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DEVELOPMENT OF ANALYSIS METHODOLOGY OF TECHNICAL INDICATORS OF PEAT AND RELATIONSHIP BETWEEN THESE INDICATORS, PEAT PROPERTIES AND FIELDS OF USE

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SUMMARY

Peat is one of the most important mineral resources of Estonia, 2.37 billion tons, extracted from 1.0 to 1.2 million tons per year. It is exported to 100 countries. It is necessary to analyze the sustainability of peat mining, develop innovative new uses (balneology, activated carbon, peat wax, humic substances, fertilizers, etc). So far, the peat is limited to only heating purposes and horticultural use. Analysis of botanical composition and chemical characteristics of peat provide opportunities for dividing peat layers according to different qualities and possible uses. In Estonia, more than 40,000 peat samples have been collected. Their botanical composition, degree of humification, pH, natural moisture and ash content were determined. Also calorific value, content of trace elements, as well as formation and genesis of peat were described. All the Estonian peat samples have been analyzed using similar methods. Samples have been collected throughout the whole peat sequence. Analysis results give possibilities to determine different quality classes of peat for raw materials and alternative use. It is also important to complete models and maps, where peat layers with different composition of organic matter can be found. The article gives the opportunity and ideas to solve the problems set by the research nationally and internationally

Keywords: *peat characteristics, different peat quality classes, peat alternative use. Peat utilization indicators*

INTRODUCTION AND PEAT INVESTIGATION MATERIALS FOR COMPILING THE DATABASE

Mires and peatlands are an important landscape element in Estonia, covering 1,009,101 hectares (22.3% of territory). Peat reserves amount to 2.37 billion tons (Orru *et al.*, 1992; Orru, 1995). The development of mires and accumulation of peat in the territory of the present-day Estonia started soon after the retreat of continental glacier, first in upland Estonia (Orru, 2010). Considering that peat deposits have formed under variable geological conditions and water regime, their properties (species association, content of mineral and organic matter, chemical composition, the amount and quality of peat reserves) are variable as well.

Peat is among the most important mineral reserves of Estonia, and has long traditions of extraction and utilization. Traditionally peat is used as fuel, in horticulture and as litter. In Estonia annually, 1.1-1.2 million tons of peat is extracted from about 2,000 hectares. Horticultural peat is mostly used in market-gardens of foreign countries, and peat is exported to 100 countries (Orru, Nurme, 2014)

In peat extraction it must be considered that the accompanying establishment of drainage systems affects the technical characteristics of peat (degree of humification, pH, natural moisture content, content of mineral matter (ash content), content of organic matter, mineralization of top peat layers). The above assumption is based on factual data and 1200 laboratory analyses collected within the revision of residual peat reserves carried out at the Geological Survey of Estonia in 1992-1997 (Ramst, 1997). This is important factual information obtained in the process of the above study and must be scientifically systematized. Hydrochemical and hydrogeological investigations for delimiting the buffer zones and elaborating protective measures (Loigu, Orru & Lode 2008) was carried out. Within the above project, the groundwater level in undrained area bordered with peat production field was measured and the quality of groundwater (pH, temperature, electro conductivity, oxygen content, oxygen saturability) in the water of the peat deposit was assessed, which suggests that similar method could be used also for defining peat layers with different properties (Kink *et al.*, 1998, Orru *et al.*, 2013). Naturally, peat layers with variable structure and association of species have different chemical and physical electric parameters.

Changes of peat properties take place in the process of peat extraction, storing and processing, where in the result of draining of a peat deposit, its biological and chemical balance is shifted, which favors mineralization of the top layers and sometimes self-combustion of peat (Ranneklev and Gislerod, 2002).

