ISSN 1070-3632, Russian Journal of General Chemistry, 2011, Vol. 81, No. 13. pp. 2672–2675. © Pleiades Publishing Ltd., 2011.
Original Russian Text © O. Roots, M. Voll, 2011, published in Ekologicheskaya Khimiya, 2011, Vol. 20, No. 3, pp. 150–154.

New Equipment for the Collection of Water Percolating through the Soil and Bulk Materials

O. Roots[a] **and M. Voll**[b]

[a]*Institute Estonian Environmental Research Institute (under Estonian Environmental Research Centre), Tallinn, 10617 Estonia*
[b]*Marine Systems Institute at Tallinn University of Technology, Tallinn, 12618 Estonia*

Received July 30, 2011

Abstract—A new equipment for the collection of water percolating through the soil and bulk material constructed in 2008 was an essentially improved variant [1]. Constructed equipment/sampler is cheap to construct on the spot, their installation does not damage the soil layer and no vacuum was necessary for taking of water samples. From the beginning of 1994 our so called, "old equipment" [2, 3] is still in operation in the international integrated monitoring stations of the Estonian national programme of environmental monitoring. The new one can be used for the collection of samples of water percolating through the soil as well as heaps of bulk materials (such as grain, fuels, construction materials) of all kinds of corner. They are necessary for monitoring the condition of natural soil, as well as for the research of the changes in the physical state of soil during construction activities and redesign of relief related to the establishment of ditches, ponds, artificial hills and other objects.
DOI: 10.1134/S107036321113007X

INTRODUCTION

The Estonian National Environmental Monitoring Programme (NEMP) was initiated in 1994 [4]. Presently there are altogether around 1800 monitoring stations in the monitoring set of 68 subprogrammes of 11 monitoring themes, the number of parameters reaching 250. Several NEMP projects are related to the European networks or regional projects in the Baltic Sea Basin and are founded on an international framework of standards, methodology and reporting. Estonia is currently participating in five pan-European programs of the International Cooperation under the UN/ECE Convention of Long-Range Transboundary Air Pollution. These are the international programs for effects on air, mosses, forest, cultural objects and ecosystems.

Integrated monitoring of ecosystems means physical, chemical and biological measurements over time of different ecosystem compartments simultaneously at the same location. In practice, monitoring is divided into a number of compartmental subprogrammes (one of them is soil–water chemistry) which are linked by use of the same parameters (cross-media flux approach) and/or the same/close stations (Fig. 1) [5].

When Estonia started to build up its natio nal environmental monitoring after gaining of independence, the entire former monitoring system had to be reformed. Estonian monitoring stations participating in international air and integrated monitoring passed complete course of renewal. Sampling and measuring equipment had to be taken into conformity with international requirements. The soil water collection equipment recommended in the manual for integrated monitoring programme [5] were not satisfactory for our country. Some of them (e.g. in Vilsandi and Saarejärve) were not suitable for our monitoring stations due to their

Ott Roots, Cand. Sci. (Chem.), Estonian Environmental Research Institute, under Estonian Environmental Research into Substances Hazardous to the Environment; special interest persistent organic pollutants, as PCB, PCDD/Fs, DL-PCBs, HCB, HCH, DDT, PBDE etc. distribution in the environment and environmental monitoring. Research relating to the State of Environment and to Environmental Protection. Environmental technology and pollution control.

Martin Voll, Engineer (Chem). Marine System Institute at Tallinn Unversity of Technology. Scientific area of focus: Bio-, Geosciences and Environment,Research relating to the State of Environment and to Environmental Protection. Environmental technology and pollution control.

