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To cite this article: U T Gayrabekov *et al* 2020 *IOP Conf. Ser.: Earth Environ. Sci.* **579** 012100

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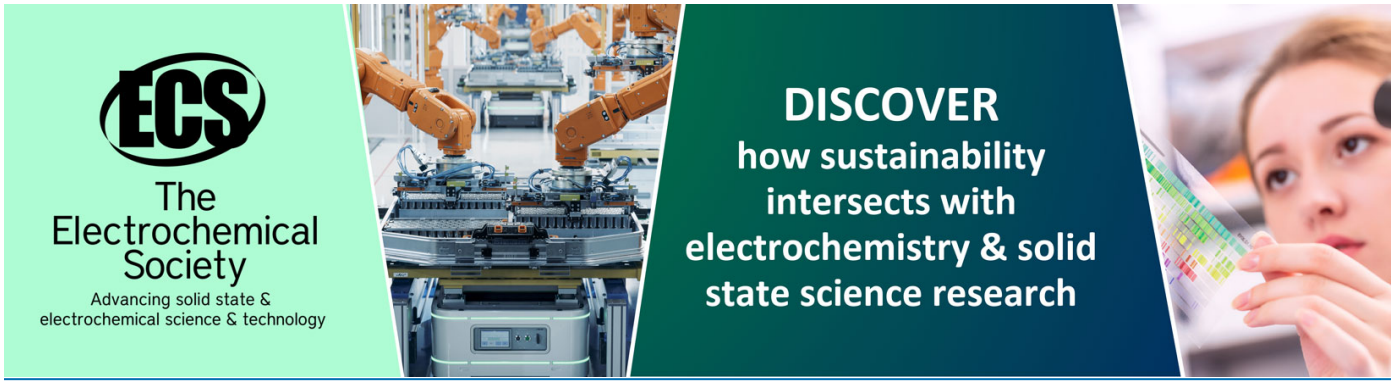

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Geoecological impact assessment of storage facilities of crude oil and refined products on the natural environment components (for example Grozny)

U T Gayrabekov[1, 2], I A Kerimov[2, 3, 4] and Z Sh Gagaeva[1, 3]

[1] Department of Ecology and Nature Use, Chechen State University, 32 A, Sheripova str., Grozny, 364907, Russia
[2] Department of Geology and Mineral Resources, Academy of Sciences of the Chechen Republic, 13, M. Esambaev ave., Grozny, 364024, Russia
[3] Department of Applied Geophysics and Geoinformatics, Millionshchikov Grozny State Oil Technical University, 100, Isaeva ave., Grozny, 364061, Russia
[4] S.I. Vavilov Institute for the History of Science and Technology of the Russian Academy of Sciences, 14, Baltiyskaya str., Moscow, 125315, Russia

E-mail: z.gagaeva@chesu.ru

Abstract. The work is devoted to the impact assessment of storage facilities of crude oil and refined products on the natural environment components of Grozny. It is noted that during the storage of oil and products of its processing in-ground and underground metal tanks, they pollute the natural environment components, worsening their sanitary and hygienic condition as a result of vapor evaporation and leakage of petroleum products from processing facilities. The impact analysis of storage facilities of crude oil and refined product on the natural-anthropogenic environment is carried out. To optimize the use of natural resources management and impact assessment of crude oil and refined products on the environment is considered the storage facilities' impact of crude oil and refined products on individual natural environment components. A map chart of pollution focuses on the industrial zone of Grozny has been compiled. Based on the identified patterns of petroleum product distribution in the geological environment are proposed recommendations for environmental rehabilitation of the geological environment of Grozny.

1. Introduction

Numerous domestic and foreign works are currently devoted to research on environmental pollution problems with petroleum products and the petroleum recovery consequences. The relevance of these problems is not in doubt today. Thus, in studies on the oil effects on sea waters, the authors note that crude oil and refined products are stored in the water for a long time; also, the duration of these effects will affect many more decades [1]. Other authors note that as a result of oil blowouts, it can affect the pore volume in soils, which can subsequently disrupt air and water exchange and hinder plant growth [2]. Soil pollution with petroleum products is considered a serious environmental problem. Over time it (in particular, diesel pollution) leads to an increase in the water-repellent properties of the soil and poses a threat to human health [3]. Problems of soil and water pollution with petroleum products and environmental disasters caused by them are covered in several other works [4, 5]. The problems that

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arise do not exist separately from each other. They coexist, complement each other, and are interdependent. Gradually, they are becoming a common problem that is moving to a global level. There are well-known consequences that affect environmental conditions and human health. However, for many of us, these consequences are virtual and do not cause us a corresponding reaction. But in each case, these consequences are linked to a tragedy. For example, from April 20 to early June 2010, as a result of an explosion on the Deep Water Horizon platform (British Petroleum company), oil spilled into the Gulf of Mexico amounted to almost 1 million barrels per day and claimed human lives [6].

