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Margaryta Radomska[1]
Anna Golovko[2]

DEFINITION OF ENVIRONMENTAL THREATS IMPOSED BY FILLING STATIONS ACTIVITY

National Aviation University
Kosmonavta Komarova avenue 1, 03680, Kyiv, Ukraine
E-mails: [1] m_radomskaya@mail.ru; [2] anna_holovko@ukr.net.

Abstract. *The role of green space was considered in the paper. The basic negative impacts on the quantity and quality of green spaces were defined. It was set that the optimization of green areas exploitation is main prerequisite of the urban environment improvement which requires their comprehensive study, assessment of natural resource potential and its possible changes, study of the approaches to their use without damage to nature and people to be. The implementation of proposed recommendations within geoecological approach allows to detect complex structural and functional properties of green spaces geosystem as natural objects and finding ways for their improvement.*

Keywords: environment quality; green spaces; urban areas.

1. Introduction

The principal reason of decline of environment conditions quality at urban areas, except the concentration of production capacities, is the impact of transport. Due to permanent growth of traffic cars on motorways the technogenic pressure on the environment increases correspondingly and is related not only to direct influence moving vehicles, but also with the system of their service and maintenance. The most typical type of vehicles maintenance facilities are the filling stations of general use. Growth of demand on services of filling stations and strong competition among oil traders results in the increase of filling stations network, their maximal approach to the users, provision of round-the-clock work and increase of services range. All together it increases the technogenic pressure in cities and extends the range of negative impacts on the environment.

2. Analysis of literature

It is hard to separate the influence of filling stations activity on the environment from the influence of motorways and transport; therefore most scientists examine them in complex. Important contribution in the analysis of transport influence on the environment was done by I.R. Golubev and Y.V. Novikov [2], B.V. Solukha [6], B.V. Filipov A.Z. [1].

The separate group of researches by different authors is devoted to the influence of petrochemical pollution on different environment components. In particular, Y.I. Pikovsky studied the consequences of oil pollution depending on composition of petrochemicals, structure and state of exposed ecosystem and physical factors, influencing on it [4].

The first attempt of complex assessment of filling stations influence on the environment was performed in Moscow by the State Department of environmental monitoring, but it took into account only the influence of filling stations on superficial flow and atmospheric air pollution [5].

So, obviously, influence of filling stations on the environment has far more difficult character.

3. Research purpose

In spite of wide distribution and great number of filling stations, complex assessment of their influence on the environment has not been carried out until now. However, exactly these objects are the source of pollutants entering air, soil and underground water and subsequently surface water objects as a result of migration. Incongruous planning and construction of communication systems and objects, imperfect isolation of reservoirs, emergency situations, violation of rules of technological processes implementation, result in the release of toxic substances to the environment, imposing danger for the workers of filling stations and habitants of adjoining territories.

Therefore, there is a need to conduct the detailed analysis of filling stations interaction with the environment and develop the mitigation activities system to limit negative impacts on the basis of organizational, technological and nature protection measures.

4. Influence of filling stations on the condition of atmospheric air

The basic receptor of filling stations influences is atmospheric air, which is contaminated with the emisions of hydrocarbons, oxides of carbon, sulfur and nitrogen, hydrogen sulfide, ammonia, formaldehyde.

Basic sources of atmospheric air pollution could be divided into 2 groups:

— tationary;
— mobile.

Vehicles, which use services of filling stations, belong to movable.

Stationary sources are the equipment of filling stations, which differs depending on filling stations type.

The typical sources of atmosphere pollution at filling stations with liquid hydrocarbon fuels are reservoirs for storage of fuel and transfer devices, and at filling stations for propane-butane the most important are reservoirs for storage of liquid fuel gases, transfer devices, compressors, emptying column. Filling stations of this type emit vapors of propane and butane into the air.

Mass of heavy metals emissions, especially MnO, as well as sulfur anhydride and hydrogen sulfide, is proportional to their content in fuel. In addition filling stations emissions contain hydrocarbons of ethylene type:

— olefines (pentene, hexene, hexane);
— low-sulfur petrol;
— ammonia;
— sulfuric acid;
— bisulfide;
— chlorides;
— fluorides;
— bromine;
— polychlorinated dioxins;
— phenol;
— resinous matters;
— heavy metals (zinc, copper, mercury, cadmium);
— suspended particles;
— inorganic dust (material of road cover);
— dust of rubber;
— hydrogen (traces).

