In this study, we investigated the problem of air pollution by harmful substances secreted by the sludge in storage in the sludge maps. Studied the emission of harmful substances in the atmospheric air in the territory of placing the sludge of wastewater treatment plants. It determines the intensity of emission of harmful substances into the atmosphere. To assess the quality of air pollution collected, processed and systematized information about cards sludge as a source of air pollution, physical characteristics and emissions, as well as qualitative and quantitative composition of the emissions of pollutants. Based on these data it was calculated the dispersion of pollutants and predicted excess of maximum permissible concentration of ammonia and hydrogen sulfide. To confirm the results of the calculations, experimental studies of pollutants in the atmospheric air. Analysis of experimental data has shown that in the atmospheric air near the experimental sludge card present excess of maximum permissible concentration of hydrogen sulfide over 3 MPC. Projected as a result of the calculation of the distribution of the air pollution level on the surface of the sludge and cards near the city of Naberezhnye Chelny excess ammonia experimental research has not been confirmed.

Keywords: sludge, silt cards, air pollution, emissions of pollutants, ammonia, hydrogen sulfide.

1. Introduction

At present, air pollution is one of the main consequences of negative human impact on the environment. Atmospheric air - important for all living natural resources, on the quality of which largely depends on human health. One of the air pollution sources include surface maps silt sludge landfills. Silt maps produced after collecting wastewater [1]. Sludge cards are designed for the storage and dewatering of sludge, formed as a result of the passage of sewage treatment plants in the purification steps. Such waste, for the most part, cannot be any processing except dewatering.
sludge on fields in vivo. The process of longterm and occupies a huge area under the silt card. In addition, storage of sludge leads to the spread of negative-gas background and does not exclude air pollution by toxic components that are part of precipitation [2].

In the Russian Federation annually produce more than 2 million tons of sewage sludge in terms of dry matter [3]. Large amounts of sludge, multicomponent, and the presence in their composition of heavy metal compounds, along with other pollutants, as well as lack of appropriate recycling technologies leads to their accumulation and, consequently, the rejection of land for storage.

Silt area on a natural basis is ground, specially planned in several areas, which are called maps. They are one of the oldest and most proven ways to waste sludge generated in the primary settling tanks, digesters, settlers bunk [4].

As a result of biochemical processes in the silt from the surface of sludge cards in the air releasing substances that give the neighboring gaseous environment stench and causing the residents of nearby settlements constant discomfort and deterioration of health [5]. The decay of organic matter favors entering the airspace of hydrogen sulfide and ammonia. Air pollution causes diseases such as lung cancer, throat and skin, central nervous system disorders, allergy and respiratory diseases, birth defects, and many others. This list is determined by the presence in the air pollutants and their joint impact on the human body[6].

It should be noted that the amount of sludge, modified through anthropogenic effects of human activity, is already reaching a significant size, and every day this number is growing.

The need for research in this area based on the fact there are a number of comprehensive aspects of this problem. They make it even more relevant in precisely the moment due to the fact that:

- an increase of sources of sludge, the geography of their distribution;

- complicated composition of sludge, which includes a growing number of environmentally hazardous components;

- people made up an increasingly negative attitude towards the "traditional" methods of disposal of this type of waste to be exported to landfill;

- legislation on waste management of different origin becomes tougher;

- introduced innovative technologies for waste disposal, including using modern waste sorting systems are built incinerator plants - power plants, landfills;

- apply new economic approaches that include an increase in the price of waste disposal, are brought to a modern system of waste management of private enterprises and major investors[7].
That is why scientific research on the assessment of anthropogenic load on the air basin of large industrial cities, as well as the development of measures for air emissions reduction are topical modern problems.

2. Experimental part

On the surface of the sludge cards by treatment facilities of urban water utilities in the air as a result of chemical and biochemical degradation following pollutants are allocated: volatile organic compounds (mainly: saturated and unsaturated aliphatic hydrocarbons, aromatic hydrocarbons, aldehydes, ketones, esters), ammonia, organic amines, hydrogen sulfide, carbon disulfide, mercaptans and others[8]. Many of them form an unpleasant fecal odor. Certain substances are characterized by the toxicity. Other materials in atmospheric conditions involved in chemical reactions that result in the formation of secondary pollutants[9].

