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THE EFFECT OF POLLUTANTS FROM ATMOSPHERIC PRECIPITATION ON SOILS AND VEGETATION OF NORTHERN KAZAKHSTAN

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ABSTRACT

The chemical composition of rainfall over the territory of Northern Kazakhstan – the main agricultural region of the Republic is analyzed. On average for a year, precipitation belongs in neutral type, however for the vegetative period the relation of acid-forming anions to neutralized cautions in most cases is less than one, i.e. predisposition to acidification is observed. The amount of the sulfur, which is dropping out per unit area, is considerable. On the most part of the considered territory, it several times exceeds the norms, which are considered as admissible.

Keywords: Northern Kazakhstan, pollutants, hydrogen indicator, sulfates, vegetative period, dynamics of pollutants.

INTRODUCTION

The territory of Northern Kazakhstan is the main agricultural region of the Republic ensuring its food security. Naturally therefore that such problems as climate change, anthropogenous pollution of a superficial drain and soils, their acidification, other consequences connected with anthropogenous pollution and cross-border transfer of the pollutants (P) are of great interest as it can affect conditions of agricultural production in the region. To a question of influence of chemical substances of rainfall on a superficial drainage and soils, and dry falling out of substances, this research is also devoted.

In recent years, much attention around the world is paid to this problem, but in Kazakhstan, such works were practically not carried out, despite their relevance. Therefore, in this work the considerable attention, first is paid to a general characteristic of pollution of the dropping-out rainfall. It is expected that on this basis it will be possibility more deeply to consider single questions of the practical application of results.

Level of anthropogenous impact is connected with weather conditions and climate change directly or indirectly, and was of interesting at least at the quality level to estimate such influence.

The territory of Northern Kazakhstan belongs to a zone of risk agriculture where from five years only three are fruitful on average. The zones of irrigation agriculture located on the South of the Republic satisfy generally local requirements. Therefore, despite

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problems, Northern Kazakhstan is the main agricultural region, where grain is cultivated, ensuring food security of the Republic.

Zones of risky agriculture are especially sensitive to anthropogenous influences and climate change as systems of a surrounding environment being in a labile equilibrium with them. In such position, small but long influences can lead to irreversible consequences. It is clear therefore that the analysis of possible climate changes, dynamic of pollutants in precipitation in the region of Northern Kazakhstan has not only scientific, but also practical interest.

Territory of researches The territory of Northern Kazakhstan stretches from the South to the North from 51 ° to 55.5° N. L. and from the West to the East from 61 ° to 78 ° E. L. [1]. Here four administrative regions of the Republic are located: North Kazakhstan (Petropavlovsk), Kostanay (Kostanay), the Tselinograd (Astana) and Pavlodar (Pavlodar), however, the southern districts of the Kustanay and Pavlodar regions are not agricultural in view of noticeable reduction for rainfall and increasing in temperatures of the vegetative period (fig. 1) any more.

The territory is located in the center of Eurasia, and it causes the big annual amplitude of temperature and the low precipitation because of big remoteness from oceans, first from the Atlantic Ocean. The geographical location promotes also that at the prevailing west-east transfer the territory appears under emissions of pollutants by the enterprises of South Ural (Russia), and at transfer from the southern component – under emissions of the enterprises of the Central Kazakhstan located quite close.

Figure 1. Territory of researches

There are possible other trajectories of carrying out of pollutants on the region. Significant characteristic sources of emissions in Northern Kazakhstan are available only in Pavlodar and the Pavlodar region. The list of stations which data are analyzed included also Karaganda located a little to the south of the region of Northern Kazakhstan, but emissions of its enterprises considerably influence on a situation.

Materials and methods

Data Data of department of chemical analysis researches of National hydrometeorological service of the Republic of Kazakhstan for the five-year period of 2005 - 2012, on 48 meteorological stations (MS) were used. Stations are located rather evenly and served in the studied work as a starting material. Then, however, we were limited to data of stations only of Northern Kazakhstan.

Methods Samples of precipitation on a chemical analysis ware made at stations with using of the same devices and by a uniform technique [4]. Depending on conditions and duration of collecting rainfall different methods of samples of precipitation could be choose. We used the cooperative monthly tests, including all precipitation, which were dropping out within each calendar month.

