

TECHNOGENIC ACTIVITY OF MAN AND LOCAL SOURCES OF ENVIRONMENTAL POLLUTION

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ABSTRACT

The technogenic activity of man influences considerably the environment. Groundwater chemical composition varies as a result of the influence of the local pollution sources such as chemical and organic fertilization agriculture, domestic and industrial wastes stored on the earth surface, air pollution in industrial areas, etc. Solid domestic and industrial wastes which are stored on the earth surface are affected by precipitation. As a result they dissolve different substances which penetrate the groundwater through the aeration zone as solutions and form pollution oreols.

INTRODUCTION

Estimation of the groundwater pollution requires consideration of the concentration behaviour and characteristics of the substance migration under technogenic human activity. The most important problem in the studies of the groundwater quality protection is the investigation of development of the technogenic local pollution sources and elaboration of recommendations on prevention of environment pollution. The results of the control chemical groundwater analysis for the functioning water intakes of one of the Byelorussian cities carried out by the Byelorussian Sanitary-Hygienic Research institute have been used for the study. The time behaviour of the main chemical components in the groundwater composition is analyzed in the paper. The present material allowed mathematical statistics methods to be used for its treatment and interpretation. Chemical analysis of annual samples from all the boreholes of the water intake were statistically treated.

RESULTS

The groundwater of aquifers between two glacial horizons are used

for water supply. The aquifers are represented by sands of different grain sizes, predominantly fine-grained, often clayish. One water intake is located near the area used for farming; the other is situated in the zone of forests and parks and is partially adjacent to the agricultural lands; the third is situated in the forest zone. The aquifers which occur in the active water-migration zone are well washed and contain fresh water of hydrocarbonate calcium composition.

The first water intake is situated in the north outskirts of the city. The contents growth of all groundwater chemical composition is fixed in time. The mineralization is also modified in time from 146 to 261 mg/l. Till 1970 the chlorine content grows inconsiderably. By 1977 its average content had made up to 20 mg/l. Simultaneously the contents of nitrate and other ingredients also increase (see Table 1).

TABLE 1

Changes of mean contents of the main ingredients in the groundwater chemical composition (mg/l) for the first water intake

Years	Chemical ingredients						
	Na	Ca	Mg	Cl	SO ₄	NO ₃	HCO ₃
1952	3.39	39.20	10.27	3.80	4.79	3.07	162.18
1962	4.15	42.18	10.19	3.72	9.58	5.30	166.36
1964	4.70	43.71	10.78	4.06	8.66	7.35	175.24
1965	6.59	45.13	10.89	5.20	10.16	10.43	177.35
1966	5.91	47.13	11.32	6.86	13.93	14.94	170.53
1967	6.70	46.05	10.94	5.98	12.34	10.76	175.32
1968	7.59	46.38	12.08	7.25	18.76	7.42	186.94
1970	11.45	47.53	12.52	7.27	13.39	10.21	194.30
1972	5.75	53.22	13.15	10.05	19.08	14.90	196.62
1977	13.91	58.69	15.27	20.06	18.40	27.29	206.64

The nitrate contents in the groundwater are found to rise. Recently their contents exceed the WHO standards. The increase of all the chemical ingredients may be explained by chemical and organic fertilizer used in farming in the water intake zone.

The second water intake is located in the north-eastern outskirts of the city. According to its chemical composition the groundwater may be classified as hydrocarbonate calcium-magnesium with 169 to 218 mg/l mineralization. The chemical type of water is controlled by hydrocarbonate ion. The mineralization increase is accompanied by the rise of all the ingredients (see Table 2).

In the water composition sulphate prevailed over chlorine. Increase of nitrate, chlorine and other ingredients may be explained by fertilizers used in farming (ref. 1).