The composition and intensity of transport emissions depends on such parameters:

— working mode;
— speed;
— road quality and form;
— weather conditions;
— technical condition and age of vehicle;
— type of engine;
— type of fuel;
— driver skills.

Thus, the more carbon oxide and hydrocarbons is emitted at low speeds and less at high speeds, but nitrogen dioxide emissions intensity has opposite character.

For example, the concentration of hydrocarbons in the air in the vicinity of traffic-lights could reach 6,4 mg/100 m^3, that is 63 times over the acceptable values for highways. The area affected by traffic-light spreads over the territory with radius of 200 m [1].

So, for filling stations, where cars mainly slow down and accelerate motion, and also idle, anomalous concentrations of hydrocarbons and carbon oxides are typical, at the same time mass of nitrogen oxides emissions could be lower.

However, it should be taken into account that filling stations are mainly located along highways and their pollution is overlaps the emissions produced by total traffic flow, although filling object play the role of pollution concentrators.

The influence of climate conditions should be also considered, as they determine distribution of pollutants in the atmospheric air. These are atmosphere stratification, relief, temperature, wind direction and speed, they facilitate pollution accumulation in the ground layer of atmosphere.

Evaluation of filling stations impacts on the state of atmospheric air should also take into account the possible processes of transformation.

Thus, there is information about photochemical oxidization of light petrochemicals in presence the nitrogen oxides and resulted formation of ozone [6].

Also in some cases air aerosols, which make their input into atmosphere pollution, are also formed.

The intensity of transformation processes is considerably determined by temperature, insolating mode, and previous atmosphere pollution and its composition.

5. Influence of filling stations on water resources

The negative consequences of filling stations activity can spread on superficial, ground and underground water. Contamination is formed directly due to petrochemicals, which are stored at the territory of filling stations, and also polluted flow and rain waters.

The analysis of production data shows that the basic ways of petrochemicals introduction in water objects are leakages from reservoirs, storages, sedimentation tanks, linear communications, intended for petrochemicals relocation from reservoirs to transfer devices, system of flow waters collection, and also migration of pollutants from superficial water objects in underground waters and vice versa.

It should be noted, that the most important direction of pollution transfer is from underground to superficial waters: pollution through the faults of reservoirs and pipelines isolation is hard to discover and control; flow water, that contain contamination, also above all get into the underground and ground waters.

Contamination of underground and ground waters from reservoir area could be avoided with the help of modern equipment, but losses at linear part are inevitable part of filling stations activity.

Linear communications are used for pumping fuel and oils over the territories of filling stations from the places of reception to the points of delivery. Here the losses of petrochemicals take place through the compression of valves, as a result of failures, and also through the openings in isolation, which appear under the influence of corrosion.

Systematic failures predefined by pipelines walls thickness diminishing and perforation are characteristic during the continuous exploitation. Although losses of petrochemicals through the openings in the walls of pipelines are insignificant, for all pipeline they can arrive at 50% general losses.

Researches show that among the reasons of pipeline failures external influences come the first (50% total number of case), the second most widespread reason is corrosion and defects of materials — 15 and 18% accordingly, and errors of exploitation responsible for 5–6% failures [3].

The result of all these phenomena is pollution of soil with petrochemicals, and then pollution of ground and underground water, caused by the absence of regular control over the state of isolating covers. If filling stations are located at the territory of important ground water resources, negative influence from the potential leakage of equipment is especially strong as a result of pollutants distribution in the process of diffusive migrations. If the annual amount of precipitations is 500–600 mm, the rate of salinization front movement reaches 30 m/year [8]. It results in the increased mineralization by 200–250 times, and the area of contamination can occupy few hectares.

During the construction stage detailed investigation of hydrological conditions at the site enables prevention of cross-flows between aquifers and change of underground waters chemical composition.

Contamination of superficial flow at the territory of filling stations is related not to the problems of equipment impermeability, but also to spills near transfer devices (to 100 g per 1 t of petrol and 50 g per 1 t of diesel fuel). Spills, motion of transport and atmospheric precipitations make their contribution into high contamination of superficial flow.

The results of researches, executed for a number of filling stations in Moscow, showed, that superficial flow contains petrochemicals — from 1,2 to 28,7 mg/l (MPC = 0,05 mg/l), chlorides — to 109 mg/l, sulfates — to 17 mg/l, lead — to 0,005 mg/l, copper — to 0,05 mg/l, zinc — to 0,08 mg/l [5].

