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ESTIMATION OF OIL PRODUCTS CONTENT IN SOIL AND WATER OBJECTS IN THE AREA OF LOCATION OF SLUDGE DRESSERS ON THE COAST OF THE VOLGA RIVER

Abstract. The article assesses the quantitative composition of petroleum products at oil waste storage areas near the confluence of the Volga River and its Kizan branch of the Volga Region of the Astrakhan Region. Studies were conducted of soil samples at different depths in two pits and groundwater, groundwater and bottom sediments. In the studied two wells, the maximum excess is observed from 104 to 260 times in the second well, while in the first well the oil content exceeds from 67.5 to 133 times. The content of heavy metals also exceeded the maximum permissible concentration, for example, total chromium 168 times and 2040 times and arsenic 1.7 times and 2.6 times, respectively, in the first and second wells. According to the results of groundwater research, the oil content exceeds 88 and 14.4 times for the 1st oil well and 520 and 86.6 times for the 2nd well. On the Volga River section, located at the 200th distance from the oil, the content of oil products in the water is lower than the MPC, however, far from the coast, the studied indicator is higher than the MPC for fishery reservoirs with a maximum at a distance of 1000 m from the second oil tank. The maximum content of petroleum products (18719.3 ± 4679.8 mg / kg) in bottom sediments was observed in the area of oil tank No. 2, which exceeded the control variant by more than 36 times. Research shows that the second hole is the most polluted.

Key words: oil pit, oil products, heavy metals, maximum permissible concentration, soil, groundwater, bottom sediments.

Introduction. The oil pits in Sokolovo at one time were intended for the storage of oil products, which were earthen excavations with sloping walls where they temporarily stored oil, kerosene, fuel oil and other oil products. To ensure stability along the sides, oil pits were furnished with wooden bars. When filling such a pit with oil, it was absorbed and filled with water in order to reduce the pit. At this time, the remains of the pipeline system pipe and the wooden fortifications of one of the Sokolovskoye oil fields remained. Then they were used to receive oily waste after from all oil bases in the Astrakhan region.

Sokolovo oil pits are located at the confluence of the Volga River and its Kizan branch. In the hydrographic network of the Volga delta, the main channel is distinguished - the watercourse of the largest category, as well as hoses, ducts, eric and banks, differing in morphometric and hydraulic characteristics. A characteristic type of delta watercourses are proranes - natural ones that occur when water breaks out from one flood to another and artificial ones created for water exchange and fish passage [1].

Administratively, the contaminated territory of the Sokolovo oil pit object is located in the Volga region of the Astrakhan region within the boundaries of the municipality of Tatarobashmakovsky Village Council on the lands of the settlement [2].

Methods. Laboratory tests of soil samples for the content of PAHs were carried out by the accredited laboratory of the Federal State Institution SevKasptekhmordirektsiya (PDN F 16.1: 2.2.3: 3.62-09).

Sample preservation method: freezing. Sample volume: 1.0 kg.

Measurement Method: IKS - spectrometric; HPLC

Determination of the mass fraction of NP in soil samples is carried out by IR spectrometry. The method is based on the extraction of NP from the soil with a solvent at room temperature. The concentration of hydrocarbons in a soil sample is determined by the optical density measured on an IR spectrometer.

Of the traditional solvents for the infrared region, carbon tetrachloride is most suitable, since it is most transparent in this area.

HPLC allows the simultaneous separation of complex samples into their constituent components, detecting most components, measuring the concentration of one or more compounds (depending on specific analytical tasks and the availability of standard samples) [3].

For the study, soil samples were taken of two oil disposal pits located in the Volga region of the Astrakhan region and water samples from both the shore and from the vessel and from bottom sediments.

Results and discussion. The results of laboratory tests of soil samples taken during the reconnaissance survey of the coastal strip are presented in table 1.

