

THE RESULTS OF MULTISTAGE LIMING AND LACUSTRINE CHALK APPLICATION IN AMD WATER RESERVOIR IN THE MUSKAU ARCH NEAR ŁĘKNICA, W POLAND

Przemysław RZEPKA^{1,2}, Piotr BOŻĘCKI¹, Maciej MANECKI¹,
Grzegorz RZEPA¹ & Tomasz BAJDA¹

¹ AGH University of Science and Technology, Faculty of Geology,
Geophysics and Environmental Protection, Department of Mineralogy,
Petrography and Geochemistry; al. Mickiewicza 30, 30-059 Krakow, Poland

² Kjeøy Research & Education Center; Kjeøy, 8412 Vestbygd, Norway

The Muskau Arc is a 40 km long moraine belt bent into a horseshoe-like shape pushed by the Mid Polish Glaciation, located in west Poland. Pyrite-bearing Neogene lignite deposits were mined there until the 1980s. The abandoned open pits filled with groundwater are forming a set of reservoirs called “Anthropogenic Lake District”. It consists of more than 100 reservoirs on the total area of more than 1500 square kilometers. Oxidation process of iron sulfide-containing lignite left in mining pits or deposited in dumps, exposed to atmospheric oxygen and water results in formation of acidic waters and precipitation of ochreous sediments. The water is characterized by high Fe and SO_4^{2-} content. This chemical association with low pH waters is causing the main environmental waste problem in this region, which is typical for most Acid Mine Drainage (AMD) areas.

The main goal of conducted experiment has been to examine the abilities of acid mine water remediation on the example of Muskau Arch lake named Africa. The chemical neutralization of acidic pH and removal of high salinity by precipitation was made by various substances application. The objective of this study was comparison of the potential effects of this treatments applied in several steps.

Africa is one of the largest and deepest reservoirs of Muskau Arch. This meromictic lake has constant vertical stratification characterized by diversity of physicochemical parameters and content of major ions. Water contained in the mixolimnion at the top (down to about 10 m depth from surface) is well mixed by air currents and saturated with oxygen. It has lower pH (pH = 2.75) and lower ion concentrations (the average TDS amounts to 2000 mg/L) than the bottom layer. Monimolimnion in the bottom part (below 10 m from

the surface) is anoxic, poor in oxygen, with higher pH ($\text{pH} = 4.75$) and salinity (TDS up to 6000 mg/L). Water in both layers is not mixing due to significant density difference preserving the geochemical stratification.

In the set of laboratory experiments samples of waters from both layers were mixed with different doses of lime and lacustrine chalk. The application was carried out over half a year in several steps, because of the ability of this water to acidify itself. In all cases, especially in second stage, the treatments lead to rapid increase of pH and to precipitation of different secondary phases, mostly gypsum and iron hydroxides (ferrihydrite, goethite and rare green rust). This results in removal of ferric and ferrous ions and reduction of sulfates content by close to 80%.

However effects was varying and depends on kind of treatment, layers, which have different acid neutralizing capacity, and step of dosing. pH of upper layer is lifted to about neutral value (7–8) by chalk dosing or slightly basic (9) in the case of liming. These treatments are successful already in first step application.

Hydrogen ion releasing in iron hydroxides precipitation process in bottom layer, due to occurring specific pH-Eh conditions, restrains neutralization effectiveness. Therefore next application steps are necessary to reach neutral pH (6–7) after chalk treatment or even alkaline (11–12) by liming.

This work was supported by AGH UST research project 15.11.104.204.