Journal of Engineering and Applied Sciences 13 (3): 596-600, 2018
ISSN: 1816-949X

Solid-Liquid Separator with Double Rotating Device

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Abstract: The purpose of this study is to clarify the effluent of wastewater from domestic wastewater and food wastewater by separating wastewater generated from food wastes or domestic animal wastes into water and sludge. Livestock wastewater treatment system and food wastewater treatment system for separating livestock wastewater and food wastewater into water and sludge were produced. The configuration of the device comprises an outer member having a cylindrical shaped and networked transfer portion, an inner member having a plurality of rotating blades arranged along a circumferential direction of the rotatable body portion rotatably disposed within the outer member. A water inlet for airtightly housing the member and the outer member and a rotating body protruding in the radial direction from the outer circumferential surface of the rotating member. Waste water is supplied between the inner member and the outer member. There is provided a sludge discharge port through which the sludge separated from the wastewater is discharged and internal rotation means for rotating the internal member with respect to the housing. We could handle more than 10 ton/h. After solid-liquid separation, the water content of solid contents was 76% for food waste and 70% for sewage sludge. After solid-liquid separation, solid component removal rate of liquid component was 40% for food wastes and 60% for sewage sludge when 0.3 mm mesh was used. The solid component removal rate of liquid component after solid-liquid separation was 32% for food wastes and 42% for sewage sludge when 0.5 mm mesh was used. The separation net size was 0.5 and 0.3 mm and clogging did not occur in this case. The solid and liquid components obtained by solid-liquid separation were not discarded but used as compost or liquid fertilizer. Also, this device can be applied to conservation of the marine environment such as disposal of garbage by dried laver.

Key words: Centrifugal, sludge, food waste, solid-liquid separator, water content, component

INTRODUCTION

Separation of water and solid components is an important process in the treatment of organic wastes such as food waste and sewage sludge (Cocolo *et al*., 2016; Song-Yeob *et al*., 2001). There is also a purification method for separating water by pressurizing the desorbing liquid by using a complicated and large-scale apparatus. However, in this case, a complicated and large-scale purification apparatus is costly to manufacture and the energy consumption for operating the purification apparatus is large. Further, since the filter is easily clogged, there is a problem that it is difficult to continuously carry out the purification operation. In addition, since, the conventional desalination liquid separation system cannot separate and remove fine sludge, there is a problem that the water content of the treated desalination liquid is low. Since, the desorbed liquid in which the fine sludge is not separated as described above must be brought into the wastewater treatment facility through chemical treatment and the like, there is a problem that the treatment cost is high and environmental pollution is caused. In the method used for solid-liquid separation, only a drum screen, a decanter centrifuge and the like were used but the filtration efficiency was rapidly deteriorated due to clogging of the filtration (Namsik, 2014; Dong-Su, *et al*., 2008; Altieri, 2010; Loginov *et al*., 2017).

MATERIALS AND METHODS

Design of equipment: A double rotary structure was applied to effectively separate livestock manure and food waste separation from water and sludge. The conventional screen-type or decanter centrifugal separator which was used in the past had a fundamental disadvantage that the holes of the screen were clogged. In order to prevent the clogging of the holes, the rotating structure with the rotating blades inside the cylindrical sieve and the sieve mesh was applied and rotated in the opposite direction. The rotating blades of the inner member are extended and spirally extended along the longitudinal direction of the rotating body portion arranged at equal angular intervals along the

circumferential direction of the rotating body portion. The squeezing member is arranged so as to be rotatably installed on the rotary vane portion and to be in contact with the transmitting portion while being spread by the centrifugal force generated by the rotation of the inner member. A weight was attached to the end of the spreader plate to increase the centrifugal force. A rotation stopper is provided to prevent rotation beyond an angle of contact with the transmission portion.

