

DEVICE FOR SORTING SOLID HOUSEHOLD WASTE

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ABSTRACT

Based on the analysis of existing designs of waste sorting complexes, taking into account the advantages and disadvantages, a prototype design of the sorting complex was chosen. The developed design of the sorting device allows you to effectively sort the organic components of the waste. A distinctive feature of this device is that the device effectively sorts not only heavy fractions, but also light fractions of waste, by means of a vacuum installed above the upper conveyor.

Keywords: solid household waste, sorting device, organic components, ballistic sorting device.

INTRODUCTION

One of the global environmental problems of the planet included by the United Nations on the agenda is environmental protection. An important component of this problem is to ensure the environmental safety of cities and towns from municipal solid waste (MSW) arising in the process of human life.

The Action Strategy for the Management of Solid Domestic Waste in the Republic of Uzbekistan for the period 2019-2028 emphasizes the need to increase the percentage of waste recycling to 60% of the volume of waste generated.

In this regard, in the field of development and design of technological machines, the importance of developing sorting machines that provide efficient waste sorting with low energy and material consumption is predetermined.

MATERIALS AND METHODS OF RESEARCH

Figure 1 shows a ballistic automated sorting machine from CLEANING & RECYCLING SYSTEMS.

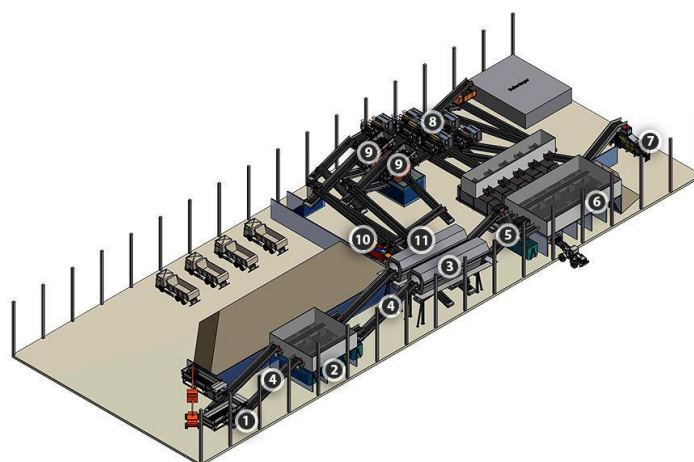


Fig. 1. Ballistic automated sorting machine of the company "CLEANING & RECYCLING SYSTEMS"

1-packet breaker; 2-pre-sorting; 3-organic separator; 4-feeding conveyor; 5-ferrous metal separator; 6 sorting cabin; 7-automated horizontal press; 8-optical separators (sorters); 9-ballistic separator; 10-separator of non-ferrous metals; 11-fine fraction separator.

Ballistic separator SORT-O-MAT company «CLEANING & RECYCLING SYSTEMS» is designed for sorting waste constituents. The principle of its operation is that a rotating rotor with blades ejects waste along a ballistic trajectory. The flight range depends on the properties of the waste:

- heavy and dense components are discarded into a distant container;
- light and loose components are discarded into the nearest container.

The blades of the SORT-O-MAT separator are made of perforated stamped metal. In this case, the sizes of the holes may be different. This approach allows you to screen out the smallest fractions in the process. In addition, depending on the material with which you are working, you can change the following parameters:

- the angle of inclination of the blade;
- the number of revolutions of the blade.

At the same time, settings are carried out without stopping the equipment, easily and simply. The design of the separator eliminates the winding of ropes and long films, and adhering waste is removed by a special cleaning device.

The advantages of sorting machine are as follows:

- waste is divided into two fractions;
- high separation accuracy up to 90%;
- there is no danger of winding films, tapes, etc.;
- high performance with low power consumption;
- drive and supporting elements are located outside and there is no contact with waste;
- Differs in convenience in service thanks to a possibility of direct access to drives;
- easily adapts to a variety of waste;
- the angle of inclination and the number of revolutions can be changed on the go;
- it is supplied completely ready for connection, with drives and electrical control equipment.

Despite the above advantages, which are characterized by the manufacturer, in our opinion there are significant disadvantages of this complex:

- waste having different properties in terms of density and shape, as well as in size, can be thrown by blades with different angles and fall into the same bins, i.e. disadvantage - under-grinding of waste;
- another important factor - moistened waste due to moisture can be thrown to the same distance, despite the differences in properties.

The German company "Husmann Umwelt-Technik GmbH" (Germany) offers a new automated complex on the market of waste sorting equipment. The scheme of this equipment is shown in Fig.2.



