

UDK 504.054:622.012:(550.42:556.5)(477.6)

**E. I. Skopichenko, V. V. Vergelska, N. V. Vergelska,  
D. M. Golovchenko, S. M. Ozirskaya**

## **MONITORING THE INFLUENCE OF COAL MAN-MADE LANDSCAPES ON THE ATMOSPHERE OF COAL-MINING REGIONS**

According to studies of recent decades, Ukraine is one of the most polluted and environmentally problematic countries in the world. The level of pressure on the environment in Ukraine has increased significantly during the fighting, starting in 2014 in the Donbas, and has deteriorated significantly since 2022. At the present stage of social development, the process of formation and implementation of an effective and efficient state environmental policy, taking into account the existing natural resource potential of the regions and the possibility of their transformation into the national economy, is of particular importance. In recent years, although there has been a decline in production, the annual level of environmental pollution is quite high, including due to incorrect reclamation after the closure of coal mining enterprises. The influence of human activity on the structures of the Earth's surface, today, is especially noticeable in the mining regions, where significant masses of rocks have been brought to the surface and new structures have been created. Human intervention in the process of landscape development leads to new relationships between its components due to the processes of oxidation of rocks brought to the surface and the release of energy and gas mixtures into the atmosphere.

The coal-mining regions of Ukraine, which are in a state of deep technogenic changes and transformations, have a chance to use the results of intensive geological and technogenic realities for the conclusions of the search for the scientific foundations of nature management and environmental conservation. At the present stage of social development, which is characterized by the acceleration of the pace of scientific and technological progress on the one hand, the aggravation of environmental problems and environmental pollution, on the other hand, the process of formation and implementation of an effective and efficient state environmental policy, taking into account the existing natural resource potential of the regions, is of particular importance.

**Key words:** coal-mining regions, waste heaps, mine closure, monitoring.

### **Introduction.**

According to research in recent decades, Ukraine is among to the most polluted and ecologically problematic countries in the world. Level of weighting on the environment in Ukraine was notably higher during the fightings since 2014 in the Donbas and has notably declined since 2022.

---

© E.I. Skopichenko, V.V. Vergelska, N.V. Vergelska, D.M. Golovchenko, S.M. Ozirska, 2022

Fightings in the area of processing areas, on the territory of Ukraine caused a extensive and multifaceted technogenic weighting on the environment, particularly in the coal mining areas. The dissolution of the coal mining enterprises in the Donets and Lviv-Volyn basins in last years leads to the origin and development of interdependent complexes of new negative phenomena and processes of repercussions on outside environmental. In the last years, the question of the repercussions of coal mining on the lithosphere, hydrosphere and atmosphere has become even more urgent in connection with world research on the impact of the extractive industry on climate changes.

The process of forming and realizing an available and effective state environmental policy takes into account the existing natural resource potential of the regions and the possibilities of their transformation into a national economy at the present stage of social development. O. Bondar, N. Djachenko, V. Kravtsev, M. Kovalchuk, V. Potapenko, L. Yakushenko, L. Yatsenko and many others devoted their work to the study of modern problems of environmental protection and the definition of directions for the formation and implementation of state environmental policy, including at the regional level [1, 4, 5, 6, 9, 10, 11, 12].

Monitoring of changes in gas mixtures of coal mine tericons is a currently central in study from the point of view of temperature changes, combustion of tericons and their effect on the ecology of coal mining regions.

### **Materials and research methods.**

Based on field's researches conducted in 2019-2021 by the authors of the publication in the Krasnoarmeysky coal-mining region of Donbass and 2022 in the Lviv-Volyn basin. Samples to determine the gas composition in tericon rocks and the composition of rocks were taken. Laboratory studies of the chemical and gas composition of terikon rocks were carried out in the complex laboratory of SE "Ukrnaukageocenter" Poltava.

