Extended abstract No. 447

PEAT EXCAVATION AND DRYING FOR FACTORY-MADE LOCAL FUEL PRODUCTION

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SUMMARY

Peat plays an important role in the energy systems of the Nordic countries. It has been a domestic fuel with a long tradition of use especially as a fuel in times of crisis. Nowadays we also observe the gain from both the environmental and energy perspectives of using peat fuel. According to research conducted in Russia, peat is a very suitable raw material for local fuel production. The ash content of the local peat fuel is smaller than that of coal, and the quality of the fuel is high. The quality of the peat raw material is stable, and the supply of peat raw material can be secured for decades.

KEY WORDS: excavation, drying, raw material, factory-made local fuel

INTRODUCTION

The purpose of this paper is to look at the possibilities of using peat as a raw material for factory-made local fuel.

The North West Federal District is an administrative region of the northern part of European Russia. The territory of the district is about 9.8% of total Russian territory. The population of the region is about 9.5 % of total Russian population. Small villages often face problems of unreliable supply of domestic fuel. Mostly, it concerns small villages using imported fossil fuel, such as coal and black oil.

The Northwest region has sufficient reserves of peat fuel resources (Kuzmin et al., 2010). The peat fuel resources of the district are about 15 % of total Russian peat fuel resources. There are 5 796 peat deposits. The area of peat fuel resources is 8 134 550 ha in peatlands of industrial depth. These potential industrial areas contain 2 901 million TOE of prospected and estimated reserves. The energy content of these peat reserves is 33 740 TWh.

MATERIALS AND METHODS

The renewal of peat fuel production at new technical and technological levels, will allow the provision of the required reliable fuel supply. Extraction of peat raw materials is based on excavation from the peat deposit, then drying and stockpiling. The focus is on the following aspects (Korpi et al., 2008):

- Minimizing the environmental impacts;
- Maximizing the utilization of solar and wind energy and minimizing the weather sensitivity;
- Current cost level;
- Improving the final product quality.

The Russian peat industry has good experience with this method of excavation. For example in 1965 about 1 million m^3 of peat raw materials for the manufacture of peat pressed production was extracted by this method.

For the majority of all technological processes involved with peat production the process of peat drying is the most significant and important process. Renewable energy sources for the peat drying process based on physical phenomena in nature include wind and solar energy.

RESULTS AND DISCUSSION

Analysis of the potential of natural renewable energy sources, which can be utilized during peat production, was based on examination of the history of climatic conditions of the Northwest region of Russia (Kuznetsov and Mikhailov 2000). The interactions of three primary climatic effects are considered: solar radiation, precipitation and wind. In Figure 1 the monthly average energy balance on a peat field in Northwest of Russia is given.

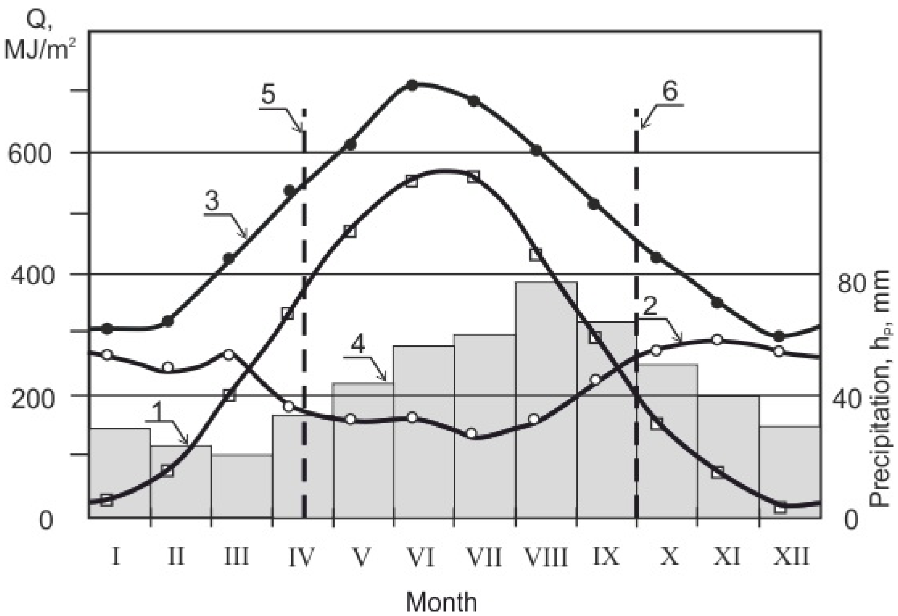

Figure 1: Monthly average energy balance on a peat field in Northwest of Russia:

1. Solar energy;
2. Wind energy;
3. Total of solar and wind energy;
4. Monthly precipitation;
5. Beginning of peat excavation season;
6. Ending of peat excavation season.

In summary, solar radiation is at its maximum during the months of March through to September; precipitation (rain) is at a maximum in summer and autumn, with precipitation in the winter months predominantly snow. Wind energy (speed) is usually moderate (medial monthly wind speed of 4-5 m/s), with maximum speeds occurring usually in months with low solar radiation (September - May). Normally the production season in Russia is from May 18 through August 31. The extraction of peat raw materials can be applied from April until September.

