Strategic prerequisites and prospects of environmental management on the example of EuroChem-BMU LLC

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Abstract. EuroChem is located in the Krasnodar Territory, Belorechensky District. Production processes were analysed. The implementation of environmental protection measures aimed at reducing environmental impact is noted. The costs of environmental protection measures are calculated. It is one of the leading suppliers of mineral fertilisers in Russia and the CIS. The size of the sanitary protection zone has been established. Along with the development of production aimed at increasing production, the company’s subdivisions carry out environmental protection measures aimed at reducing the impact on the environment. The costs of environmental protection measures have been calculated.

1 Introduction

Today nitrogen, phosphate, potash, complex NPK and water-soluble fertilisers can be produced. Among the main advantages of the products are the purity of raw materials extracted from domestic deposits, advanced European technologies integrated into production, quality control at every stage from extraction to packing. The range of products developed for a wide range of crops and natural conditions will meet the needs of any agribusiness. The company’s portfolio includes nitrogen, phosphate and potash fertilisers, including the tried-and-tested classics: ammonium nitrate, ammophos, potassium chloride; as well as products with increased efficiency and special purpose: granulated NPK grades and fertilisers with sulphur. Highly efficient agricultural production and increased profitability are EuroChem’s main focus. This is why the company is developing new forms and formulations to improve the efficiency of plant nutrition and reduce environmental impact. The site is located in the Krasnodar region, Belorechensky district. GPS coordinates: N 44° 45' 21.7296” E 39° 46' 0.3972”. Cadastral number 23:39:0602005:722.
2 Main part

LLC “EuroChem-Belorechensk Minudobrenia” has been operating since 1977 and supplies fertilisers for agriculture in the Krasnodar Territory, the Russian Federation and abroad.

The territory of EuroChem-Belorechensk Minudobrenia LLC covers an area of 544 hectares and is located in the south-eastern part of the Belorechensk District of the Krasnodar Territory. The industrial site of the chemical plant occupies a watershed between the Przysh and Pshekha rivers, crossed by the Ganzha-1 and Ganzha-2 beams.

Limited Liability Company “EuroChem-BMU” is located 8 km west of Belorechensk on the allotted site of the industrial zone (2.5 km from the village of Lukashina and the village of Druzhnoye), which corresponds to sanitary rules and norms SanPiN 2.2.1/2.1.1.12016-03. The total area of the land plot allocated for the objects of the enterprise is 5443200 m², including asphalt or concrete pavement - 201976 m², ground pavement - 177724 m², lawns - 205500 m². The industrial site is one.

Belorechensky District is located in the central part of Krasnodar Krai, on the southern border of the climatic belt of temperate latitudes. An important factor affecting the district's climate is atmospheric circulation, which is characterised by meridian directionality against the background of general zonal transport. EuroChem-BMU LLC is located in an area of interaction between the wastes of different western black circulation systems. As a result of the overlapping of the local circulation with the general circulation, and also due to the peculiar conditions of orography, the prevailing winds during the year, according to the data of the Belorechensk meteorological station, are of an easterly direction. Westerly winds are somewhat less frequent, but rather significant. In summer, the wind direction is extremely unstable and the east wind direction prevails less frequently. Westerly winds prevail in July.
Fig. 1. Wind Rose in Belorechensk

The average annual air temperature in the survey area is 11.1 °C. The average air temperature of the coldest month (January) is minus 1.1 °C, the warmest month (July) is 22.9 °C. The absolute minimum reaches minus 38.7 °C, the absolute maximum 41.5 °C. The amplitude of fluctuations of absolute air temperatures is 80.2 °C. The first frosts occur on average in the third decade of October, the last frosts in the first decade of April. In some years, the first frosts are possible in the third decade of September, the last in the second decade of May, but the probability of such values is low.

Soils on the territory of the district are distinguished as follows:
- chernozems, leached low and low-humus super thick (in the north-west and north-east of the rayon);
- chernozems, leached merged of different thickness (on the watersheds between the rivers Marta and Przysh, Przysh and Belaya, Belaya and Psenafa);
- grey forest-steppe and forest (in the south of the district);
- meadow and meadow-chernozem (valley of the Belaya and Psenafa rivers);
- meadow (floodplain), less often wet meadow (the valley of the Przysh River).

Leached chernozems are merged light clayey and clayey on quaternary brown clays and loams with olive tinge. The characteristic morphological feature of soils is unusually dense composition, merging, especially in horizon B. Merging and lack of drainage causes stagnation of water on the soil surface in wet years. By granulometric composition soils belong to clay and loamy varieties and their humus is rich in nitrogen [1, p. 219].

Table 1. Distribution of lands by categories

<table>
<thead>
<tr>
<th>no.</th>
<th>Land categories</th>
<th>ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Agricultural land</td>
<td>69490</td>
</tr>
<tr>
<td>2</td>
<td>Lands of populated areas</td>
<td>19971</td>
</tr>
<tr>
<td>3</td>
<td>Lands of industry, energy, transport, communication, radio broadcasting, etc.</td>
<td>2224</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Distribution of lands by categories.
<table>
<thead>
<tr>
<th>Lands of specially protected territories and objects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lands of the forest fund</td>
</tr>
<tr>
<td>Lands of the water fund</td>
</tr>
<tr>
<td>Reserve lands</td>
</tr>
</tbody>
</table>

Mineral resources of the district: non-metallic building materials: clay raw materials, sand and gravel mixture, building sands; thermal waters and healing muds.

