ISSN: 1231-4005
e-ISSN: 2354-0133
DOI: 10.5604/12314005.1165978

COMPARISON OF NONWOVEN FABRICS IN TERMS OF USEFULNESS FOR OIL SPILL COMBAT

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Abstract

The petroleum substances (oil) spilled on the hard surface can be easily neutralized and collected by using powdery or granular sorbents. We are dealing with more difficult situation when oil spill appears on the soft ground or on the surface of the water. Extremely difficult is removing the oil from body of water polluted by dispersed one. In such cases useful are various balls, sleeves and mats filled by nonwovens. It is important to identify a material, which strongly absorbs different type of oil in a wide temperature range. At the same time, such material should have physical properties allowing easy and rapid contact with the spilled oil and then its removal from the environment. This paper provides an overview of impregnability of nonwoven fabrics made from two materials – polypropylene and cotton. The impregnability was tested against the water and the used lubricate oil. The tests were carried out by using experimental device constructed by members of the student's scientific society at Faculty of Marine Engineering (Gdynia Maritime University). Principle of construction of testing device takes into account aspect of placing the sorbent in the package as well as possibility of repeating the experiment in precisely defined measurement conditions. Among tested materials, the best in terms of oil sorptivity proved to be polypropylene. The same material was the least absorbing water. It can therefore be assumed that this material is the most suitable for removing oil from the polluted water.

Keywords: *oil spill combat, sorbents, nonwoven fabrics*

1. Introduction

Various materials can be applied to collect oil pollution spilled on hard surfaces, for example: peat moss, straw, bird feathers, bark or wood fibre, pearylite or vermiculite. More difficult problem is created when oil is spilled on the water surface. If additionally oil-in-water emulsion appears – the problem really increases. Therefore, materials, which will absorb oil, but not water, are hardly needed.

Application of sorbent in aquatic environment is reasonable in the cases when surface of oil polluted with small amount of oil (for example monomolecular film) [2]. Usefulness of various oil-sorbents is frequently tested in scientific laboratories or by the producers. Procedures of application of any material depend on their physical form. Sorbent materials are usually in the form of powders, granules, sheets, patches or nonwoven fabrics. For example mineral sorbent (*Densorb*) were analysed volumetrically [3] whereas nonwoven patches by weight [4].

This paper presents description of tests on oil-sorptivity of two materials dedicated as fulfiller of special pads and pillows able to absorb oil residues from water environment. The tests were carried out within the Student Scientific Society „Nautica" (at Faculty of Marine Engineering of the Gdynia Maritime University).

2. Material and methods

There were four sorbents used, namely: two types of polypropylene wadding – called further "winter" and "summer", scraps of polypropylene nonwoven (every three produced by "Ava Sp. z o.o."), and the typical medical cotton wool. Fig. 1 presents photos of samples of studied sorbents.

