Industrial management of peat sorbent production in Tomsk region

D S Rozhkova, I A Hadkevich, T S Glyzina and E G Matugina
Tomsk Polytechnic University, Tomsk, Russia

E-mail: rozhkovads@yandex.ru, hadkevi4@mail.ru, inosine@yandex.ru, emk512542@mail.ru

Abstract. The intensification of production development causes the growth of energy consumption and increases the risk of oil leak. This involves the implementation of measures for the effective breakdown elimination. In this case the best method meeting the environmental requirements is the use of appropriate sorbent. The economic research of using the peat sorbent by oil and gas extraction companies in Tomsk region was carried out.

Introduction
The intensification of production and consumption of goods in modern society has a direct impact on the structure of national economy and the system of economic relations. The orientation on the use of traditional energy resources forms the relationship between the growing demand and the use of energy resources. It is accompanied by the increase of technogenic environmental impact. Not only the enterprises using energy resources sources are the reason of negative impacts are, but also mining enterprises, processing and transporting. In particular, the matter is in the accidental leak of petroleum products. According to the Greenpeace, in Russia oil stock losses during its production and transportation are about 1%; NPO "Centre of Ecology FEC" indicates the amount of 3.5 ... 4.5%. Accordingly, at the current production level of 510 million tons per year, losses amount from 18 to 23 million tons or from 14.2 billion to 17.2 billion dollars. Taking into account that in 2013 the volume of oil production exceeded the forecasted value and amounted 523.2 million tons [1], the losses are of greater amount. However, this is only the direct damage, which should be supplemented by the expenditures connected with the delay of other production operations, the environmental disruption, and the elimination of accident consequences in the current (proper oil spill response) and prospective (compensative measures) periods.

Thus, a prompt emergency response is one of the ways to minimize the damage. There are a lot of sorbents, used in case of oil spill, which are diverse in composition (containing organic, inorganic, synthetic and other components). Depending on the type of feedstock, sorbents can be classified into inorganic (natural or artificial minerals) and organic (caustobiolith, synthetical, organic mineral, natural raw materials of plant and animal origin and recycling waste). But in the aspect of the ecological safety, sorbents of natural origin are the most attractive – sawdust, hay, coal and peat. The disadvantages of synthetic sorbents are - environmental threat, complexity of recycling, and high cost. Despite the hydrophobic properties, they have low selectivity and can absorb oil and water with the same intensity.
The use of sorbents in a dispersed form (rubber crumb, phenol-formaldehyde powder, polystyrene foam granules) can lead to a secondary pollution by these sorbents, due to poor decomposition in natural conditions (due to the possibility of arbitrary scattering by the wind outside the booms) [2, 3]. The extra arguments for using sorbents of natural origin are their availability in sufficient quantity, renewability, quick and cheap production (in comparison with synthetic sorbent production), and etc. Thus, in Russia peat reserves (68 billion tons) exceed of oil and gas reserves (respectively 31 billion tons and 22 billion tons). Moreover, according to the results of researches 1.5 billion m$^3$ of raw material grow in peat swamps every year.

**Theoretical Bases**

The problem under study is essential for Tomsk region, as oil and gas complex is one of the significant sectors of the local economy (about 30% of GRP is the share of mineral resource extraction (for the year 2011), being at the same time a source of technogenic risk (in terms of accidental leaks in the main oil and gas pipelines and production pipelines). Tomsk region is a unique area due to combination of significant reserves of natural energy resources (by 2030 it is planned to increase the annual oil production up to 20 million tons including the tight oil production up to 5 million tons) as well as a natural sorbent – peat. 1444 of peat deposits are discovered on this territory with total area of 7988209 hectares in commercial value with the ultimate reserves and predicted resources of 30881.4 million tons of peat per 40% of humidity, this accounts 18.07% from the total reserves and predicted resources of peat in Russia. Tomsk region occupies the second place among Russian regions, first is for Tyumen region [4, 5].

The location of peat deposits in the territory of Tomsk region is shown on figure 1.

![Figure 1. Peat deposits in Tomsk region.](image)

**Results and discussions.**

Technical characteristics. According to the intended use of peat as a sorbent, its main characteristic lies in the oil capacity indicator, defined as the amount of oil, absorbed by a unit of sorbent mass. The experiments on sorbent oil capacity of peats with different degrees of a decomposition showed the variability of researched index within 2 ... 8 g/g, which is comparable with the Canadian peat sorbent SpillSorb and Russian synthetic sorbent EcoSorb. Moreover, the peat sorbent allows eliminating completely the accidental oil spill on the ground. If the spills occur on water surfaces, peat is the most
effective help on the last stage, as it destroys the oil slick. Comparing oil capacity of Tomsk and Canadian sorbent SpillSorb (comparable as feedstock), widely used by oil companies of Tomsk region, it is worth taking into consideration their identity which conditions the equal consumption rate in oil spill response (table 1).

Table 1

| Coefficient (Ratio) | Breakthrough at the rate of 25% of maximum volume of pumping within 6 hours and the volume of oil between block valves on the damaged section of the pipeline. | Perforation at the rate of 2% of maximum volume of pumping within 14 days |
|---------------------|-------------------------------------------------------------------------------------------------|------------------------------------------------------------------|
| Volume of the spilled oil, t | 1287.7                                                                                           | 4200                                                             |
| Weight of Tomsk Sorbent, t | 161                                                                                              | 525                                                              |
| Weight of Canadian Sorbent, t | 161                                                                                              | 525                                                              |

Consumption rate of a sorbent per 1 t of spilled oil, t:
- Tomsk sorbent: 0.125
- Canadian sorbent: 0.083
- Ecosorbo: 0.083

Economic characteristics. It is necessary to compare the sorbent consumption rate for collecting 1 t of oil (table 2).

Table 2

| Sorbent | Type of Sorbent | Oil capacity, g/g | Cost, rub/Kg | Sorbent consumption rate per 1 t of oil, rub |
|---------|-----------------|-------------------|--------------|---------------------------------------------|
| SpillSorb | Peat-sorbent    | 4-8               | 284.60       | 35 575                                      |
| Peat of Tomsk region | Peat-sorbent    | 2-8               | 100          | 12 500                                      |
| Ecosorb | Synthetic sorbent(polypropylene) | 6-12             | 350          | 29 050                                      |

* The cost of sorbent is given without transportation costs [6, 7]

When using the peat sorbent of Canadian origin, it is necessary to note significant transport costs, directly affected the expenditures on the oil spill response. Almost a triple excess of the cost of the...
imported sorbent over the Tomsk analogue (without taking into account the delivery costs) is a strong argument in favor of using local raw materials. It is possible to use a peat sorbent of any deposit, located near the main pipeline. The functioning of the given production will be connected with additional job vacancies (social effect), the development of the territory, and the increased tax payments into the budget.

Despite a wide extension at the oil spill response, sorbents should be appropriately used in order to prevent their inexpedient and excessive expenditure, which creates difficulties in terms of logistics, secondary environmental pollution, gathering, storage and waste disposal. Furthermore, the use of sorbents involves forming an additional infrastructure. The use of peat sorbent implies fire safety measures, careful storage sites planning, and etc.

Thus, the use of sorbent of bog peat origin of Tomsk region is appropriate as having familiar characteristics with the materials, applied now by the enterprises of the region. The competitiveness of a peat sorbent is caused by such characteristics as the geographical proximity of the raw material reserves and consumer companies of a product, minimizing costs of transportation; the low cost of sorbent, (excluding delivery costs), identical rates of oil capacity, and etc.

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