### **Presentation of the main material.**

The problems associated with excessive use of natural resources, which is caused by a transgress in the placement of productive forces and production capacities for a long time in certain territories, have become especially acute at the present stage of the development of society. As a result, mining regions with technogenic weight and significant environmental problems are formed. In recent years, although there is a decline in production, the annual level of environmental pollution is quite high, including due to incorrect recultivation after the closing of coal mining enterprises. The influence of human activity on the structure of the Earth's surface is especially

noticeable in extractive regions today in the place where large masses of rocks have been brought to the surface and new structures have been created. Human intervention in the development of the landscape leads to new relations between its components due to the processes of oxidation of rocks brought to the surface and the release of energy and gas mixtures into the atmosphere.

Each coal basin (in particular, a mine or a carbon cut) has both - the general and individual consequences of the development of carbon masses, which affect negatively on the environment, is also determined by the geological structure of the region [2, 3, 7]. Monitoring of structural and geomorphological new formations in the geological environment which has natural-technological origin, especially in the mining areas, can be used as a ground of the development a methodology for determining their effect on the atmosphere.

In considering from the modern conditions of terricons (Fig. 1, 2), there is no doubt about the relevance and need to determine the geological processes of newly formed objects, which are a consequence of the interaction of natural-technological factors of the modern geological process. Since the abundant masses bred and raised to the surface are included in the natural energy-real circulation of matter and energy on the surface, geological and geological-geochemical processes become. The most pronounced are the processes in the combustion of slagheaps, which are representative of both Donets and Lviv-Volyn basins (Fig. 3, 4). The processes of rock transformation in the terricons in themselves have not been studied enough.



Fig. 1. Slagheap coal mine "Dorbropilska", Donets basin.



Fig. 2. Slagheap SE CC "Krasnolymanska", Donets basin.



Fig. 3. Slagheap coal mine "Rodynska", Donets basin.



Fig. 4. Slagheap coal mine " Lisova ", Lviv-Volyn basin.

During the study of the gas composition of tericons of the Krasnoarmiysk coal mining area, the characteristics of the distribution of gas mixtures in various tericon rocks were determined. Features of the composition of the gas mixture in the areas of smoke spread on terikons have been established. That is, in the areas where unsaturated hydrocarbons are determined in summer at the slagheap of Rodynska mine, smoke and temperature rise are established in autumn-winter time with a clearly pronounced smell of the gas mixture.

Smoke spread on slagheaps in November 2021 was fixed up in the both of mines – Rodynska (Fig. 5) and Stepova (block 2) of the Pavlograd coal mining area. In 2022, the smoke spread on slagheap was investigated in the Lviv-Volyn basin at the Chervonogradska 5 mine (Fig. 6, 7). It is noted that acetylene was determined in gas mixtures from slagheaps with smoke of the Krasnoarmiyska area, and ethylene in the Chervonogradska area. Therefore, the study of the gas content of slagheaps should continue to monitor such phenomena and establish the release of gas mixtures into the atmosphere.



Fig. 5. Slagheap coal mine " Rodynska ", Donetsk basin.



Fig. 6. Slagheap coal mine " Chervonogradska 5 ", Lviv-Volyn basin.



Fig. 7. Slagheap coal mine " Chervonogradska 5 ", Lviv-Volyn basin.

Monitoring of ecological violations in coal mining regions has been taking place for many years, but this is conceived as a result of extractive works of energy raw materials [7, 8, 13]. Today, a good few has been done to improve the environmental situation in technologically loaded in the coal mining regions, but even more remains to be solved with the subsequent closure of coal mines. In recent years a decision has been made: it is planned to reform the coal industry and transform the coal mining regions of Ukraine together with international partners.

### **Conclusions.**

Coal mining regions of Ukraine, which are in a condition of deep technogenic changes and transformations, have a chance to use the results of intensive geological and technogenic realities to conclude the search for scientific foundations of nature management and environmental conservation. At the present stage of social development, which is inherent an accelerating the movement of scientific and technological progress from the one side, escalation environmental problems and environmental excursion - on the other, the process of forming and realization an effective state environmental policy, which is considering potential the existing natural

resources of the regions.