In Estonia, humic substances have been studied in three peat deposits and using the newest laboratory methods (Orru, 2010). The primary results have been positive (Orru *et al.*, 2011) and have attracted interest also internationally (Orru *et al.*, 2010). This peat is good for balneological purposes and successfully used in spas, clinics, exported to many countries. In the Department of Mining, the balneological peat research gives good results and after that it is popularized to use in domestic conditions (Orru, *et al.*, 2013).

In the process of the revision of peatlands carried out by the Geological Survey of Estonia in 1972-1987 (Orru *et al.*, 1972-1987), more than 40, 000 samples of peat were collected (Orru, 2008), their botanical composition, degree of humification, pH, natural moisture content was determined, and the formation and genesis of peat was described (Orru, 1997). Uniquely, in Estonia, large number of peat samples has been analyzed by similar method (Orru & Orru, 2003; Orru & Orru, 2006). The samples have been collected from the whole peat sequence in both, as harvested and natural areas. In many countries only visual assessment is used in peat investigations. In Estonia the botanical composition was determined by microscope, all plant species have been determined starting from Preboreal up to today. It is valuable information on impact of postglacial climate and human activity on environmental changes. In the last two decades in Estonia peatlands investigations have focused on the inventory of vegetation. Practically peat-focused research has not been done in the last 25 years.

In Estonia, the inventory of peatlands was completed in 1987 and in the next 25 years most of the obtained data of peat technical analysis have not been systematized and scientifically analyzed. However, the character of both ecological and water regime depends firstly on the character of the peat layers since in less plant species are found in raised bogs, in comparison with fens. The properties of peat determine can provide information on its field of utilisation and quality classes, and the price forecasting. Systematization of the existing extensive factual material (ca 40,000 determinations) allows distinguishing the raw material of different groups and classes within the whole sequence.

However, there are also several perspectives that can be developed in the future. About 40,000 determinations of the peat types and composition of peat by plant species by entire peat sequence (from late Preboreal until present) are stored at the Depository of Manuscript reports of the Geological Survey of Estonia. In further investigations, this material could be used, for instance, for assessing the climate changes during the Holocene as well as the anthropogenic influence.

In Estonia the topic is essential for compiling the concept of utilization and protection of peatlands, and internationally for the programme Strategy for Responsible Peatlands Management. To solve these problems, which are mentioned in the stated article, the Department of Mining set up new project to compile peat characteristics database.

METHODS AND WORKING HYPOTHESES

1. Working hypothesis is that geobotanical inventories of peatlands should be done simultaneously with peat deposit investigations and to prove the allegation that the character of vegetation of a peatland largely depends on the properties of peat. The latter is closely related to water regime and quality. That hypothesis is supported by before done results (Peatlands mapping-1972-1987). It is necessary to analyze the sustainability of peat mining and different fields of use.
2. The development of a new research method, which supports the hypothesis that the peat properties depend on genesis, hydrological regime and climate conditions. Hypothesis are mostly based on technical properties of peat (species associations, pH, ash content, degree of humification, natural moisture content), which are collected prior to peat investigations. The representative factual data (40000 analyses) and experience obtained can be used for successful execution in the future. It gives possibility to determine peat different quality classes of raw materials and alternative use (balneology, active carbon, peat wax, humic substances, etc). It is important to compile models and maps, where we can find peat layers with different organic matter composition. Proof of the hypothesis is mainly by statistical analysis, as well as laboratory and field studies. This hypothesis is the first to be introduced in Estonia and internationally.
3. Proving the hypothesis that draining alters the density of peat, as well as its properties and quality. This hypothesis will be used as foundation and peat sample materials for study peat layers density.
4. Considering the results of earlier investigations of peat properties and water regime, the planned research will provide a new method which enables distinguishing of the prospective peat deposits of highest quality which will be shown on the map. The new method will be economically efficient since minimal amount of new analyses will be required.
5. Assessing the actual mineralization level of top layers of a peat deposit in the result of draining (peat production area, paleudified field, forest). Will be used soil, forest, water and etc maps, LIDAR system for compiling models of mineralized peat layers.

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