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ARTICLE

RELATED RESEARCH ON BIODEGRADABLE OIL ADSORBENTS

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ABSTRACT

Developments of biodegradable oil sorbents home and abroad are introduced in this paper. Biodegrading mechanisms and some present questions of biodegradable oil sorbents are discussed as well. It indicates that with the increase of human's understanding of environment, biodegradable oil sorbents will have more broad potential application.

KEYWORDS

Biodegradable, oil, development, sorbent

1. INTRODUCTION

In recent years, offshore oil exploration and development and tanker and pipeline accidents still cause serious oil pollution to the ocean. Among many processing methods, such as mechanical recovery method, adsorption method, chemical dispersion method, sedimentation method, biodegradation method, burning method, oil spill recovery of shallow sea and coast, and other processing facilities inaccessible areas of the oil spill, oil absorption material is a very effective tool with less investment, and can be reused. The emergence of new biodegradable oil absorbing materials can not only maintain the advantages of adsorption method to deal with oil spills, but also avoid new environmental problems. It is an environmental protection method to deal with oil spills and has broad application prospects.

2. DEVELOPMENT STATUS OF OIL ABSORBING MATERIALS

2.1 Natural organic oil absorbing materials

They include straw, straw, wood chips, straw ash, reeds, peat, corn cobs, feathers and other products based on charcoal, which are mostly cheap and readily available. Such general can absorb oil absorption materials weighing 3 - 15 times the oil itself, but this kind of material has a large number of relatively thin in recycling of oil flowing again, some organic adsorbent in adsorption a certain amount of water and oil absorption as well as sinking, many natural organic oil absorption materials such as sawdust is bulk grain, into the water after it is difficult to collect. Therefore, some measures must be taken to overcome its sinking or to facilitate recovery, and this kind of adsorbent is not easy to store.

2.2 Natural inorganic oil absorbing material

They include clay, perlite, vermiculite, glass fiber, sand or volcanic ash, their adsorption capacity is generally weak, can adsorption weight 4 to 10 times the amount of oil, similar to natural organic oil absorbing materials, they are cheap and can be obtained in large quantities.

2.3 Synthetic oil absorbing material

They include polyamine ester, polyethylene, or nylon fiber. Most synthetic oil absorbing materials can absorb the weight of about 70 times their own weight of oil, and some kinds of synthetic oil absorbing materials can also be washed after reuse. At present, most of the commercial oil absorbing materials are synthetic polymer materials. Although their oil absorption is high, they will pollute the environment in their disposal process (such as incineration or landfill, etc.). For example, incineration will produce various harmful gases and pollute the atmosphere. If landfills are used, they will contaminate soil and groundwater resources because they are generally non-biodegradable or refractory substances. Once the oil absorbent materials are used to treat spills, they must eventually be removed from the water surface and properly disposed of or reused, and the oil on the adsorbent also needs to be treated or recovered to avoid new pollution to the environment. Based on this, people are more and more inclined to use environmentally compatible materials as raw materials to avoid the occurrence of secondary pollution when developing oil absorbing materials. Biodegradable oil absorbing material is a new type of environmental protection material.

3. RESEARCH PROGRESS OF BIODEGRADABLE OIL ABSORBING MATERIALS

Biodegradable oil absorbing material is an environment-friendly material that can become pollution-free through the degradation of the material itself when the oil absorbing material is disposed. In recent years, developed countries have researched the new biodegradable oil absorbing materials deeply and developed corresponding products, but China is only in the initial stage in this field.

Spill-sorb is a non-toxic, natural oil absorbent from a Canadian company that is biodegradable in its natural state, consisting of 100% organic matter. It is mainly composed of 90% peat, and the rest is about 10% water. Shape of brown fibrous particles, density of 0.06 - 0.09g/cm^3, pH 4-6, insoluble in water, flammable (ignition point 260°C), as long as away from the source of fire and keeping it dry, can be stored for a long time. The Spill-Sorb weight

ratio ranges from 1 : 7.955 to 1 : 8.091. The oil absorption rate depends on oil uniformity, composition, and specific gravity, as well as external temperature and oil absorption time. In general, it has the fastest adsorption speed for oil with a specific gravity of about 1.0, but slower for oil with a specific gravity of less than 0.8. Spill-sorb expands rapidly after absorbing oil, allowing it to float on oil-contaminated water for a long time. When using SPILL-SORB, you can manually or mechanically pour it upwind (upstream for flowing water) to the water surface, and recover the saturated SPILL-SORB with a latched rake or suction device after the oil is absorbed. Spill-sorb can also be added to the container to allow the oil to adsorb onto the Spill-sorb and solidify. Sprinkle some spill-Sorb around the container and seal it for safe transportation.

