UDC 628.504

APPLICATION POTENTIAL OF SOLID RESIDUE FROM THE HIGH TEMPERATURE PYROLYSIS OF AUTOMOBILE TIRE WASTE AT THERMAL POWER PLANTS

I. V. Roik, graduate student, E. V. Kofanova, PhD in Chemistry (National Technical University of Ukraine "KPI")

Виконано аналіз методів очистки стічних вод теплоелектростанцій, визначено перспективи використання твердого залишку високотемпературного піролізу автомобільних шин як сорбенту нафтопродуктів.

Ключові слова: забруднення води нафтопродуктами, стічні води, сорбція, сорбенти, піроліз автомобільних шин.

Выполнен анализ методов очистки сточных вод теплоэлектростанций, очерчены перспективы использования твердого остатка высокотемпературного пиролиза автомобильных шин как сорбента нефтепродуктов.

Ключевые слова: загрязнение воды нефтепродуктами, сточные воды, сорбция, сорбенты, пиролиз автомобильных шин.

The analysis of the methods of wastewater treatment at thermal power plants is carried oud and the perspectives of usage of solid residue from high temperature automobile tire pyrolysis as sorbent of petroleum products are determined.

Key words: petroleum products waste water, wastewater, sorption, sorbents, pyrolysis of automobile tires.

Introduction. Operation of thermal power stations needs the usage of large quantities of water. The most of total amount of water (more than 90 %) is used in cooling systems of different sets. If the thermal power station works on black oil, the wastewater that contains oil occurs.

Oil and petroleum products are toxic substances especially for hydroecosystems and their inhabitants. When they get into the water they cover a water surface with a thin film. This film dissolves both organic and inorganic substances, including compounds of such metals as ferrum, copper and zinc, which can easily form complex metalorganic compounds and then can be adsorbed and sink to the bottom. So layers of bottom sediments and lower sea-bottom water layers may be highly contaminated with oil.

Oil film, except its toxic effect, isolates the water surface from the atmosphere. As a result a significant reducing of oxygen content in water basin is observed, what is very dangerous for hydroecosystems inhabitants. In turn, decompositions of oil products contain polyaromatic hydrocarbons that in their turn cause a carcinogenic effect [1].

The analysis of the problem. Nowadays the filters (type FSV-2.6–6.0) on the base of active carbon for purification wastewater from regenerative air heaters and convective surfaces of boilers, which work on black oil, are used at thermal power

station "Kievska". This allows cleaning the condensate containing petroleum products under 10 mg/dm^3, which comes from thermal power station black oil sector. According to [2] the maximum design capacity of purification system of oil contaminated condensate is 35 m^3 per hour.

This method of the condensate treatment includes two main stages. At first it is rough treatment with the help of sedimentation in the tank with contaminated condensate. The second stage is the filtering at pressurized carbon filters. Purified condensate after purification system of oil-contaminated condensate is served by the pumps in the tank with contaminated condensate and reused in the technological process. Meanwhile, the content of oil in the purified condensate should not exceed 0,3 mg/dm^3 [2]. The main drawback of this method is relatively high cost of active carbon adsorbent and necessity of its regeneration. It's not justified in terms of environmental protection. Restoration of primary properties of filtering material is carried out by passing a hot condensate through it. So it is very energy intensive way.

In turn, the complete replacement of filtering material is also related to material cost. However, it is possible to pick up the sorbent that does not require regeneration or will be used as a secondary material; it will be beneficial both economically and for environment.

Thus, the conducted analysis showed that the method of purification of sewage used at the thermal power station «Kievska» definitely needs improvement because of the global shortage of primary resources. Therefore there is a necessity to expand a resource base and to get sorbents, in particular on the base of processing of automobile tires products.

Goals of the article. Based on analysis of literature data the evaluation of the effectiveness of methods of sewage treatment used at the thermal power station «Kievska» has been conducted. Also it has been proved that remaking worn automobile tires on sorbents for sewage treatment from petroleum products is promising.

