Geophysical Research Abstracts
Vol. 15, EGU2013-8763, 2013
EGU General Assembly 2013

Optimization of water treatment methods for the purification of peat extraction derived runoff: Evaluation of chemical treatment response to variations in incoming water quality using a 2k factorial test design

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The sustainable use of peatland areas requires measures to minimize and when possible eradicate the identified environmental impacts. The drainage of peatlands and other peat extraction, agriculture and forestry activities are known to increase the leaching of pollutant substances resulting in the eutrophication and siltation of receiving water bodies, causing water quality deterioration. Due to the geochemistry characteristics of peat soils the quality of peatland derived runoff water is known to oscillate with location and also with variations in runoff and peak discharge occurrences. Affordable, simple and reliable purification methods that can purify waters rich in particulates, nutrients and dissolved organic carbon while capable of coping with incoming water quality variations are therefore required. Chemical treatment is considered one of the best available technologies for the purification of peat extraction runoff water in Finland; however, until recently little research had been applied on the development of this treatment method for the purification of non-point source pollution. Chemical purification, using metal salts as coagulant agents, is currently applied in several treatment facilities in Finnish peat extraction sites. Nevertheless, variations in runoff water quality and the lack of development of field process parameters has led to the application of high chemical dosages, significant and undesirable fluctuations in purification efficiency and high metal concentration in the discharging waters.

This work aims to develop and optimize the chemical purification method by using high level scientific methods to evaluate the response of the purification process to variations in water quality which are typical of peatland derived runoff. The evaluation of how the purification process responds to these variations is a critical step which will enable the development of preventive measures and optimization of relevant process parameters and thus reduce the environmental impacts related to this treatment method. The influence of variations in water quality parameters was accessed using a 2k factorial test design and a well-known chemical purification pilot test procedure (jar test). The k factors or parameters evaluated were: organic matter as chemical oxygen demand (COD 20mg/l and 80mg/l), suspended solids (SS 10mg/l and 60 mg/l), applied coagulant dosage (ferric sulphate 35mg/l and 100mg/l) as well as pH (4.5 and 7.0). Water samples were collected from different peat extraction sites and suitable samples were manipulated using techniques such as centrifugation, dilution and acid or base addition to produce samples with the combinations of high and low concentrations presented. The complete statistical analysis of obtained results will include evaluation of variability using the univariate repeated measures ANOVA as well as the multivariate repeated measures ANOVA methods. Preliminary results of the univariate analyses shows that the interaction between the concentration of a particular substance (COD, SS and pH) and the dosage applied impose significant higher influence on the overall purification efficiency than the substance concentration and applied dosage as individual factors.