

S.M. LEVONIUK¹, I.V. UDALOV²

**THE TECHNOGENIC ASPECT IN THE PROCESSES OF GROUNDWATER
QUALITY CHANGES WITHIN THE URBAN WATER INTAKES
OF EASTERN UKRAINE**

¹*Ukrainian Research Institute for Natural Gases, Kharkiv, Ukraine;*

²*V. N. Karazin Kharkiv National University, Kharkiv, Ukraine;*

¹*sergii.levonyuk@gmail.com;*

²*igorudalov8@gmail.com*

Introduction. The buchak-kaniv aquifer (BKWK) is the one of strategic resources of drinking groundwater within Eastern Ukraine. There is about 40 – 60 % of the total volume of water supply is exactly the water from this aquifer here.

The drinking groundwaters of region are currently the most contaminated with F within Ukraine. As provided by our research, an excess of element content of current WHO drinking water quality standard ($1,5 \text{ mg/dm}^3$) can be traced within about 80 % of the work area. Its average content is more than 3 mg/dm^3 , it reaches values $7,4 - 8,8 \text{ mg/dm}^3$. At the same time, F refers to the components of I (the highest) hazard class.

But the issue of high F content in the waters of aquifer is not fully explored. The concept, that has been developed by authors, allows scientists to expand knowledge about these processes.

Identification of previous unsolved parts of the general problem. In terms of most researchers, the problem of F increased content in the BKWK of Eastern Ukraine has only a natural essence. Scientists distinguish three factors. Firstly, it is a lithological composition of water-bearing and overlying rocks [1, 3, etc.]. Secondly, the geochemical preconditions for increasing the solubility of solid phase in the natural system «solution-rock» because of changes in the water chemical composition under the influence of neotectonic factor [1, 3, 4, 6]. Thirdly, the additional migration of element of purely deep origin is possible [4, etc.].

The technogenic aspect and dynamics of changes in the component content have been studied poorly.

In the previous papers the authors have determined, that F is a typical element-indicator, its increased content points out the transformation processes of water composition. According to the developed concept, an active technogenic pressure on groundwater of territory has played a key role in these processes.

The purpose of paper is to investigate the technogenic component in the mechanism of groundwater quality changes towards the increase of F content at the buchak-kaniv urban water intakes of Eastern Ukraine.

Results and discussion. Initially, the dynamics of F content in the target aquifer waters during the period of active technogenic pressure on a geological environment of region (1960-2015) has been traced. Based on an actual data at the beginning of this period, the geological base content (GBC) of component has been determined (about 2 mg/dm^3). Also the characteristic intervals of component content are found:

- 1) from $0,2 - 0,3$ till $2,0 \text{ mg/dm}^3$ (values within 1 GBC) – without an influence of geo-ecological factors of groundwater enrichment with F;
- 2) from $2,0$ till $3,7 - 4,0 \text{ mg/dm}^3$ (from 1 till 2 GBC) – with an influence of lithological and neotectonic factors, but without an influence of active technogenesis;
- 3) over $3,7 - 4,0 \text{ mg/dm}^3$ (from 2 GBC and over) – an influence of all geo-ecological factors.

It has been determined that during the process of active exploitation of powerful urban water intakes (water intakes of Poltava, Lubny, Khorol, Karlivka, Krasnograd, Reshetylivka, Velyka Bagachka cities and some others) the F content increases. For a 55-year period, the number of values which correspond to more than 1 GBC has increased from 38 % to 63 %.

The plane changes of index before the beginning of active technogenesis period and now have been investigated. In 1960, the component content was equal to 2 intervals of values: till 1 GBC – within the territories with less active tectonic processes (northern and southern parts of the region); from 1 to 2 GBC – within the area with an active influence of salt tectonics (central part).

At present (2015), in addition to reducing the areas with contents till 1 GBC, the territories with contents of more than 2 GBC (to 4 inclusive), which is a critical for the population health, have been appeared (Figure 1). Their area is about 20 % of the total.

