Study and evaluation of crude oil absorbency using polyvinyl acetate and polyol as sorbents

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STUDY AND EVALUATION OF CRUDE OIL ABSORBENCY USING POLYVINYL ACETATE AND POLYOL AS SORBENTS

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ABSTRACT:

This study involves preparation of polymer blends that consist of poly vinyl acetate and polyol mixed with mill rice husk by 50% weight and their capability as absorbing materials for treating oil pollutions of Iraqi waters. The study points directly to the high efficiency of the absorbing substance in the treatment oil. The sorption capacity of the samples was found to increase with increasing the time of sorption till it reaches the maximum value at the time of sorption equal to 70 min .The study, also includes data about the effect of crude oil API gravity and that of the loading capacity and of the efficiency of sorbents. It was also noticed that the efficiency of absorbing substance increases with the decrease in the polyvinyl acetate to polyol ratio.

Keywords: polyvinyl acetate, polyol, blend, polymers, rice, pollution.

INTRODUCTION

Environmental pollution resulting from crude oil is a big problem in the world. The oil exploration, transport, storage and use of derivatives cause a potential risk of spills in marine waters [1]. Oil pollution caused by petroleum oil affects marine life, economy, tourism and recreational activities, as the result of physical properties of crude oil which causes oil spill floating on the water. Oil spills harm the beauty of nature, where marine emit foul odours from the site of the pollution changing the colour of the sea and the excessive growth of algae green can be seen miles away from the contaminated sites [2].

Crude oil spilled into the marine environment is a subject to a wide range of air operations, which include evaporation and dissolution, dispersion, and photo-oxidation, microbial degradation, adsorption on particulate matter, agglomeration, etc [3]. These physical and chemical processes contribute to the strengthening of the decomposition of the oil-contaminated [4].

Some previous studies have shown that

the processes of oxidation of oil-contaminated water into the environment lead to the production of many materials such as aliphatic and aromatic compounds , alcohols, phenols and aliphatic ketenes[5-7].

The mechanical recovery is the process of retrieving or transporting oil spilled from the contaminated area to area for temporary storage through the use of sorbents for oil [8]. The most important sorbents for oil are polymers and natural materials or cellulosic fibres [9]. The trends of modern research tend towards the manufacture of porous materials to absorb oil contaminants and there are many natural substances and materials used as an absorbent for crude oil [10]. The most common industrial materials and sorbent for oil pollution are polyurethane and polypropylene [11,12] , these materials are the positive characteristics of hydrophobic material, but this material is not biodegradable [13]. There are many natural sorbents studied to be used in the treatment of oil pollution, such as cotton, wool and rice straw, these products and agricultural residues are inexpensive and available. The wood products that are found in the form of fibres can form easily in the form of a mat or woven as needed and possible use absorbers of oil pollution

Experimental

Materials

The rice husk used in this study was a waste produced from mills industry. It's moisture content was found to be about 40%. The rice husk was thoroughly washed with water to remove soil and other foreign materials and dried at 105 ◦C for 2 hrs, crushed and sieved. The fraction particle size between 1 mm and 0.8 mm was selected and then subjected to a mixed with polymer blend made from poly vinyl estate (PVA) and polyol(PO) .The polymers were mixed together with different weight ratio (PVA\PO=1\1,2\1 and 3\1) then each ratio was mixed with mill rice husk by 50% weight.The mixture was poured in a steel mould with inter dimensions of (50*50*15)mm , then the steel moulds were dismantled and the specimens whose dimensions were 50*50*15 mm were taken out . The specimens were cured in an environmental chamber for one day in constant conditions of 25◦C, after that the specimens were cured in 150◦C for 2 hrs, then the sorbent materials were ready to be tested.

Tested oils

Crude oil of different API (11 and 22) was supplied from Nehran omer laboratories, these ranges would be an interest to oil pollution problems in Iraqi waters.