It is advisable to carry out complete recultivation on the territory of closed mines, to improve the environmental condition of technologically loaded (mining) regions. In some cases, it is reasonable to give preference to complex scientific, industrial and tourist projects, which will allow to conduct the monitoring and establishing geological and geochemical changes to reduce the negative impact on the environment, in particular on the atmosphere.

## REFERENCES

1. Baranovsky V.A. 2001. Ecological geography and ecological cartography. Kyiv: Phytosocial Center, 252 p.
2. Vergelska N., Vergelska V., Melnyk V. 2020. Influence of spent coal workings on the environment. *Collection of scientific works IX International Geomechanics conference*, September 7-11, 2020. Varna, Bulgaria. P. 304 - 310.
3. Vergelska N. V., Vergelska V. V. 2020. Man-made landscapes of coal mining enterprises of Ukraine. *Proceedings of the eighth scientific-practical conference "Mineral resources of Ukraine: ways of optimal use"* (October 2, 2020, Khoroshiv). Kyiv. P. 31 - 34.
4. Final report on research work "Analysis of the state of implementation of regional environmental policy" [Electronic resource]. – Access mode: <http://www.menr.gov.ua/docs/activity-ecopolit/NDR%20regionalna%20politika%202013.doc>.
5. Law of Ukraine "On the basic principles (strategy) of state environmental policy of Ukraine for the period up to 2020" of 21.12.2010 № 2818-VI [Electronic resource]. - Access mode: <http://zakon2.rada.gov.ua/laws/show/2818-17>.
6. Kravtsiv V. S. 2007. Regional environmental policy in Ukraine and mechanisms of its implementation: NAS of Ukraine. Institute of Regional Studies. Lviv. 72 p.
7. Liventseva H. A., Vergelska V. V., Melnyk V. V. 2019. Ecological and hydrogeological challenges of coal mining regions of Ukraine. *Tectonics and stratigraphy*. Is. 46. pp. 133–140.
8. Melnyk V. V. 2020. Monitoring the impact of coal mining regions on the environment. *Tectonics and stratigraphy*. Is. 47. pp. 139-144.
9. Nesterchuk I. K. 2011. Geocological analysis: conceptual approaches, sustainable development: a monograph. Zhytomyr: ZhSTU. 312 p.
10. Olishevskaya Y. A. 2005. Methods of geocological zoning of the territory of Ukraine: author's ref. dis. Cand. geogr. Sciences: 11.00.11 Kyiv. 22 p.
11. Potapenko V. Environmental and man-made problems in Ukraine that need to be addressed as a matter of priority. Analytical note [Electronic resource]. - Access mode: <http://www.niss.gov.ua/articles/577/>.
12. Yakushenko L. M., Yatsenko L. D. On ways to increase the effectiveness of national programs in the field of environmental protection. Information and analytical reference [Electronic resource] Access mode: <http://www.niss.gov.ua/articles/537/>
13. Vergelska N. V. 2014. Geological prerequisites to evaluate gas-bearingness of the Krasnoarmiysk coalmine district, Donbass. *Tectonics and stratigraphy*. Is. 41. P. 41–46.



**Є. І. Скопиченко, В. В. Вергельська, Н. В. Вергельська,  
Д. М. Головченко, С. М. Озирська**

## **МОНІТОРИНГ ВПЛИВУ ВУГІЛЬНИХ ТЕРИКОНІВ НА АТМОСФЕРУ ВУГЛЕВИДОБУВНИХ РЕГІОНІВ**

За даними досліджень останніх десятиліть, Україна входить до числа найбільш забруднених та екологічно проблемних країн світу. Рівень навантаження на довкілля в Україні значно зріс за час бойових дій починаючи з 2014 року на Донбасі та значно погіршився з 2022 року. На сучасному етапі суспільного розвитку особливого значення набуває процес формування та реалізації дієвої та ефективної державної екологічної політики, що враховує існуючий природно-ресурсний потенціал регіонів та можливості їх трансформування у народне господарство. Останніми роками, хоч і спостерігається спад виробництва, щорічний рівень забруднення довкілля досить високий, в тому числі, і за рахунок некоректної рекультивації після закриття вуглевидобувних підприємств. Вплив людської діяльності на структури поверхні Землі на сьогоднішній день особливо відчутний у видобувних регіонах, де на поверхню виведено значні маси порід та створено нові структури. Втручання людини у процес розвитку ландшафту призводить до нових відносин між його компонентами за рахунок процесів окислення виведених на поверхню порід та вивільнення енергії і газових сумішей в атмосферу.

