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GRAIN DRYER

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Abstract
In the article given the short review of drying units and described the offered new energy saving up mobile device for drying of grain crops. It is displayed joint applications of two methods of drying of a grain: absorbing and convective. Adducted basis parametres of the device and calculations for power savings of process of drying in the device. It is displayed improvement of physical properties of separate grain crops conducive to power savings of process of drying at use of the given device. Possibility of application alternative to energy for process of drying and advantage of the given device is reduced.

Keywords: Energy-efficient, the drying device, flowability, porosity, heat conduction, thermal diffusivity, hydraulic conductivity, the reducer, a muff, a belt transmission, a gutter, the screw.

Introduction

Drying-it the most widespread master schedule. In our country for drying of grain crops spend about 300 thousand tons of fuel. As grain drying is the most power-consuming technological operation working out of new drying units, methods of their perfecting and efficiency heightening has an important economic value.

As it is known, in fresh-cut a grain proceeds process postharvest ripenings. Correctly picked up process of drying of a grain promotes alignment of damp and degree of a maturity of grain mass, improvement of appearance and technological properties of a grain [1].

In last years in our country after harvesting wheat are sowed crops (rice), leguminous (bean, golden gram) crops-leguminous (maise) and oily (sunflower, peanut) cultures and turn out big crops. Harvesting of such cultures to have in the autumn which drying at lowering of air temperature, cloudy and rainy weather is a problem. Thus, acute necessity on grain drying devices is observed. To a member of a farm having about 500 kg dry up a grain product (rice) not favourably from the economic point of view to use dryer grains with capacity 5 ton/hour which spends material means on 80$ / hour. Material expenditure on transportation to a stationary drying unit besides, is required. Therefore, considering local conditions it is required mobile, economic drying devices.

Offered the device treats with us to agricultural technicians, rice, a peanut, sunflower, etc. in farmer, private enterprises can be applied to drying of products of grain crops as. A device problem is heightening energy-efficient process of drying and quality of an exsiccated product, security use of alternative energy for architecture of process of drying on the remote districts from the farm electric power line.

It is known various aspects drying devices for products of grain crops. The drying device for grain XLM 350 has a principle of a recycling [2]. Capacity of drying more than 300 m3/days,

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overall dimensions 4040x5400x8700 mm, power of the electric motor of 75 kw. The high cost price of the device has.

Drying devices series MHTD approaches for maize, wheat, rice, with power of 2400 tons / days, and series MHTY approaches for a soy, colza, peanut, with power of 5000 tons/days [3]. The big overall dimensions and the high cost price have these devices.

.The device for grain drying model WGH has of brands 100,200,300,400,500,600,700,800 which are grounded on a convective mode of drying [4]. The device height reaches from 6 meters to 20 meters. In the device the temperature of an exsiccated product reaches 550C that is to inadmissible values for separate grain (for example, for rice).

The mobile drying device of bunker type СЗП-32 has a principle of cyclic character [5]. In the given installation at maintenance are used extras means, has the big overall dimensions (8000x3200x7550), the big mass (4400 kg), high power consumption (60 kw).

In the drying device of bunker type CM-1 the exsiccated product is transmitted from a hopper to the bunker [6]. The device has high efficiency (120-170 tons/day), however has the big expenditure of diesel fuel (80liter/hour).

The mobile device for drying of grain products has the nutritious bin fixed on the screw which is at an angle to horizon and has the foundations [7]. The flute is attached to the screw and fixed section. The drier drum which has regulated a slot is attached on the trailer and located at an angle to horizon. Under an adjustable slot installed the sorting gear, under which there is a container for dried a product. Aside the upper part a drier drum located the fixed section, which has the ventilator and a calorifier. The drier drum drive gear consists of the electric motor, the reducer, a clutch. The drive gear of the screw conveyor consists of the electric motor and a belt transmission. For security of the mobility the device it is installed on the trailer. However there are rather big losses of heat in the drier drum what to lead to an excessive energy consumption. In the offered device the convective mode of drying [8] is applied, therefore under recommendations reduced in operation [9] is planned feeding of warm air on a grain current. In given the device the problem is executed thus: For drying the certain portion of an exsiccated product of grain crops undertakes. Due to portion, pleiocyclic drying it is ensured uniform mixing an exsiccated grain which is carried out by means of two screws and the drier drum which result to serve for uniform drying of a grain. Uniformity of drying grain, ensures qualities of a grain at its further processing. For example, at rice processing (unrefined rice) after defined dry up is exposed to machining job ergo turns out refined rice. Deriving of a qualitative product immediately depends on homogeneity of an exsiccated product.