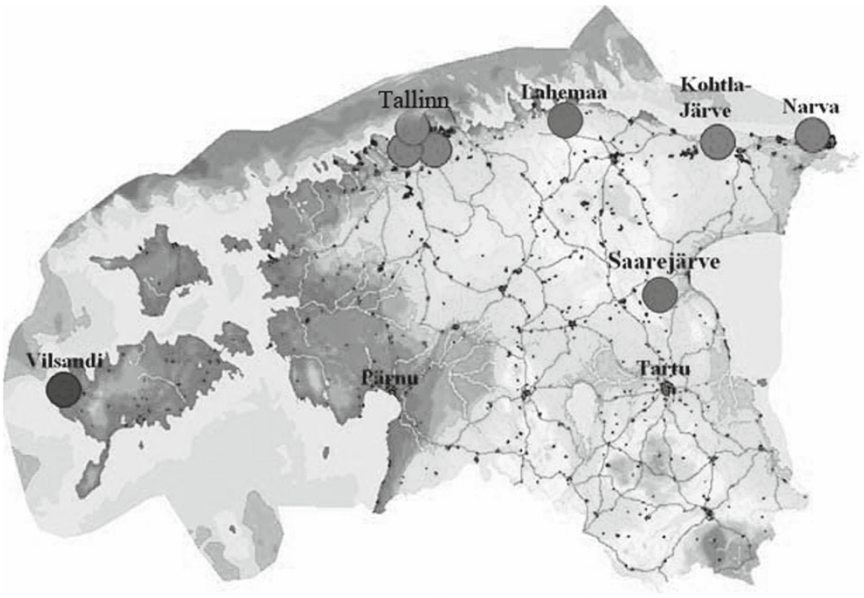

Fig. 1. Estonian National Air and IM Quality Monitoring Network. Vilsandi, Lahemaa and Saarejдrve are background stations and the others are urban stations.

construction and sampling methodology, while some others were too expensive. Therefore a new equipment for the collection of water percolating through the soil [2] and a lysimeter [3] were constructed, and the costs related to their development and registration as useful models were covered by the authors. This equipment, which is still in operation in the integrated monitoring stations of the Estonian national programme of environmental monitoring, were cheap to construct on the spot, their installation did not damage the soil layer and no vacuum was necessary for taking of water samples. In 1994 and 1995 a new equipment was compared to other lysimeters in Vilsandi monitoring station, and the results [6] proved superiority of our units. Our "old equipment"[2, 3] have been used also for the measuring the pollution level of water percolating through the ash hills in the oil shale regions [7].

METHOD

Applied method should not change the content of the soil water during sampling. The value of soil water samples used in ecological studies is highly dependent on the quality of the samplers. The description of the old equipment used in the integrated monitoring stations of Estonia (Fig. 1) and the fixed results are available also on the web page of the European Lysimeter Platform. Lysimeter represents an assemble fromstainless steel fringed plates 1 (Fig. 2) [6].

The following operations are required out:

1. Dig a trench, having at least one vertical wall.

2. Push (tip) the lysimeters at the required height into the soil of the vertical wall in a little inclined direction.

3. Put in place a soilwater collecting vessel 7 and connect it with the lysimeters pipe 6.

4. Put in place the tube 8 (for evacuation of the collected soilwater by the pump 9).

5. Replenish the trench with soil removed.

6. Reinstate uppermost humusrich.

RESULTS AND DISCUSSION

So called "old equipment" [2, 3], which is still in operation in the integrated monitoring stations of the Estonian national programme of environmental monitoring was cheap to construct on the spot, their installation did not damage the soil layer (Fig. 3).

The depth to install the lysimeters-samplers should be within the 10–20 cm layer and the 30–50 cm layer, i.e. within and below the main rooting zone (0=mineral soil surface) [5].