Table 1 - Contaminant content in soil

Name of pollutants	MPC_{soil}, mg / kg	UEC_{soil} sand / loam, mg / kg	The content of pollutants, mg / kg	
			oil pit number 1	oil pit number 2
Oil products		1000	**from 67500 to 133000**	**from 104000 to 260000**
HM (gross form):				
lead	32		up to 4,48	up to 5,98
copper		33/132	up to 8,27	up to 8,26
cadmium		0,5/2,0	up to 0,09	up to 0,09
nickel		20/80	up to 18,1	up to 18,1
zinc		55/220	up to 20,5	up to 20,6
common chrome (6+)	0,05	-	**up to 8,38**	**up to 102,0**
mercury	2,1		up to 0,027	up to 0,022
arsenic	2,0		**up to 3,40**	**up to 5,3**

The data in the table indicate that in the soil of the coastal strip of oil pit No. 1, the content of oil products exceeds the MEA (maximum estimated amount) by a minimum of 67.5, and a maximum of 133 times. For oil pit No. 2, this excess is from 104 to 260 times. Such indicators of oil products characterize the level of land pollution with chemicals as very high [4].

According to the calculation of the integral index of pollution Zc, according to the degree of pollution with chemicals, the coastal ground soils are classified as “dangerous” and “extremely dangerous”. Sanitary regulations have recommended on such lands the implementation of measures to reduce pollution and the binding of toxicants in soils, the organization and monitoring of toxicants in soils, groundwaters and local water sources [5].

An important circumstance is the excess of MPC for such heavy metals as total chromium (168 times for oil pit No. 1 and 2040 times for oil pit No. 2) and arsenic (1.7 times for oil pit No. 1 and 2.6 times for oil pit No. 2). Due to the fact that the coastal strip is located 100m from the beach and is often visited by vacationers, fishing enthusiasts and local residents, this level of pollution poses a threat to human health. The problem is exacerbated by the destruction of the coast and the ingress of contaminated soil in the river Kizan, which is a source of centralized water supply and a reservoir of the highest category of fishery use, is a place of reproduction of fish stocks of the Volga-Caspian basin.

Given the highest excess concentration, a particular danger in this case is chromium. Despite the biological needs for it, its high concentrations are toxic. Chromium has a generally poisonous, irritating, cumulative, allergic, carcinogenic and mutagenic effect on the human and animal organism. According to published data, chromium is able to penetrate intact human skin in contact with an aqueous solution (hexavalent chromium in doses of 0.25; 0.025 and 0.005 mg / kg). Which leads to severe damage to the enzymatic system of the liver, with manifestations of embryotoxic and mutagenic effects [6]. In general, the data in the table indicate that the most polluted and therefore most dangerous is oil pit No. 2, which is located 10 meters from the residential development. At the end of it is the pumping station of the cottage village. This situation requires urgent decision-making in order to prevent environmental dangers to the local population.

In soils, oil and oil products cause deep, irreversible changes in the morphological, physical, physicochemical, and microbiological properties of soils, and with a strong and very strong degree of contamination, they can provoke significant changes in the soil profile, and as a result, loss of fertility and exclusion of the territory from agricultural use [7].

The figure shows that the maximum amount of oil products was noted in the second oil pit at a depth of 1 and 4 m. For the first oil pit, the highest content of oil products was recorded at a depth of 2 m.

Such indicators of oil products characterize the level of land pollution with chemicals as very high and medium [8].

According to the degree of pollution with chemicals, the soil is classified as “moderately dangerous” and “dangerous” [5].

Sanitary rules imply control over the content of pollutants in all environmental objects, including soil, surface and groundwater, and a list of measures to reduce their impact on vegetation [5].

