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CONSIDERATION OF THE REPORTS CONCERNING PREPARATORY ACTIVITIES FOR THE CONFERENCE

INTERIM REPORTS OF THE TECHNICAL PANELS

Report on the use of peat for energy*

Note by the Secretary-General

At its thirty-third session, the General Assembly, in resolution 33/148 of 20 December 1978, identified peat as one of the new and renewable sources of energy within the scope of the Conference.

At its thirty-fourth session, the Assembly, in resolution 34/190 of 18 December 1979, considered that "adequate arrangements should be made to ensure equally detailed consideration for those areas of new and renewable sources of energy for which no technical panels have been created, namely peat and draught animal power".

The Government of Finland undertook to prepare a study on the energy uses of peat for the Conference secretariat and has provided an interim report on the subject (see annex below), summarizing the situation with regard to:

(a) Peat resources;

(b) Peat production;

(c) End-use of peat;

* Prepared by the Government of Finland.

(d) Conversion of peat;

(e) Uses of peat for purposes other than energy production;

(f) Economic and social aspects of peat use;

(g) Environmental aspects of peat use;

(h) Utilization of peat resources.

Annex

REPORT ON THE USE OF PEAT FOR ENERGY; ABSTRACTS

1. Peat resources

1.1 Distribution and characteristics of world peat resources

Knowledge of the extent and depth of peatlands in different countries is still insufficient but is increasing as a consequence of intensified research activities. Global peat resources were estimated at 100 million hectares in 1929, 112 million hectares in 1964, 150 million hectares in 1968, and 350 million hectares today. Estimates on the extent of peatlands are nevertheless still inadequate in many countries; there is, for instance, very little information available on the peatlands of South America and Africa.

Surveys of peat resources are also insufficient, although further light has been shed on these problems in recent years.

1.2 Peat resource estimation

Before bogs are prepared for peat production, much survey work is needed to determine the quantity and quality of peat and bogs suitable for peat production. This article describes bog-surveying methods from map investigations to complete field surveys. Equipment and labor requirements for survey work are described, as well as the analysis of samples.

1.3 Biological properties of peat and peat classification

Peat is a naturally occurring organic soil, composed mainly of more or less decomposed residues of platns grown in bogs. The plant that is peculiar to peat and distinguishes peat from all other organic soils is peat moss (sphagnum). Its structure is unique. Each of the numerous water cells has a pore, through which water enters readily, and ringlike thickenings of the wall, which strengthen it. Because of these cells, peat moss contains an in-built capillary system for storing and conducting water. It is also highly porous. Its cation exchange capacity is also high. In addition to the peat mosses, other important peat-forming plant groups are sedges, true mosses, grasses and woody plants (shrubs and trees).

Bogs and peats are closely connected. Every bog-type forms its own type of peat. The most important factors affecting the formation of a bog-type are the moisture content and acidity of the habitat. The peats formed in wet habitats have many similar properties, such as low-volume weight, low moisture-holding capacity, high permeability, fibrous structure, low degree of decomposition, low cation exchange capacity and high nitrogen content. The typical properties of the peats formed in dry habitats are: high-volume weight, high moisture-holding capacity, low permeability, high degree of decomposition, high cation exchange capacity and low nitrogen content. The structure of peats formed in acid habitats is amorphous and that of peats formed in slightly acid or neutral habitats is granular.

/...

Because peat is formed of more or less decomposed bog-plant residues, the plant species and the degree of decomposition are used as criteria for peat classification. The lower the degree of decomposition, the more the properties are determined by the plant species, and the further the decomposition is advanced, the more the properties are determined by the decomposition products. On that basis, the peats are classified into light, dark and black peats. On the basis of the peat-forming plant groups, the peats are classified into moss, sedge, grass, woody peats and so on. The acidity of the peat (trophicity) is often used as a third criterion for peat classification (oligotrophic, mezotrophic and eutrophic peats).

1.4 Properties of peat as a fuel

According to its fuel properties, peat is placed between biomass and young brown coal grades and is classified in the group of long-flame fuels.

One characteristic of milled peat, used for fuel primarily in large units, is that the moisture content is relatively high and the volume weight small. Hence the heat content of the unit volume of milled peats is about one tenth of that of oil and about one fifth of that of coal. The qualitative variations of milled peat are also considerably higher than those of coal and oil. As milled peat is in most cases fed as volume flow into the furnace, variations in the volume weight strongly affect the heat content of the feed. As there are also variations in the calorific value of peat, the ratio of maximum and minimum values may be nearly four in extreme cases.

The softening and smelting points of peat ash have usually been slightly lower than those of coal grades.

Thanks to the low content of sulphur and heavy metals, most peat grades are very high-quality fuels in terms of environmental protection.