The chemical analysis of all parameters was made by a uniform technique in strict accordance with the document [2, 3], which is common not only for the countries of the former Soviet Union, but corresponds to the criteria accepted in countries of Western Europe [4]. Such approach allows comparing data not only within the territory of the Republic, but also to data in territories of the countries – neighbors.

Samples were analyzed no later than in 10 days after receipt in laboratory where the following macro components are defined: value of pH, direct-current conductivity, and the active and total acidity. Mass weight concentration of macro components were analyzed: sulfate ions, nitrate ions, chloride ions, hydro carbonate ions, ions of an ammonium, sodium, potassium, calcium and magnesium – and trace components: phosphate ions, ions of zinc, lead, cadmium, manganese and nickel. Separately concentrations of heavy metals in precipitation were defined: lead, cadmium, copper and arsenic. Except the sizes pH in precipitation also the contribution of sulfates of a sea origin decided on use of data on the content of cautions of sodium. The main acid-forming anion took SO_4^{2-}.

$$|SO_4^{2-}|_{surplus} = |SO_4^{2-}|_{total} - 0,25|Na^+|,$$

where $|SO_4^{2-}|_{surplus}$ and $|SO_4^{2-}|_{total}$ – contents "surplus", i.e. not a sea origin of sulfates and total sulfates respectively.

$[Na^+]$ - content of sodium.

For the analysis of conditions of acidification, the relations of the equivalent concentration of cautions were calculated:

$$K = \left(Ca^{2+} + Mg^{2+} + NH_4^+ + Na^+\right)$$

and anions:

$$A = \left(SO_4^{2-} + NO_3^-\right)$$

Then relation K/A was found. If the size of this relation is equal or more one, then there is no threats of acidification of the surface water and soil. Otherwise, than the size of the relation is lesser than one, the probability of an acidification is higher.

At a conference on problems of acidity of an environment it was recommended to consider that acidification of the surface water is possible if the amount of the dropping-out sulfur with precipitation exceeds 0.5g/m² in a year [5]. Therefore, in the work calculations of size of the dropping-out sulfur, which is contained in pollutions, per square meter on stations of the region as for the whole year and for the vegetative period, are executed.

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Results

Distribution of the main substances in precipitation is presented in table 1.

Anions SO_4^{2-} have the greatest average concentration. At the same time, the maximum of concentration is observed in Kostanay, 21.1mg/l. In Pavlodar and Astana concentrations make 20.4 and 19.39 mg/l respectively. In Karaganda, the most advanced industrial center, they make only 9.4 mg/l. Thus, the spatial distribution of concentration will not quite be coordinated with volumes of emissions of this substance by the production enterprises in the corresponding points. Apparently, meteorological conditions, space transfer play a noticeable role. At the same time the minimum SO_4^{2-} 3.67 mg/l, takes place in the resort area of the region where there are no production enterprises.

Concentration of anions of HCO_3^- are slightly lower, than SO_4^{2-}, but they are too high. At the same time they will be not bad coordinated with a spatial distribution SO_4^{2-}, remaining in all

Stations	Precipitation, mm	SO_4^{2-}	Cl^{2-}	NO_{3-}	HC_3^-	NH_4^+	Na^+	K^+	Mg^{2+}	Ca^{2+}
		Anions				Cautions				
Kostanay	308,9	21,10	9,62	1,76	15,93	1,93	4,91	2,73	4,25	5,96
Petropavlovsk	372,0	7,91	6,29	0,90	6,12	0,80	3,00	1,34	1,26	3,32
Borovoe	359,4	3,67	1,97	1,55	3,15	0,50	1,34	0,69	0,55	1,34
Shchuchinsk	375,5	10,77	3,43	1,24	11,43	1,09	2,62	1,61	2,08	3,48
Astana	328,7	19,39	11,62	1,78	15,63	0,99	4,37	4,35	3,33	6,96
Karaganda	373,7	9,54	4,55	1,36	5,50	0,65	3,01	0,63	1,19	3,19
Ertis	281,4	5,37	2,15	1,25	7,59	0,31	1,30	0,98	1,14	2,70
Pavlodar	293,8	20,04	8,86	2,06	9,95	0,86	6,91	1,90	2,64	5,84

considered territory slightly lower, than concentration SO_4^{2-} Only in points Irtysh and Shchuchinsk concentration of HCO_3^- is above than concentration SO_4^{2-} (tab. 1).