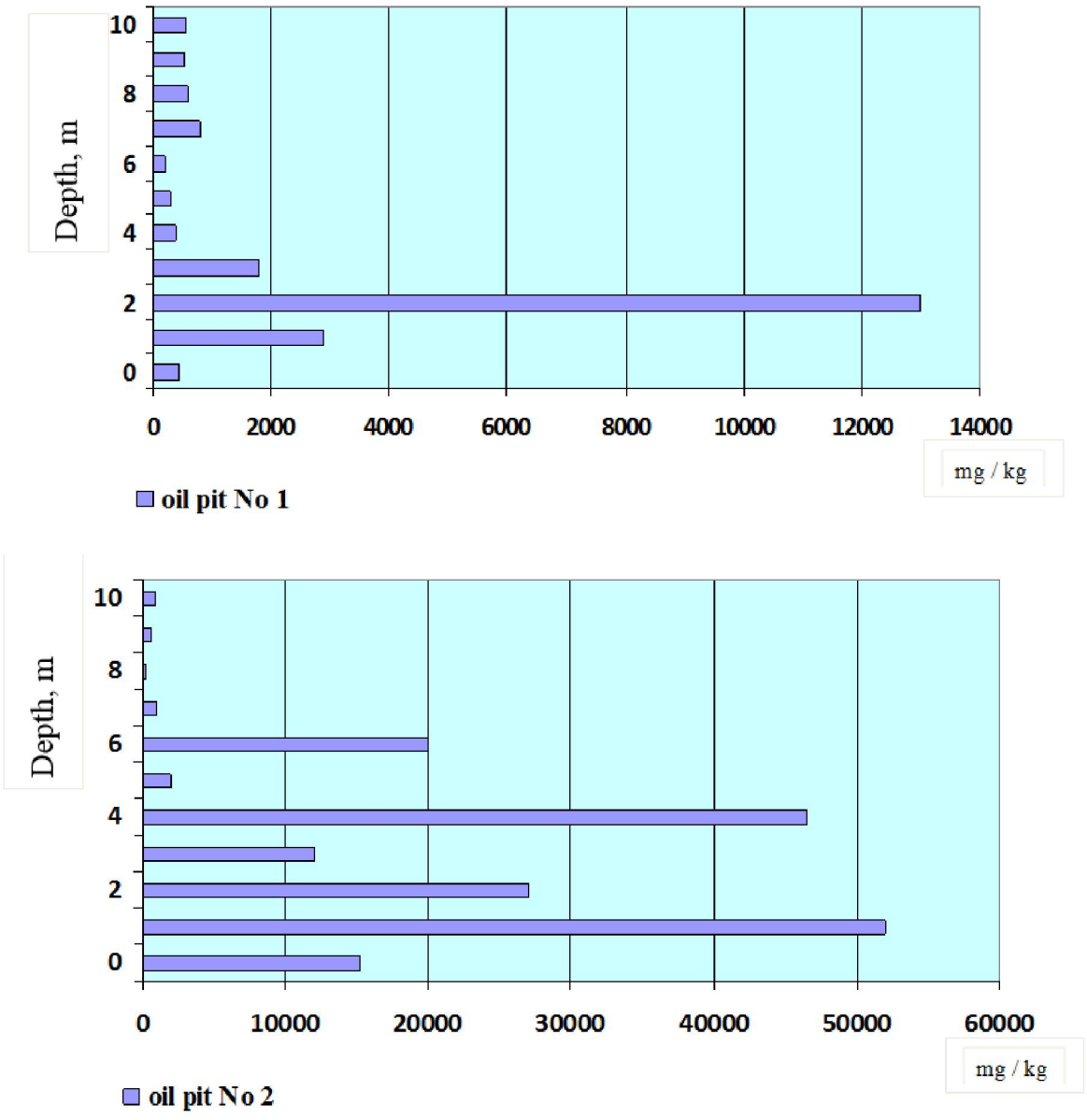

Figure 1 - The content of petroleum products in soil at different depths

The indicators presented in the figure show that the most polluted oil products in depth is also oil pit No. 2.

The results of laboratory tests of groundwater selected during the drilling of engineering and geological wells are presented in table 2.

Table 2 - The content of petroleum products in groundwater

MPCAw, mg / dm^3 (reservoirs of fishery significance)	MPCw, mg / dm^3 (reservoirs of household and cultural and domestic water use)	Contaminant content, mg / dm^3	
		oil pit No. 1	oil pit No. 2
0,05	0,3	4,4	26,0

The standards for maximum permissible concentrations of pollutants in the water of fishery facilities are established by order of the Federal Agency for Fisheries dated January 18, 2010 No. 20.

The standards for maximum permissible concentrations of pollutants in the water of water bodies of domestic, drinking, and cultural and domestic water use (GN 2.1.5.1315-03) are established by the Resolution of the Chief State Sanitary Doctor of the Russian Federation of April 30, 2003. No. 78 [9].

The data in Table 2 indicate an excess of oil products in groundwater by 88 and 14.4 times for the 1st oil pit and 520 and 86.6 times for the 2nd oil pit, taking into account the fact that the Kizan River is both a fishery and household and cultural purposes.

It should be noted that the increased content of petroleum products in groundwater indicates their high migration activity. And since the unloading of groundwater occurs in the river Kizan there is a risk of these pollutants entering the river [10].

