Classification of vibrators

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Abstract. Currently a large variety of vibrators are available, such as vibration sieves, vibration screens, and vibration platforms. They are called .in general vibration units. But before they are fed with biogas, the manure should be sorted, exactly, the bolders; long straw stems should be removed not to inhibit manure stirring in the reactor; vibrator implements this purpose. The article advances the classification of available vibrator s. The accomplished analysis helps chose the vibrosieve to separate manure at the biogas unit inlet.
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Introduction

Vibration installations are used in various industrial branches. Vibrators are used in the civil construction industry to compact and to tramper concrete mixtures, to prepare construction stone, in deposit miming, for instance, the vibrator serves to cut off coal, in the chemical industry they separate bulk materials into fractions. It is projected to use the vibrator in livestock mechanization to separate the material into fractions in biogas units. The material implies manure.

Main part

Manure is the organic fertilizer consisting of animal excretions generated during life (fecal asses, urine, bile, blood, mucus membrane dead portions from the gastrointestinal tract, et cetera) usually mixed up the bedding. The bedding comprises chaff and peat yielding the best animal manure [1].

Below is simplified manure classification (Figure 1).

By water content the manure is divided into cold and hot. The manure relates to that of the horse and sheep, the cold manure is that of the cow and hog.

By the degree of decomposition:

– the fresh when the strength and color mostly remain;

– the half rotten has the dark brown color, the chaff is torn off easily;

– the rotten has black color; the chaff is fully decomposed;

– the humus is the earthy loose mass.

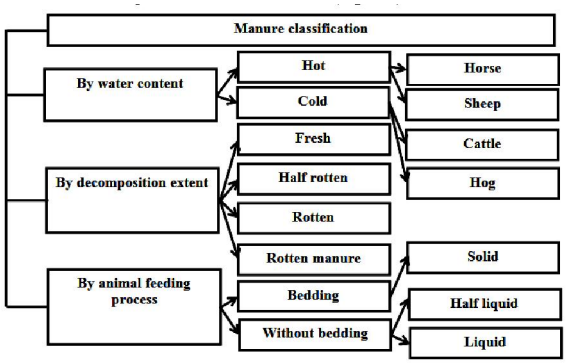

Fig. 1 – Manure classification

The process of livestock divides breeding the manure into the bedding – solid without bedding – liquid, half liquid. While in Germany the manure is typically liquid, in Kazakhstan it is solid.

Based on the manure classification, we are interested in the cattle manure, fresh, bedding, solid. The chaff is used for the bedding.

The cattle farm accomulates very much manure, which is stored into the piles for rotting, later, it taken to fields. Close to the farms the ponds of huge size grow larger and larger with corresponding smell. There is the following manure processing techniques (Figure 2).

The best manure processing technique is to use biogas generators with are ecologically clean and produce electric energy, heat and fertilizer [2, 3].

Before obtaining the biogas, manure should be sorted, implying that boulders should be removed, big stones, long chaff impairs the manure mixing in the reactor where the vibration installation is projected [4].

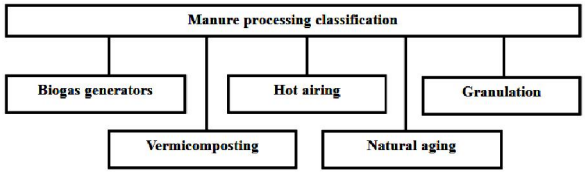

Fig. 2 – Manure processing techniques

The vibrator comprises the following installations:
– vibration screens;
– vibrators;
– vibration platforms;
– compactors;
– void producers for compacting;
– vibration units;
– vibration sieves.

The most typical vibrators are those for compacting concrete mixtures. The ball excites the circular vibrations in the proposed vibrator.

The vibrators with the flat moving working tool include the vibroplatform to compact concrete mixtures in the mold.

By the working surface shape the vibrators can be flat, drum and arc. The drum screen relates to the devices separating materials by size and can be employed in coal dressing, chemical, metallurgical and construction industries [5].

The main device by screening surface arrangement is the vibroscreen, which contains the surface inclined to the original material flow [6].

The vibrosieves differ by installed sieves tension and frame-type. The typical vibrosieves have the screening surface as a set of strings tensioned in the frame [7].

The vibrators in which the vibration excitors are mechanical offset vibrators (vibration screens, conveyers, vibration crushers) broadly polar in various industries [8].

The vibrators are also popular with built-in devises like the vibroiseve containing two fixed vibrators with the offset parallel rotation axes [9].

Mainly most vibrators are designed with frames. The typical vibrator is the one having the frame to compact stem mixtures, which have the frame with fixed pieces.

The single level sieves are most popular. Because the screening process is observable, the sieve wear can be supervised. For instance, the hydraulic screen has an inclined sieve chute, the feeding hopper and a striking mechanism to shake the sieve [10]. The sieve has single level.

We have developed the following classification of available vibrators (Figure 3).