The device for drying of products of grain crops (fig. 1) contains the nutritious bin 1 fixed on the screw 2 which has a drive gear consisting of the electric motor 3 and belt transmission 4. The screw to be under a certain edge to horizon and has the foundation. The bin of a time delay 5 is fixed on the screw 6 having drive gear the electric motor 7 and a belt transmission 8 which is under a certain edge to horizon and has the foundation. The gutter 9 is attached to the screw 8. Fixed section 10 has the foundation and contains the ventilator 11 and a calorifier 12. The Drier drum 13 having a foundation is located at an angle to the horizon which drive gear consists of the electric motor 15, the muff 16, the reducer 17, the muff 18 and the slot 14 for grain release. The special gutter (the sorting gear) 19 has the foundation and a drive gear consisting

of the electric motor 15, a belt transmission 20. The vessel for dried grains 21 is under the sorting gear. The bin of a time delay 5 has a lock 22. The cyclone 23 has the foundation which drive gear consists of the electric motor 24 and belt transmission 25 and has pipe ducts 26, 27 and 28. The pipe duct 26 has conoidal a tip the enveloped mesh which is in the bin of a time delay 5. The pipe duct 27 is under the bin of a time delay 5. The pipe duct 28 is over special gutter (the sorting gear) 19. The drying device is fixed on the trailer 29. Dual-circuit solar water-heating installation 30 is located sideways, and the solar photo-electric battery 31 from above (fig. 1).

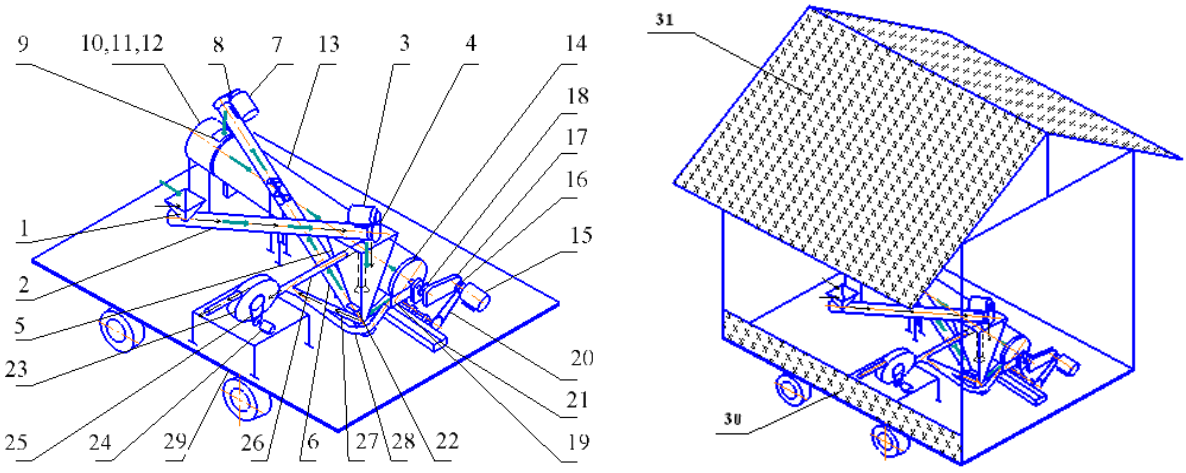

Fig. 1. The mobile device for grain drying.

In the device for drying of a grain the power savings increase is reached following manner: Cheeseparings of machining job of rice (unrefined rice) is a rind of rice, which utilizable. In the work given the rind of rice as a sorbent (fig. 2) is used.