To determine the oil content in the water, samples were taken both from the shore and from the vessel. The results of laboratory tests of water samples are presented in table 3.

Table 3 - The content of petroleum products at various points of sampling

No.	Water sampling site	MPCAw, mg / dm^3 (reservoirs of fishery significance)	MPCw, mg / dm^3 (reservoirs of household and cultural and domestic water use)	Oil content in samples, mg / dm^3	
				ship samples (50m from the coast)	samples from the shore
1	River Volga upstream (200 m) from the river Kizan	0,05	0,3	0,02±0,02	-
2	River Volga downstream (200 m) from the river Kizan			0,03±0,02	-
3	River Kizan (beach, control)	0,05	0,3	0,06±0,02	0,06±0,02
4	oil pit No. 1			0,04±0,02	0,18±0,06
5	oil pit No. 2			0,05±0,02	0,21±0,07
6	500 m downstream			0,05±0,02	0,13±0,04
7	1000 m downstream			0,03±0,01	0,28±0,10

The results of the table indicate that in the Volga River, located at the 200th distance from the oil industry, the content of oil products in the water is below the MPC. But already in the control, both offshore and far from it, this indicator exceeds the MPC for fishery reservoirs by 0.01 mg / dm^3 and has the same values for both samples (0.06 ± 0.02 mg / dm^3).

In further samples, the results are dramatically different depending on the sampling points. The coastal part is characterized by an excess of the studied indicator relative to the MPC value for reservoirs of fishery value with a maximum at a distance of 1000m downstream from the 2nd oil well. For samples 50m from the coast, the situation is more favorable, since the content of petroleum products meets the standards.

Thus, the research results indicate the direct impact of Sokolovo oil on water pollution by oil products near the coast of the Kizan branch.

An important indicator of the ecological state of the catchment is the chemical composition of bottom sediments. Bottom river deposits, accumulating and concentrating petroleum hydrocarbons, resins, heavy metals, are a representative indicator of pollution. Knowledge of the natural concentrations of heavy metals in the bottom sediments of rivers makes it possible to judge the state of their purity or contamination [11]. The results of laboratory tests of samples of bottom sediments taken from the vessel by the grab bottom grab DG-0.16 are presented in table 4.

Table 4 - The content of petroleum products in bottom sediments at various points of sampling

No	Sampling point	Petroleum products, mg / kg
1	River Kizan (beach, control)	513,9±128,5
2	oil pit No. 1	14994,5±3748,6
3	oil pit No. 2	18719,3±4679,8
4	500 m downstream	807,7±201,9
5	1000 m downstream	474,8±118,7

As can be seen from the table, the maximum content of petroleum products (18719.3 ± 4679.8 mg/kg) in bottom sediments was observed in the area of oil pit No. 2, which exceeded the control variant by more than 36 times. The minimum value (474.8 ± 118.7 mg / kg) was recorded at a distance of 1000 m downstream from the test object, and in the control (beach) the value of this indicator was slightly higher ($P < 0.05$).

Thus, a gradual increase in pollution of bottom sediments by oil products from control to oil pit No. 2 is observed, after which the picture changes in the direction of decreasing this indicator. Consequently, there is a clear dependence of the impact of Sokolovo oil on pollution of bottom sediments by oil products of the adjacent water area.

Conclusion. The petroleum product indices at oil pit No. 1 (from 67500 to 133000 mg / kg) and No. 2 (from 104000 to 260,000 mg / kg) characterize the level of land pollution with chemicals as very high.

The maximum content of oil products is observed in the second oil pit at a depth of 1 and 4 m (51400 and 46100 mg / kg, respectively). For the first oil pit, the highest content of oil products was recorded at a depth of 2 m (13000 mg / kg), which characterizes the level of land pollution with chemicals as very high and medium [12].

At the Volga River, located 200th from oil, the oil content in the water is below the MPC, although this indicator exceeds the MPC for fishery reservoirs by 0.01 mg / dm^3 and has the same values for both samples (0.06 ± 0.02 mg / dm^3). Away from the coast, the studied indicator is characterized by an excess relative to the MPC value for reservoirs of fishery value with a maximum at a distance of 1000 m from the 2nd oil pit. For samples from water (from a vessel), the content of petroleum products meets the standards.