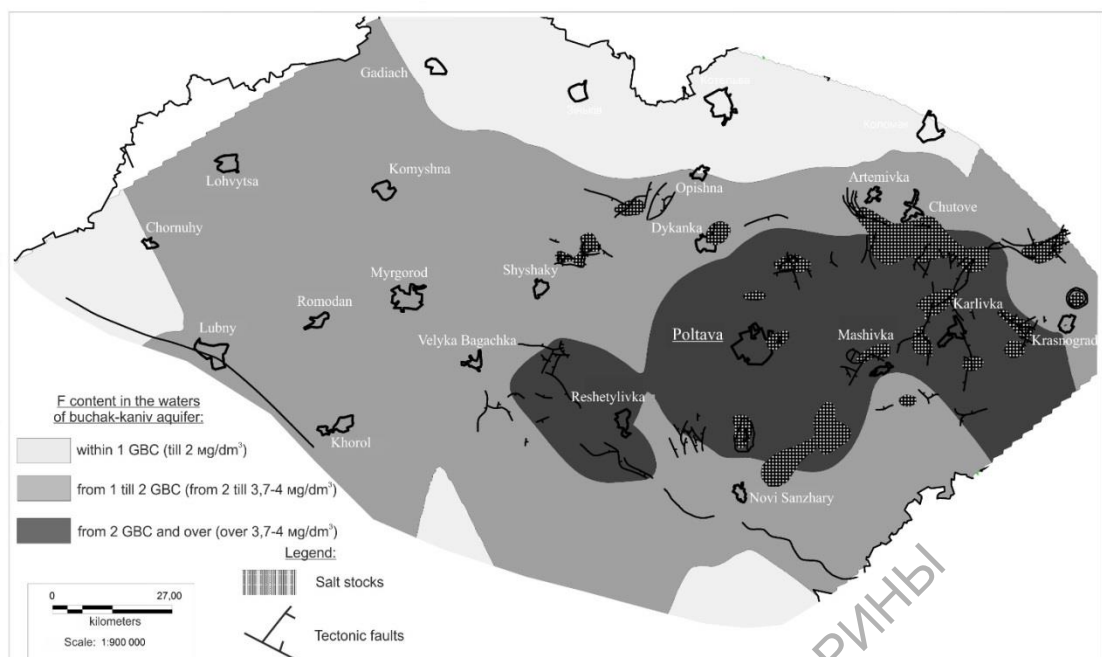


Figure 1 – Schematic map of F content in the waters of buchak-kaniv aquifer within the water intakes of study region at present (2015)

The authors associate this with the active processes of technogenesis during this period: intensification of groundwater withdrawal; changes in the hydrodynamic conditions of aquifers by expanding the networks of water intakes; the formation of regional depression funnels of aquifers, their overlays create a synergetic effect.

Within the limits of established zone of critical values of F content, there is an «overlay» of especially active manifestations of these processes (water intakes networks of Poltava city and some less powerful ones) on the tectonic structures of central part of Dnipro-Donets depression. These structures are considerably divided into blocks by tectonic faults, which are the migration paths for deep highly mineralized waters to the working aquifers.

This process has been investigated in more detail at the water intakes of Poltava, which are strategically important within the region. The water intake No. 1 is located on the left bank of the city, No. 2-5 – within the right bank.

As provided by the obtained data, 3 stages of development of these water intakes have been identified. During the period of maximum technogenesis – 1976 – 1995 – the water chemical composition undergone the greatest transformational changes (an increase in the F content 81-90 % of the total).

It is necessary to note a general trend in the water composition – an increase of studied component in eastern direction, that is, towards the water intake No. 1. The reason is East-Poltava tectonic structure, which is located within the eastern suburbs of city. It is divided into blocks by tectonic faults in the central part.

On an example of water intake No. 1, according to the results of correlation analysis, a direct connection between the change in the F content and the value of water withdrawal in the zone of influence of tectonic fault has been established. The correlation coefficient $C_c = 0,80$ has been calculated. At the same time, for the other, right-bank group of water intakes $C_c = 0,57 – 0,63$.

Conclusions. The geo-ecological factors of F increased content in a drinking groundwater within the urban agglomerations have been considered.

The authors have identified the geological base content (GBC) of component (about 2 mg/dm³) at the beginning of active technogenesis period.

It has been determined that the F content increases in the process of active exploitation of powerful water intakes. It has been established that the territories with a critical for the population health content (from 2 to 4 GBC) have appeared now.

It has been shown that the investigated natural mechanism of F enrichment of groundwater is activated by an influence of technogenic component (intensification of groundwater withdrawal, extension of the water intakes network, hydrodynamic changes). During the period of maximum technogenesis – 1976-1995 – the water chemical composition undergone the greatest transformational changes.

According to the results of correlation analysis, a direct connection between the changes in F content and the value of water withdrawal in the zone of influence of tectonic fault has been established (correlation coefficient $C_c = 0,80$).

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