Proceedings of the 8th International Conference on Environmental Science and Technology
Lemnos Island, Greece, 8 – 10 September 2003
Full paper Vol. A, pp. 365 - 372

ALKALISATION AND NUTRIENT INFLUX FROM THE AIR AS DAMAGING FACTORS FOR SUB-BOREAL ECOSYSTEM

Marko KAASIK[1], Tõnu PLOOMPUU[2], Tiiu ALLIKSAAR[3] and Jüri IVASK[3]

[1]Institute of Environmental Physics, University of Tartu, Estonia
[2]Tallinn Pedagogical University, Estonia
[3]Institute of Geology, Tallinn Technical University, Estonia
E-mail: mkaasik@ut.ee

EXTENDED ABSTRACT

The well-known environmental effects of acidic precipitations include acidification of soils and damage of coniferous trees. Just opposite occurs, when a naturally nutrient-lacking forest stand on the acidic soil is exposed to a moderate influx of alkaline particles (cement dust or fly ash containing CaO, MgO, K_2O etc. alkaline oxides) from the air. The most sensitive ecosystems to the alkaline influx are typical for boreal and sub-boreal latitudes: bog and forest on the *podzolic* soil .

An exceptional region suffering alkalisation is the world's largest oil shale mining area in the north-eastern part of Estonia. Total emissions of fly ash nowadays constitute over 50 thousand tonnes annually, but were 3 – 4 times larger during seventies and eighties. The limestone-like mineral part of *Kukersite* oil shale constitutes about 60% of its total mass. At high temperatures in the furnace carbonates are decomposed. As a result, fly ash contains 30% CaO, 9% Al_2O_3, 7% K_2O, 2% MgO and other alkaline oxides (Pets et al., 1985).

Observations at forested bog sites near two large oil-shale-fired power plants show that (1) growth of trees (*Pinus sylvestris*) was accelerated after the power plants were launched during 1959 – 1973, (2) large changes in the plant cover occurred (acidophilous species, incl. *Sphagnum* disappeared, several non-typical species appeared) and (3) accumulation of atmospheric carbon in the peat layer has decreased or stopped as a result (Karofeld, 1996).

Preliminary results of this study were presented at 7th CEST (Kaasik et al., 2001). Several new details were added recently to the knowledge about the effects of alkaline pollution. In particular, new methods were applied to quantify the pollution load and its effects to the ecosystem:

- bulk sampling of deposited matter (modified EMEP methodology; EMEP, 1996) to validate and differentiate the model-estimated deposition fluxes;
- tracing the spheroidal fly ash particles (typical for the emissions from high-temperature combustion) in the precipitated water;
- investigation of the radial increment of trees to reconstruct the history of their growth for comparison with the modelled history of deposition.

Relying on the field results, empirical relations between the technogenic influx and quantitative ecological impact parameters (bog water pH, plant cover indexes) are derived. This knowledge is expected to contribute to the understanding of ecological impact mechanisms of aerotechnogenic loads. Decrease of atmospheric carbon sink due to perturbed peat layer growth is quantitatively estimated. Calculations show that due to alkalisation of bogs atmospheric CO_2 binding ability of the ecosystem has decreased by at least 17 000 tonnes per year within the borders of Estonia.

Key words: alkalisation, nutrients, bog, atmospheric influx, precipitation chemistry, spheroidal fly ash particles, radial tree growth, peat layer, carbon binding.