



Development of Ecological Regional Maximum Permissible Concentrations of Fuel Oil in Arid Soils of South of Russia

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Abstract: Soil contamination with oil and petroleum products, including fuel oil is often found in the South of Russia. The growth of oil production and transportation leads to increased soil pollution in the region. It is established that contamination of the studied soils with fuel oil leads to deterioration of their biological properties: the total number of bacteria, activity of catalase and dehydrogenase, cellulolytic ability, abundance of bacteria of the genus *Azotobacter* decreases, indicators of germination and initial growth of plants deteriorate. A series of soil resistance of arid ecosystems of the South of Russia to fuel oil pollution has been obtained. (number-averaged doses, the soil located at least reduce their resistance): ordinary black \geq dark brown soil > chestnut soil > light chestnut soil > brown desert-steppe soil > sandy soil. The study allowed us to propose regional standards for the maximum permissible content of fuel oil in the arid ecosystem of the South of Russia on the basis of violations of environmental and agricultural soil functions.

Keywords: Arid soils, Brown semi-desert soils, Chestnut soil, Fuel oil, Maximum permissible concentrations, Pollution, Resilience, Sandy soil

Currently, oil and oil products are one of the main soil pollutants. Sources of soil pollution with oil products can be leaks from underground tanks and pipelines, accidental spills during transportation, irregularities when drilling wells and improper waste disposal methods, unauthorized tapping into oil pipelines, gas stations, boiler houses, etc. (Rakowska et al 2012, Vodyanitsky et al 2016, Hewelke et al 2018). Soil contamination by oil and oil products causes a great damage to soil fertility (Yeung et al 2011, Anikwe et al 2019). This is due to the fact that petroleum hydrocarbons are mixtures of organic compounds with low bioavailability, and in addition are potentially carcinogenic and mutagenic (Janbandhu and Fulekar 2011, Souza et al 2012, Kaczyńska et al 2015). Oil products are characterized by high toxicity, scale of pollution and high ability to migrate (Bandura et al 2015, Bieganowski et al 2018). In assessing the eco-toxicity of heavy metals and oil products, biological indicators of the state of the soil play a primary role (Adesina and Adelasoye 2014, Kazeev et al 2016). Soil pollution by oil and oil products, including fuel oil, is often found in southern Russia. Volgograd and Astrakhan regions, Krasnodar Territory, Ingushetia and the Chechen Republic have great potential of hydrocarbon raw materials. An increase in oil production and transportation leads to increased soil pollution in this region (Atlas of socio-economic development of the South of Russia 2011). Soil conservation in arid ecosystems is important to maintain the biodiversity and sustainability of natural ecosystems.

The soil cover of arid ecosystems in the South of Russia is represented by zonal chestnut and brown semi-desert

soils, as well as intrazonal sandy brown semi-desert soils (National Atlas of Soils of the Russian Federation 2011). These soils differ significantly in ecological and genetic properties (Val'kov et al 2008), and accordingly, in resistance to fuel oil pollution (Kolesnikov et al 2010). Accordingly, the maximum permissible concentration of pollutants in these soils should also differ. The aim of the work is to develop regional standards for fuel oil content in arid soils of the South of Russia.

MATERIAL AND METHODS

Fuel oil pollution was simulated in the laboratory conditions. The soils of arid ecosystems of the Southern Russia (dark chestnuts, chestnuts, light chestnuts soils (arenosolscalcaric), as well as ordinary chernozems (chernozemschernic), were used as objects of study. Soil samples for model experiments were selected from the top layer from the 0-10 cm surface. In the non-arable soils, the major amount of the pollutants is accumulated in this particular layer (Tables 1, 2).

Soil contamination by fuel oil was simulated as a percentage 1, 5, 10 per cent of the soil mass, Contamination of soil by fuel oil in such concentrations is often found in areas of oil extraction, transportation and processing of gasoline, even after the liquidation of pollution. The soil was incubated in the vegetation vessels at a room temperature (20-22°C) and the optimal moisturizing (60% of the field moisture capacity) in a three-fold replication. The biological status of the soil was determined 30 days after the pollution. For the