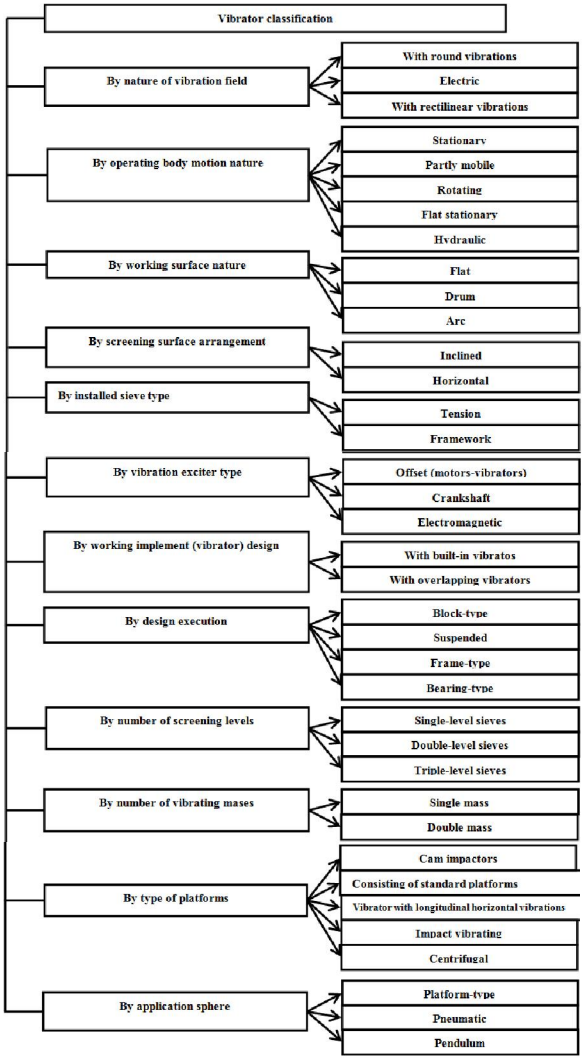

Fig. 3. Classification of vibrators

By the number of vibrating masses, the vibrators are single or double mass. The typical double mass vibroplatform relates to the production of concrete and reinforced concrete articles. The platform vibrators are the pneumatic centrifugal vibrators with directed vibrations containing the body mounted on the axis of the bearing plate.

By application there are pneumatic vibrators. For instance, the pneumatic vibrator my serve to drive the vibration feeder. The vibrator comprises the body with pneumatic chamber and channel to supply and release compressed air [11].

Different mechanical designs such as vibration sieves need calculation by the elaborated engineering drawings using the software CAD and structural analysis in the software CAE. At the designing stage (CAD and CAE) the repeating process is performed which may be declared before the equipment

fabrication or even before the prototype is manufactured considerably saving time and cost [12]. Experimental methods and tools are used to verify numerical modeling.

The screening is the main stage of many production processes when the product is screened throughout production cycle.the vibration screens perform sorting off rejects and bear the main burden of the driving system due to the features of organic stock. In addition, this equipment satisfies market demand because it is cheaper and delivered in time, it is more reliable and accessible. Another feature is high efficiency due to a large screening surface; hence, the vibration screens are wider. It is known that wider screens complicate considerably the designing of vibratory equipment.

Final part

The most efficient vibrator to separate manure into fractions in biogas generators is the vibration sieve with single-tier sieves and inclined screening surface.

The vibration sieve is mainly held in a strong frame consisting of steel sheets and called the screen chute. The latter rests on cylindrical screw springs or rubber vibration absorbers and is completed with the driving system and (single- and multiple-deck) sieves. Sometimes the absorption serves to reduce the transfer factor of dynamic loading to the bearing structure. In general, the vibration screens are identified by the screening surface width and length.

The vibration screens have mostly two motion types: circular (inclined or round vibration screens) and linear (horizontal or linear vibration screens).

The round vibration screens move particles in circles by the driving system and the deck slope. The amplitude equals the circle radius formed when the chute moves (the stroke equals the diameter).

The linear vibration screens are designed to reduce overall vertical dimensions needed for round screen and better supervision of dehydration. But in addition to dehydration the linear vibration screens are broadly used to for sorting. Unlike the round vibration screens, the linear screens are capable to transport material without the force of gravity when the vector of excitation angle equals usually 450 using the deck surface. The amplitude equals half the trajectory length (the stroke equals the whole length). A high screening efficiency is achieved by proper determination of the screening surface dimensions, proper type choice, proper amplitude and working screening frequency choice. The particle should move along the screening surface without hitting the same cell or missing several cells.

Conclusion

From the review of classification of vibrators it is necessary, on the one hand, the practical knowledge needed to determine the proper screening surface dimensions to guarantee performance, and, on the other hand, the mathematical tools, such as numerical modeling using the finite elements to assure the structural stability. The variables, like the impact, frequency, acceleration, live cross section and their effect on the screening efficiency, the shape of vibration, static and dynamic effects and their influence on the structural design, will be considered in further research.

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