ENVIRONMENTALLY-FRIENDLY ALTERNATIVES TO PEAT

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Summary

Protection of the environment is a relatively new and rapidly growing sector in the use of peat. Slightly decomposed *Sphagnum*- peat has a high cation exchange capasity, good liquid holding ability, high porosity, high organic matter content and it is a good growing medium for microbes. In the treatment of wastes the absorption capacity, antiseptic properties and deodorizing capacity of peat have long been known and used. These properties could be exploited as a growing medium, as a litter material in cowsheds and chicken farms, in sludge handling in agriculture or in municipal sewage treatment plants, in composting of sludge or biowaste, in cleaning of waste waters, in biological air purification, in oil absorbing or in filtering heavy metals from waste waters in different industrial processes. Fast developing sector is also the use of peat for balneological purposes and exploitation of the fibers in textile industry.

1. Introduction

Peat organic matter is a valuable chemical-technological raw material. The organic composition of peat can be divided into four different groups: bitumens (waxes and resins), carbohydrates (hemicelluloses, cellulose and pectins), and lignin and humus substances. Dry peat contains bitumen 1 to 20 weight %, hemicelluloses 1–30 wt %, cellulose 0–20 wt %, lignin 0–40 wt % and humus substances 0–60 wt %, primarily depending on the decomposition degree and type of peat. The chemical technology of peat-processing is carried out by hydrolyses, extraction and chemical modification. On the bases of hydrolysis and chemical modification, valuable substances and materials have been prepared for plant growing, cattle breeding and medicine. Especially in

Belarus and Russia much attention has been directed to develop peat based medicinal preparations. Despite of the high number of conversion alternatives, chemical conversion of peat in a large industrial scale is rather limited, because the industrial realization is dependent on the price development of fossil fuels and other competitive biomass raw materials.

The production of peat for environmental purposes takes place alongside other peat production. The more sophisticated products are developed, the better quality control and pre-treatment methods in the production must be.

2. Peat as a Growing Medium

The total production of peat used as a growing medium in agriculture, and horticulture with its sectors in floriculture, vegetable- and mushroom-growing, nursery stock, fruit growing, landscape gardening amounts to 70 Mm^3 annually. In 1994, Russia with the production of 17.5 Mm^3 was the largest producer of horticultural peat. Germany is in second place worldwide with a production in the same year of 8.9 Mm^3. Canada produced 7.4 Mm^3 (in 1994) and supplied markets in the USA and Japan as well as its own, and to a small extent, other markets. Estonia and Finland produced approximately 2.2 Mm^3, United Kingdom, the USA and Lithuania had a production of 1.2 Mm^3, Ukraine and Sweden 1.1 Mm^3. Alone for Germany the total value of horticultural produce and services was in 1992 more than 9000 million US$. Floriculture is the most technical orientated sector of horticultural production. In the EU some 60 000 glasshouse operations produced flowers and foliage crops on 20 000 ha. Another 51 000 businesses produced the same produce on 47 000 ha in the field. Vegetables were produced in more than 80 000 greenhouse operations, field production not included.

With respect to its structure, growing medium should be stable as well as resistant to shrinkage and degradation during storage. Medium should also be easily wetted. The principal physical functions of medium are to hold and supply water and oxygen to plant roots. The more sophisticated a growing method is, the more reliable the medium must be. The quality of the substrate is essential to roots. To guarantee enough water, oxygen and nutrients for the roots, the substrate needs to be sufficiently porous with larger air pores and smaller water pores in the right proportion. It should also have a suitable pH level and nutrient status and be free from any harmful substances or organisms.

No other substrate material has so many favorable physical, chemical and biological properties as peat; the properties of which are primarily determined by its plant species composition and degree of decomposition. The best substrate is slightly decomposed *Sphagnum*-peat, which still contain the moss cell structure resulting in high pore volume (approx. 90%) and large specific area (up to 200 m^2g^{-1}). In this respect peat resembles activated carbon, which has a specific area of 500 to 1400 m^2 per gramme. Slightly decomposed peat with delivery moisture content of approximately 50%, has a density of 150 to 200 kg m^{-3}. Due to its structure, *Sphagnum*-peat can hold up to 600–800 kg of liquid per cubic meter of peat. The most important characteristics of peat for horticultural purposes are its porous and durable structure, excellent physical qualities such as good water and air holding capacity, low pH and thus easily adjustable by

liming, low nutrient content and thus easily adjustable according to the needs of plants, contains no harmful chemical compounds, contains useful microbes, has no weed seeds, diseases or pests and it is easy to handle and refine. Because peat is a natural material, it is environment- friendly substrate. Though slightly decomposed *Sphagnum*-peat is free from plant pests, it has active micro-organisms that do not exist in synthetic substrates. These kinds of microbes provide a buffer against plant diseases causing fungi. This can be concluded from the fact that diseases spread more slowly in new growing media than in substrates disinfected by hot steam. Microbe population in new peat is rich in *Penicillium, Mortierella, Mucor* and *Trichoderma* fungi and bacteria, especially those belonging to the *Streptomyces* group. By its microbes slightly decomposed *Sphagnum*-peat can protect plants against, for example, seed-borne diseases.

The main part of slightly humified peat resources in the world is situated in the northern hemisphere. In addition to this in Argentina and Chile in the southern hemisphere are appreciable horticultural peat resources. The majority of the horticultural peat is produced in Europe, accounting for 70% of the world's production. Canada produces 25% and the USA 5%. Although only a few countries produce peat for horticultural purposes, many use it. For instance, Canada exports 80% of its production, Ireland 71 percent, Estonia 95%, Sweden 38%, Germany 49% and Finland 14%. In the middle of 1990s the USA imported 5.8 million cubic meters of horticultural peat, the Netherlands 2.5 Mm^3, Germany 1.0 Mm^3, Japan, and Great Britain 0.9 Mm^3, France and Italy about 0.3 Mm^3 and other countries 0.4Mm^3.

3. Composting

In composting process various organic substances, like sludge and biowaste could be mixed with slightly decomposed *Sphagnum*-peat. Peat as supporting material has both a high liquid holding and cation exchange capacities. It also has capability to maintain air circulation in compost. Peat is also an excellent source of carbon in the treatment of sewage sludge. A lack of carbon could cause higher emissions of ammonia, which would mean odor problems and loss of nitrogen. The use of peat as a supporting material in composting is increasing and becoming more and more popular in many countries.

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Biographical Sketch

State geologist **Dr. Eino Lappalainen** was born on November 9, 1939. Graduation in geology and paleontology in 1965 at the university of Helsinki, PhD in 1970 at the university of Turku. Has been appointed Guest Professor of the Changchun Institute of Geography, Chinese Academy of Sciences in 1996. Eino Lappalainen has worked the period of 1962 to 1997 in the Geological Survey of Finland. For over 20 years he was in charge of peat geological surveys. His research was directed towards the survey, genesis, classification and utilization of peat resources. He has published about 150 scientific papers as well as investigations on the use of peat and peat lands, published in Finnish as well as in international bulletins and journals. His latest accomplishment is the book Global Peat Resources, released by the International Peat Society in 1996. The author has been actively involved in national and international co-operation projects and act as member and chairman in numerous scientific and technical societies and committees. He has also worked as a consultant in Sweden, Brazil, P. R. China, USA, Canada, Sri Lanka, Indonesia, Estonia, and the former Soviet Union.