2. Peat production

2.1 Fuel-peat production in the world

Articel briefly describes peat production and gives statistics from countries that have supplied information to the International Peat Society.

2.2 Preparation of peat production sites

Peat production has one significant advantage compared with oil and coal mining; peat deposits are located on the surface of the earth. Therefore it is easy to find them and analyse the quality. On the other hand there are problems, too. The high moisture content of virgin peatland (86-95 per cent by weight) is a limiting factor. The drying of peat-bog for production normally takes from three to six years depending on the quality of peat and the thickness of the peat layer.

In addition to the drainage, timber must be cut, roads built, stumps extracted and the surface of the bog levelled before peat-bog is ready for production. All these operations are rather costly and demand high capacity equipment. In Finland, the Union of Soviet Socialist Republics and Ireland, special machinery has been developed for bog preparation. A typical characteristic of these machines is the low ground pressure due to the small bearing capacity of wet peat-bog. Before the preparation of peat-bog for production is begun, a thorough survey of the bog must be carried out. A production plan, including a scheme for drainage and for a transportation network, is drawn up on the basis of the survey. A good knowledge and experience of peat production are needed to draw up a peat production plan.

2.3 Technology for peat production; abstract

Articel describes the main production methods used nowadays, milled-peat and sod-peat methods, and the equipment commonly used by big and small enterprises.

2.4 Storage handling and transportation of peat

The low density and relatively non-homogenous quality of peat are factors that affect the handling of peat in the various phases. For these reasons, peat is normally stored on the peat production sites, while the stocks at the user's site are sufficient for a few hours only or, at most, for from one to two days usage. The storage of peat is an essential part of peat production technology, the final stage of which is the collecting of peat into stockpiles. The greatest problems in the storage of peat are the tendency of peat to self-ignite, rain, the relatively high humidity of the air, especially in the autumn and, finally, the losses in storage due to freezing of peat in winter. The keeping quality of peat can be improved by using various roofing materials, for instance, polythene film. Variations in the quality of peat can, to some extent be reduced by using proper methods of stockpiling. Peat is stored in almost the same way in all countries. There are, however, small differences due to climatic factors and the means of long-distance transportation used.

Peat transportation is a demanding task, which must be carried out at all times of the year. The exacting nature of the task is increased by the fact that peat can be stored at the user's site in small amounts only. In the USSR, narrow gauge railways are only used to transport fuel-peat. Peat used for soil improvement is moved by lorries. In Ireland, peat is transported by narrow-gauge railways because the power stations and peat briquette factories are located near the production sites. In Finland, 70 per cent of the peat transportation is done by lorries and the remaining 30 per cent by rail. Narrow-gauge railways are not used in Finland. Special equipment demanding considerable investment is needed in peat transportation. The contribution of transportation to the fuel cost at the consumer's site is approximately 30-40 per cent. Owing to its low density, peat is regarded as a local fuel, the maximum distance it can be transported economically being about 100-200 miles.

3. End-use of peat

3.1 Peat use in the world

Describes different uses of peat and gives statistical information collected by the International Peat Society.

3.2 Peat-fired power and heat production plants

The paper discusses the latest developments and technical solutions applied in peat-fired power and heat production plants. The operational experiences of various plants will also be presented, and the economical and environmental aspects of the plants will be compared.

3.3 Small-scale use of peat

A number of factors are discussed that make the small-scale use of fuel-peat attractive in both industrialized and developing countries. Suitable forms of peat for household and farm applications are sod-peat, briquettes and various high-quality peat-derived fuels, such as pellets and charcoal. The production possibilities of fuel-peat in developing countries are briefly examined. Finally, different peat-bruning facilities are presented, ranging from small bonfires for cooking purposes to heating furnaces and small boilers.

3.4 Use of peat in industrial processes

Peat or processed peat can be used as an energy source in several industrial processes. Each of these processes has its own special requirements. In cement kilns, for instance, a temperature level of 1,450-1,600° C is required in the flame. Such a level requires combustion air preheating and peat with a low moisture content.

The article describes the peat processing and firing system in cement kilns, drying drums and ovens, heat treatment furnaces and furnaces in the glass and clay industry.

4. Conversion of peat

4.1 Conversion into higher-quality solid fuels

The quality of peat after production can be increased by various means. The paper will describe the drying of peat by waste heat and flue gases, and indirectly by steam. Drying equipment and their commercial stages (Peco, flash drier, drum driers) will also be explained.

After predrying, peat can be densified and the compressed products can be in the form of briquettes, semibriquettes, pellets and semipellets. Use, economy, competitiveness, and commercial stage will be discussed.

Solid products can be gained from raw peat by wet carbonization pyrolysis and by coking. Alternative equipment, economy and commercial stage will be described.