Therefore atmospheric precipitations, which flow down the territory of filling stations, are collected in the local engineering networks of rain sewage system for treatment. The characteristic features of this type of waste waters is small volume, limited area of filling stations territory; high unevenness of formation, which depends on periodicity of precipitations; increased content of suspended particles and petrochemicals.

Separate group of waste waters of filling stations is made of cars washing waters, if the territory of filling stations includes such facility. In this case separate collecting network and local treatment installations are foreseen. After treatment these water can be returned for washing, or discharged into city sewage system. Average waste water volume from typical filling station is 0,3 m^3/day or 100–150 m^3/year depending on the average amount of precipitation.

The basic component of contamination, except for heavy metals, phenols, acids, alcohols, ethers, benzene, mechanical admixtures and surfactants, include petrochemicals. In water petrochemicals undergo one of the following processes: assimilation, sedimentation, emulsification, and formation of oil aggregates, oxidization, dissolution and evaporation, consumption by water organisms.

It should be noted that sanitary standards usually estimate the acceptable content of soluble components of petrochemicals. But insoluble components form the biggest share of water pollution in case of accidents.

6. Influence of filling stations on soils condition

The important environmental issue of operating filling stations is their impact on soils. Big cities include few hundred filling stations, and it means that, together with the area of sanitary-hygienic areas they occupy 4–5 km^2 or 5% urban territory is affected.

First of all their influence includes land withdrawal for permanent use. Usually it is 0,4 hectares. The fertile layer of soil is removed from the site and used for arranging flowerbeds, still loosing part of its fertility. At the same time the static and dynamic loadings on the surface are growing, which results in compression of rocks and ground and water properties worsening. As a result infiltration of precipitations becomes complicated and thus the conditions for excessive area moistening and activation of erosive processes are created.

Exploitation of filling stations leads to soil pollution with petrochemicals and increased gas content in the ground environment. Such type of pollution is hard to detect and complicate to describe its distribution and transformation, especially in relation to their interaction with ground waters.

Soils polluted with petrochemicals accumulate iron, manganese, and loose phosphorus, potassium and magnesium. The correlation between carbon and nitrogen grows, share of insoluble sediment in humus increases, which weakens the stability of soil ecosystems and its resistance to unfavorable external influences, reduces fertility. Except the abovementioned changes, petrochemicals result in lixiviating and diminish hydrolysis acidity of soils.

All noted effects cause deep change of natural biocenosis components or their transformation: changes of quantity and diversity limitation (ground meso- and microfauna and microflora). The reaction of soil biota is unequivalent in the case.

Thus, the first step is massive death of ground mesofauna: in three days after pollution most types of the ground animals fully disappear or make up not more than 1% control [4]. Then, the complex of ground microorganisms after brief inhibition (first periods of reaction) reacts with the increase of gross quantity and intensification of activity (second period). The maximum density of microorganisms is formed in the horizons of fermentation and goes down farther on the soil profile decreasing with diminishing hydrocarbon concentrations.

The change of ecological situation results in oppression of photosynthesis activity of vegetative organisms. Foremost it affects development of ground water-plants: from their partial oppression and replacement of one group with other to disappearance of separate groups or complete death of all algae.

The processes of natural regeneration of biocenosis go slowly, and the restoration rates of different tiers of ecosystems are different too. The period of ground-vegetable associations renewal after pollution with petrochemical to 12 is known to be contamination in an amount 12 l/m^3 makes up from 10 to 15 years, depending on climatic and landscape geochemical features of territory, but the total restoration is impossible: negative consequences are irreversible [4].

With passing time concentration of petrochemicals in soil goes down due to evaporation of light factions, physical removal, washing away with water, limification (converting into the products of microbiological metabolism, insoluble in neutral organic solvents). Correlation of these factors of self-treatment depends on soil and climate conditions, composition and properties of petrochemicals and depth of their penetration in soil.

7. Physical factors of filling stations influence on the environment and humans

The important factor of filling stations influence on the environment is noise pollution. Typical filling station is characterized with sound-level of 80 dB. Taking the size sanitary protecting zone into account, the sound-level at the border will make 56 dB, which exceeds standards, established for night-time, and it is an important negative factor, as filling stations often work in the round-the-clock mode. It is also important to take into account that noise from filling stations has impulsive character: the basic source of noise is engine, which work on idling, and also noise, at braking and acceleration, — all these sounds are inconstant and arise up suddenly and unevenly, creating the variable noise field, which can negatively influence on the habitants of adjoining areas, and also workers of filling stations.