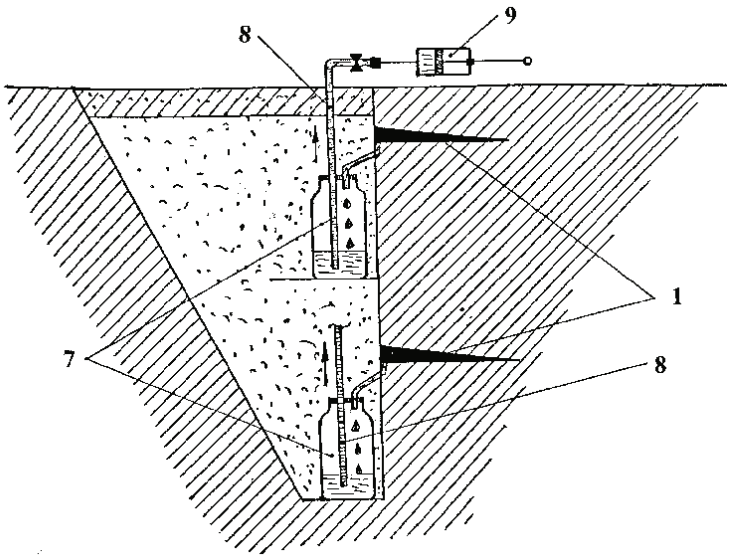

Fig. 2. Installation of the lysimeters in soil [6].

Fig. 3. Soil water monitoring station in Vilsandi monitoring station soil [9].

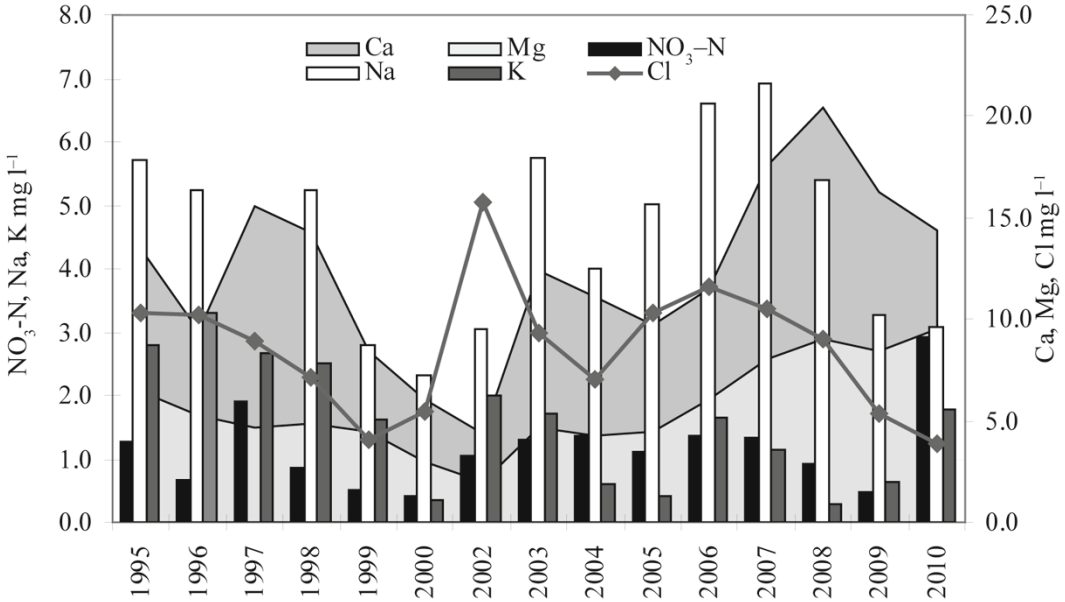

Fig. 4. Soil water nitrate, chlorine, sodium, potassium, magnesium and calcium composition in Vilsandi monitoring station soil water from depth of 17 cm from 1995–2010 [9].