Vegetation of the district - steppes, forest-steppes and broad-leaved forests (occupy more than 80% of the area of the district). The vegetation on pastures is grass-grass: awnless brome (Brōmus inērmis), bristlewort (Setária), thistles (Sônchus), daisies (Matricária). The following weeds are common on arable land: bristlecone (Setária), wheatgrass (Elytrígia), thistles (Sônchus), chickweed (Amaránthus), ragweed (Ambrosia), barnyardgrass (Thláspi), chamomile (Chenopódium).

Wildlife of the area - more common: fox (Vulpes vulpes), hare (Lepus), badger (Meles meles), jackal (Canis aureus, literally "golden dog"), wild boar (Sus scrofa), wolf (Canis lupus), weasel (Mustela nivalis), hedgehog (Erinaceus europaeus), mouse (Mus musculus), less common: Deer (Cervidae), elk (Alces), roe deer (Capreólus capreólus), muskrat (Ondatra zibethicus), raccoon dog (Nyctereutes procyonoides), striped raccoon (Procyon lotor); many birds.

Production is classified as Class I. Class I (extremely hazardous to humans). These include sulphur-carbon production and large agro-industrial complexes, and pig-breeding enterprises.

According to sanitary rules and regulations SanPiN 2.2.1/2.1.1.1.1031-01, the current production of LLC "EuroChem-BMU" belong to class I for the release of harmful substances, for which the size of the sanitary protection zone is set at a distance of at least 1000 m from the fence of the plant [2].

Within 1000 m there are field protection plantations. For protection of the industrial site along its perimeter there are 25 m wide isolating type forest belts, and on the rest of the territory there are 16 m wide filtering type forest belts at a distance of 100 m from each other. The territory of the sanitary protection zone includes forest plantations of Belorechnoye lesnichestvo and Belorechenskoye leskhoz on the area of 255 ha. The system of green plantings of the sanitary protection zone consists of separate forests of natural origin and forest strips, located perpendicular to the prevailing wind direction, taking into account which the blowing corridors from 60 to 80 m are arranged, coinciding with roads and railway communications on the territory of the green zone. Green plantings of the sanitary protection zone are a reserve of clean air, filter and precipitate heavy-suspended dust particles, direct air flows in the surface layer in the necessary direction (according to the project of Giprokommunstroy), which together with measures on gas and dust collection provides favourable sanitary and production conditions at the enterprise [3, p. 24].

For all harmful substances, individual and groups, possessing the effect of summation, emitted by the operating production facilities of LLC "EuroChem-BMU" the surface concentration at the border of the sanitary protection zone and beyond it is less than the maximum permissible concentration, established for residential areas. The nearest motorways and road junctions are located at a distance of 1.5 km from the main perimeter of the enterprise. At a distance of 0.5 km from the boundaries of all existing industrial facilities (sludge collectors, pumping stations, industrial communications) in operation, there are no...
other industrial and agricultural facilities and structures. All facilities of the enterprise are located outside the settlements.

The industrial site of the chemical plant occupies a watershed between the rivers Przysh and Pshekha (a tributary of the Belaya River), crossed by the Ganzha-1 and Ganzha-2 gullies, is located on the territory of the State Forest Fund and partially on the lands of JSC "Komsomolskoye". According to sanitary rules and norms of SanPiN, operating production at the chemical plant on the composition of emissions of harmful substances belong to class I, for which the size of the sanitary-protective zone is set at a distance of 1 km from the fence of the plant.

The chemical plant produces sulphuric acid, extraction phosphoric acid, complex mineral fertilisers - ammophos, liquid complex fertilisers, feed defluorinated phosphates. The production waste is called phosphogypsum. It is used in agriculture as a calcium-sulphur-containing fertiliser on soils with calcium and sulphur deficiency, as an additive in the production of organomineral fertilisers by composting, as an ameliorant for chemical reclamation of saline soils and as an ameliorant mixed with lime materials for chemical reclamation of acidic soils.

A comprehensive survey and analysis of the qualitative and quantitative composition of wastewater was carried out. In the course of which the initial effluent revealed the presence of a mixture of domestic, industrial and mixed wastewater, with extremely low BOD, 10 times lower than concentrations of domestic wastewater. At the same time, the phosphorus content was 5-8 times higher relative to the concentration for "standard" effluents.

Such disproportion in the initial effluent did not allow to apply the standard technology of biological wastewater treatment. It was decided to apply the IBR biochemical treatment technology. Using a mobile experimental unit, the unique technology of biochemical treatment of industrial wastewater was tested in real conditions. The tests confirmed the efficiency of IBR technology and allowed to reduce risks. Along with the development of production facilities aimed at increasing output, the company's subdivisions carry out environmental protection measures aimed at reducing environmental impact. The cost of environmental protection measures totalled about 133 million roubles.