Another Canadian company, Landmark, produces an oil-absorbing material called amino plastic capillary adsorbent, which can absorb up to 60 times its own weight in oil. It has a unique structure containing nitrogen elements, and at the same time, it can provide necessary oxygen and nutrients for the growth of microorganisms in the oil spill site. Under the action of light and air in the natural environment, it slowly breaks down into plant nutrients (water, carbon, and carbon monoxide). It can be made into loose granule, powder, bag, and mat, which is very convenient for application.

ProZorb is a kind of highly efficient and degradable oil absorbing material produced by an American company. It is a light-yellow solid particle, hydrophobic and oil loving, with a density of 0.03 - 0.045g/cm3, pH of 6.5 - 7, moisture content of 20% - 30%, not easy to burn, and contains carbon, oxygen, phosphorus, potassium, and some trace elements. It can hold 60 times its own weight in oil. The ProZorb adsorbs oil efficiently and quickly. Once the oil is sucked into its interior by capillary action, it holds the oil like a capsule. Even when squeezed, the oil does not spill out of the ProZorb. After use, ProZorb is usually disposed of by landfill. Since ProZorb contains a variety of nutrient elements needed by microorganisms, it can accelerate the natural degradation of microorganisms after landfill, so as to not cause secondary pollution to the environment.

A Denver company has invested in the development of a biodegradable, non-toxic, oil-loving, hydrophobic, and oil-absorbing material called Sea Sweep. The material is made of saw slag as raw material by thermal decomposition process, which can float on the water surface and be easily recovered from the water surface. It has also been REPORTED THAT SCIENTISTS HAVE DEVELOPED a biodegradable granular mixture of oil absorbent products, in which 20%-70% wood fiber, 80%-30% acid-treated hydrophobic and oil-loving WATER-moistened cotton wool fiber. The advantages of this oil absorbing material are high buoyancy, can float on the surface of the oil for a long time, has a high absorption capacity of oil, with good oil holding effect. It is biodegradable when removed from water surface. It is also effective at washing contaminants away from contaminated soil and rocks, and can be used as a containment material to enclose or cut off oil spill sources and prevent their spread.

Polysaccharide material fermentation by microorganism fermentation and organic solvent from the cellular metabolite in the extraction and preparation of PHBV (hydroxybutyric acid-pentanoic acid copolymer) not only has the basic characteristic of the polymer compounds, such as light, full of elasticity, plasticity, abrasion resistance, resistance to radiation, more important is biodegradable and biocompatibility. It is a promising new oil absorbing material. China Environmental Science Research Institute Environment Purification Materials Lab, through hydrophobic modification and processing of PHBV material in the lab accordingly, make a new biodegradable oil absorption material. This product is hydrophobic and lipophilic, with a density of 0.005 - 0.008g/cm^3 and an oil absorption multiple of 15-20 times of its weight. It can be used as a new oil absorption material with promotion significance in the field of oil spill treatment.

4. CURRENT PROBLEMS AND DEVELOPMENT TRENDS OF BIODEGRADABLE OIL ABSORBENT MATERIALS

4.1 Degradation

Generally speaking, the raw materials used produce biodegradable oil absorbing materials are mostly naturally formed and have good biodegradability. However, after certain molding and modification processes, their physical degradability may change and need to be reevaluated. For example, PHBV is naturally formed and has good biodegradability. According to the biodegradability test conducted by the Institute of Solid Waste Pollution Control Chinese Research Academy of Environmental Sciences, the carbon dioxide release measured by composting method is very high. The biodegradation rate reaches 53% within one month. However, the biodegradation rate will decrease after processing into oil absorbent material, which is beneficial to the storage of the biodegradable oil absorbent material. In addition, scientists have shown that the burial method does not provide sufficient microorganisms, which may also affect the degradation of these biodegradable oil absorbing materials.

4.2 The price

In order to improve the oil absorption capacity, some traditional biodegradable oil absorption materials are processed, or new biodegradable oil absorption materials are developed. These measures may increase the cost of biodegradable oil absorption materials, thus leading to the price increase, and reduce their market competitiveness.

4.3 Oil absorption capacity.

At present, the strongest oil absorption ability is synthetic materials such as polyurethane and polypropylene. Its oil absorption capacity can exceed 70 times of their weight. Therefore, biodegradable materials in its surface or structure and other aspects need to be further studied to improve its oil absorption ability, so as to catch up with or exceed the oil absorption ability of synthetic materials.

As the environmental protection consciousness worldwide is being strengthened, the use of biodegradable oil absorption material will receive more and more attention. At the same time, with the continuous deepening of research on biodegradable oil absorbing materials and the improvement of processing technology, various biodegradable oil absorbing materials with low price and excellent oil absorbing performance will continue to be launched to the market and become the leading products of oil absorbing materials.

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