The content of oil products in groundwater is 88 and 14.4 times higher than those for first oil pit and 520 and 86.6 times for second oil pit, taking into account the fact that the Kizan River is a reservoir of fishery, household and cultural purposes [13].

The maximum content of petroleum products (18719.3 ± 4679.8 mg / kg) in bottom sediments was observed in the area of oil pit No. 2, which exceeded the control variant by more than 36 times. The minimum value (474.8 ± 118.7 mg / kg) was recorded at a distance of 1000 m downstream from the test object.

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ЕДІЛ ӨЗЕНІНІҢ ЖАҒАЛАУЫНДА ҚАЛДЫҚТЫ ТОҒАНДА ОРНАЛАСҚАН АЙМАҚТА ТОПЫРАҚ ЖӘНЕ СУ ОБЪЕКТІЛЕРІНДЕ МҰНАЙ ӨНІМДЕРІНІҢ ҚҰРАМЫН БАҒАЛАУ

Аннотация. Мақалада Еділ өзені мен Астрахань облысының Еділ бойындағы Кизан тармағының жанындағы мұнай қалдықтары қоймаларындағы мұнай өнімдерінің сандық құрамы бағаланады. Соколоводағы шұңқырлар бір кездері мұнай, керосин, мазут және басқа да мұнай өнімдерін уақытша сақтайтын көлбеу қабырғалары бар жер қазбалары болған мұнай өнімдерін сақтауға арналған. Топырақ үлгілерін зерттеу екі шұңқырда және жер асты суларында, жер асты сулары мен түбіндегі шөгінділерде әртүрлі тереңдікте жүргізілді. Зерттелген екі ұңғыманың екінші ұңғымада максималды жоғарылау 104-тен 260 есеге дейін, ал бірінші ұңғымада мұнайдың мөлшері 67,5-тен 133-ке дейін байқалды. Сондай-ақ, ауыр металдардың құрамы шекті рауалды мөлшерден асып кетті, мысалы, жалпы хром 168 есе және 2040 есе, мышьяк 1,7 есе және бірінші ұңғымаларда сәйкесінше 2,6 есе. Бұл жағдайда ең қауіпті - бұл хром, ол улы, тітіркендіргіш, кумулятивті, аллергиялық, канцерогендік және мутагендік әсерге ие. Топырақтағы мұнай өнімдерінің мөлшері екінші ұңғымада 1 м тереңдікте 51400 мг / кг-ға дейін және 4 м тереңдікте - 461000 мг/кг дейін жоғарылауымен сипатталады, сонымен қатар жер бетінде мұнай өнімдерінің мөлшері 15000 мг / кг, 2 метр тереңдікте 27000 мг / кг, 6 м тереңдікте - 20 000 мг / кг тең. Алғашқы мұнай құятын ыдыста 2 м тереңдігі 13000 мг / кг мұнай өнімдерінің ең көп мөлшері сипатталады, бұл 2 мұнай құятын қоймадағы ең көп мөлшерден 3 есе төмен. 1 және 3 метр тереңдікте майдың мөлшері 2000 мг / кг құрайды, басқа тереңдікте - 0, 4, 5, 6, 7, 8, 9, 10 метр, олар 1000 мг / кг-дан аз. Екінші мұнай резервуарында 2000 мг / кг-нан төмен топырақтағы мұнай өнімдерінің құрамы тек 7-ден 10 метр тереңдікте болады.

Жер асты суларын зерттеу нәтижелері бойынша мұнайдың құрамы 1-ші ұңғыма үшін 88 және 14,4 еседен, ал 2-ші ұңғымадан 520 және 86,6 еседен асады. Жер асты суларындағы мұнай өнімдерінің жоғарылауы олардың көші-қон белсенділігінің жоғары екендігін көрсетеді. Өзенде жер асты суларының түсуі орын алады. Кизанда осы ластаушы заттардың өзенге ену қаупі бар. Мұнай өнеркәсібінен 200-қашықтықта орналасқан Волга өзенінің учаскесінде судағы мұнай мөлшері ШРМ-нен төмен, дегенмен, жағалаудан алыс жерде, зерттелген көрсеткіш 2-ші мұнай резервуарынан максималды 1000 м қашықтықта балық аулау су қоймалары үшін ШРМ мәнінен жоғары. Төменгі шөгінділердегі мұнай өнімдерінің максималды мөлшері (18719,3 ± 4679,8 мг / кг) №2 мұнай резервуарының аумағында байқалды, бұл бақылау нұсқасынан 36 есе асып түсті. Ең төменгі мәні (474,8 ± 118,7 мг / кг) сынақ объектісінен 1000 м қашықтықта тіркелді, ал бақылауда (жағажайда) бұл көрсеткіш шамалы жоғары болды ($P < 0.05$). Осылайша, мұнай шөгінділерінің мұнай өнімдерімен бақылаудан №2 мұнай резервуарына дейін ластануының біртіндеп артуы байқалады, содан кейін көрініс осы көрсеткіштің төмендеуіне қарай өзгереді. Демек, Соколовское мұнайының әсер етуінің түбіндегі шөгінділерді іргелес су аймағының мұнай өнімдерімен ластануына айқын тәуелділігі бар.