The slider is slidable in the radial direction with respect to the rotating blade, so that, the squeezing member can be brought into close contact with the transmitting portion due to the centrifugal force generated by the rotation of the inner member. An elastic member is provided between the rotary blade and the slider so as to have an elastic force in a direction away from the transmission portion. A sliding stopper for restricting the radial displacement of the slider is provided in the rotary blade so as not to slide with respect to the rotary blade having a displacement greater than or equal to the displacement of the slider in contact with the transmission portion. Figure 1 shows the anatomy of a double rotary solid-liquid separator.

Figure 2 compares before and after the operation of the binaural rotating device. The rotating blade shows three types. This eliminates the gap between the blades and the spinning wheel when rotating which essentially prevents clogging of the perforated holes in the screen. By this principle, the diameter of the perforated net is 0.5, 0.3 and 0.1 mm is possible if necessary. Even if the diameter of the perforations is reduced, the number of perforations can be increased to prevent the hole area of the perforated mesh from being reduced and the size of the passing solids can be reduced to increase the effect of the solid-liquid separation.

It is very few when compared with a decanter centrifuge or drum screen having a mesh diameter of 2 mm or more. The small perforated network dramatically increases the recovery rate of solids. The solids content of the separated liquid components should be less than the reference value to go to the sewage treatment plant. Figure 3 is a front view and a side view of the installation of the device. The vertically separating foreign material separator moves the inlet mixture upwardly from the periphery, so that, heavy metallic contaminants are easily separated by specific gravity. The drive motors were operated at different elevations to facilitate the operation of the belt. Figure 4 is a cross-sectional view of the device. The name of each numbered part is as follow: 1 mounting top plate, 2 treated water inlet, 3 overflow treated water withdrawal port, 4 foreign matter removing device, 5 treated water supply port, 6 main body, 7 screw, 8 separation net cylinder, 9 separation net, 10 treated water outlet, 11 solids outlet, 12 solids discharge device,