TABLE 2

Changes of mean contents of the main ingredients in the groundwater chemical composition (mg/l) for the second water intake

Years	Chemical ingredients						
	Na	Ca	Mg	Cl	SO ₄	NO ₃	HCO ₃
1960	4.21	38.92	10.45	1.52	6.95	-	180.27
1962	4.30	42.83	11.00	4.29	8.92	4.95	172.80
1964	4.69	43.63	11.01	4.59	9.34	-	176.20
1965	5.13	45.50	11.11	5.42	11.15	8.84	179.20
1966	3.23	47.18	11.51	5.83	11.86	5.94	180.90
1967	7.15	46.39	11.11	5.69	11.35	5.82	185.30
1968	5.19	46.22	12.24	6.81	13.19	11.66	180.80
1969	10.58	44.11	11.87	7.59	14.49	9.06	187.90
1970	10.36	46.61	12.30	7.29	15.44	8.45	190.70
1973	6.69	50.34	13.06	9.06	17.16	10.34	192.30
1975	9.14	52.50	13.91	12.80	14.98	11.86	200.70

The third water intake is situated in the east outskirts of the city. During the observation period from 1960 to 1976 there was no considerable fluctuation of the main chemical ingredients in the groundwater composition. The water intake is in favourable sanitary conditions.

Technological progress induced appearance of local pollution sources of the environment in different regions of the world. The wastes of chemical industry, galvanic shops and domestic wastes stored on the earth surface are essential local groundwater pollution sources. For instance, the solid dressing wastes of potassium industry is the source of salt occurring in the groundwater and the aeration zone. In these places chlorine sodium brines with 90 to 140 g/l and higher mineralization are formed. The storage of industrial and domestic wastes influences considerably the groundwater composition (ref. 2,3). Dry domestic wastes react with precipitation and form local groundwater pollution (ref. 4). Stored at the permeable sandy rocks they are of especially great pollution danger. The problem of groundwater protection is solved in this case by choosing the storage places at the rocks of low permeability and by using different types of screens and coverings to prevent the wastes and precipitation from reacting.

Exploitation of useful mineral deposits disturbs natural hydrogeological conditions. Often it is accompanied by falling of the groundwater level. The increase of aeration zone thickness induces oxidation processes and transformation of different rocks and minerals into dissoluble state. This makes it possible for different substances to penetrate the groundwater and even to change the water chemical composition (ref. 5). Shower and melted snow flows from highways are also a source of groundwater pollution (ref. 6).

The pollution is especially intense in spring because of snowmelting. Snow accumulates considerable salt quantity which is used for road icing control.

Air pollution near industrial enterprises leads to higher amounts of sulphates, chlorides in precipitation, increases their leaching capability. These effects should be taken into account in the studies of formation of groundwater composition.

CONCLUSIONS

To solve the problem of environment protection, including groundwater, clear knowledge of the natural conditions and pollution sources is necessary. The investigation of groundwater quality is a principal condition for evaluation of the environment state. Theoretical concepts on formation of the water chemical composition may serve as a initial material when many-years observation are not available. If the results of the investigations performed deviate considerably from the theoretical concepts it may be explained by pollutants from local sources in groundwater. In order to protect the groundwater quality which is used for water supply it is necessary to pay attention to the state of sanitary protection zones of water intakes. and to diminish the quantity of fertilizers applied. Besides hydrogeochemical mapping allows the pollution source dislocation to be found and a number of measures to be outlined which would promote timely prevention or reducing pollution. It should be remembered it is easier to prevent pollution, than to eliminate it. That is why detection of the ingredients alien for the hydrogeochemical situation considered and their inlets to groundwater is an urgent problem of the groundwater quality protection. Then the works on elimination of pollution sources or considerable delution of the pollutant concentrations in the groundwater which exceed the highest permissible ones are in progress. Development of wasteless industry production processes and arrangement of a closed water supply cycle are measures which ensure the environment protection.

REFERENCES

- 1 E.M.Grey and M.Morgan-Jones, *Ground Water*, 2(1980)159-167.
- 2 V.M.Goldberg and V.M.Noshkin, *Bull. Moskovskogo Obschestva Ispytatelei Prirody, Otd. Geol.*, 4(1980)97-103.
- 3 B.Laksman, *Water and Sewage Works*, 6(1979)94-96.
- 4 J. M.Baedecker and W.Back, *Ground Water*, 5(1979)429-437.
- 5 V.D.Kostenko, E.A.Lushnikov and E.P.Panteleev, *Increase of the Efficiency and Quality of Using the Entrails of the Kursk Magnetic Anomaly, Voronej*, 1979, pp.13-19.
- 6 H.Dauschek, *Z. Dtsch. Geol. Ges.*, 1(1980)293-306.