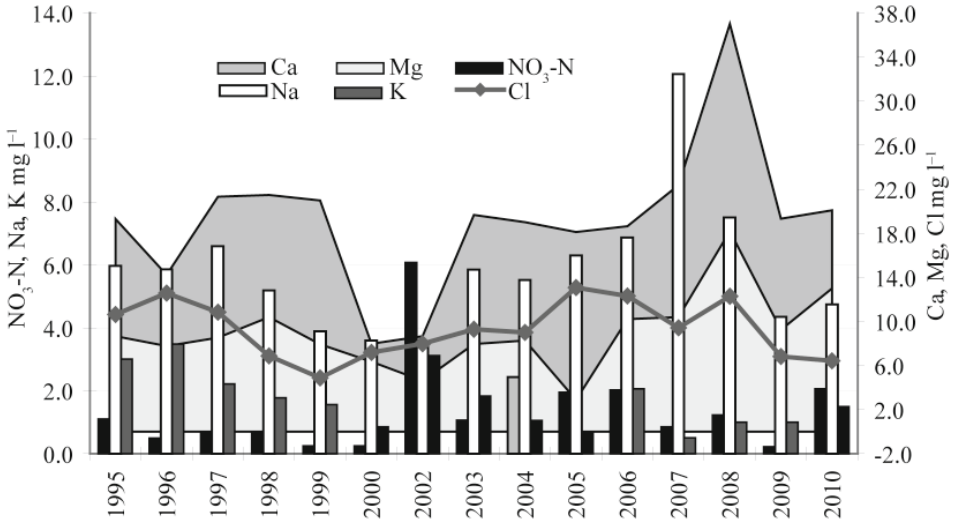

Fig. 5. Soil water nitrate, chlorine, sodium, potassium, magnesium and caltsium composition in Vilsandi monitoring station soil water from depth of 35 cm from 1995–2010 [9].

The authors, which constucted all soil water systems worked in Estonia, recommend to revise the Integrated Monitoring (IM) Manual 1993–1996 and to use for soil water sample collection in IM stations. The succesfully work in Estonian IM stations in Vilsandi (Figs. 4 and 5) and Saarejärve [8, 9].

SUMMARY

A new constructed equipment can be used for the collection of samples of water percolating through the soil as well as heaps of bulk materials (such as grain, fuels, construction materials) [1]. It is the essentially improved variant. New sampler collects the samples of water percolating through the soil or bulk materials (such as grain, fuels, construction materials) with all kinds of corner. They are necessary for monitoring the condition of natural soil, as well as for the research of the changes in the physical state of soil during construction activities and redesign of relief related to the establishment of ditches, ponds, artificial hills and other objects.

Until now, there has been no interest in the production and use of our measuring equipment in Estonia, and therefore the authors have started to look for foreign partners.

REFERENCES

1. Voll, M. and Roots, O., *Kasuliku mudeli tunnistus nr. 00865. Kasuliku Mudeli Leht,* 2009, no. 4, p. 14 (*IPC klass: E02D 1/06 (2008/4) E21B 49/10 (2008/4)*, 2008.
2. Voll, M. and Roots, O., Pinnasevee kogumise seade. *Kasuliku mudeli tunnistus, nr. 00078, EE 950078U. Kasuliku Mudeli Leht,* 1996, no. 2, p. 13. *(Int. Cl.: EO2D 1/06; E21B 49/10).*
3. Voll, M. and Roots, O., *Lüsimeeter. Kasuliku mudeli tunnistus*. 1998, nr. 00178, EE98 00011 U *(Int. Cl.: EO2D 1/06; E21B 49/10).*
4. Roots, O. and Saare, L., *Environ. Monitoring and Assessmen*t. Kluwer Academic Publishers, 1996, vol. 40, no. 3, p. 289.
5. *International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystems. Manual for Integrated Monitoring. Subprogramme 7.8: Soil water chemistry. UN ECE Convention on Long–Range Transboundary Air Pollution,* ICP Programme Centre, Finnish Environment Institute, 2008.
6. Voll, M. and Roots, O., *Environ. Monitoring and Assessment*. Kluwer Academic Publishers, 1999, vol. 54, p. 283.
7. Kirso, U., Irha, N., Reinik, J., Urb, G., and Laja, M., *ALTA*, 2007, no. 35, p. 119.
8. Talkop R. and Roots, O., In.: Kleemola, S. and Forsius, M. (Eds), 10th Annual Report 2003, UN ECE ICP Integrated Monitoring, Finnish Environment Institute, *The Finnish Environ.*, 2003, no. 498**,** p. 43.
9. Riiklik keskkonnaseire programm. Kompleksseire Vilsandil. Aruanne (Leping nr. 4–1.1/115)(Koostajad Pauklin, T., Truuts, Akimova, J), *Eesti Keskkonnauuringute Keskus, OÜ*, 2010, 63 lk (in Estonian).