Methods of oil sorption experiments

A 500-mL sample of artificial sea water (3.5% NaCl) was placed in a 1-L glass beaker, as described in Technical Manual of the American Association of Textile Chemists and Colourists [AATCC] (12). A forty ml of oil was added to the beaker. The beaker containing crude oil and artificial sea water was mounted in a shaking apparatus; approximately five grams of a sorbent material was placed in the system, which was shaked for 15 minutes at 130cycles min. The wetted sorbent material was weighted agreement with Deschamps and Caruel (2003)(9). The results show that the retention behaviour of all sorbents follows almost the same trend. There are at least two distinct zones in each retention curve. The first zone is the initial stage of release, which occurs over 10min. The rate of release is very high during this period. The second zone represents the steady-state period, during this period, the sorbent tends to show a descent towards a steady state,through this zone, additional time will weight of sorbent under static conditions

Fig(3) shows that as the weight of samples increases the sorption capacity (g oil/ total weight of fibre) till it reaches a maximum value at 4 g and then it decreases again. The polymer blend PVA\PO=1\3 has the highest sorption capacity of 40 g oil/ total weight of fibre at a weight of sorbent of 4 g and PVA\PO=1\2 has a sorption capacity of 34 g oil/ total weight of fibre at a weight of sorbent of 4 g and PVA\PO=1\1 has the lowest sorption capacity of 30 g oil/total weight of fibre at a weight of sorbent of 4 g. In earlier stage, i.e. from 1-4 g the sorbent surface area contact to oil was the maximum due to sorbent surface area, pores of polyol materials and channel produce between rice husk particle due to random distribution of particle and irregular surface shape.