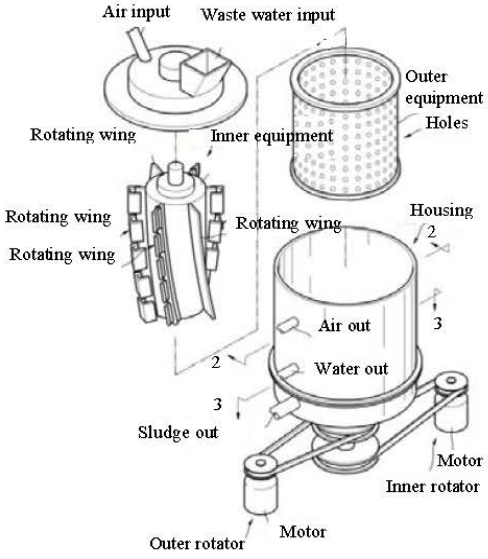

Fig. 1: Anatomy of core structure

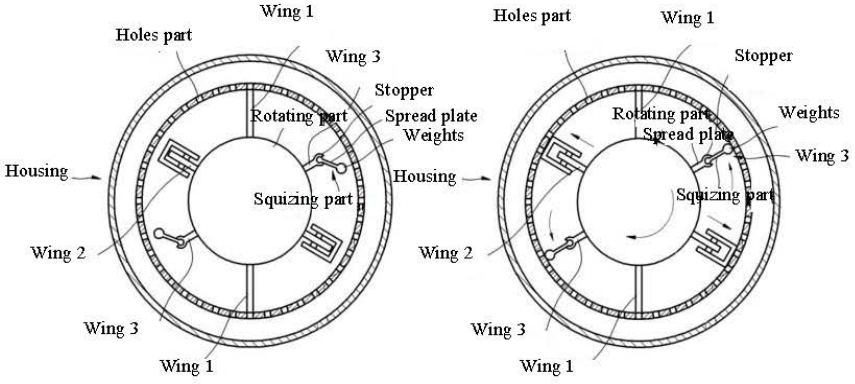

Fig. 2: Double rotating device

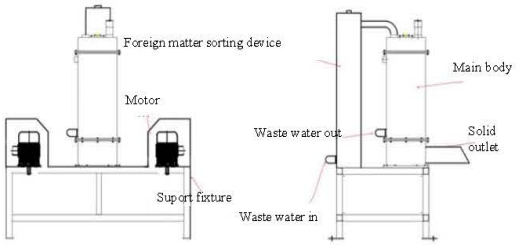

Fig. 3: Layout chart

Fig. 4: Cross-section

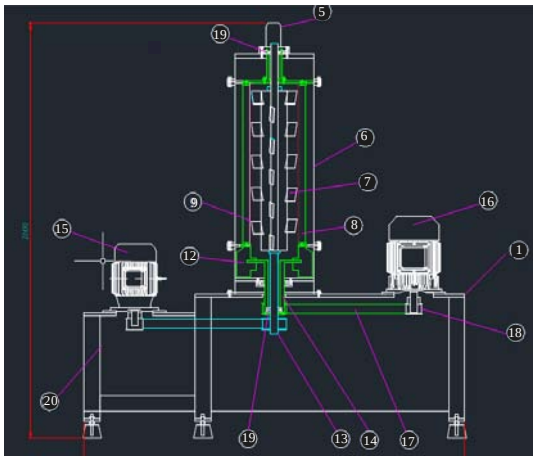

Fig. 5: Test equipment

13 screw rotating shaft, 15 screw motor, 16 motors for separating net, 17 drive belt, 18 pulley, 19 bearing, 20 main table, 21 body holder.

Production of demonstration equipment: The treatment of crude wastes has long been studied but not perfect. Rotten fish treatments had the disadvantage of aggregating into the effects of protein and fat (Han, 2014). Food waste has problems with salt and immaturity (Han, 2014). Sewage sludge has been introduced as a soil stabilizer together with solidifying agent due to the smell of the treatment process (Han, 2017). Solid liquid separation is an important factor in the treatment of various organic wastes (Han, 2017).

A device for the removal of food wastes and treatment of solid waste was prepared. Figure 5 shows the demonstration devices built. Diameters of 0.5 and 0.3 mm were applied to the cylindrical screen. The water content of solid-liquid separated solid is minimized and the discharged wastewater can be taken out directly to the wastewater treatment facility. By applying a double rotary, there is no retinal force in the separation network and therefore it can always be operated unattended.

Separation net and main body use stainless steel to prevent corrosion and enhance durability. It does not need to clean the inside of the machine. No coagulant input is required and no consumables such as brushes are required. Foreign substances such as iron are separated by passing through a vertical separator. The special type screw and turning view rotates independently in the opposite direction around one drive shaft to generate double centrifugal force. The solids and desalinate are separated and come down. Separated solids and liquid are discharged separately from the lower part of the machine.

RESULTS AND DISCUSSION

Although, many solid-liquid separation parts are required it was applied to solid-liquid separation of food waste disposal liquid and swine. Due to the prohibition of discarding organic wastes into the Sea, the processing cost has increased rapidly. Furthermore, it is necessary to remove the small components contained in the wastewater because it limits the content of the hometown component in the wastewater treatment plant.

Solid-liquid separation of food waste: Domestic food wastes were initially approved for installation in processing facilities to be used as compost or livestock feed. However, composting was ineffective due to inadequate fertility and salt content and farmers were faced with an unexpected accident due to lack of toxicity. The generalized process includes a solid-liquid separation process by crushing and compression. Domestic food wastes were initially approved for

Table 1: Solid liquid separation (food waste)

	Throughput (ton/h)		Solids recovery (%)		
Types	0.3 mm	0.5 mm	0.3 mm	0.5 mm	Water content
I	10	15	41	30	77
2	5	7	40	32	76
3	2	3	44	33	75

