

ENVIRONMENT PROTECTION

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**ENVIRONMENTAL SAFETY IMPROVEMENT OF SURFACE AND GROUND WATER
CONTAMINATION AT THE AIRPORT AREA**

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Abstract

Purpose: Taking into account that the airport "Kyiv" is located in one of the central districts of Kyiv and does not have clearly established sanitary protection zones, the problem of environmental pollution is topical and requires monitoring and research. In order to improve environmental compliance we made assessment of superficial and ground water quality in airport zone. **Methods:** Water quality was estimated by the biotesting method, hydrochemical analysis, and by oil products detection method. **Results** We performed analysis of wastewaters of airport "Kyiv" and superficial waters of river Nyvka. The samples took place: above the airport drainage, in the drainage place and below drainage place. We conducted assessment of ground waters, which are sources of water supply, on different distance from an airport (20 m, 500 m, 1000 m, 1500 m). Results of hydrochemical investigations of river indicated excess of nitrogen compounds content compare to regulatory discharge. Thus, it was defined excess of ammonia nitrogen in wastewaters in three times and in place of dispersion – in ten times; the content of nitrite nitrogen in the river sample after discharge exceeds in 22 times norm. Analysis of drinking water in airport zone has showed extremely high level of pollution by nitrite nitrogen exceeding norm in 7-17 times. After analysis it was defined high level of river pollution by oil products (in 26-32 times higher than MPC), and ground water in 1, 5-2 times. Results of biotesting confirmed data of hydrochemical investigations of superficial water state (acute toxicity was observed in drainage area and in place of drainage dispersion). **Discussion:** Increased content of nitrite indicates the strengthening of decomposition process of organic matter in conditions of slower oxidation of NO_2^- into NO_3^- . This parameter is major sanitary indicator which indicates pollution of water body. High content of such specific pollutant for aviation transport processes as oil products indicates negative impact of airports on superficial and ground waters. Complex usage of hydrochemical and biotesting methods has increased accuracy of assessment. So, the most effective method for assessment of possible hazard of some sources for water flora and fauna is biotesting, which is based on registration of test objects reactions.

Keywords: biotesting; contamination; environmental safety; ground water; superficial water; technosphere.

1. Introduction

In current conditions water bodies in the airport zones are under intensive technogenic influence, which leads to change of hydrogeological, hydrochemical and hydrobiological regimes [1].

Airport activity leads to pollution of soil, superficial and ground waters by industrial and household sewages.

The main sources of industrial sewages in airports are buildings of technical maintenance of planes (aviation bases, auxiliary productions) and also buildings of utility rooms (warehouses of property, auto bases, boilers, depots).

The main sources of household sewage waters – are buildings of transportation services: air terminal, hotel, canteens and service of board meal.

Runoff waters are also additional source of water bodies' pollution the airport zone/ Runoff accumulates from the territory of airports different chemical substances. It is formed from rain and melted water and from buildings cleaning waters. These waters contain oil products phenols, chemical compounds for aircraft cleaning, mineral oils, heavy metals. Rain and melted waters absorb harmful emissions from cars and aviation transport, which settle down in an airport [2].

2. Problem statement

According to Water Code of Ukraine? [6] water quality is characteristic of water content and properties, which define its suitability for certain types of water usage.

In 1997 the Ministry of Healthcare approved State Sanitary Norms and Rules (SSNR) "Drinking water. Hygienic requirements for water quality of centralized water supply" [7]. This document formulated strict requirements for content of pollutants like norms of World Health Organization.

The elimination of groundwater pollution is complex, expensive and sometimes impossible procedure. Therefore protection of groundwater intakes should provide a variety of preventive and other protective measures [2, 4, 5].

3. Analysis of the latest research and publications

In works [1-4] it is defined negative technogenic impact of aviation processes on atmospheric precipitations in zone of airport "Kyiv".

Wastewaters of airport "Kyiv" are dumped in the river Nyvka (right tributary of Irpin, length - 19 km, basin area - 93,2 m²). This small river is located in the Zhulyany district, which is located in closest vicinity to the airport (the nearest settlements are located at a distance about 20 meters from the airport) [3-5].