Table 1 - The maintenance of anions and cautions in precipitation (mg/l)

Spatial distribution of anions of Cl^{2-} and Na^+ follow distribution SO_4^{2-} and HCO_3^-.

From cautions the highest concentration have Ca^{2+} and Na^+, at the same time distinctions in sizes of concentrations are not big. Only in Pavlodar concentration of Na+ exceeds concentration of Ca^{2+}, and in Borovoe they are equal and have minimum in the region, 1.34 mg/l. Concentration of Mg^{2+} and K^+ follow a spatial distribution of Ca^{2+} and Na^+, but their concentrations are much lower (tab. 1).

Common for a spatial distribution of anions and cautions is rather expressed regularity according to which to the level of concentration of one of substances there correspond the same levels of concentration of all other substances. It indicates high similarity of conditions of formation of all substances, which observe in concrete point.

Annual sizes of hydrogen indicator pH of precipitation and averages sizes of pH in five years are given in tab. 2. It is possible to see that averages for a year of the size pH

fluctuates ranging from 5.43 to 6.66, and averages in five years – 5.73 to 6.55. It is natural to assume that in separate cases of precipitation falling the size of pH can be as below, and above average sizes specified in the table 2.

Unfortunately, we have no data on acidity of separate rainfall. On average, however, the sizes pH are in the region ranging from neutral to weakly alkali type [1-4].

Table 2 – Hydrogen ion indicator pH in atmospheric precipitation

Stations	2005	2006	2007	2008	2009	Average
	pH					
Kostanay	6,43	6,30	6,11	5,99	6,17	6,20
Petropavlovsk	6,01	5,92	5,91	5,92	6,13	5,98
Borovoe	5,82	5,43	5,69	5,65	5,94	5,73
Shchuchinsk	6,21	5,81	5,69	5,75	5,94	5,88
Astana	6,66	6,36	6,50	6,55	6,66	6,55
Karaganda	6,06	5,95	5,91	5,97	6,23	6,02
Ertis	6,33	5,80	5,96	5,89	6,40	6,08
Pavlodar	6,20	6,09	5,95	6,05	6,33	6,12

Further, it was considered the dynamics of pH during the vegetative period (tab.3). The average size pH in the region during the vegetative period makes 6.11 at space variability ranging from 0.04 to 0.57. At the same time, the maximal variability were observed where the sizes pH were the least ones (tab. 3).

The table 3 Dynamics pH during the vegetative period

Stations	Month				Average	ΔpH
	May	June	July	August		
Kostanay	6.25	6.33	6.08	6.03	6.17	0.30
Petropavlovsk	6.21	6.15	5.96	5.94	6.06	0.27
Borovoe	5.54	6.09	5.82	5.92	5.84	0.55
Shchuchinsk	5.64	6.07	5.99	6.21	5.98	0.57
Astana	6.72	6.53	6.36	6.70	6.58	0.36
Karaganda	6.11	5.89	5.89	5.79	5.92	0.32
Ertis	6.02	6.06	6.05	6.04	6.04	0.04
Pavlodar	6.19	5.97	5.97	6.24	6.09	0.27
Sum	48.68	49.09	48.12	48.87	48.68	2.68
Average	6.09	6.14	6.02	6.11	6.09	0.34

In [6, 7], etc. the method by calculation of excess, i.e. not sea sulfates in precipitation with using of data on sodium is offered. The method of calculations was described above. It is known that anthropogenous acidification of rainfall is caused by dissolution in drops of clouds and rainfall of "surplus" sulfates, i.e. sulfates not of a sea origin. If surplus of sulfates were not, then it would be also no acidification there. Such sulfates

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can have a biogenic, terrigenous or anthropogenous origin. However, in most cases in the industrial regions sulfates have an anthropogenous origin. For this reason, they are of special interest. Let us consider results of calculations (tab. 4).