4.2 Gasification and liquefaction of peat

The following is a list of the subjects that will be discussed:

Production of fuel gas for use on a small scale (1-25 MW). Production methods (counter-current and co-current, fixed bed, fluidized bed techniques) and their commercial stage. Utilization of fuel gas in industrial furnaces, conversion of oil-fired boilers into gas-fired ones. Generation of electricity by fuel gas in power engines (diesel, otto) for scarsely populated areas or generation of electricity and heat in small communities or at small industrial plants.

Production of synthesis gas and synthetic natural gas from peat. Alternatives to commercial coal-gasification processes and the peat-gas process that is being developed for the generation of synthetic natural gas.

Alternative methods of producing liquid fuels from peat (hydrogeneration, pyrolysis, gasification using the Fischer-Tropsch process or methanol synthesis, the production of ethanol by hydrolysis or a combination of these). Technical evaluation, potentials, commercial stage, requirements for raw material (quality and deposits).

Detailed presentation of alternative methods of producing methanol and potential objects of use, based on the availability of raw material and on technical selection criteria and economic evaluation, etc.

5. Uses of peat for purposes other than energy production

In addition to energy production, peat can also be used as raw material for many other applications. The most important of these is the use of peat for substrate and many special products in horticulture.

The high absorption capacity of weakly decomposed sphagnum peat-moss has been used on cattle farms (litter) and in environmental protection. By making peat hydrophobic it is also effective material for the purification of waste waters containing oil and organic solvents.

It is possible, for instance, to manufacture activated carbon and coke for special purposes in the metallurgy and chemical industries from strongly decomposed peat grades with a low ash content.

Peat also contains separate substances and compounds, for which applications can be found in practice.

Differences between peat grades in separate peatland areas, even within the

same climactic zone, are so great that solutions for the utilization of each peat deposit - except for energy - must be made separately.

6. Economical and social aspects of peat use

6.1 Competitiveness of peat in energy production

Peat is a competitive fuel today. Especially compared with fuel oil, the margin is increasing all the time to the advantage of peat.

Under certain conditions, peat is able to compete with coal and nuclear energy in generating condensing power; in most cases peat and coal are very much equal but a big nuclear unit seems to compete quite well.

In base load operation of cogenerating plants the competitiveness of peat is well compared to heavy fuel oil and import coal.

In small- or medium-size heating stations peat-fired plants show a good economic feasibility compared to other fuels when the duration of peak load is long enough.

The competitiveness of peat in small-scale use depends very much on the calculation of personnel cost.

Generally we can say that the most important factors affecting the energy production costs have been found to be plant size, load factor and plant location.

6.2 Capital inputs and labour requirements in peat production and use

Peat production and bog preparation need a number of special types of machinery. Peat transportation unloading, handling, storage and firing also need their own special equipment. Peat is a capital-intensive fuel. The short production period in very northern latitudes increases even further the importance of capital costs. Capital costs per produced unit is shown in the article on bog preparation, peat production, transportation, handling and firing.

The seasonal character of peat production raises problems regarding the skilled labour-force that is needed. In conventional peat production, only aobut one-third of the personnel has a permanent position. The article also describes labour requirements for peat production throughout the year and for peat handling and firing.

7. Environmental aspects of peat use

7.1 Environmental impacts of peat production

Depending on the peat production, there are various environmental factors that can affect ecology, climate, hydrology and people. Conventional peat production requires pre-drainage of the bogs. The drainage water containing

organic material going into rivers and lakes can have a negative effect. The details and seriousness of this will be discussed in the paper, as well as methods of prevention. Peat harvesting forms a great deal of dust. The effects of the dust on nature and also on the people working in the bogs will be evaluated. A recent health study conducted among peat workers in Finland will be discussed.

Peat dust can be hazardous and has to be handled with care to prevent explosions or fires. The modern wet carbonizing method involves the treatment of waste water, especially if it is returned in large amounts to lakes.

7.2 Emissions from peat-fired plants

The results of measurements of emissions from existing platns will be presented. Particulates, sulphur and nitric oxides will be covered, as well as various types of plants.

The merits of different types of combustion arrangement are discussed.

Various methods of the gas treatment are discussed with regard to cost-effectiveness, reliability and safety.

7.3 Reclamation of cutaway peatlands

As a consequence of the sharp increase in peat production, more and more bottom layers of peatlands are being bared in many countries and will be bared in the next few years. These can effectively be used for cultivation or pasturing, afforestation or the growing of energy forests.

Cultivation of cutaway peatlands

In north-western Germany, the surface peat has been cut off for soil improvement and the more decomposed peat of the lower layers has been cut away to be used as fuel in the vast peatland areas. Regulations in the Federal Republic of Germany specify that a peat layer of at least half a metre must be left at the bottom of the peat field for cultivation. A deep-ploughing method has been developed for the cultivation of cut-away peatlands, whereby peat is mixed with mineral soil. In this way, an excellent substrate is obtained for agricultural crop production. The same method can be used for recultivating weak peatland cultures. In north-western Germany, about 120,000 hectares have been recultivated with the aid of the deep-ploughing method since 1936.