Such emissions makes the following environmental risks:

- pollution of the soil, rivers, reservoirs and groundwater with heavy metals;
- epidemiological danger of parasites and helminths (pathogenic microflora);
- the death of the surrounding flora and fauna;
- the spread of fecal odor.

Calculation of volumes pollutant emissions from the surface of sludge cards represents general nature. It does not take into account the peculiarities of the particular chemical composition as the aqueous phase and the anhydrous portion sludge silt certain city fields. Thus, a feature of treatment facilities in NaberezhnyeChelny is to bring together urban wastewater of the city and industrial wastewater containing heavy metals, petroleum and oxygenated volatile organic compounds, etc[7]. It is clear that in this case the quantitative chemical analysis contained in the air over the silt cards pollutants is essential and allows you to get information about the real nature of air pollution treatment facilities[10]. This will, in particular, to develop more effective measures to reduce air pollution and reduce the emission of pollutants. The complex biological treatment facilities for sludge treatment are provided for dewatering sludge fields in natural conditions and mechanical dewatering plant (Fig. 1). Sludge fields are planned land (maps), enclosed on all sides by earthen ridges. The number of cards has 54 units, the area occupied by silt fields is 101 hectares, silt cards occupy 75 hectares. Sludge cards arranged in three stages: stage A-B, consisting of 26 cards (130 x 80 m), a cascade of C-D, consisting of 18 cards (140 x 80 m) and a cascade of E-F, consisting of 10 cards (130 x 80 m). The depth of all the cards of 2 meters. Sludge fields are the technical facilities intended for the mechanical dehydration (disinfection) of sewage sludge, according to SNIP 2.04.03-85 "Sewerage. Externalnetworksandfacilities".
Figure 1: Technological scheme of sludge fields of regional wastewater treatment plants.

After filling out the cards silt site sediment and sludge draining the separated water further dewatering is carried out by evaporation of the remaining moisture from the surface [11].

The total capacity of all the silt cards is 1,152,000 m$^3$.

Since the commissioning of the biological treatment plant (1974) has been more than 40 years, silt card is almost full.

The situation is complicated by the fact that the silt fields are in close proximity to population centers, as can be seen from Figure 2.

Figure 2: Silt cards (satellite image).

On silt card comes sediments with a moisture content of 97-98% of the pumping station digested sludge and sediments with humidity of 75-80% of the capacity of the solid phase of mechanical sludge dewatering plant. Drain the water from the sludge fields are collected in the reservoir pumping station drainage water is pumped from the head of treatment facilities.

In order to assess the quality of the air pollution we have collected, processed and systematized information about cards sludge as a source of air pollution, physical characteristics and emissions, as well as qualitative and quantitative composition of the emissions of pollutants.
Summary calculation of the dispersion of pollutants [12] has been made on the basis of the data obtained. Performing the calculation, the influence of local weather conditions and terrain on the character of impurities distribution was considered.

To confirm the results of the calculations we have conducted experimental studies content of pollutants in the atmospheric air. Ammonia and hydrogen sulfide content in the atmospheric air was measured instrumentally. Sampling of air was conducted in accordance with claim 4 RD 52.04.186-89 and requirements in the measurement of selected parameters (Table 1). During the measurement data sampling conditions were recorded.

Table 1: Measurement procedures

<table>
<thead>
<tr>
<th>Name of substance</th>
<th>Measurement procedures</th>
<th>Technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonia</td>
<td>RD 52.04.791-2014</td>
<td>Photometric</td>
</tr>
<tr>
<td>Hydrogen sulfide</td>
<td>RD 52.04.795-2014</td>
<td>Photometric</td>
</tr>
</tbody>
</table>

3. Results and discussion

The calculations provided a picture of the distribution of the air pollution above the surface of sludge cards near Naberezhnye Chelny (Fig. 1 – Map of ammonia dispersion, Fig. 2 – Map of hydrogen sulfide dispersion) [13].