The table 4 Contents of "surplus" sulfates$SO_4^{2-} - 0.25Na^+$ in precipitation during the vegetative period (mg/l)

Months	Astana	Borovoe	Shchu chinsk	Karaganda	Kostanay	Pavlodar	Petropav lovsk
May	18.68	4.43	10.30	9.21	19.91	14.50	15.74
June	15.00	3.60	9.40	9.00	18.10	16.70	7.46
July	9.69	1.74	7.50	6.64	8.86	8.41	6.82
August	18.02	1.91	7.97	15.11	13.33	15.09	4.89
Sum	61.39	11.68	35.17	39.96	60.20	54.70	34.91
Average	15.35	2.92	8.79	9.99	15.05	13.68	8.73

From table 4 it is possible to see that the average for the vegetative period the content of surplus sulfates significantly changes across the territory. Extreme of surplus sulfates, in fact, were observed in the same places where also SO extreme: maxima in the districts of Kostanay and Astana, more than 15 mg/l, and a minimum in the area Shchuchinsk – Borovoe, 2-7 mg/l.

Interannual variability of sulfates is large. The least and greatest values of surplus sulfates calculated for the seven-year period for four months of the vegetative period differ from two to ten times (table 5).

Table 5 - Variability of "surplus" sulfates

Stations	Month							
	May		June		July		August	
	max	min	max	min	max	min	max	min
Astana	29.54	8.33	22.64	11.5	15.24	6.48	47.75	6.44
Borovoe	10.19	1.42	7.99	0.21	4.76	0.48	3.86	0.57
Shchuchinsk	17.42	0.76	16.22	0.68	12.24	1.9	19.05	0.73
Karaganda	13.95	7.2	17.92	5.35	16.3	2.23	51.91	1.59
Kostanay	59.42	5.92	27.61	11.78	15.03	6.51	17.05	6.28
Pavlodar	26.94	7.14	34.42	7.16	11.25	4.29	21.26	6.79
Petropavlovsk	38.6	3.05	14.36	4.8	9.54	3.81	7.32	2.73

At the same time a good inverse relation between an amount of precipitation, dropped out in a month, and concentration of "surplus" sulfates (fig. 2) takes place.

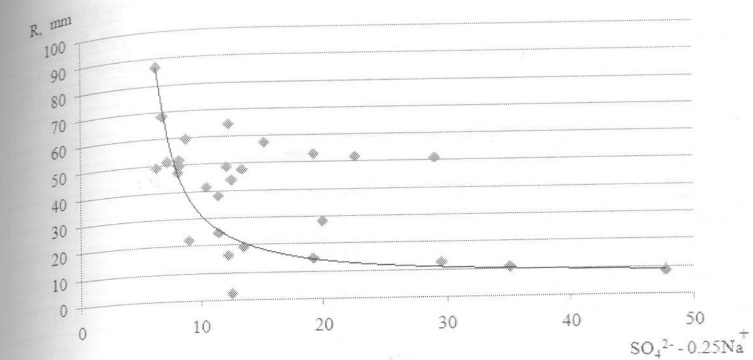

Figure 2. Dependence between "surplus" concentration of sulfur and an amount of precipitation

In most cases (to 70 %) the rule is followed that to extremely high concentration there corresponds extremely low amount of precipitation in this month, and to extremely low concentration – extremely high amount of precipitation. In other cases, probably, the direction from where air mass comes is defining. Similar results were received in [8].

It is interesting temporary change of concentration of surplus sulfates during the vegetative period. The greatest concentrations take place at all stations in May, which then go down to a minimum in July, and then again increasing a little in August (tab. 4). Some exception is observed in Petropavlovsk where depreciation in surplus sulfates continues also in August.

At the International conference on problems of acidification of components of an environment [5], it was recommended to take for the threshold size of content of sulfur 0.5 g/m ^{2} pro year. This size corresponds to the mean value of pH equal 4.7 respectively, if the content of sulfur surpluses 0.5 g/m ^{2} pro year, then conditions for acidification take place and if contents is lower, then - no.

We calculated amount of the dropping-out sulfur in several options: for the whole year, for the vegetative period. Results of calculations of amount of the sulfur, which is dropping out within a year, are presented in table 6.