Table 2: Fertilizer component (food waste)

Farm	N (%)	P_2O_5 (2)	K_2O (%)
A	0.020	0.040	0.230
B	0.018	0.001	0.190
C	0.019	0.031	0.211

Table 3: Solid liquid separation (livestock manure)

	Throughput (ton/h)		Solids recovery (%)		
Types	0.3 mm	0.5 mm	0.3 mm	0.5 mm	Water content
1	10	20	61	40	70
2	5	10	63	42	69
3	3	5	64	42	69

Table 4: Fertilizer component (livestock manure)

Farm	N (%)	P (%)	K (%)
A	0.446	0.182	0.397
B	0.079	0.023	0.096
C	0.666	0.071	0.893

installation in processing facilities to be used as compost or livestock feed. However, composting was ineffective due to inadequate fertility and salt content and farmers were faced with an unexpected accident due to lack of toxicity. The generalized process includes a solid-liquid separation process by crushing and compression.

However, there are many hometown components among liquid components and new waste is made by adding coagulant to separate it. Coagulant dosing is not required for this system. Table 1 summarizes the requirements for solid-liquid separation of food waste. A processing speed of more than 10 tons/h can be achieved and more than 40% of the solid component can be separated in the case of the 0.3 mm mesh in the liquid phase component. After the solid-liquid separation, the moisture content of the hometown component can be maintained at about 76%.

Attempts to utilize salvia as a liquid have long been attempted but odors from corruption cause problems. It is recommended to add a fermentation process using microorganisms to prevent odor in advance and promote aging. Table 2 shows the composition of fertilizer after solid-liquid separation of food waste.

The best quality Kim in the world was known as the Japanese mountain. That's because the process is clean and hygienic. It is applied to the farm of the dried laver in the south sea of Korea and it is possible to make good quality of Kimchi by dry seaweed by making clean water by solid-liquid separation of waste generated in the initial process.

Pig shit liquid separation: The organic waste such as pig shit is relatively odorous, also, waste water sludge is odorous. Especially, as population livestock complexes are expanded, contamination of groundwater nitrogen in rural areas by pigs is seriously considered. The problem of reducing the solids content after the prohibition of marine dumping was raised and the developed double rotary solid-liquid separator worked effectively. Giban Inc. located in Hongseong, Chungnam Province. Ltd., showed the ability to treat more than 10 tons/h as a result of applying to pigs. Table 3 shows the solid-liquid separation effect of pigs. In the case of 0.3 mm mesh, about 60% of the solid component was recovered and in the 0.5 mm mesh, the recovery rate was about 40%. After the solid-liquid separation, the water content of the solid component was about 70%. Table 4 shows the composition of fertilizer when pigs are used as manure. If the odor problem is solved it can be used as a good quality liquid compost.

CONCLUSION

The livestock flour and the food wastewater purification apparatus can very effectively perform the operation of separating the sludge and water contained in the wastewater. In addition, the apparatus for purifying livestock flour and food wastewater according to the present invention does not deteriorate the efficiency of separating sludge and water due to the sludge generated during the wastewater purification operation and continuously performs the purification of the livestock flour and food waste wastewater with high efficiency. In addition, since, the present invention can separate and remove fine sludge contained in wastewater, the wastewater treatment cost can be reduced and burden on environmental pollution can be reduced.

We could handle more than 10 ton/h. The water content of solid contents after solid-liquid separation was 76% for food waste and 70% for sewage sludge. The solid component removal rate of liquid component after solid-liquid separation was 40% for food wastes and 60% for sewage sludge when 0.3 mm mesh was used. The solid component removal rate of liquid component after solid-liquid separation was 32% for food waste and 42% for sewage sludge when 0.5 mm mesh was used. The separation net size was 0.5 and 0.3 mm and clogging

did not occur in this case. The possibility of using the liquid ingredients after the liquid-liquid separation was investigated.

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