Қорытындылай келе, зерттеу нәтижелері №1 мұнай кеніштеріндегі мұнай өнімдерінің көрсеткіштері (67,500-ден 133 000 мг / кг-ға дейін) және №2 (104 000-нан 260 000 мг / кг-ға дейін) жердің химиялық заттармен ластану деңгейінің өте жоғары екенін сипаттайды. Мұнай өнімдерінің ең көп мөлшері екінші мұнай кенішінде 1 және 4 м тереңдікте байқалады (сәйкесінше 51400 және 46100 мг / кг). Алғашқы мұнай резервуарда мұнай өнімдерінің ең жоғары мөлшері 2 м (13000 мг / кг) тереңдікте тіркелді, бұл жердің химиялық заттармен ластану дәрежесін өте жоғары және орташа деп сипаттайды. Мұнайдан 200-ші жерде орналасқан Волга өзенінің суында мұнай құрамы ШРМ-ден төмен, дегенмен бұл көрсеткіш балық шаруашылығы су айдындары үшін ШРМ-ден 0,01 мг / дм^3-ге асады және екі үлгі үшін де бірдей (0,06 ±) 0,02 мг / дм^3). Кизан өзенінің балық шаруашылығы, тұрмыстық және мәдени мақсаттағы су қоймасы болғандығын ескере отырып, жер асты суларындағы мұнай өнімдерінің мөлшері бірінші мұнай кенішіне қарағанда 88 және 14,4 есе, 2 резервуарда 520 және 86,6 есе жоғары.

Төменгі шөгінділердегі мұнай өнімдерінің максималды мөлшері (18719,3 ± 4679,8 мг / кг) №2 мұнай резервуарының аумағында байқалды, бұл бақылау нұсқасынан 36 есе асып түсті. Ең төменгі мәні (474,8 ± 118,7 мг / кг) сынақ объектісінен 1000 м қашықтықта тіркелді. Зерттеу нәтижелері екінші ұңғыманың ең көп ластанғанын көрсетеді.

Түйін сөздер: мұнайқалдықты тоған, мұнай өнімдері, ауыр металдар, шекті рауалды мөлшер, топырақ, жер асты сулары, су түбіндегі шөгінділер.

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ОЦЕНКА СОДЕРЖАНИЯ НЕФТЕПРОДУКТОВ В ПОЧВЕННЫХ И ВОДНЫХ ОБЪЕКТАХ В РАЙОНЕ РАСПОЛОЖЕНИЯ ШЛАМОНАКОПИТЕЛЕЙ НА ПОБЕРЕЖЬЯХ РЕКИ ВОЛГА