The main research results. Indisputably, the problem of recycling tires usage as sorbents is of a great ecological importance because the tires after their using are stored at the fleet, airfields, industrial and agricultural enterprises, mining plants, etc. Due to strong resistance to external factors (sunlight, oxygen, ozone and microbial effects) the tires pollute an environment for a long time.

The accumulation of waste tires is estimated as millions of pieces per year in almost every country of the world. Therefore the problem of their disposing is quite sharp. There are many different methods of automobile tires disposal, one of which is a thermal recycling. However, while a ton of tires burns about 270 kg of soot and 450 kg of toxic gases come into the atmosphere. The composition of pollutants is as follows: dioxins, furans, polyaromatic hydrocarbons, polychlorinated biphenyls, chromium, arsenic and cadmium compounds, etc.

In our opinion, the tire pyrolysis as a method of treatment cannot only utilize the worn tires and provide valuable materials, but also reduce environmental impact.

Therefore, from the economic and environmental standpoint the reusing of automobile tires is very important task; the industrial needs of natural resources are increasing all the time and their value is steadily increasing [3].

Various powders and small crumbs obtained by crushing waste of rubber can be used as petroleum sorbents. However, active powder materials obtained by high temperature recycling of tire rubber occupy a special place among such sorbents [3]. Automobile tires can be recycled by one of high or low temperature methods of pyrolysis. Let's consider the details of a high-temperature pyrolysis. This method allows getting secondary materials that can be used as sorbents. The method of high temperature pyrolysis of automobile tires involves some stages. At the beginning the raw (worn tires) are passed through the mechanical cleaning and grinding. Then it is loaded in the pyrolysis reactor. In the device the overpressure (0,02…0,03 MPa) and temperatures above 1000 °C are achieved by feeding carbon dioxide or azotes. In the result the liquid pyrolysis products are formed which consist of a mixture of aromatic and unsaturated hydrocarbons, as well as solid and gaseous products. Solid remains of the automobile tires are relatively soft, wet black product; its characteristics are represented in the table [4]. It has to be clear from metal cord before applying as a sorbent [4].

Characteristics of solid remain of automobile tires pyrolysis

Parameter	Solid residue of tire pyrolysis
Content of Cinder, %	13,2
Carbon in the dry state, %	95,5
Sulfur in the dry state, %	2,36
Mass fraction of sulfur, %	2,31
Volatile substances, %	4,0
Higher heat of combustion (kJ/kg)	34131
Mass fraction of moisture, %	13.0

Conclusions. As we can see from the table, 95,5 % of solid remains of high temperature automobile tires pyrolysis is carbon. Obtained product can be used in many ways: in the form of powder composite materials, as block porous materials, as balls or other bulk items. An important feature of obtained sorbents is their high water resistance. It's very important that the sorbent that has already been used can be collected at the manufacture of regenerate or as a fuel or as additives to asphalt concrete in the future [4].

The result of this work is the analysis of the methods of wastewater treatment at thermal power station «Kievska». It was found that the sorbents based on activated carbon are quite expensive and require periodic regeneration. Also it was grounded the perspectives of usage of solid residue from high-temperature tires pyrolysis as sorbent for the purification of wastewater from petroleum products. It's also planned to explore the possibility of using this type of sorbent at thermal power station «Kievska». Undoubtedly, the usage of products of processing of worn automobile tires as sorbents is very promising method.

1. *Тимонин А. С.* Инженерно-экологический справочник. Т. 2. – Калуга: Изд-во Бочкаревой, 2003. – 884 с.

2. *Стовбун Б. Ф.* Инструкция по эксплуатации очистных сооружений на АК «Киевэнерго», теплоэлектроцентраль № 5, 2005. – 132 с.

3. *Когановский А. М.* Адсорбционная технология очистки сточных вод / А. М. Когановский. – К.: Наук. думка, 1983. – 240 с.

4. *Пат.* 2114064 РФ, МПК C02F 1/28, E02B 15/04. Способ очистки поверхности воды от нефти и нефтепродуктов / И. Ф. Глумов, Н. Г. Вагизов, Н. П. Кубарев, В. В. Шатохин, Р. Ш. Салихов и др. – Заявл. 6.06.95, № 95109480/25; Опубл. 27.06.98, Бюл. № 18.