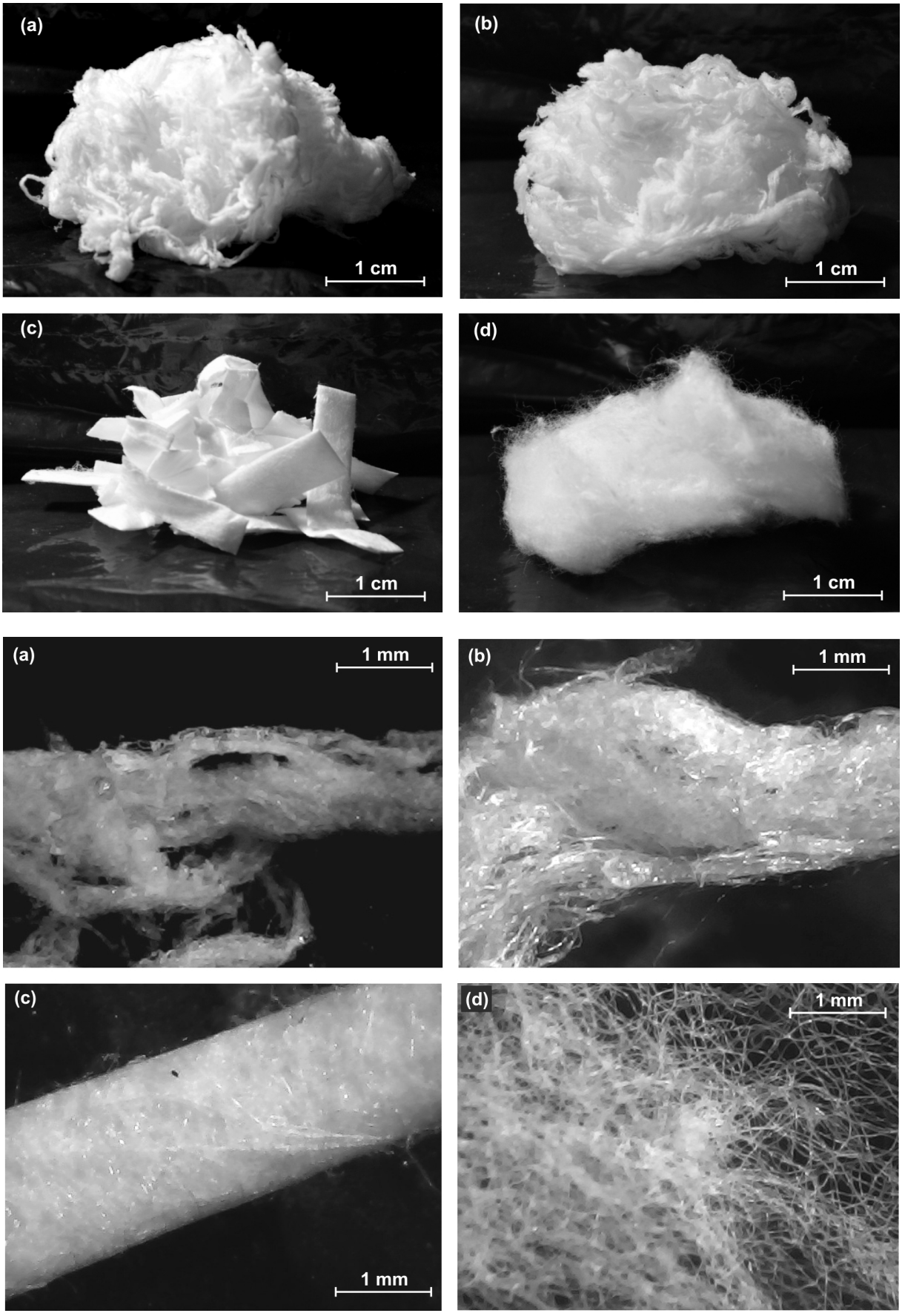

Fig. 1. Pictures of sorbents: (a) polypropylene wadding "winter", (b) polypropylene wadding "summer", (c) polypropylene nonwoven, (d) cotton wool

The experiment consisted of measurements of absorption of oil by the sorbent contacted separately: with the surface of oil and with the surface of water. Two types of oil were used, namely: fresh lubricate oil *Marinol RG 1240* (characteristics in Tab. 1) and the same but used one (in the vessel engine 3 AL 25/30 circuit). Tests were carried out in containers, which were the transparent plexiglass tubes (Φ 34 mm, 250 mm long, mass 82.5 g). Tubes were fulfilled with sorbent in ¼ of their length (Fig. 2 and 3). Every test was prepared in three containers to analyse results after three different times of contact of sorbent with defined liquid (fresh lubricate oil, used lubricate oil, water).

Tab. 1. Characteristics of oil

Kinematic viscosity coefficient	100°C ASTM D-445	11.5 mm^2/s
Pour point	ASTM D-5950	–27°C
Flash-point	PN-EN ISO 2592	250°C
Total basic number	ASTM D-2896	12.8 mgKOH/g