It is possible to see that only near the station Borovoe amount of the dropping-out sulfur is lower than 0.5 g/m^2 pro year. At other stations, it exceeds this size in two – three times (tab. 6). Therefore, conditions for acidification of the soil are favorable practically in all territory of Northern Kazakhstan, however the dropping-out precipitation on average still neutral or weakly alkali type (tab. 2).

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Table 6. Amount of sulfur and ammonia nitrogen, dropping out with precipitation

Stations	Anions, mg/l			Sulfur, S		
	SO_4^{2-},	NO_3^-,	SO_4^{2-}/NO_3^-	S, g/m2	S, kg/ga	S, t/km2
Kostanay	13.38	1.47	9.10	1.54	15.40	1.54
Petropavlovsk	7.51	1.01	7.44	0.87	8.70	0.87
Borovoe	2.85	0.64	4.45	0.33	3.30	0.33
Shchuchinsk	9.47	0.96	9.86	1.09	10.90	1.09
Astana	13.17	1.38	9.54	1.52	15.20	1.52
Karaganda	9.33	1.06	8.80	1.08	10.80	1.08
Ertis	6.15	1.25	4.92	0.71	7.10	0.71
Ekibastuz	14.16	1.14	12.42	1.64	16.40	1.64
Pavlodar	14.77	1.55	9.53	1.71	17.10	1.71

Except sulfates an important acid-forming elements are nitrates. According to the same information in the table 6 nitrates make about 10 % of the content of sulfates in the region. We calculated the relation of sulfates to nitrates to specify their role. If this relation is more than one, then the role of sulfates prevails and if it is less, then the role of nitrates prevails. From table 6 it is possible to see that only in areas of Borovoe and Irtysh stations the relation is less than five. At other stations, it is higher and reaches or exceeds ten. Therefore, the role of nitrates in acidifying impact of rainfall is minor.

Neutralized properties in relation to sulfates are cautions of calcium and sodium. Cooperative content of these cautions in precipitation only at the Borovoe station is lower 1t/km^2, at all other stations it is higher (tab. 7).

Table 7. The sums of ions and neutralized cautions of calcium and sodium in an annual amount of precipitation

Stations	Sum of ions, mg/l	Ca^{2+}, mg/l	Na^+, mg/l	Ca^{2+}, g/m2	Na^+, g/m2
Kostanay	68.19	5.96	4.91	2.33	1.92
Petropavlovsk	30.94	3.32	3	1.18	1.07
Borovoe	14.76	1.34	1.34	0.42	0.42
Shchuchinsk	36.75	3.48	2.62	1.15	0.87
Astana	68.42	6.96	4.37	2.38	1.49
Karaganda	29.62	3.19	3.01	1.03	0.98
Ertis	22.79	1.3	2.7	0.37	0.77
Ekibastuz	33.97				
Pavlodar	59.42	5.84	6.91	1.56	1.85

The maximal concentration of cautions of calcium and sodium take place at stations Kostanay, Pavlodar and Astana, at the same stations also the highest sum of ions are noted.

The collateral analysis of sulfates (tab. 6) and neutralized cautions (tab. 7) shows that the cooperative content of neutralized cautions at all stations exceeds the content of sulfates of sulfur. Probably, this factor is also the basic in acidification process control, despite the high content of sulfates in precipitation.

For more overall estimating of influence of rainfall on acidification process we calculated for months of the vegetative period the relation of amount of the cautions neutralizing acidification to the anions promoting this process. These months are taken because sour precipitation during their dropping out can influence on activity of plants (table 8) directly.

Table 8. Distribution of relation K/A for months of the vegetative period

Stations	Month				Year	Number of months	Number of months K/A>1	Number of months K/A<1
	May	June	July	August				
Kostanay	0.85	0.88	1.07	0.92	0.93	40	13	27
Petropavlovsk	0.86	1.38	1.43	1.11	1.19	30	13	17
Borovoe	0.93	1.31	0.98	0.86	1.02	40	18	22
Astana	0.98	1.26	1.07	0.86	1.04	40	23	17
Karaganda	0.74	0.81	0.88	0.74	0.79	39	6	33
Pavlodar	0.74	0.68	0.68	0.68	0.7	32	0	32
Sum	5.1	6.32	6.11	5.17	5.67	221	73	148
Average	0.85	1.05	1.02	0.86	0.95	xxx	12,1	24,7

It is possible to see that only in 33 % of all months the amount of neutralized cautions exceededs quantity of acid-forming anions. Therefore, there are conditions for accumulation of sulfur in the soil and gradual acidification of all considered territory.

