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Obtaining superhydrophobic sand on the basis of soot synthesized during combustion of oil waste

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Abstract

In this work, a number of experimental studies to determine effective soot by burning waste oils were carried out. The raw materials used waste oil from service stations to replace oil cars. Used oil burned using a conventional wick, by impregnating carbon and glass fiber fabric. The results showed that the surface of the soot produced by burning waste oil has a hydrophobic property to the wetting angle 145-150^0. The experimental research on the production of soot by burning waste oils showed that the combustion of 100 grams of oil, depending on the combustion conditions can be obtained from 0.5 to 1.5 grams of soot. And, also was determined the elemental composition and the surface functional groups of hydrophobic sand by IR-spectroscopy. Flexible hydrophobic self-destroying carpet on the basis of hydrophobic sand was developed and built. For comparison was conducted studies of growth process of potato in the soil layer of earth on the surface of the usual soil and on the surface-degradable hydrophobic carpet based on hydrophobic sand under greenhouse conditions.

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Keywords: soot; waste oil; wetting angle; superhydrophobic sand.

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1. Introduction

The problem of recycling waste lubricating oil is acute throughout the world, as along with other hydrocarbons used lubricating oil significantly pollute the biosphere. Unlike oil and other petroleum products, waste oil when released into the environment is not rendered harmless by natural means (oxidation, photochemical reactions, biodegradation). In this regard, there is an actual problem of recycling waste oil.

It used oils include engine, transmission, hydraulic, industrial, transformer, mineral and synthetic oils contaminated by physical or chemical impurities. Depending on the application and the operating environment becomes dirty oil or degrades the properties, after which it becomes unsuitable for further use. Sources of waste oil are many, most are garages, metal production, power plants, etc. The significant environmental damage does drain used oil into the soil and water bodies, which according to the researchers, more than in terms of accidental discharges and oil losses during production, transportation and processing.

Hydrophobic sand is ordinary beach sand coated with tiny particles of pure carbon, which have been exposed to a special treatment with hydrophobic soot and polyurethane glue. Hydrophobic sand has been rated physiologically safe, and comes with a long time guarantee for its hydrophobic effect.

Hydrophobic sand can be used in agriculture, mixing it with soil in potted plants allows the roots to breath even when the plant has been over watered. A layer of hydrophobic sand at the bottom of the pot stops water from passing through and yet allows air to pass through the sand grains and provide the roots with the air needed to breath [1]. Once the additive is applied to the sand, it creates a capillary breaking, hydrophobic encapsulation of the sand, making it resistant to salts, particularly sodium chloride ions.

Agriculture farms can use the hydrophobic sand below their sweet soil to minimize water wastage. The water stops flowing through into the ground water, and instead, becomes trapped above the hydrophobic sand layer, allowing roots to reach into the pool of water collected below. Some of the previous studies explained the usage of different hydrophobic materials for reducing water shortages and conserving irrigation water in crop plants [2, 3].

1.1. Experimental

The raw materials used waste oil from service stations to replace oil cars. Used oil burned using a conventional wick, by impregnating carbon and glass fiber fabric. To check the resulting hydrophobic soot was soaked in an ethanol solution and after drying was tested for properties by the hydrophobic droplet reclining. The experimental research on the production of soot by burning waste oils showed that the combustion of 100 grams of oil, depending on the combustion conditions can be obtained from 0.5 to 1.5 grams of soot. Extraction of the resulting soot shows a benzene soluble content of the small parts, which indicates non-toxicity of the obtained product.

In continuation of research the synthesized soot from waste oils use to prepare the hydrophobic sand. We used sand 2-5 mm of coarse fraction and fine fraction to 0.5 mm, and 1% soot obtained from used oils. Experimental setup for the production of hydrophobic sand which consists of a stirring apparatus and the controlled power supply has been assembled.

As part of work about practical application of the developed hydrophobic sand based on superhydrophobic soot, it was developed and built a flexible hydrophobic self-destroying carpet on the basis of hydrophobic sand. Study is about a choice of self-destroying bedding material. For comparison was conducted studies of growth process of potato in the soil layer of earth on the surface of the usual soil and on the surface-degradable hydrophobic carpet based on hydrophobic sand under greenhouse conditions.

1.2. Results and Discussion

In Fig.1. shown behavior of water droplets on the surface of hydrophobic sand. As we can see that the surface of the soot produced by burning waste oil has a hydrophobic property to the wetting angle 145-150^0.