Fig. 2. A rice rind

Amounts of a used sorbent in the course of drying it is defined by expression:

$$m_{sor}=0,3\ m_{gra}$$

Where, m_{gra} -weight of an exsiccated grain, kg;

Sorbent provides moisture removal on 5 % from mass of an exsiccated grain. Amounts of a portion of an exsiccated grain are made by 150 kg. It is known that the average value of

expenditure of warmth for evaporation of a moisture makes of 1 kg nearby 6000 кJ. Thus, the sorbent ensures energy sawing following amount of warmth at capacity of drying of 150 kg/h:

$$Q_1=7,5\cdot6000=45000 \text{ кJ}=10748,06 \text{ kcal}$$

Sorbent application allows to save energy:

$$N_1=10748,06/860=12,5 \text{ кW}\cdot\text{h}$$

In the drier drum it is ensured moisture removal grains about 4 %. An external surface of the drier drum it is coated by a heat-insulating composite material which prevents heat losses on 20 % therefore it is reached following power savings of amount of warmth:

$$Q_2=1,2\cdot860=1032 \text{ кcal}=4320,8 \text{ кJ}$$

Amounts of the saved energy:

$$N_2=1,2 \text{ кW}\cdot\text{h}$$

Thus, a general meaning of power savings of amount of warmth equally:

$$Q = Q_1+ Q_2=11780,06 \text{ kcal}$$

General meaning of amount of the saved energy at capacity of drying of 150 kg/h equally:

$$N = N_1+ N_2=13,7 \text{ кW}\cdot\text{h}$$

In a current of process of drying of rice in the device physical properties of rice as porosity, flowability, an angle of slide, a thermal capacity, heat conduction, diffusivity and hydraulic conductivity are examined. At rice transiting through the screw observed breakage a bough of rice. As a result of breakage a rice bough has decreased porosity that has augmented a flowability value. The flowability increase has led to reduction of an angle of slide of rice. It is known that flowability and angle of slide has a special value in the course of processing of a product of grain crops. Besides, porosity lowering has led to reduction of air spaces between pellets of grain mass that is the favorable phenomenon. It is known that air is a bad conductor of heat, temperatures, a moisture and has rather great value of a thermal capacity. Porosity lowering has led to increase in a value of heat conduction, thermal diffusivity, hydraulic conductivity and to reduction of a value of a thermal capacity. It is known that demanded amount of warmth for drying directly proportional to a thermal capacity. Thus, has decreased demanded amount of warmth that is the answering purpose.

In given the device for pellet drying it is provided use of alternative energy which creates possibility architecture of process of drying on places where is not available current lines. For a hot-air heater the double-loop solar heating plant with a tank the accumulator is used. For deriving of electric energy the solar photo-electric battery into the square 30 m2 is placed. Considering that, using 1m2 the solar battery it is possible to receive on the average 200 W electrical energy in the given construction possibility of deriving of 6 kW electrical energy is created. For execution of process of drying the value demanded electrical energy in the device has:

$$N_{dem}=N_{m.3}+ N_{m.7}+ N_{m.11}+ N_{m.15}+N_{m.24}=0,75+0,75+0,2+0,55+1,1=3,35 \text{ kW}$$

Where, $N_{m.3}$–electric motor power 3; $N_{m.7}$ – electric motor power 7; $N_{m.11}$ –heater power; $N_{m.15}$– electric motor power 15; $N_{m.24}$– electric motor power 24.

Thus, the amount electrical energy received by means of solar batteries is sufficient for execution of process of drying.

The device for drying of products of grain crops (fig. 1) has next sizes: - diameters of screws of 250 mm, - length of screws of 2700 mm, -angle of screws to horizon 600, external diameter of the drier drum of 880 mm, - length of the drier drum 2000 mm, drier drum angle to horizon 200. Turnovers of shafts of the screw of 94 rpm, a turnover of the shaft of the drier drum of 15 rpm, a turnover of the shaft of a cyclone of 2900 rpm. Device overall dimensions 4000x3000x25000 mm. Power consumption N=3,35 kw, voltage 380 V, a frequency of 50 Hz, weight≈440 kg.

Conclusion

The offered construction of the device for grain drying has following advantages:

- As a sorbent the withdrawal of processing of crude rice (a rice rind) is used, expenditure on a sorbent thus drying cost is not required remains invariable;
- Use a rind of rice in the form of a sorbent leads power saving process of drying of a grain;
- Application in given device the bin of a time delay of a grain creates applications a drying mode witgh sorptive medium;
- Provides uniform mixing, hence what to serve for grain improvement in quality at the further processing;
- Application of a composite material for the drier drum to lead to improvement of power-economic indexes of process of drying of a grain;
- Use of solar batteries and a double-loop heating plant creates possibility of realisation of process of drying in district where there are no current lines;

Thus, distinctive signs of the offered device are essential, are necessary and a sufficient condition for the decision of tasks in view. The offered construction is efficient, simple in the realisation and can be put, as in the fundamentals of creation of new highly effective, power saving up drying units.

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