Cars, which move on territory of filling stations and stand with engines on idling, are the sources of vibration, but because of insignificant distance of its distribution its level is insignificant at the border of filling station and thus imposes threat only for the workers of filling stations. Ultrasounds, electromagnetic pressure, ionizing radiation are usually absent.

8. Conclusions

The conducted analysis of filling stations activity has shown dangerous processes and sources of influence on natural and social environment.

It has been set, that the most intensive impacts of filling stations are related to the atmosphere, hydrosphere and pedosphere, and this createthis creates possibility for humanshuman's exposure to petrochemicals pollution. Principal reasons of chemical pollution, resulted from the activity of filling stations are losses of petrochemicals, which take place at transport operations, exploitation of imperfect equipment, and also violation of equipment integrity under the influence of aggressive environmental factors and due to neglecting technological regulations of work. The volumes of losses depend on the period of year, type of works, equipment involved, fuel composition, source and type of loss.

According to the obtained results, the constructional phase has minor influence on the environment, except for physical changes: violation of soil cover and aquifers integrity.

The exploitation of filling stations brings the problems of air and water pollution, soil degradation, as well as physical and chemical threats to humans, both working at filling station and living in the vicinity.

Therefore it is necessary to expand the sanitary protection zone of these enterprises and enforce additional monitoring systems at the territory of filling stations. It is also recommended to improve the system of personnel training and control over technological operations fulfillment.

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М.М. Радомська[1], Г.М. Головко[2]. Виявлення екологічних загроз, спричинених діяльністю паливозаправних об'єктів

Національний авіаційний університет, просп. Космонавта Комарова, 1, Київ, Україна, 03680

E-mails: [1]m_radomskaya@mail.ru; [2]anna_holovko@ukr.net

Проаналізовано основні причини хімічного забруднення навколишнього середовища внаслідок діяльності паливозаправних об'єктів, а саме втрати вуглеводневої сировини, які відбуваються при товарно-транспортних операціях і експлуатації недосконалого обладнання. Відзначено, що джерелами негативних впливів паливозаправних об'єктів є дощові води, які змивають із території розлиті нафтопродукти, а пряме забруднення навколишнього середовища внаслідок аварійних розливів нафтопродуктів є рідкісним явищем. Указано, що негативні наслідки діяльності АЗС поширюються на атмосферне повітря, прилеглі ґрунти та водні об'єкти, у тому числі ґрунтові та підземні води, забруднюють довкілля та створюють загрозу здоров'ю людей.

Ключові слова: дощові води; забруднення навколишнього середовища; нафтопродукти; паливозаправні об'єкти.

М.М. Радомская[1], Г.М. Головко[2]. Выявление экологических угроз, вызванных деятельностью топливозаправочных объектов

Национальный авиационный университет, просп. Космонавта Комарова, 1, Киев, Украина, 03680

E-mails: [1]m_radomskaya@mail.ru; [2]anna_holovko@ukr.net

Проанализирована основная причина химического загрязнения окружающей среды в результате деятельности топливозаправочных объектов, а именно потеря углеводородного сырья, которая происходит при товарно-транспортных операциях и эксплуатации несовершенного оборудования. Отмечено, что источниками негативных влияний топливозаправочных объектов являются дождевые воды, которые смывают с территории разлитые нефтепродукты, а прямое загрязнение окружающей среды в результате аварийных разливов нефтепродуктов редкое явление. Указано, что негативные последствия деятельности АЗС распространяются на атмосферный воздух, прилегающую почву и водные объекты, в том числе грунтовые и подземные воды, загрязняют окружающую среду нефтепродуктами и создают угрозу здоровью людей.

Ключевые слова: дождевые воды; загрязнение окружающей среды; нефтепродукты; топливозаправочные объекты.

Radomska Margaryta (1983). Candidate of Engineering. Associate Professor.
Ecology Department, National Aviation University, Kyiv, Ukraine.
Education: Ivano-Frankivsk National Technical University of Oil and Gas, specialty “Ecology and Natural Environment Protection”. Ivano- Frankivsk , Ukraine (2005).
Research area: related to environmental risk assessment, environment condition assessment and prognosis.
Publications: 30.
E-mail: m_radomskaya@mail.ru

Golovko Anna (1991). Student.
National Aviation University, Kyiv, Ukraine.
E-mail: anna_holovko@ukr.net