Вугледобувні регіони України, які перебувають у стані глибоких техногенних змін та перетворень, мають шанс використати результати інтенсивних геолого-техногенних реальностей для висновків, пошуків наукових засад природокористування та збереження навколишнього середовища. На сучасному етапі суспільного розвитку, якому притаманне прискорення темпів науково-технічного прогресу з одного боку, загострення екологічних проблем та забруднення навколишнього середовища – з іншого, особливого значення набуває процес формування та реалізації дієвої та ефективної державної екологічної політики, що враховує існуючий природно-ресурсний потенціал регіонів.

**Ключові слова:** вугледобувні регіони, терикони, закриття шахт, моніторинг.

**Е. И. Скопиченко, В. В. Вергельская, Н. В. Вергельская,  
Д. Н. Головченко, С. Н. Озирская**

## **МОНИТОРИНГ ВЛИЯНИЯ УГОЛЬНЫХ ТЕРРИКОНОВ НА АТМОСФЕРУ УГЛЕДОБЫВАЮЩИХ РЕГИОНОВ**

По данным исследований последних десятилетий Украина входит в число наиболее загрязненных и экологически проблемных стран мира. Уровень нагрузки на окружающую среду в Украине значительно вырос за время боевых действий, начиная с 2014 года на Донбассе, и значительно ухудшился с 2022 года. На современном этапе общественного развития особое значение приобретает процесс формирования и реализации действенной и эффективной государственной экологической политики, учитывающей существующий природно-ресурсный потенциал регионов и возможности их трансформирования в народное хозяйство. В последние годы, хоть и наблюдается спад производства, ежегодный уровень загрязнения окружающей среды достаточно высок, в том числе и за счет некорректной рекультивации после закрытия угледобывающих предприятий. Влияние человеческой деятельности на структуры поверхности Земли, на сегодняшний день, особенно ощутимо в добывающих регионах, где на поверхность выведены значительные массы пород и созданы новые структуры. Вмешательство человека в процесс развития ландшафта приводит к новым отношениям между его компонентами за счет процессов окисления выведенных на поверхность пород и высвобождения энергии и газовых смесей в атмосферу.

Угледобывающие регионы Украины, находящиеся в состоянии глубоких техногенных изменений и преобразований, имеют шанс использовать результаты интенсивных геологотехногенных реальностей для выводов поисков научных основ природопользования и сохранения окружающей среды. На современном этапе общественного развития, которому присуще ускорение темпов научно-технического прогресса с одной стороны, обострение экологических проблем и загрязнение окружающей среды – с другой, особое значение приобретает процесс формирования и реализации действенной и эффективной государственной экологической политики, учитывающий существующий природно-ресурсный потенциал регионов.

**Ключевые слова:** угледобывающие регионы, терриконы, закрытие шахт, мониторинг.

ДУ «Науковий центр гірничої геології, геоecології та розвитку інфраструктури НАН України»,  
м. Київ, Україна

Євгеній Скопиченко

Вікторія Вергельська

e-mail: [vvika09@meta.ua](mailto:vvika09@meta.ua)

<https://orcid.org/0000-0002-6206-710X>

Наталія Вергельська

доктор геологічних наук

e-mail: [vnata09@meta.ua](mailto:vnata09@meta.ua)

<https://orcid/0000-0002-1440-6082>

Дина Головченко

Світлана Озірська

Стаття надійшла: 08.12.2022