

Jan Kochanowski University in Kielce
Faculty of Natural Sciences
Institute of Geography and Environmental Sciences
Division of Environmental Research and Geoinformation

ABSTRACT

Assessment of the state of natural environment in the southwestern part of the Świętokrzyskie Mountains based on geo- and bio-indicators

Author: *mgr Mirosław Kazmierz Szwed*

Supervisor: *prof. UJK dr hab. Rafał Kozłowski*

The state of the natural environment was assessed in the area of intense industrial activity in the southwestern part of the Świętokrzyskie Mountains, in a district called "Białe Zagłębie". This activity is mainly focused on the exploitation and processing of rock raw materials. Raw materials (limestones, marls, gypsum, dolomites, and clay minerals) necessary for the production of cement, lime and construction materials are of the greatest importance in this respect. In the study area, apart from a dozen smaller enterprises, there are plants in Nowiny and Małogoszcz, specialised in production of cement, as well as plants in Bukowa and Trzuskawica, specialised in production of lime.

The analysis was made of bio-indicative properties of pine needles and lichens as well as geo-indicative ones of atmospheric precipitation, including snow. Moreover, the quality of air, volume of emission, and chemical composition of the emitted cement and lime dust were analysed.

The obtained results confirm significant changes in the natural environment in the analysed part of the Świętokrzyskie Mountains. They are primarily a consequence of economic activities conducted there. These cause a reduction in the quality of air and changes in physico-chemical properties of precipitation, which, in turn, affect the entire natural environment. The analysis of air quality showed significant dynamics of the volume of pollution in individual years. A large number of days with exceedances of the permissible diurnal PM10 concentrations at both measuring stations in Nowiny and Małogoszcz should be noted. A relationship between air temperature and dust concentrations during the periods of

severe frosts was found. Such a situation causes an additional reduction in the quality of air due to the emission of pollutants from the municipal and housing sector (low emissions) and the inflow of polluted remote air masses.

The analysis carried out on the geo-indicators confirms the impact of existing plants on the quality of atmospheric precipitation. It was discovered that both physico-chemical properties and chemical composition of precipitation are subject to transformation. An increase in pH and electrolytic conductivity, as well as the presence of heavy metals, including lead, zinc and chromium, were found. The increased values of pH and mineralisation indicate that the cement and lime industry remains the main source of pollution in this area, additionally supported by remote sources of pollution and road transportation, as well as the municipal and housing sector during a heating season. The concentrations of heavy metals, especially iron, aluminium, and zinc occurring in all measuring stations indicate a significant dispersion of these elements in the atmosphere.

The collected samples of pine needles indicated different physico-chemical and chemical properties conditioned by the deposition of cement and lime dust. The highest concentrations of heavy metals were found in the samples collected in the vicinity of the cement plants in Nowiny and Małogoszcz (Pb, Cr), the lime plants in Truskawica and Bukowa (Fe), and the quarries in Radkowice and Miedzianka (Al, Cu, Ni, Zn). The analyses on the content of selected metals and the SEM/EDS analysis confirm the possibility of modifying the course of biological processes of the studied trees.

To sum up, it should be stated that the selected geo- and bio-indicators used in the analysis have confirmed their effectiveness in assessing the state of the natural environment being under the influence of anthropogenic pressure. High sensitivity to pollution and accumulative capacity of lichens in all the measurement series allowed for determining zones most exposed to the impact of cement and lime plants. It was shown that dust and gases emitted to the atmosphere by the cement and lime industry plants substantially reduce the quality of air and modify the properties of atmospheric precipitation. Selected ranges of occurrence of the analysed heavy metals (Pb, Cr, Cu, Cd, Ni, Zn, Al, and Fe) show the real area of impact of anthropogenic emission sources on the surrounding geographical space.

Miroslaw Bawed

5.02.2021n