DEVELOPMENT AND IMPLEMENTATION OF DRYING PLANTS FOR ORGANIC WASTE PROCESSING

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Introduction. The level of use of renewable wet biomass resources in Ukraine is currently many times lower than in European countries, and in recent years there has been a clear trend towards further deterioration of this indicator [1, 2].

As a result, livestock farming, absorbing crop products and being a serious environmental pollution factor, does not return organic matter to the fields, which has led to a catastrophic decline in soil fertility.

The loss of humus in Ukraine as a whole in the amount of 11.4 million tonnes per year has led to a reduction in its reserves by 25-30% over the past 20 years [2].

The main reasons for this situation are the high cost of mineral fertilisers, which is also on a steady upward trend, the lack of manure due to the disappearance of most small farms and a sharp decline in cattle numbers. The sharp increase in the unit capacity of livestock farms (especially poultry and pig farms) has led to a large concentration of biomass in one place, and it is unprofitable to transport unprocessed manure, which has ballast in the form of a large amount of water (up to 80% moisture content), further than 5 km due to high transport costs.

Another important reason for the problems faced in agriculture is the inability to ensure long-term storage of biomass fertilisers due to the closure of many drying facilities due to the sharp rise in the price of fossil fuels and electricity.

Existing foreign biomass waste processing technologies are not suitable for large-scale livestock farms, which are typical for Ukraine but rarely built in developed countries due to the high costs of meeting environmental requirements.

In addition, modern foreign technologies for the disposal of waste from livestock complexes are closely linked to the technological process and equipment for the production of the main products - meat and eggs. For this reason, the application of these technologies in Ukraine requires large capital expenditures to replace a significant part of the existing equipment of a poultry or pig farm and does not justify itself economically.

Therefore, the prospect of using biomass as fertiliser directly depends on the solution to the issue of replacing natural gas with solid fuels. Cost-effective fertiliser production on an industrial scale is only possible if cheap heat energy is available.

Currently, the main types of wet biomass used as fuel are *sunflower husk and wood*. *Straw is* used in small volumes.

Due to the fact that husks are quite fire hazardous when piled up and stored, a few years ago they were taken to a landfill and burned there. Currently, the husk is successfully burned at the enterprises where it is produced, completely replacing natural gas, and *pellets are* made from it and exported.

Straw is burned in small quantities at low-capacity thermal power plants and is also used to make briquettes or cylindrical fuel pellets (pellets).

Wood is used in the form of firewood, wood chips and artificial pressed fuel - briquettes or pellets. At the same time, the bulk of wood fuel is exported (especially pellets), which is due to the fact that the countries participating in the Kyoto Protocol have economic mechanisms in place to encourage the use of biomass fuel and specialised devices for its use to improve the global environment. For example, German legislation provides for a surcharge for each kilowatt of heat produced and an additional surcharge for the installation of a specialised boiler in proportion to its capacity.

Pellet production is a multi-stage process that includes deep artificial drying and is characterised by significant specific electricity consumption for the mechanical work of grinding the material to very small sizes and pressing it.

In addition, pellet production is characterised by significant operating costs associated with the rapid wear and subsequent frequent replacement of loaded machine components (e.g. press dies), which are made of expensive alloyed metals.

Materials and methods. In recent years, in European countries, and more recently in Ukraine, boiler equipment adapted for the combustion of wood chips with a moisture content of up to 60% has been used. This technical solution is used for the reasons that it is not rational to organise drying production at single heat and power facilities, especially those of small capacity, which requires large capital expenditures.

However, when operating several facilities at a short distance from each other, it is more cost-effective to organise pre-drying of the chips.

Summing up the above, it can be stated that when using wet biomass as fertiliser, fuel and feed, it is desirable to organise its energy-efficient dehydration in order to reduce the loss of energy potential during storage and combustion of biomass [3].

Results and discussion. The ITTF of the National Academy of Sciences of Ukraine has long been conducting research aimed at creating energy-efficient equipment for the utilisation of organic waste from the agro-industrial complex.

Fig. 1 shows an installation for drying organic waste from poultry farms with a capacity of up to 600 kg/h, with the possibility of heat treatment of highly moist materials with a moisture content of up to 90%. Specific energy consumption: up to 3500 kJ/kg of fresh moisture (850 kcal/kg of fresh moisture).

Based on the results of experimental studies, technologies and equipment for processing thermolabile materials (chicken manure, fish meal, sugar production waste, etc.) were developed at the ITTF of the National Academy of Sciences of Ukraine under various drying conditions.

Fig. 2 shows the following pilot rotary installation developed at the ITTF of the National Academy of Sciences of Ukraine, which can be used for drying wood chips with a fuel capacity of up to 1000 kg/h, with the possibility of heat treatment of highly moist materials with a moisture content of up to 55%. Specific energy performance: up to 4000 kJ/kg of moisture content (950 kcal/kg of moisture content).

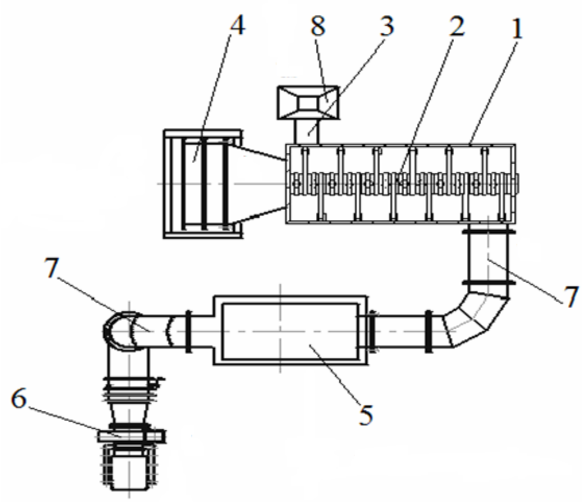

Fig. 1. A plant for processing organic waste from poultry production developed at the ITTF of the National Academy of Sciences of Ukraine: 1 - chamber for the combined drying and dispersion process; 2 - rotor; 3 - screw feeder-dispenser for feedstock; 4 - heat generator; 5 - device for separating solid and gaseous phases, which separates the finished product from the coolant; 6 - fan; 7 - air duct system; 8 - receiving hopper.

Fig. 2. General photo of the rotary drying unit with the possibility of drying fuel chips developed at the ITTF of the National Academy of Sciences of Ukraine.

Theoretical analysis and pilot tests show the prospects of using plants that operate with simultaneous drying and dispersion in one working chamber, which meets modern requirements for drying equipment. They create large heat and mass transfer surfaces, increase specific productivity compared to, for example, drum plants, and reduce capital expenditures and energy consumption for moisture evaporation.

Conclusions. Thus, the many years of experience in experimental research and design development carried out at the ITTF of the National Academy of Sciences of Ukraine allows us to offer various Ukrainian farms our own domestic developments for the post-war recovery of the Ukrainian economy.

References:

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