Aim of the work: assessment of superficial and ground water quality in airport zone.

Methods: Water quality was estimated by the biotesting method [6,7], hydrochemical analysis [7], and by oil products detection method [8].

4. Assessment scheme of pollution level of superficial and ground waters near airports

We performed analysis of wastewaters of airport "Kyiv" and superficial waters of river. The samples took place: above the airport drainage, in the drainage place and below drainage place. We conducted assessment of ground waters, which are sources of water supply, on different distance from an airport (20 m, 500 m, 1000 m, 1500 m) in northern-west direction (prevailing wind direction according to rose of wind).

The results of hydrochemical analysis are given in table 1.

Table 1

Results of hydrochemical analyses of superficial and ground waters in the zone of airport

Place for sample taking	Indicators of water quality, mg/dm ³					
	pH	N/NH ₄	N/NO ₃	N/NO ₂	COD, mgO/d m ³	Oil products
20 m	7,5	1,1	3,1	35	18	0,2
500 m	7,2	0,6	2,2	40	35	0,5
1000 m	6,8	1,3	2,5	56	45	0,6
1500 m	6,8	0,8	1,8	22	20	0,3
Above drainage	7,2	6,5	2,5	1,2	25	1,3
Drainage	6,2	45	3,5	1,2	50	23
Below drainage	7,4	4,8	1,2	1,8	20	1,6
TLV drink	6,5-8,5	2	45	3,3	30	0,3
TLV fishery	6,5-8,5	0,5	40	0,08	30	0,05

Results of hydrochemical analysis of superficial and ground waters compare to TLV (according to drinking and fishing TLV) are presented on the fig.1.

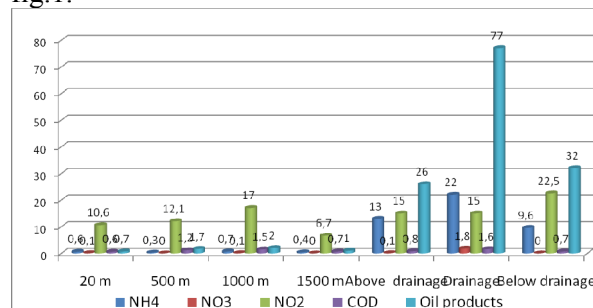


Fig. 1. Comparison of results of hydrochemical analyses of superficial and ground waters in the zone of airport "Kyiv" with TLV

Results of hydrochemical investigations of river Nyvka indicated excess of nitrogen compounds content compare to regulatory discharge. Thus, it was defined excess of ammonia nitrogen in wastewaters in three times and in place of dispersion – in ten times; the content of nitrite nitrogen in the river sample after discharge exceeds in 22 times norm [9]. Analysis of drinking water in zone of airport has showed extremely high level of pollution by nitrite nitrogen exceeding norm in 7-17 times [10].

Household wastewaters may be one of the sources of superficial water pollution by ammonia

ions. Increased concentration of ammonia ions can be used as an indicator, which reflects the deterioration of sanitary condition of water bodies during the process of surface and groundwaters pollution [7].

The presence of nitrate ions in natural waters might be connected with internal processes in the water body: nitrification of ammonia ions with the assistance of oxygen under the influence of nitrifying bacteria; atmospheric precipitation absorbing of nitrogen oxides formed during atmospheric electrical discharges, emissions from aircraft engines; industrial and domestic wastewater especially after biological treatment [11].

Nitrates in surface waters are in dissolved form. The concentration of nitrates in surface waters is prone to seasonal fluctuations: the minimum is in the growing season, it increases in autumn and reaches peak in winter, when decomposition of organic matter and the transition of organic nitrogen in mineral form is performed with minimum consumption of nitrogen [6].

Nitrites are an intermediate stage in the chain of processes of bacterial oxidation of ammonia to nitrate (nitrification – is possible only under aerobic conditions) and reverse, the restoration of nitrates to ammonia and nitrogen (denitrification – is possible only under shortage of oxygen). These oxidic-restore reactions are typical for natural waters. Moreover, nitrites are used as corrosion inhibitors in the process of technological water treatment; therefore nitrites may get into the system of drinking water supply [11]. In surface waters nitrite are in dissolved form. Increased content of nitrite indicates the strengthening of decomposition process of organic matter in conditions of slower oxidation of NO_2^- into NO_3^- . This parameter is major sanitary indicator which indicates pollution of water body. Seasonal fluctuation of nitrites is characterized by appearance of them in spring during decomposition of nonliving organic matter [12].