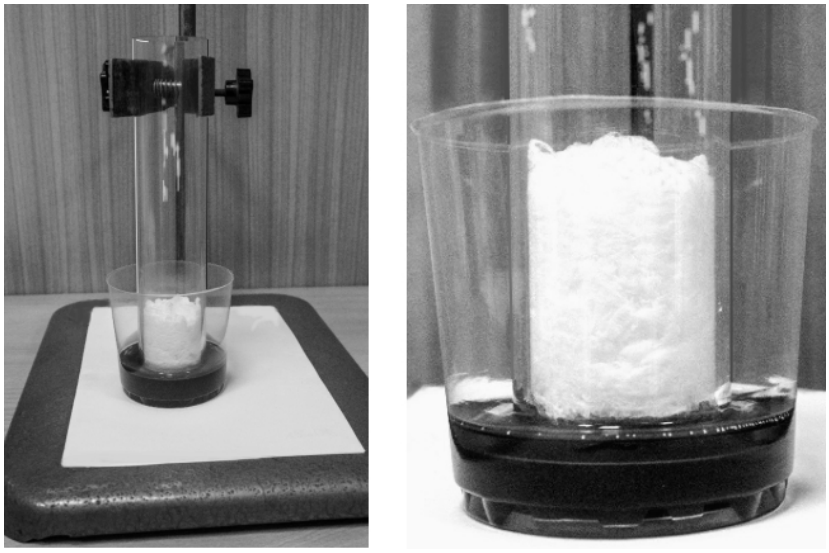

Fig. 2. The way of contacting of sorbent with oil

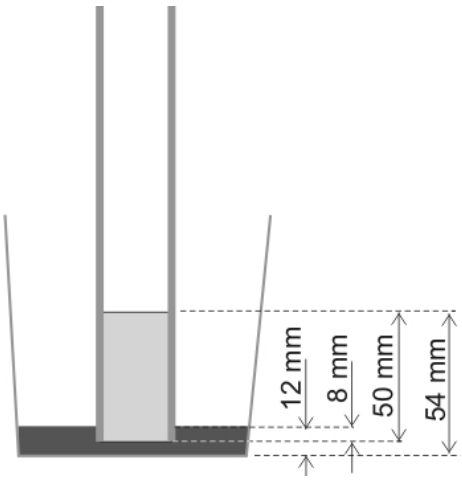

Fig. 3. Measurement geometry

The tests were carried out in laboratory conditions with environment parameters as follow: temperature 22°C, humidity 43%, atmospheric pressure 1004 hPa.

3. Results

The mass of oil absorbed by sorbent were calculated as the difference between the mass of tube filled with the clean sorbent and the mass of tube with sorbent after contact with oil. Dirty tube was cleaned before waiting.

Taking into account the polypropylene wadding following conclusions can be formulated:

– sorbent called “winter” fulfils it role better than sorbent “summer” (Fig. 4). It should be noted, however, that test was performed with oil – and one could not know how it works in the case of the system oil-water (future analysis shall it settle),
– used oil is absorbed better than fresh one (Fig. 4),
– both sorbents absorb water in similar level (Fig. 5),
– water is absorbed about 200 times less than oil.

If the cotton wool is considered:

– water is about 3 times better absorbed than oil (Fig. 6),
– oil is absorbed similarly like in the case of propylene wadding.

Scraps of polypropylene nonwoven shows following features:

– absorption of oil is similar lake in polypropylene case (from comparison of Fig. 4 with Fig. 7),
– water is absorbed about 50 times less than oil (Fig. 7).

Above presented method, for testing of sorption of oil seems be useful. Obtained results confirm results of other authors that analysed similar kinds of sorbents [1].

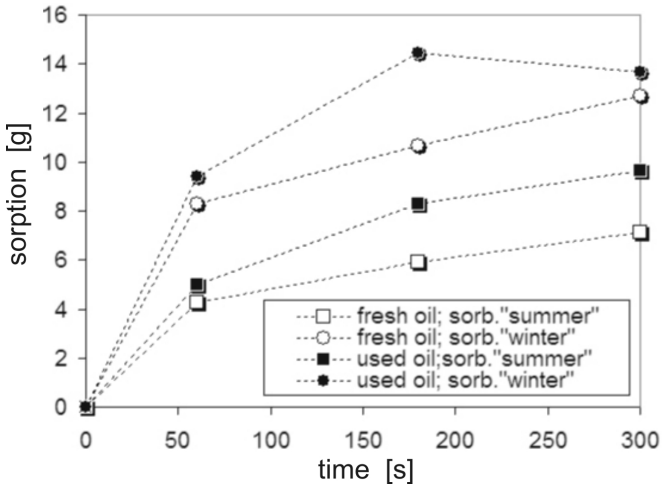

Fig. 4. Mass of absorbed oil as the function of the time of contact of the sorbent with oil

