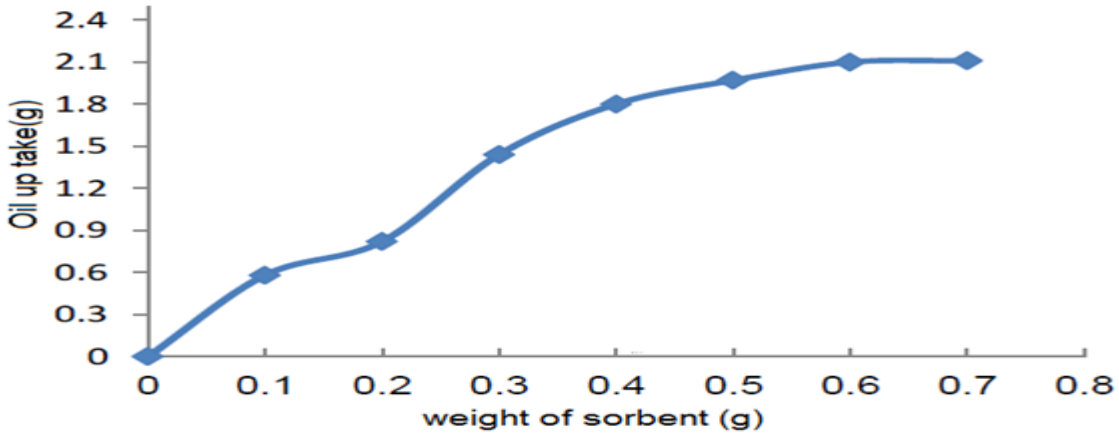

Fig. (5): The effect of increasing the weight on oil spill cleanup for PSBC Composite.

Table (1): Optimum weight and optimum oil uptake of sorbent material.

Comp	Optimum Weight (g)	Optimum uptake (g)	Oil absorption Capacity (g/g)
PSBC	0.7	1.9	2.484

Studying effect of increasing the time on oil spill up take with constant weight of composite (PSBC)

To explore this, specific time periods were used with the normal weight of sorbent fabric for the PABC composite at room temperature. The experimental setup was the same as described in section (2). Results from fig. (6) demonstrate that the amount of oil uptake increases as the absorption time lengthens. Additionally, table (2) reveals a linear relationship between the absorption time and the most effective values of oil uptake (Q). The ability to absorb oil is influenced by various factors such as the polymer's shape, polar businesses with hydrophilic and oleophobic properties, and cross-linking density (swelling ability) (Bejarano *et al*., 2016; Xie *et al*., 2020). A lower cross-linking density leads to higher swelling, increased absorption capacity, and greater molecular weight. Table (2) provides information on the optimal timing and maximum oil uptake achieved in this study.

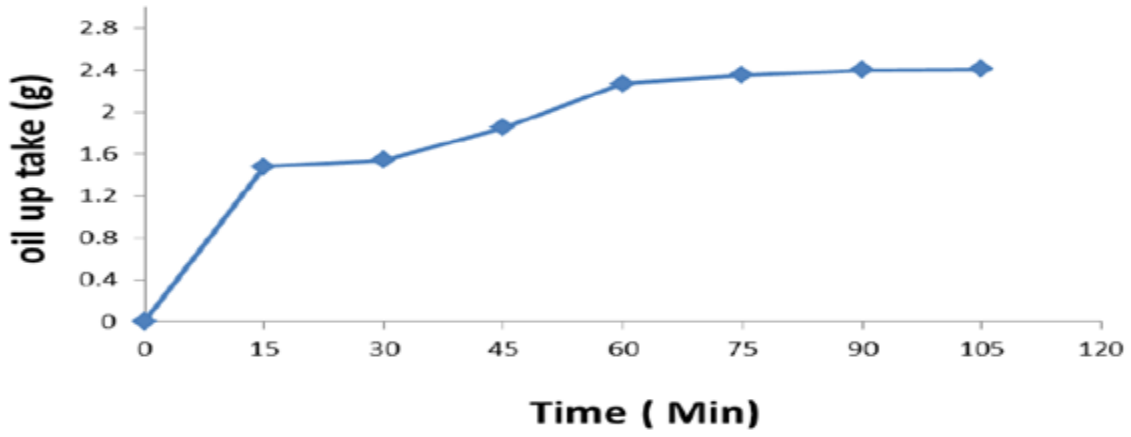

Fig. (6): The effect of increasing time of absorption on the oil up take with constant weight (0.5 g) of the compound psbc.

Table (2): optimum time and optimum oil up take of sorbent material.

Comp	Optimum time(min)	Optimum uptake (g)	Oil absorption Capacity (g/g)
PSBC	105	2.4	1.720

Crude oil recovery from sorbent materials

After the oil spill was cleaned up, the crude oil was recovered by first dissolving the sample (sorbent materials laden with crude oil) in gasoline, filtering it, and then washing the precipitate (sorbent material) many times in gasoline before drying it and using it again. To get rid of the solvent, the filtrate (crude oil) was put into a rotary evaporator to remove the solvent. This method is based on the principle of dissolution, the solvent is chosen that has the ability to dissolve crude oil and is unable to dissolve the sorbent material. The method is considered good and successful in complete recovery of the quantity of crude oil after a spilling and reusing it again and didn't effect on sorbent material. The sorbent material can be dried and used again to remove oil spill from water (Tayeb *et al*., 2019; Zhuang *et al*., 2020).

Fig. (7): Crude oil recovery from sorbent materials (PSBC).

Conclusions

The following statements might serve as a summary of the study's principal findings:

1. You may utilize the PSBC as oil sorbent materials.

2. The PSBC show strong potential for cleaning up oil spills at short time105 minutes.

3. After the absorption operations, the crude oil may be recovered from sorbent materials, and sorbent materials can also be employed once again after crude oil recovery.

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أزالة بقع النفط الخام عن طريق استخدام خليط بوليمري من حافظات البولي ستايرين التالفة والبيتانين المستخلص من الشمندر

حكمت عبدالرحيم علي

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المستخلص: يتضمن العمل الحالي تحضير خليط بوليمري ماص للزيت بعرف برمز له ب(PSBC) الذي حضر من حافظات البولي استارين التالفة و البيتانين المستخلص من الشمندر. يعمل الخليط البوليمري (PSBC) كمنظف لبقع النفط الخام الحاصلة نتيجة لانسكاب النفط الخام في المياه . وفقاً للنتائج، فأن المركب PSBC ابدى فعالية عالية جداً في أزالة بقع النفط الخام . بعد ذلك درس تاثير تغير نسبة البيتانين على فعالية الخليط البوليمري الناتج ، اذ استخدمة النسب (0.1,0.2,0.3,0.4,0.5 and 0.6 wt%) عند ثبوت وقت الامتزاز . أظهرت النتائج ان المركب PSBC اعطى اعلى قابلية امتصاص للبقع النفطية عند النسبة 0.6 . ثم درس تاثير تغير الوقت عند ثبوت نسبة الخلط (0.6) اذ كان افضل وقت امتصاص هو 105 دقيقة وفي النهاية تم استعادة النفط الخام من المادة الماصة PSBC عن طريق اذابتها في الكازولين . من خلال النتائج في هذا البحث يمكن اعتبار الخليط البوليمري PSBC مادة عالية الكفاءة في ازالة البقع النفطية واستعادة النفط الخام بعد انسكابة في الانهاروالمحيطات.

الكلمات المفتاحية: شمندر، نفط خام، بقع نفطية، بوليمر، مواد ماصة.