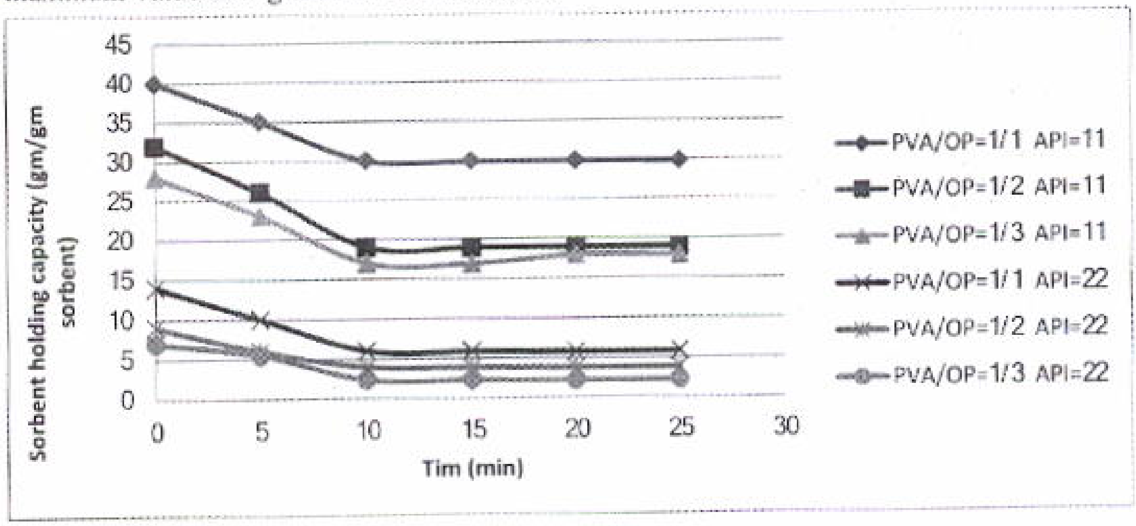

Fig.(2): Effect of desorption time on the holding capacity

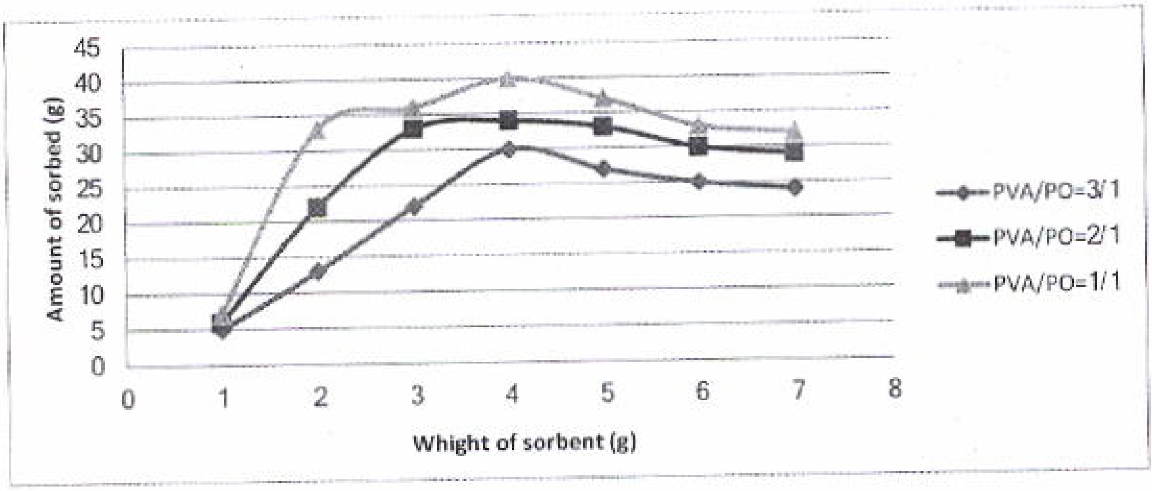

Fig.(3) :Effect of sorbent weight on oil sorption capacity

Fig(4) shows that as the samples weight increases, the sorption capacity (g/g, fibre) also increases till it reaches a maximum value at 2 g of sorbent material . By increasing the weight of sorbent, the sorption capacity decreases, because when the sorbent weight increases at limited area (pad), the sorbent particle, which is not in contact with oil, increases (there will be sorbent accumulation in the limited area pad) so the sorption capacity decreases.

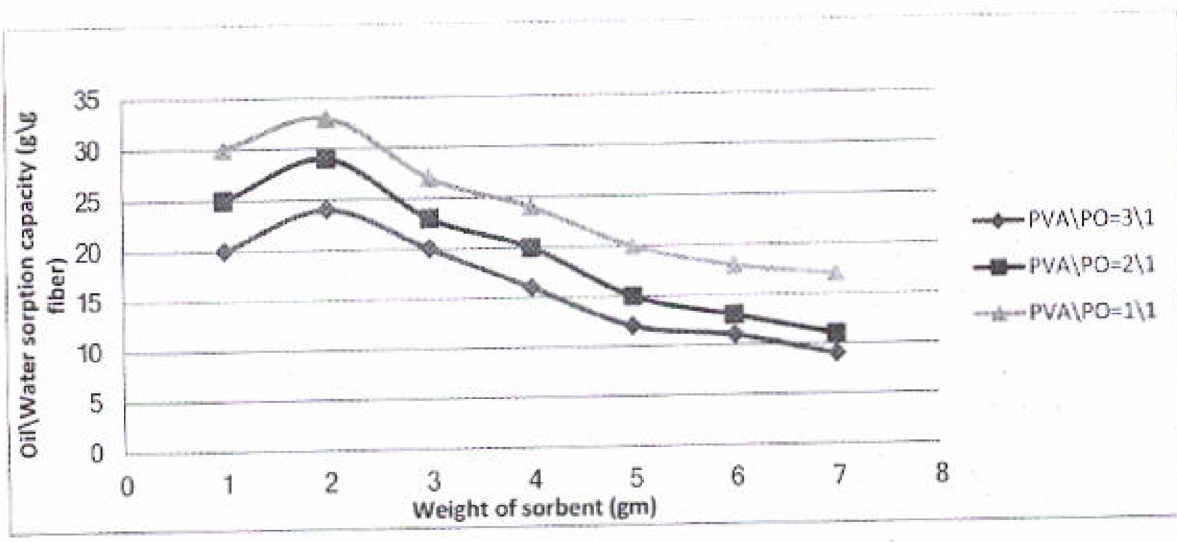

Fig.(4): Effect of sorbent weight on oil sorption capacity

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