After analysis it was defined high level of river pollution by oil products (in 26-32 times higher than TLV), and ground water in 1, 5-2 times. There was high content of oil products in runoff – 23 mg/dm^3 .

High content of such specific pollutant for aviation transport processes as oil products indicates negative impact of airports on superficial and ground waters. Samples of superficial and ground water also were investigated by biotesting methods. Complex usage of hydrochemical and biotesting methods has increased accuracy of assessment. So, the most

effective method for assessment of possible hazard of some sources for water flora and fauna is biotesting, which is based on registration of test objects reactions. To define toxicity of water such test objects were used: for natural water - *Daphnia magna* Straus, and for drinking water – *Ceriodaphnia affinis* Lilljeborg.

A main criterion to define toxicity was mortality of microorganisms. Samples of water were considered as acute if within 48 hours there was death of 50% of organisms (table 2).

Table 2
Biotesting results of superficial and ground waters in airport "Kyiv"

Places for sample taking	Mortality, %	Conclusion about toxicity
20m	40	Absence of acute toxicity
500 m	33	Absence of acute toxicity
1000 m	27	Absence of acute toxicity
1500m	10	Absence of acute toxicity
Above drainage	43	Absence of acute toxicity
Drainage	100	Acute toxicity
Below drainage	87	Acute toxicity

Results of biotesting confirmed data of hydrochemical investigations of superficial water state (acute toxicity was observed in drainage area and in place of drainage dispersion). There was not defined acute toxicity of drinking water, but there was a clear trend to decreasing of mortality of microorganisms (*Ceriodaphnia affinis* Lilljeborg) with increasing of distance from airport. So, it can be stressed that toxicity of water increases in vicinity of airport.

5. Conclusions

To control the state of water bodies on the territory of an airport it is necessary to develop a methodology for monitoring investigations.

On the current level of technogenic load on the river Nyvka (there are about 60 enterprises working in the basin of river) first of all it is necessary to review status of river (today it is water body of fishery and cultural purpose).

To reduce and prevent pollution of superficial and ground waters in the area of the airport it must be ensured correspondence of sewage treatment to standards through repair and upgrading of old treatment plants or the introduction of new treatment technologies.

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С. М. Маджд

Підвищення рівня екологічної безпеки поверхневих і ґрунтових вод в районі аеропорту

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Мета: Враховуючи те, що аеропорт “Київ” не має чітко встановленої санітарно-захисної зони і знаходиться в одному із центральних районів міста Києва, проблема забруднення довкілля є актуальною і потребує проведення моніторингових досліджень. І тому для підвищення рівня екологічної безпеки гідроекосистем була здійснена оцінка якості поверхневих і ґрунтових вод в зоні аеропорту. **Методи:** Якість вод оцінювалася за допомогою методу біотестування, гідрохімічного аналізу, а також за допомогою методики на визначення нафтопродуктів. **Результати:** В роботі здійснений аналіз стічних вод аеропорту “Київ” та поверхневих вод річки Нивка: в місці вище стоку аеропорту, в місці стоку і місці нижче стоку, а також проведена оцінка ґрунтових вод, які є джерелом водопостачання криниць житлового масиву Жуляни, і знаходяться на різній віддаленості від аеропорту (20 м, 500 м, 1000 м, 1500 м). Результати гідрохімічних досліджень поверхневих вод р. Нивка свідчать про перевищення азотовмісних сполук порівняно з нормованим скидом. Зокрема, встановлені перевищення в стічній воді азоту амонійного – в три рази, в місці розсіювання – в десять разів; в пробі річки після скиду стоку виявлено перевищення за вмістом азоту нітритів в 22 рази. Аналіз питної води в зоні, що досліджувалась, показав надзвичайно високий ступінь забруднення азотом нітритів – в 7-17 разів вище нормативу. В результаті аналізу на наявність нафтопродуктів виявлено високий ступінь забруднення ними поверхневих вод (в 26-32 рази вище ГДК), ґрунтових вод в деяких створах (в 1,5-2 рази). Результатами біотестування підтверджують (гостра токсичність спостерігається в стоці і в місці розсіювання стоку) дані гідрохімічних досліджень стану поверхневих вод. **Обговорення:** Підвищений вміст нітритів вказує на посилення процесів розкладання органічних речовин в умовах більш повільного окислювання NO_2^- у NO_3^- , що вказує на забруднення водного об'єкта, тобто є важливим санітарним показником. Високий вміст нафтопродуктів – специфічного поллютанту, характерного для авіатранспортних процесів – свідчить про вплив діяльності аеропорту на поверхневі і ґрунтові води досліджуваної зони. Комплексне використання