The deep-ploughing method has also been used in the Netherlands, Sweden and Norway. Peat deposits have also been exhausted by the modern peat industry in Ireland and these cutaway areas are used successfully for arable crops and especially for grass production. The practice of hand-cutting peat for fuel has been, and still is, widespread throughout Ireland. Some hand-cut peat areas have been reclaimed for agriculture and these are capable of producing grass growth and beef production and vegetable crops comparable to that obtained from mineral upland soil.

Utilization for forestry

Afforestation is in many cases the most rational use of cutaway peatlands. The area to be afforested is nowadays about 100 hectares per annum but in 10-20 years' time it will have increased to 1,000-3,000 hectares per annum. The areas are usually well suited for forestry because of their effective drainage and mainly shallow layer of peat, through which the roots of trees are able to reach the underlying mineral soil.

Soil preparation with deep ploughing is preferable, or indeed necessary if the peat layer is thin and the bottom soil is not stony. Where the peat layer is more than about 40 centimetres thick, PK fertilization is needed. Ash fertilization is also suitable. In some cases, grey alder interplanting can replace the fertilization. Because of the extreme microclimate of these areas, only frost-resistant pioneer tree species can be used in afforestation. In Finland, Scotch pine is the most suitable species; in future, some short-rotation species (e.g. salix) may also be considered.

(There are also other possible uses for these lands. Near settled areas they can be repaired for recreation. If there are difficulties with the drainage they can be used as water reservoirs. If there is no practicable use for them, they can be left alone and the paludification process allowed to begin once more.)

8. Utilization of peat resources

8.1 Industrial countries: Finland

Proportionally, peat is expected to meet 10 per cent of the total energy demand of Finland by the end of the 1980s. The Finnish Government is a key factor, since it finances the State Fuel Centre to produce the peat. Peat is competitive compared with fuel-oil and coal and the Government is promoting the use of peat by assisting consumers financially. The Government also finances and directs the research work for peat production, processing and usage.

8.2 Developing countries: Burundi

Tropical countries like Burundi seem to have unknown energy reserves in peat deposits. Mostly the quality equals that of peat in countries like the USSR, Finland or Ireland. Peat deposits have been surveyed by UNDP. This paper will discuss the amount, location and quality of the paat. Various methods of producing and using peat will also be evaluated. Among them are sod-peat production, hydraulic mining and modern hydrothermal peat processing, the result being a homogeneous fuel with a high heating value. The extensive known nickel-ore deposits can be used and peat can provide a domestic source of energy to produce heat, power and chemicals for the nickel process. Also, processed peat can be used for heating and cooking in individual homes.

Appendix

INFORMATION ON WORLD PEAT RESOURCES AND THE USE OF PEAT FOR FUEL

	Peat resources (millions of tons oil equivalent)	Fuel-peat production (thousands of tons per annum) a/
Africa		
Angola	n.a.	-
Burundi	150	-
Rwanda	n.a.	-
South Africa	n.a.	-
Zimbabwe	n.a.	-
/Probably some other countries near the equator have peat resources, that is, Zaire, Kenya and Uganda./		
Asia		
Indonesia	600	-
Israel	n.a.	-
Japan	145	-
Malaysia	n.a.	-
Republic of Korea	40	-
/Probably the resources in Indonesia are greater. Some other countries in the Far East probably have peat resources too./		
Australia and New Zealand		
Australia	20	-
New Zealand	35	-
Europe		
Austria	20	-
Czechoslovakia	50	-
Denmark	120	-
Finland	5 000	500
France	50	-
German Democratic Republic	250	-
Germany, Federal Republic of	1 500	-
Greece	n.a.	-
Hungary	25	-
Iceland	500	-
Ireland	1 200	3 500
Italy	50	-

	Peat resources (millions of tons oil equivalent)	Fuel-peat production (thousands of tons per annum) a/
Netherlands	20	-
Norway	500	-
Poland	1 500	-
Romania	20	-
Spain	2	-
Sweden	3 000	-
Union of Soviet Socialist Republics	45 000	70 000
United Kingdom of Great Britain and Northern Ireland	1 000	-
Yugoslavia	7	-
North America		
Canada	7 000	-
United States of America b/	4 000	-
Mexico	n.a.	
South America		
Argentina	20	-
Brazil	n.a.	-
Paraguay	n.a.	-
Uruguay	n.a.	-

/Probably some other countries in South America, that is, Jamaica have peat resources too./

Source: "Survey of energy resources", report of the World Energy Conference held at Detroit in 1974.

a/ Forty per cent water.

b/ Excluding Alaska.