The results of calculation of the distribution air pollution level above the surface of sludge card and near the city of Naberezhnye Chelny suggest excess of maximum permissible concentrations of the following pollutants: ammonia and hydrogen sulfide. Zones with maximum concentration at ground level on ammonia and hydrogen sulfide over 1 MPC observed directly above the silt cards. Exceeding the maximum allowable concentrations of pollutants emitted silt cards not intended for nitrogen dioxide, nitrous oxide, methane, saturated hydrocarbons [14].

Figure 1: Map of ammonia dispersion.
The highest concentration in the MPC ratios projected for the following pollutants: ammonia 4 MPC; hydrogen sulfide 7.5 MPC.

Ammonia has a colorless gas with a pungent odor. Gaseous ammonia is a toxic compound. Maximum permissible concentration of ammonia in the atmospheric air is 0.02 mg / m$^3$. Ammonia is dangerous if inhaled. In acute poisoning with ammonia affects the eyes and the respiratory tract. At high concentrations, death is possible. It causes coughing, choking, with a high concentration of vapor - the excitement, delirium. Skin contact causes burning pain, swelling, burns with blisters. In chronic poisoning, there are digestive disorders, catarrh of the upper respiratory tract, easing of hearing. Hydrogen sulfide gas is heavier than air, has the smell of rotten eggs. Outside of manufacturing hydrogen sulfide formed during the decay of organic (protein) products. Maximum permissible concentration of ammonia in the atmospheric air is 0.008 mg / m$^3$. The general effect is to block the tissue respiratory enzymes. At low concentrations, hydrogen sulfide irritates, and then depresses the respiratory system (at high concentrations it happens instantly). At high concentrations as a result of the defeat of smell does not feel heavy smell of hydrogen sulfide. At low concentrations, the beginning is marked irritation of the conjunctiva and cornea, the symptoms of inflammation in the nasal cavity, cough, weakness, salivation, headache, low blood pressure, rapid pulse; with longer lesions may develop pulmonary edema. Based on the results of the calculations and the obtained dispersion maps of priority pollutants and identified sampling points were selected. Sampling of air was carried out in four silt cards sludge landfill water treatment plant at a height of 2 meters to 4 km from the western edge of the city of NaberezhnyeChelny in the summer and autumn. During the experiment conducted instrumental monitoring of the content of the priority pollutants (hydrogen sulfide and ammonia) in the atmosphere air in the vicinity of experienced silt cards. Measurement results (average values) are presented in Table 2.
Table 2. Results of air quality analysis about advanced sludge cards.

<table>
<thead>
<tr>
<th>Object</th>
<th>Pollutant</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ammonia, mg / m³</td>
<td>hydrogensulfide, mg / m³</td>
<td></td>
</tr>
<tr>
<td>Card №5</td>
<td>0.003</td>
<td>0.030</td>
<td></td>
</tr>
<tr>
<td>Card №9</td>
<td>0.059</td>
<td>0.037</td>
<td></td>
</tr>
<tr>
<td>Card №10</td>
<td>0.003</td>
<td>0.024</td>
<td></td>
</tr>
<tr>
<td>Card №11</td>
<td>0.004</td>
<td>0.040</td>
<td></td>
</tr>
</tbody>
</table>

Table 3. Coefficients of concentration of pollutants in the atmospheric air at the water treatment plant sludge cards relatively MPC.

<table>
<thead>
<tr>
<th>Object</th>
<th>Pollutant</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ammonia</td>
<td>hydrogensulfide</td>
<td></td>
</tr>
<tr>
<td>Card №5</td>
<td>0.02</td>
<td>3.8</td>
<td></td>
</tr>
<tr>
<td>Card №9</td>
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</tr>
<tr>
<td>Card №10</td>
<td>0.02</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>Card №11</td>
<td>0.02</td>
<td>5.0</td>
<td></td>
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</tbody>
</table>

Analysis of the data (Table 3) shows that in the atmospheric air in the vicinity of experienced silt cards present excess of maximum permissible concentration of hydrogen sulfide over 3 MPC. Projected as a result of the calculation of the distribution of the air pollution level on the surface of the sludge cards near the city of Naberezhnye Chelny excess ammonia experimental research has not been confirmed.

Thus, the work shows the dangers of air pollution discharge of pollutants from the surface of sludge card of sludge fields of urban water utilities and the necessity of measures to reduce the emission of pollutants into the air.

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4. References
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