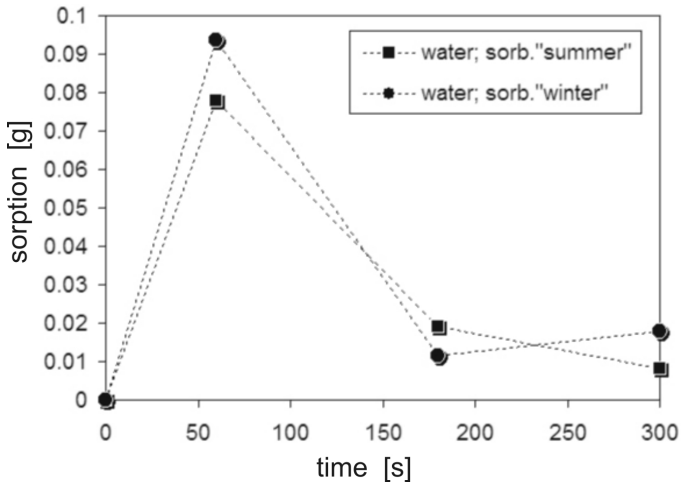

Fig. 5. Mass of absorbed water as the function of the time of contact of the sorbent with water

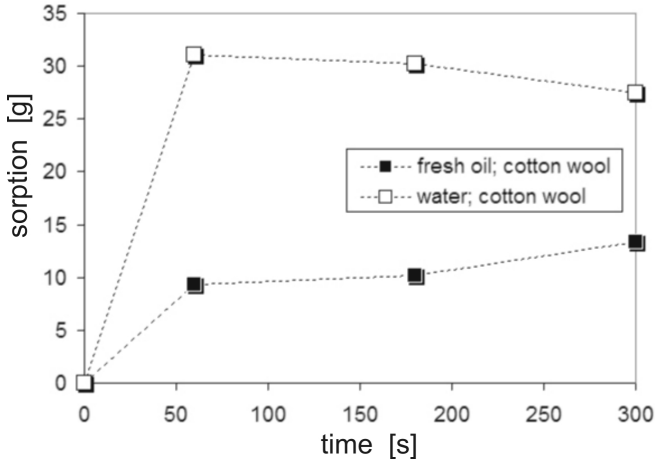

Fig. 6. Mass of absorbed oil and water as the function of the time of cotton wool contact with water

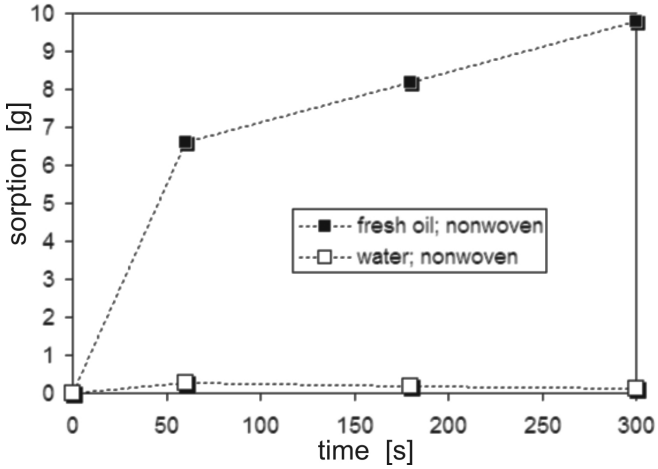

Fig. 7. Mass of absorbed oil and water as the function of time of polypropylene nonwoven contact with water

Acknowledgements

This paper was supported by Gdynia Maritime University grant No. DS/411/2015. We would like to thank the firm AWA Sp. z o.o. for support in obtaining sorbents for research.

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