The expressed time course during the vegetative period has relation of neutralized cautions to anions. On average on the region, it grows of May by July, and then decreases in August. At the same time, dynamics of concentration of $SO_4^{2-} - 0.25Na^+$ has the return time motion with a maximum in April and a minimum in July (tab. 4). Comparing these sizes to the average size pH for the region (tab. 3), we can see that in four cases time of a maximum of surplus ions and the minimum size pH coincided, and in other three cases they did not coincide. To high concentration of $SO_4^{2-} - 0.25Na^+$ considerably there the low sizes pH correspond, however the weak positive correlation between the content of sulfur in precipitation and the size pH nevertheless is visible.

In [6] for five points of observations of EMEP in the territory of the former USSR the linear inverse relation between the content of surplus sulphatic sulfur and the size pH was found. Physical explanation of communication is prime. In the absence of the anions promoting acidification, rainwater is in an equilibrium state with pH which is equal to 5.6. The more sulphatic sulfur in precipitation, the below there has to be pH, i.e. the precipitation are sourer. We, apparently from tab. 8 and fig. 3, received that such dependence in fact is almost absent. Moreover, with increasing in concentration of sulfur the size pH even increases a little. In [8] the results of a research of this dependence on long-term data are contained.

It was received that with growth of the contents of sulfur during the long-lived temporary interval the size pH increases a little too. The second important conclusion from this research is the fact that the size pH practically does not react to the considerable fluctuations of content of sulfur in separate years. Still some other conditions are necessary, therefore, in order that acidification began.

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Discussion

According to our data, the maintenance of ions in precipitation in the region within a year fluctuates from 3.0 to 160 mg/l. Let us compare these data with results of other authors. In [8] data on a chemistry of rainfall for the four-year period at five stations of the former USSR by Voyeykovo, Kemeri, Mudyyug, the Vysokaya Dubrava, Kaunchi located close the cities of Leningrad, Riga, Arkhangelsk, Sverdlovsk, Tashkent respectively are analyzed. Ion concentrations fluctuated over a wide range from 3.0 to 67.0 mg/l. However, average sizes were slightly less – from 11.0 to 21.0 mg/l. At the same time, the maximal sizes were observed near the industrial centers of Leningrad and Sverdlovsk. The similar situation takes place and in our region though the concentration, which are observed at us, are higher. The maximal ion concentrations take place near the industrial centers of Pavlodar and Karaganda, and in Kostanay, where the large industrial enterprises are absent, but it is under the influence of emissions of the enterprises located in South Ural in Russia.

According to [7, 9] average annual sizes of ion concentrations in Irkutsk from 2000 for 2010 raised with 20 to 30mg/l with a minimum in 2005. These sizes are close to our averages on the region, but below the maximal averages. Large volumes of emissions characterize power and metallurgical industry of Kazakhstan and South Ural of Russia.

The considerable maintenance of ions in precipitation assumes existence and the significant amount of sulfates of sulfur as sulfates, according to a number of works [10-15] and our researches, make the main contribution to a cooperative mineralization of rainfall, about 50 %. The greatest average concentrations of sulfates take place in the same place where also the maximal ion concentrations, i.e. in Kostanay, Astana, Pavlodar (13-15 mg/l), and minimum - near the Borovoe station (2.85 mg/l) where there are practically no production enterprises.

The contribution of anions of NO_3^- in the course of acidification appeared less than 10 %. It coordinates with data [8] and others. At the same time, contribution of anions of NO_3^- in region of South Baikal is at least twice above than in our region and across Russia according to data [6-8]. Fulfilled by us in [15] analysis of distribution NO_3^- across the territory of all Kazakhstan did not show such high concentration anywhere too. A source of emissions near the Southern Baikal, thus, specific.

From the analysis of the sizes of excess sulfates calculated by us it is visible that they, in fact, are observed in the same place where also SO_4^{2-}: maxima in the districts of Kostanay and Astana, more than 15 mg/l, and a minimum in the area Shchuchinsk – Borovoe, 2-7 mg/l. The accounting of cautions of sodium in a formula of calculations exerts weak impact on assessment of a role of sulfates in general. Approximately the same results are received in [6,7].

