

# Testing the Effectiveness of Natural Zeolite on Polymetallic-Contaminated Soils in Bulgaria

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## Abstract

Soil contamination is a serious issue that poses a threat to both the environment and human health. This research focuses on the soils between Plovdiv and Asenovgrad in Bulgaria, contaminated with lead, zinc, and cadmium from a zinc-lead processing plant operated in the last century. The area is currently home to the largest lead-zinc production facility in Southeastern Europe, which takes a new approach to nature conservation. However, the damage caused by past pollution persists. This study aimed to test the effectiveness of natural zeolite on polymetallic-contaminated soils with a neutral or slightly alkaline pH and its impact on lettuce cultivation. The goal is to reduce the effects of contaminants in the food chain.

The experiment involved three soil variants with varying levels of heavy metal loading: soil 1, soil 2, and soil 3. The Pb contents in soil 1, 2, and 3 were 6, 9, and 18 times higher than 120 mg/kg. For zinc, the contents in soil 1, 2, and 3 were 2, 3, and 6 times higher than 400 mg/kg, while for cadmium, they were 5, 6, and 16 times higher than 3 mg/kg. Natural zeolite was added at 1%, 5%, and 10% levels to each soil while maintaining a humidity level of 60%. The experiment was conducted for 45 days under vegetation house conditions. After conducting a multifactorial analysis, it was found that soil is the most influential factor affecting lettuce yields, followed by the interaction between soil and zeolite. The amount of zeolite used has little effect on lettuce growth in heavily contaminated soil. Nevertheless, the slow release of nutrients like potassium, ammonium, or phosphates from zeolite can make it an excellent carrier for potassium fertilisers. It has been found that decreased levels of heavy metals in soil can lead to improved photosynthetic activity and plant transpiration rates, indicating a better physiological state. Additionally, adding zeolite to heavily contaminated soil significantly impacts the plants' photosynthetic activity and gas exchange parameters. The study has also confirmed that lead and cadmium are the primary toxic elements, and applying zeolite at 5% and 10% levels can reduce plant contamination. However, even if safe levels are

achieved, growing leafy vegetables in the area still pose risks.

**Keywords:** Remediation, Adsorption, Soil quality, Heavy metals, Environmental impact

### **References**

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