Аннотация. В статье дана оценка по количественному составу нефтепродуктов в местах хранения отходов нефти в районе слияния реки Волга и ее рукава Кизань Приволжского района Астраханской области. Нефтяные ямы в Соколово в свое время были предназначены для хранения нефтепродуктов, представляющие собой земляные выемки с наклонными стенками, где временно хранили нефть, керосин, мазут и прочие нефтепродукты. Были проведены исследования проб почвы на разных глубинах в двух ямах и подземных, грунтовых вод и донных отложений. В исследуемых двух ямах отмечается максимальное превышение от 104 до 260 раз во второй яме, тогда как в первой яме содержание нефтепродуктов превышает от 67,5 до 133 раз. По содержанию тяжелых металлов также отмечается превышение предельно-допустимой концентрации, например, по хрому общему в 168 раз и в 2040 раз и по мышьяку в 1,7 раз и 2,6 раз соответственно в первой и второй ямах. Наиболее опасным при этом является хром, который очень токсичен, оказывая отравляющее, раздражительное, кумулятивное, аллергическое, канцерогенное и мутагенное действие. Содержание нефтепродуктов в почве характеризуется повышенным содержание во второй яме на глубине 1 м до 51400 мг/кг и на глубине 4 м – 461000 м. При этом на поверхности земли содержание нефтепродуктов составляет 15000 мг/кг, на глубине 2 метров 27000 мг/кг, на глубине 6 м – 20000 мг/кг. В первой нефтеяме самым максимальным содержанием нефтепродуктов характеризуется глубина 2 м с 13000 мг/кг, что более чем в 3 раза ниже максимального содержания во 2 нефтеяме. На глубине 1 и 3 метров содержание нефтепродуктов составляет около 2000 мг/кг, на других глубинах – 0, 4, 5, 6, 7, 8, 9, 10 метрах они составляют менее 1000 мг/кг. Во второй нефтеяме содержание нефтепродуктов в почвогрунте ниже 2000 мг/кг характерно только на глубинах от 7 до 10 метров.

По результатам исследований подземных вод содержание нефтепродуктов превышает в 88 и 14,4 раз для 1-ой нефтеямы и 520 и 86,6 раз для 2-ой ямы. Повышенное содержание нефтепродуктов в грунтовых водах говорит о высокой их миграционной активности. И так как разгрузка грунтовых вод происходит в р. Кизань, существует угроза попадания этих загрязнений в реку. На участке р.Волга, находящейся в 200-ом отдалении от нефтеям, содержание нефтепродуктов в воде ниже ПДК, однако **вдали от берега характерно превышение исследуемого показателя относительно значения ПДК для водоемов рыбохозяйственного значения с максимумом на расстоянии 1000м от 2-ой нефтеямы.** Максимальное содержание нефтепродуктов (**18719,3±4679,8 мг/кг**) в донных отложениях отмечалось в районе нефтеямы №2, что превосходило контрольный вариант более чем в 36 раз. Минимальное значение (**474,8±118,7 мг/кг**) было зарегистрировано на расстоянии 1000м по течению от исследуемого объекта, причем в контроле (пляж) величина данного показателя была несколько выше ($P < 0,05$). Таким образом, наблюдается постепенное нарастание загрязнения донных отложений нефтепродуктами от контроля до нефтеямы №2, после чего картина меняется в сторону снижения данного показателя. Следовательно, прослеживается четкая зависимость воздействия Соколовских нефтеям на загрязнение донных отложений нефтепродуктами прилегающей водной площади.

В заключении, результаты исследований показывают, что показатели содержания нефтепродуктов на нефтеямах №1 (от 67500 до 133000мг/кг) и №2 (от 104000 до 260000мг/кг) характеризуют уровень загрязнения земель химическими веществами как очень высокий. Максимальное содержание нефтепродуктов наблюдается во второй нефтеяме на глубине 1 и 4 м (51400 и 46100 мг/кг, соответственно). Для первой нефтеямы наибольшее содержание нефтепродуктов зарегистрировано на глубине 2м (13000 мг/кг), что характеризует уровень загрязнения земель химическими веществами как очень высокий и средний. На участке р.Волга, находящейся в 200-ом отдалении от нефтеям, содержание нефтепродуктов в воде ниже ПДК, хотя данный показатель превышает ПДК для водоемов рыбохозяйственного значения на 0,01 мг/ дм^3 и имеет для обеих проб одинаковые значения (**0,06±0,02 мг/дм^3**). Содержания нефтепродуктов в подземных водах в 88 и 14,4 раз превышают таковые для 1 нефтеямы и 520 и 86,6 раз для 2 ямы с учетом того, что р.Кизань является как водоемом рыбохозяйственного, так хозпитьевого и культурно-бытового назначения [13].

Максимальное содержание нефтепродуктов (**18719,3±4679,8 мг/кг**) в донных отложениях отмечалось в районе нефтеямы №2, что превосходило контрольный вариант более чем в 36 раз. Минимальное значение (**474,8±118,7 мг/кг**) было зарегистрировано на расстоянии 1000м по течению от исследуемого объекта. Результаты исследований показывают, что наиболее загрязненной является вторая яма.

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