The peat machines and production equipment required for the excavation of peat raw materials are as follows (Mikhailov et al., 2010):

- excavator;
- tractors and semi-trailers;
- bulldozer;
- peat brush equipment;
- front-end loader with sieving bucket.

The quantity of energy above the surface of the peat fields can be estimated as the total of solar and wind energy (Figure 1). The analysis of the energy balance for the region demonstrates that the energy balance of solar and wind energy are 'measured' values, lines 1 and 2 (total energy is shown in line 3).

It is generally accepted that the degree of utilization of solar energy for milled peat production is 15-20 % (Leinonen 1993). The general consensus is that wind essentially does not influence peat drying, and is not typically used in general peat production methods for drying. Its role is reduced to venting of the processed peat, i.e. ablation and replacing the moisture saturated air with dry air. The average wind speed along the ground stratum of a peat field is 0.2-0.5 m/s. Thus, the milled peat drying process uses no more than 1 % of wind energy.

At the modern level of technical development of civilization, currently the following can potentially be realized (Kuznetsov and Mikhailov 2000). Up to 1/5 of the potential solar energy and up to 1/3 of the potential wind energy can be utilized. Consequently, in our case the energy use limit for peat production is 1/4 of the total annual energy potential. For the requirements of the Northwest region of Russia, this probable level of energy potential throughout the experimental year is shown (Figure 2, pos. 1).

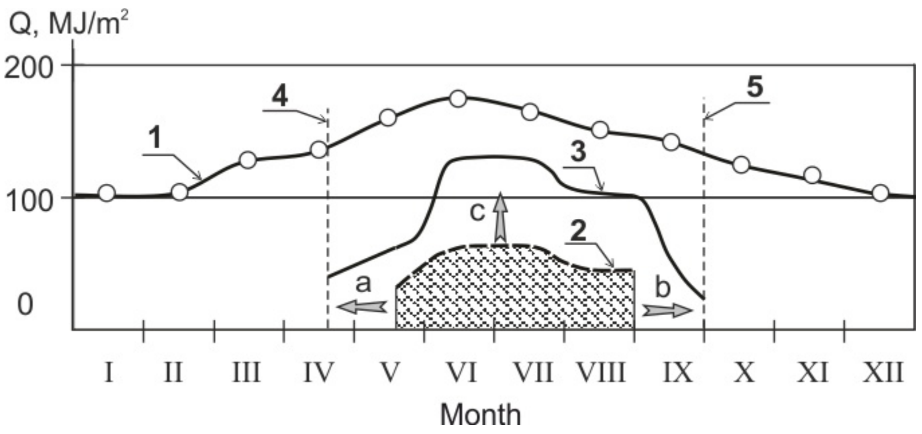

Figure 2: The tendencies of energy potential use during peat production:

1. Greatest possible degree of energy potential usage;
2. Energy use during industrial peat production process in one season;
3. Energy use during experimental peat production process in one season;
4. Beginning of experimental peat production season
5. Ending of experimental peat production season

a and b - tendency of season duration magnification; c - tendency of peat drying processes intensification.

Analyzing the technological level of peat production manufacturing processes (Kuznetsov and Mikhailov 2000), we selected two key directions to enhance the degree of energy potential use:

- magnification of peat production season duration;
- intensifying the processes of peat raw material excavation and drying.

An increase of the degree of solar energy usage has been enhanced by 2 – 3 times the normal use for peat production and has been demonstrated in various experimental conditions as follows: peat drying on side face of ridges and stockpiles. In this case, new technological solutions supplying energy for peat drying during the entire year are required.

Due to the climatic conditions in Northwestern Russia, the optimum moisture content for peat processing is peat with a moisture content ranging from of 60 – 65 %. This results in an economically positive process, with effective:

- ridging of peat raw material and drying on side face of ridges;
- stockpiling of peat raw material and drying on side face of stockpiles.

Our work has shown that, through creative techniques, wind energy may be successfully guided for the drying of peat stockpiles. Special brush equipment has been developed for peat drying on the side-face of ridges, for stockpiling and drying on the side-face of stockpiles.

Wind power can be used as an energy source for all-year venting of stockpiles. The intensity of drying can be increased by 30 %. To achieve these results, a uniform milled layer of peat must be formed with particle thickness of 20 mm and weighted average diameter of 6 mm. Drying of such pieces increases the efficiency, equal to about 90 % of evaporability.

Effective radiation-convective drying, through proprietary methods, during the period of February – May, allows the moisture content of peat to de decreased from 85 to 45 %.

CONCLUSION

These and other technological developments can be a basis for scientific discussions with the purpose of examination and development of new technologies for achieving maximal results for the production of peat raw material. This former method of peat raw material excavation using modern equipment is now being tested in both the Leningrad and Tver regions.

ACKNOWLEDGEMENT

This work was supported financially by State contract No. P641 “Expansion of peat application in small power”.

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