Fig.2. Scheme of an automated sorting complex Husmann Umwelt-Technik GmbH (Germany)

The technological scheme of waste processing according to this scheme is as follows. The imported solid waste is dumped at the work site. Bulky waste, without sorting, is taken to landfills for disposal. Waste from the feeder is fed to the pack breaker. Further along the technological chain they are fed to the belt conveyor. There is also manual sorting into plastic and paper. Further, with the help of a drum screen, fractional sorting of waste with a size of less than 80 mm is carried out. Waste fractions smaller than 80 mm are taken to a landfill for disposal. A valuable waste component is lost - organic components, since almost the entire volume of organic components fits into a size of less than 80 mm. According to the technological scheme, waste, the size of which is more than 80 mm, is divided into ballast inclusions and other components. Ballast inclusions go to the landfill for disposal, and the rest for incineration [1; pp.1087-1092, 2; pp.506-510, 3; pp.160-163, 4; pp. 80-83.5; pp.27-33, 6; pp.97-102, 7; pp.20184-20187, 8; pp.2345-2356].

In Fig.3. the scheme of the waste sorting complex of the company "Sifania-Ekotechnika" is presented.

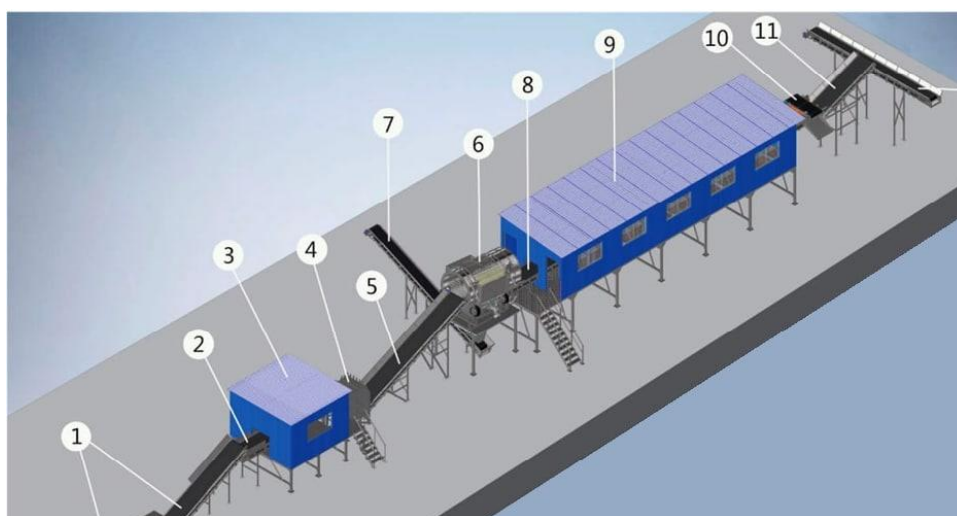


Fig.3. The scheme of the waste sorting complex of the company "Sifania-Ekotechnika"

1 - receiving conveyor with a pit; 2 - pre-sorting conveyor; 3 - cabin for preliminary sorting of bulky waste; 4 - trash bag breaker; 5 - inclined feed conveyor; 6 - drum separator; 7 - outfeed conveyor of fine fraction; 8 - sorting conveyor; 9 - sorting cabin on the flyover; 10 – metal separator; 11 - intermediate conveyor; 12 - reverse conveyor.

Offered by the firm "Sifania-Ekotechnika" waste sorting complex is designed for sorting mixed and separately collected waste. The main disadvantage of this complex is also the low efficiency of separation of dissimilar materials.

An analysis of the principles of operation of all the above impact sorting machines, as well as a patent search on this topic, showed that the waste is not crushed after preparatory manual sorting and fractional sorting on drum screens. In all technological schemes, the "tails" formed from the screenings of the past drum screens are sent to a landfill. Thus, valuable secondary raw materials for industry are lost.

Taking into account the above disadvantages of impact sorting machines, the design of a ballistic sorting machine has been developed.