### Table 2. Emissions of pollutants into the atmosphere from operating production facilities

<table>
<thead>
<tr>
<th>Emissions</th>
<th>MPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen (II) oxide (Nitrous oxide)</td>
<td></td>
</tr>
<tr>
<td>Hydrochloric acid</td>
<td></td>
</tr>
<tr>
<td>Sulphuric acid</td>
<td></td>
</tr>
</tbody>
</table>

### 3 Results

<table>
<thead>
<tr>
<th>Emissions</th>
<th>MPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>g/sec</td>
<td>t/year</td>
</tr>
<tr>
<td>Nitrogen (II) oxide (Nitrous oxide)</td>
<td></td>
</tr>
<tr>
<td>Hydrochloric acid</td>
<td></td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Substance</th>
<th>Value 1</th>
<th>Value 2</th>
<th>Value 3</th>
<th>Value 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federation Carbon</td>
<td>0.0162170</td>
<td>0.680000</td>
<td>0.0162170</td>
<td>0.680505</td>
</tr>
<tr>
<td>Sulphur trubilin dioxide</td>
<td>42.9096852</td>
<td>686.061</td>
<td>42.9096852</td>
<td>1070.39889</td>
</tr>
<tr>
<td>Sulphur wet element</td>
<td>0.8418000</td>
<td>-</td>
<td>0.8418000</td>
<td>6.000000</td>
</tr>
<tr>
<td>Hydrogen sulphide</td>
<td>0.00010410</td>
<td>0.000003</td>
<td>0.00010410</td>
<td>0.000009</td>
</tr>
<tr>
<td>Carbon vulpes oxide</td>
<td>16.2167767</td>
<td>8.25900</td>
<td>16.2167767</td>
<td>331.777093</td>
</tr>
<tr>
<td>Phosphoric anhydride</td>
<td>9.8175200</td>
<td>-</td>
<td>9.8175200</td>
<td>235.901900</td>
</tr>
<tr>
<td>Hydrocarbons</td>
<td>1.0048467</td>
<td>2.645</td>
<td>1.0048467</td>
<td>7.030622</td>
</tr>
<tr>
<td>Amyleni</td>
<td>0.1363333</td>
<td>0.341000</td>
<td>0.1363333</td>
<td>0.955717</td>
</tr>
<tr>
<td>Benzol</td>
<td>0.1096667</td>
<td>0.281000</td>
<td>0.1096667</td>
<td>0.765373</td>
</tr>
<tr>
<td>Xylene</td>
<td>0.1689000</td>
<td>0.207000</td>
<td>0.1689000</td>
<td>0.553103</td>
</tr>
<tr>
<td>Toluene</td>
<td>0.0403333</td>
<td>0.017000</td>
<td>0.0403333</td>
<td>0.057996</td>
</tr>
<tr>
<td>Dust shared with ammophos</td>
<td>4.2220130</td>
<td>56.02200</td>
<td>4.2220130</td>
<td>67.705800</td>
</tr>
<tr>
<td>Reaction petrol</td>
<td>0.3129800</td>
<td>0.330</td>
<td>0.3129800</td>
<td>4.150352</td>
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<tr>
<td>Paraffin</td>
<td>0.0184625</td>
<td>0.017</td>
<td>0.0184625</td>
<td>0.020919</td>
</tr>
<tr>
<td>Hydrocarbons</td>
<td>0.0338307</td>
<td>0.00092</td>
<td>0.0338307</td>
<td>0.002173</td>
</tr>
<tr>
<td>Ameliorant</td>
<td>8.3340000</td>
<td>-</td>
<td>8.3340000</td>
<td>148.862013</td>
</tr>
<tr>
<td>Local inorganic dust</td>
<td>70.000000</td>
<td>-</td>
<td>70.000000</td>
<td>70.000000</td>
</tr>
<tr>
<td>Inorganic dust prepared to 20% 8Y2</td>
<td>11.4901000</td>
<td>52.273</td>
<td>11.4901000</td>
<td>61.74200</td>
</tr>
<tr>
<td>Corundum white</td>
<td>0.0270000</td>
<td>0.076</td>
<td>0.0270000</td>
<td>0.0972</td>
</tr>
<tr>
<td>Weasel wood dust</td>
<td>75.49900</td>
<td>0.205</td>
<td>75.49900</td>
<td>0.730800</td>
</tr>
</tbody>
</table>

\[ \Delta m_i = m_{i1} + m_{i2}^{\text{new}} - m_{i2} - m_{isp} \]

\[ M = \Delta m_i \times K_{ei} \]

\[ Y_{est}^d = Y_{sp} \times \sum M \times K_{ei} \]

\[ Y_{est}^d = 62.1 \times 1006.08 \times 1.9 = 117999.44 \text{ rub.} \]
\[ \sum m = \text{the total present mass of pollutants for the period we calculate equal to one year, thousand tonnes} \]

\[ K_e = \text{coefficient of ecological situation and ecological significance of natural resources, for Kuban is equal to 1.9.} \]

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New technological concept of utilization animal and poultry waste.