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Monitoring explosive based nitrogen (N) emissions




Introduction

Rock exctraction requires the use of nitrogen containing explosives. In ideal explosion ammonium nitrate converts to nitrogen and water and oxygen and fuel converts to carbon dioxide and water. Rain- and groundwater are the main transport media that leaches the remains of N from the surface of the rock material after blasting. Water is pumped from the pit to the receiving body of water via settling pond. Good blasting management and the use of low leaching emulsion explosives are part of controlling nitrogen discharges at the mining sites. Therefore, monitoring of the nitrogen emissions and possible leaching to the drainage water, is a key element in implementation of good practices in blasting management.

Methods

Monitoring of drainage water quality after the blasting event was performed at Lapinlahti anorthosite quarry in Finland, in October 2016. Water samples were taken three days before the blasting event which took place on 6.10 and the last samples were collected on 3.11.

Samples were taken from three points. 1) Pipe: water pumped from the pit to the settling pond 2) Pond: middle of the settling pond 3) Background: the concentration from upstream of the receiving river, to see the natural variation of nitrogen compounds. Field measurements included electrical conductivity, dissolved oxygen, temperature and pH. Ammonium and nitrite concentrations were measured with portable spectrophotometer using cuvette tests.

Laboratory analysis for NO^{-}_{3}, NO_{2-} concentrations were made by Labtium Oy (Labtium codes: 143R and 090C respectively) and for N and NH_4^+ by Metropolilab (methods: SFS-EN ISO 11905-1 and ISO 7150: 1984).

The samples were collected to plastic bottles and stored in a cooling box, which was sent to the laboratory immediately after sampling

Results

The precipitation data was acquired from Lapinlahti Lamminkäyrä observation station (fig. 1). October 2016 was exceptionally dry month in Finland with maximal precipitation of 7.3 mm recorded at the end of the month.

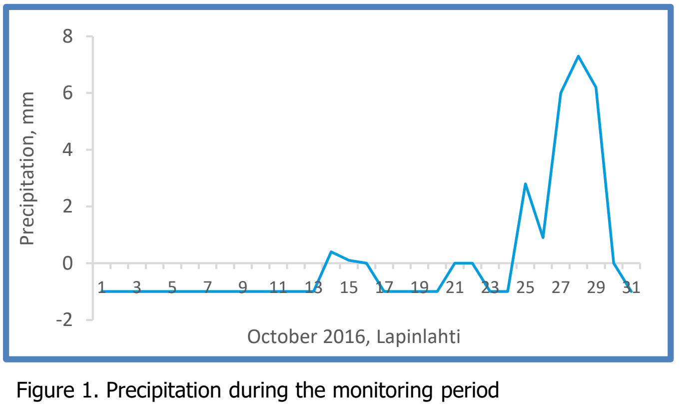

Figure 1. Precipitation during the monitoring period

From this reason the water coming from the dewatering pipe was mainly groundwater. If the precipitation in October 2016 would be comparable with the previous years then the higher concentration of nitrogen could be expected. Specific conductance determined in water sample collected from the pipe and the pond was high (max. 460 uS/cm) compared to the background samples (max. 88 uS/cm).

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Good Practices: Monitoring explosive based nitrogen emissions

During the monitoring period, the pH and temperature of pond and pipe water samples were slightly higher than the background samples (fig. 2).

Despite the lack of rain, the results revealed increased nitrogen concentration in the drainage water and settling pond (max. 80 %), after the blasting event 6.10.2016

The ammonium and nitrite content was negligible, but the NO3-N content was close to the total N concentration (fig. 3 and 4). The nitrogen in the background water was mainly in the organic form, while water from the settling pond contained mainly N in the form of nitrate.

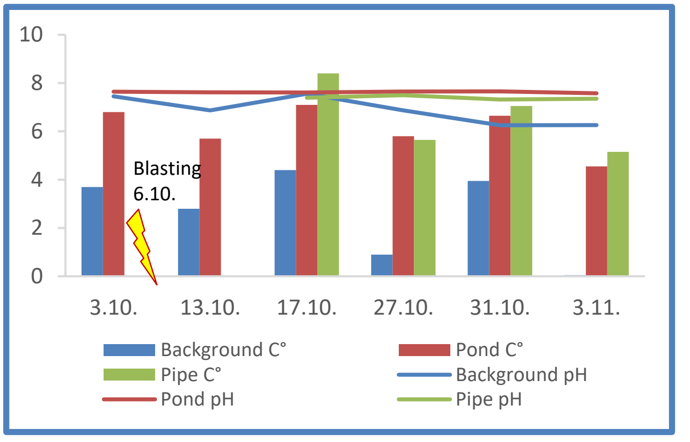

Figure 2. pH and temperature conditions during the monitoring period

Summary

Extracting of rock material with explosives produces nitrogen-rich drainage waters. Monitoring of the nitrogen concentration in the drainage water facilitates the implementation of good blasting management.

Monitoring of water quality conducting for one month after blasting event confirmed increasing of the nitrogen content in the drainage water. The nitrogen concentration was relatively low, but gave information about the magnitude of explosive based nitrogen emissions for larger extracting operations.

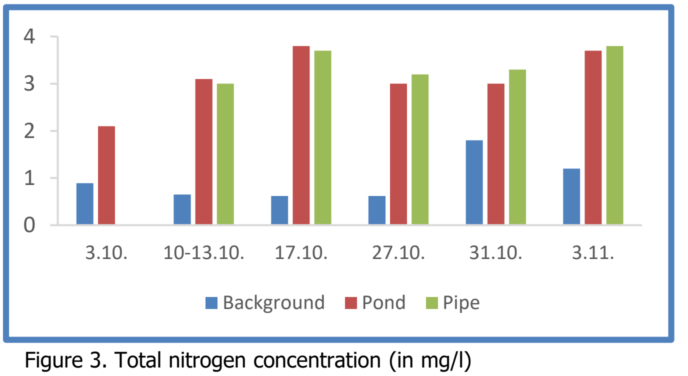

Figure 3. Total nitrogen concentration (in mg/l)

Tips for monitoring:

*It is recommended to analyse one drainage water sample in laboratory prior the monitoring campaign to have the knowledge about the concentration level of different nitrogen forms. It allows to select suitable range of cuvette tests concentrations if the spectrophotometric measurements are considered.

*Inform laboratory beforehand about samples needing urgent proceedings. Store the samples in a proper cooling box to maintain their natural temperature and deliver immediately to the laboratory for analysis.

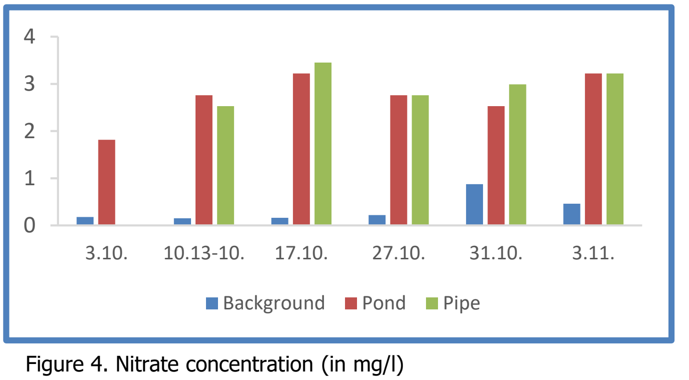

Figure 4. Nitrate concentration (in mg/l)

More information:

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