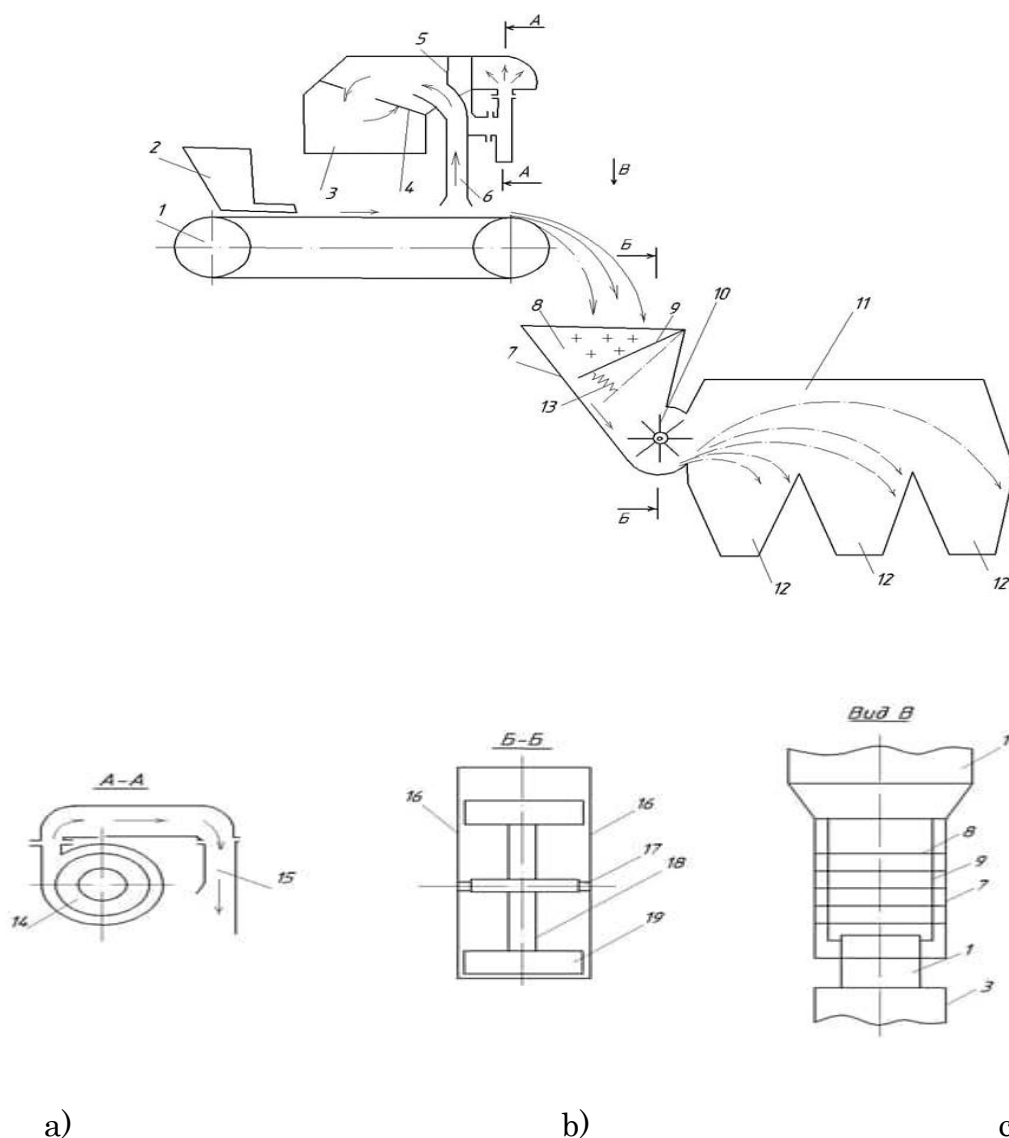


Fig.4. Scheme of an automated sorting machine

The machine for sorting organic components of solid waste includes the following units: the loading hopper of solid domestic waste consists of a belt conveyor 1 located above the left end of the feeder conveyor and a vacuum pump located above the belt conveyor, which in turn consists of the following main parts: hopper for light fractions 3, baffle sheet 4, mesh 5 and suction sleeve 6. Throwing device, located under the lower right end of the belt conveyor, consists of the following main parts: hopper 7, elastic rods 8, metal bar 9, rotor 10, housing 11, 12 bunkers for heavy fractions, 13 compression springs.

Figure 4, a shows the section A-A of the vacuum pump, the section consists of a fan 14 and an exhaust pipe 15. Figure 4, b shows a cross-sectional view of the rotor. The rotor consists of a shaft 17 installed between the side walls 16 of the loading part of the thrower, rods 18 rigidly connected to the blades 19. In fig. 1.6, in shows a top view of the receiving part of the bunker.

Five elastic bars are shown, three of them are located on the top and two are located below them. Elastic rods have a length of 1 m and are fixed at both ends to the side walls of the bunker.

The principle of operation of the device is as follows: pre-crushed to a size of 15 mm, the waste, passing through a sorting machine equipped with an inclined metal plate, enters the loading part of the feeder 2, the conveyor belt 1 entrains this waste in a uniform layer, which is facilitated by the design of the feeder.

To extract light fractions of waste such as paper, rags and polyethylene, a vacuum pump is installed above the conveyor belt.

The fan 14 creates a vacuum in the suction hose 6. The vacuum value is selected in such a way that only light fractions such as paper, rags and polyethylene are extracted. The extracted light fractions, being transported from the suction hose, fall into the hopper 3.

To ensure that the transported light fractions do not mix with the intake air, a mesh 5 is designed.

Heavy fractions, transported along the belt, enter the hopper 7 of the throwing device, to prevent the formation of lumps of household waste, elastic rods 8 are installed in the receiving part of the hopper, then the loosened waste falls on the metal bar, to increase the gap between the wall and the bar, it is equipped with a compression spring.

Automatic adjustment of the gap between the metal bar and the wall of the hopper serves to eliminate possible clogging of the hole.

Further, the waste, sliding along the base of the loading hopper, falls into the working area of the rotor 10 in a uniform layer, rotating at a speed necessary to impart kinetic energy that has fallen on its blades to heavy waste fractions.

Heavier fractions fly off along a longer trajectory and fall into the far bunker, less heavy ones into the middle or near bunker, respectively [9; pp.533-537, 10; pp.372-375].

CONCLUSIONS

1. The design of the sorting device has been developed, which allows sorting almost all components of the waste.
2. After simple design modifications, this device can be introduced into waste sorting complexes.

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