For an important role of neutralized cautions in the course of acidification it is noted in [8, 11-14], etc. works. Communication, however, between sulfate of sulfur or sulfur in precipitation and acidity of rainfall is not obvious. The author [6] found for six stations EMEP the inverse linear communication between concentration of "excess" sulphatic sulfur and acidity of rainfall. Moreover, in work it is said that "the size of a slope angle is shown the more distinctly, than the weighted-mean pH value of rainfall", i.e. sensitivity of pH to change of concentration of sulphatic sulfur is high. However, in [8] based on the analysis of data of four stations located in different regions of the country it is not received for the twelve-year period (1962-1974) of such communication. We gave the result of such communication on one of stations received in [8] above.

From [8] we can see that with lowering of concentration of sulphatic sulfur pH of rainfall not only does not go down, but even increases a little. The second a conclusion important in our opinion from this drawing is the fact that on the studied period the size pH in fact did not react to the essential fluctuations of content of sulphatic sulfur taking place.

Similar data are obtained by authors [8] and for other stations which data they analyzed.

In [16] on the latest material similar researches are executed for the region of the Russian Arctic, and authors received the following: "The statistical regression analysis showed lack of correlation between averages on the region streams of sulfur and an index of pH in snow cover....".

We can see so, that our results about the connection between the concentration of sulfur and the size pH coordinate with a number of results of other researches of a problem. However, the mechanism of acidification is not clear yet.

CONCLUSIONS

As a result of the executed assessment of a chemistry of precipitation over Northern Kazakhstan and their possible acid impact on vegetation and soils the following is received:

Anions SO_4^{2-} make about 40 % in the total amount of anions. The contribution of a nitrate anion of NO_3^- makes 10 %. The cooperative contribution of the anions promoting acidification is close to 50 %.

From the cautions neutralizing influence of sulfates and nitrates, Ca^{2+} and Na^+ are prevailing. In the sum, they make up to 60 % of all cautions.

Despite excess on average for a year of cautions over anions during the vegetative period the number of months when acid-forming anions prevail over neutral anions concerns as two to one. Conditions for impact on vegetation and gradual acidification of the soil are available.

Correlations between dynamics of acidifying anions and the size pH for this region was not revealed though such communication, certainly, exists. Its mechanism is more complicated.

Now the signs promoting acidification of the soil are not revealed though predisposition takes place, especially during the vegetative period. The under average monthly sizes pH during the vegetative period indicate a possibility of direct negative impact on vegetation at separate rains.

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THE ENVIRONMENTAL IMPACT OF THE POLLUTANTS GENERATED BY MINING UNITS FROM JIU VALLEY COAL FIELD

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ABSTRACT

Environmental pollution has become one of the most debated issues of the contemporary times, being a consequence of using imperfect methods in production technologies.

One of Romania's areas where the environment has suffered as a result of human activities is the Jiu Valley, a place where the main activity was and continues to be mining.

In this paper the authors aim to identify and quantify the pollution sources related to the coal mining activity from the western part of the Jiu Valley and, based on data relating to this pollution, to identify, describe and assess/evaluate the impact generated on the environment.

For this purpose are covered, in a logical sequence several stages, starting with a short description of the Jiu Valley basin and mining units which operate in the studied area, identification of pollution sources associated with it, describing the evaluation methods of pollution and the impact assessment and finally the application of these methods to a concrete case.

Keywords: impact, air pollution, pollution source, evaluation methods, mine

INTRODUCTION

The environmental pollution has become one of the most debated issues of the present days. With great scientific advances that have revolutionized the human society, causing widespread use of the technique and the great boom of civilization in recent centuries, namely population growth and development of industry and transport, the waste quantity and nature have fundamentally changed. As pollution is a consequence of the use of imperfect methods of production technologies, which remain still wasteful with raw materials and energy, removing it is a matter of correcting the errors it causes.

Some of the main polluters of the environment are the energy and mining industry. The extractive activity, regardless of how unfold, always leads to long term negative effects on the environment.

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