гідрохімічних методів і методів біотестування підвищило достовірність оцінки. Адже найбільш ефективним методом, що дозволяє оцінити можливу небезпеку тих чи інших джерел забруднення для водної флори та фауни, є біотестування, засноване на реєстрації реакцій тест-об'єктів.

Ключові слова: біотестування; ґрунтові води; забруднення; екологічна безпека; поверхневі води; техносфера.

С.М. Маджд

Повышение уровня экологической безопасности поверхностных и грунтовых вод в районе аэропорта

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Цель: Учитывая то, что аэропорт "Киев" не имеет четко установленной санитарно-защитной зоны и находится в одном из центральных районов города Киева, проблема загрязнения окружающей среды является актуальной и нуждается проведения мониторинговых исследований. И потому для повышения уровня экологической безопасности гидроэкосистем была осуществленная оценка качества поверхностных и грунтовых вод в зоне аэропорта. **Методы:** Качество вод оценивалось с помощью метода биотестирования, гидрохимического анализа, а также с помощью методики на определение нефтепродуктов. **Результаты:** В работе осуществлен анализ сточных вод аэропорта "Киев" и поверхностных вод реки Нивка: в месте выше стоку аэропорта, в месте стока и месте ниже стоку, а также проведенная оценка грунтовых вод, которые являются источником водоснабжения колодцев жилищного массива Жуляни, и находятся на разной отдаленности от аэропорта (20 м, 500 м, 1000 м, 1500 м). Результаты гидрохимических исследований поверхностных вод р. Нива свидетельствуют о превышении азотосодержащих соединений сравнительно с нормируемым сбросом. В частности, установленные превышения в сточной воде азота аммонийного – в три раза, в месте рассеивания – в десять раз; в пробе реки после сброса стока выявлено превышение по содержанию азота нитритов в 22 разы. Анализ питьевой воды в зоне, которая исследовалась, показала чрезвычайно высокая степень загрязнения азотом нитритов – в 7-17 разы выше нормативу. В результате анализа на наличие нефтепродуктов выявлена высокая степень загрязнения ими поверхностных вод (в 26-32 разы выше ПДК), грунтовых вод в некоторых створах (в 1,5-2 разы). Результатами биотестирования подтверждают (острая токсичность наблюдается в стоке и в месте рассеивания стока) данные гидрохимических исследований состояния поверхностных вод. **Обсуждение:** Повышенное содержание нитритов указывает на усиление процессов разложения органических веществ в условиях более медленного окисления NO_2^- у NO_3^- , что указывает на загрязнение водного объекта, то есть является важным санитарным показателем. Высокое содержание нефтепродуктов – специфического поллютанта, характерного для авиатранспортных процессов – свидетельствует о влиянии деятельности аэропорта на поверхностные и грунтовые воды исследуемой зоны. Комплексное использование гидрохимических методов и методов биотестирования повысило достоверность оценки. Ведь наиболее эффективным методом, что позволяет оценить возможную опасность тех или других источников загрязнения для водной флоры и фауны, есть биотестирование, основанное на регистрации реакций тестовых объектов.

Ключевые слова: биотестирование; грунтовые воды; загрязнение; поверхностные воды; техносфера; экологическая безопасность.

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