Oil and petroleum product storage facilities are direct sources of environmental pollution. In the process of "large" and "small" tank breathing and vapor evaporation atmospheric air pollution occurs. Pollution of soil, ground, surface and groundwater is mainly associated with sewage, storm and meltwater containing petroleum products formed by leaks from processing facilities. Environmental pollution sources are also storage facilities of fuel filling stations, agricultural and other oil tank farms, oils and greases, and overpasses for the discharge and loading of petroleum products. Depending on the storage and application conditions, losses of grease lubricants reach 30-40% of their total consumption [7, 8].

Leaks of petroleum products, and consequently their losses, occur mainly due to insufficient control of the technical condition of the shut-off valves, pump glands, regulating equipment, seepage of pressure and suction hoses. The petroleum product seepage observed on reservoirs through micro-cracks invisible to the naked eye leads to large losses. We are talking about large losses of petroleum products during storage. Therefore, oil depots that store petroleum products, based on the sanitary standards of industrial process engineering (CH 245-71), can be attributed to the 1st harm class to the environment [9].

Oil recovery, transportation, storage and processing is usually accompanied by emergency and man-made leaks, oil spills to the surface. Oil is the main pollutant of the natural environment components of the Chechen Republic, for a long period, the oil complex operated using low-tech schemes of waste disposal [10]. At the same time, the maximum violations of natural landscapes and their transformation are observed in the area covering Grozny and adjacent territories, where soils, ground, surface, and subterranean waters were heavily polluted [11–13].

To solve some related problems associated with the study, it is proposed to create geodynamic polygons in the areas of oil fields. This is due to the study of the induced earthquakes genesis caused by the oil field development [14, 15].

2. Materials and methods

The article is based on the research results on the impact assessment of oil industry facilities on the natural-anthropogenic environment. Materials of field research (1991-1993; 2001-2004; 2007-2008), remotely sensed data LANDSAT – 5.7, archive materials, statistical and literary sources were used.

3. Results and discussion

The growing energy needs of fossil fuels and the resulting extraction of fuel resources have led to large-scale oil spills and environmental disasters. The physical and chemical approaches to oil and petroleum product spill response are mentioned in the works of some authors, who consider them sufficiently productive for remediation of polluted space, but still limited in the final results [5].

Storage of oil and petroleum products is an important link in a complex system of recovery-processing-storage – transportation of oil and its products. During storage, oil, and petroleum products entering the environment, as a rule, pollute the gas blanket, soil, surface, and groundwater, impairing their sanitary and hygienic condition. This will continue until the policy of natural resources development, primarily oil production and processing, as well as oil products storehouse, is reviewed. The consequences of oil and petroleum products recovery and storage affect not only spatially, but also in terms of time duration [16, 17]. The study territory is Grozny, which is a classic example of a landscape that for decades (since the discovery of oil fields) has experienced the consequences of

storing oil and petroleum products.

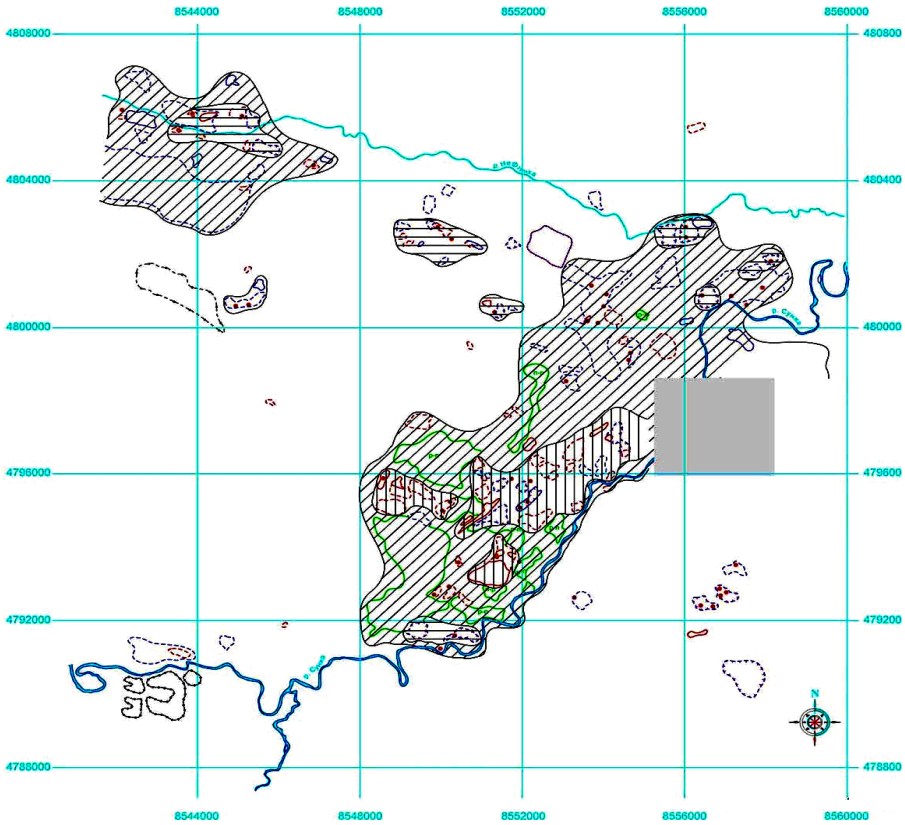

Figure 2. Pollution map chart of the industrial zone of Grozny

Legend:

areas and zones of pollution concentration associated with oil and petroleum products processing and storage facilities: 1-intensive pollution, 2-less intensive

areas and zones of pollution concentration of uncertain origin: 1-intense, 2-less intense

areas of intensive degradation of soil and vegetation cover

areas of the vegetable inhibition

anthropogenic anomalies of the temperature field

concentration areas of anthropogenic anomalies of the temperature field

anomalous areas of uncertain origin

areas with a high pollution level:
1-elevated, 2-high, 3-very high

areas of soil moistening

areas of soil erosion

To protect groundwater from contamination are used special measures, both to pollution prevention and to localize or eliminate a pollution groundwater area that has already been created in the aqueous

layer. To do this, use engineering structures whose layout, type, and design depend on hydrogeological conditions, the pollution source type, the pollution scale, as well as the nature and value of the protection object: the aquifer as a whole, individual groundwater intakes, surface watercourse, etc. The type of special protective measures to combat groundwater pollution should be chosen by the development results of the protection project feasibility, which should compare, on the one hand, the amount of damage from groundwater pollution and, on the other, the cost of various options for the natural environment protection.

Only based on the consumption scale of oil and petroleum products, it is possible to assess the environmental damage caused to nature as a result of natural losses. Therefore, the effectiveness of tools and methods that reduce the loss of petroleum products during storage, receiving and shipping operations, and storage methods that exclude petroleum products evaporation should be evaluated from environmental protection [4]. Of course, it is impossible to give a real (cost) assessment of environmental damage. All assessments are conditional.

The problem solution of land and water bodies reclamation of territories polluted with petroleum products is most often complicated by an extremely high level of their pollution, which prevents the activity of carbon-oxidizing bacteria and natural self-purification. In this regard, in each specific situation, depending on the scale and nature of the pollution distribution, an optimal technology is developed for the reclamation of subsurface rocks and underground water contained in them.

Existing methods of geological environment treatment from oil pollution are characterized by two fundamentally different technological approaches. The first approach is cleaning itself provides for the direct pollutant elimination from the geological environment. The second approach is based on the inactivation of contaminant (detoxification) by neutralizing, decomposing, binding, localizing, etc.

Currently, the development of technologies for geological environment cleaning from oil pollution is aimed at increasing efficiency and reducing the cost. This determines the main requirements for cleaning methods, that is the using possibility of the method in-*situ,* including at a significant depth, the method selectivity about certain ecotoxicants, the ecological cleanness of technologies and the absence of negative side effects in ecosystems, a relatively high degree and speed of cleaning.

Based on the identified patterns of petroleum product distribution in the geological environment of Grozny, recommendations for environmental rehabilitation of the territory are as follows:

- pumping of dissolved petroleum products accumulated at the groundwater level;
- territory cleaning from oil pollution should take place at the expense of aboriginal microflora with the introduction of nutrients and aeration through existing and additionally drilled wells; this procedure should be performed repeatedly in the presence of analytical control of the state of the solid and liquid phases of the geological environment.

4. Conclusion

The relevance of the problem of storage consequences of oil and petroleum products is well known and has many confirmations. Oil and gas continue to be the engine of the economy on the world market. It should be noted that there is currently an imbalance between supply and demand for oil. The decision on the production-decline rate of oil and gas has not yet been reached by society, because then it is necessary to switch to alternative sources of energy production. However, we should not forget that the consequences caused by oil recovery, storage, and processing activities continue to cause crisis and unstable situations in the environment.

Impact assessment of storage facilities of crude oil and refined products on the natural environment components allowed:

- assess the geo-ecological situation in the Zavodskoy district of Grozny due to the long-term impact of the oil complex;
- identify the features of the influence of storage facilities of oil and petroleum products on the natural environment components;
- draw up a pollution map chart of the industrial zone of Grozny;

- based on the identified patterns of petroleum product distribution in the geological environment, to propose recommendations for environmental rehabilitation of the geological environment of the Zavodskoy district of Grozny.

The current environmental situation in the Zavodskoy district of Grozny is the result of long-term operation of the oil complex with obsolete technologies, non-compliance with environmental legislation, and military actions on the territory of the Republic. It aggravates the difficult environmental situation in the region and poses a threat to the unique ecosystems of the Caspian Sea.

To ensure environmental safety, measures are needed to minimize the impact of anthropogenic deposits of petroleum products on the natural-anthropogenic environment of Grozny and the environmental rehabilitation of urban landscapes. This should take into account the "oil history" of the territory, where were accumulated and "preserved" environmental problems. These problems elimination is not less than a long period.

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