UDC 504.4:54-414:628.35(045)

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OIL SORBENTS MANUFACTURING FROM PLANT MATERIAL FOR WATER RESERVOIRS ECOLOGICAL IMPROVEMENT

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Abstract. *Methods of oil sorbents manufacturing from raw plant material are analyzed. Impact of thermal and chemical treatment on oil sorption of sawdust is presented.*

Keywords: purification process, raw plant material, sorbent, thermal and chemical treatment.

1. Introduction

Water quality standards breaking which leads to water ecosystems degradation, decreases reservoir productivity. Among the most dangerous impurities, that get into reservoirs, are oil products. Strong requirements concerning oil products concentration in quality of drinking household water dictate the necessity of new materials application and new technologies development complex solution of water reservoirs pollution problem.

2. Analysis of research results and publications

Among the wide range of materials, which are used today for the purification of water used in various purposes, more and more attention is payed to plant wastes as the most available source of sorbents for ecological needs. Due to the application of such base materials as husk of buckwheat, sunflower, oat, rice, shuck of walnut, maize waste, waste of grass processing, fallen leaves, straw, chitin, chitosan that are widely spread in comparison with other materials used for oil sorbent manufacturing. The raw plant material costs less in comparison with such well-known sorbent as active granulated carbon the technological production of which is complicated and requires expensive equipment.

Usage of plant materials provides better purification and gives the opportunity to remove the oil products from water, and, moverover, to eliminate agricultural wastes, that is hardly possible to achieve applying usual sorbents.

There is a number of works that research the methods of carbon materials receiving from husk of rice by means of different activators (Pavliukh 2012; Zemnoukhova et al. 2005). Japan plays a leading role in the field of active carbon technologies development from rise husk and adsorbents (Zemnoukhova et al. 2005).

Numerous methods of sorbents producing for water purification from oil products and sorption improvement as the main factor, that identifies the effectiveness of material are described in researches (Kamenschikov, Bogomolny 2005; Pavliukh et al. 2012; Pavliukh, Boychenko 2011; Shvetc et al. 2003).

The **purpose** of this scientific research is to analyze the methods of oil sorbents manufacturing from raw plant material, in particular sawdust, for water purification from oil products.

3. Research

Oil sorption of raw plant material is the main criterion, that must be taken into account during the production of sorbents, as oil sorption of sorbents directly depends on initial oil sorption of pure material. After certain treatment the oil sorption of sorbents, received from raw plant material can be substantially improved. Majority of produced raw plant material sorbents is treated by high temperatures, for oil sorption improving. During the test sawdust was exposed to 100ºC and 200ºC temperatures (Kamenschikov, Bogomolny 2005). Oil products were dissolved in the water, complicating the purification process in comparison with the case when the oil products are in the form of film on the water surface. The research results are given in the Table 1.

Table 1. Influence of sawdust thermal treatment on the waste water purification degree

Material	Initial concentr. of oil products, mg/l	Temperature of treatment, ºC	Purification degree, %
Sawdust	1,88	0	8,5
		100	22,9
		200	50,4

The main disadvantage of treatment by high temperatures is additional waste of energy.

The basic components of raw plant material are cellulose and lignine, that are connected in a biopolymer complexes. In the non-treated state they have non-effective sorption properties due to fiber-like structure and law level of free functional groups in it (Pavliukh 2012).

During hydrolysis and further activation of raw plant material the amount of lignine increases substantially, that improves sorption properties of sorbents on the base of raw plant material. The treatment of raw plant material is based on lignine and cellulose complexes macromolecule depolymerizing, partial oxidation of ethanolic groups to carboxylic, obtaining alkyl oxides with compounds, that contain the additional functional groups with acid properties.

Technological parameters of powder treatment from lignine and cellulose waste are shown in the Table 2.

Lignine is easily treated by chloridizing, nitridating, oxidating, during acids treatment – hydrolysis.

The development of new perspective sorbents is based on mentioned lignine properties.

Another method of manufacturing sorbents from raw plant material is chemical reagents treatment. The influence of mineral chemical compounds and organic acids on sawdust oil sumption is presented in Tables 3 and 4.

The given results show that the influence of organic compounds on initial material is different, and the range of obtained results is rather wide. Due to this new opportunities and perspectives of organic compounds application for the improving of sawdust sorption rate as the raw material for oil sorbents appear. The main disadvantages of raw plant material chemical treatment are, mainly, toxic level and the complicity of the process.

Table 2. Technological parameters of raw plant material treatment for sorbents obtaining

Technological parameters	Material			
	Shuck of walnut	Shuck of walnut	Sawdust	Sunflower peeling
Hydrolysis				
Acid	HCl	H_3PO_4	H_2SO_4	H_3PO_4
Acid, mass. %	10	0,5	2	1
Solution temperature, °C	100	70	100	200
Duration, min	20	230	180	15
Activation				
Alkali	NaOH	Na_2CO_3	NaOH	Na_2CO_3, NaOH
Alkali, mass. %	0,5	0,5	1	4
Solution temperature, °C	100	70	75	110
Duration, min	60	60	60	60
Lignine content, %	86	91	85	88

Table 3. Oil sumption of sawdust after mineral acids treatment

Reagent	Concentration of reagent, %	Oil sumption, kg/kg	Oil sumption increasing, %
Sawdust	–	4,3	–
Hydrochloric acid	10	5,0	16
Phosphoric acid	10	5,3	23
Azotic acid	10	4,4	2
Sulphuric acid	1	5,2	21
	5	6,2	44
	10	6,6	53
	25	5,0	16
	70	4,0	7
Sodium hydroxide	10	5,0	16

Table 4. Oil sumption of sawdust after organic acids treatment

Reagent	Concentration of reagent, %	Oil sumption, kg/kg	Oil sumption increasing, %
Sawdust	–	4,3	–
Sulfanilic acid	10	5,0	16
Sulphosalicylic acid	11	6,3	46
3-ethanol-hydrochloride	10	2,0	115
Grease	10	3,6	19
Benzol extraction of peat	10	5,0	16
Glycerin	10	4,5	5
Paraffin	10	8,3	93

4. Conclusions

Ecological problems solution, in particular water purification by means of either existing methods improvement or developing the new methods of oil sorbents production from raw plant material, becomes evident. The scientific research of this article becomes determinative for efficient use of the resources in our country and the objective utilization of raw plant material.

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Received 19 November 2012.

Л.І. Павлюх. Отримання нафтових сорбентів рослинних відходів для покращення екологічної ситуації водних об'єктів

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Проаналізовано способи отримання нафтових сорбентів із рослинних відходів. Розглянуто вплив термічної та хімічної обробки на нафтоємність тирси.

Ключові слова: процес очищення, рослинні відходи, сорбент, термічна та хімічна обробка.

Л.И. Павлюх. Получение нефтяных сорбентов из растительного сырья для улучшения экологической ситуации водных объектов

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Проанализированы способы получения нефтяных сорбентов из растительных отходов. Показано влияние термической и химической обработки на нефтеемкость опилок.

Ключевые слова: процесс очистки, растительные отходы, сорбент, термическая и химическая обработка.

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