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MESH CHOOSING CRITERIA FOR AN ELECTROMAGNETIC SIEVE

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Abstract: This paper presents a mesh choosing criteria an electromagnetic sieve. Depending on the requested sort, the mesh of the sieve is chosen. The size of the mesh is chosen so that it is somewhat larger the limit size of the material we wish to pass through the mesh. In the electromagnetic sieves, the excitation of the net acts mainly strictly normal to the surface of the net. Until recently, graphs were used to choose the meshes of the sieve. The paper below contains the table with meshes size function of the granulometry.

1. GENERAL INFORMATION

In order to choose the right mesh we must have the following information: The mesh productivity and the requested sorts, the material that will be sieved, including the granulometric curve of the material. Given the productivity of the electromagnetic sieve, and that sort that requested sort, the parameters of the mesh can be defined.

Depending on the requested sort, the mesh of the sieve is chosen. The size of the mesh is chosen so that it is somewhat larger the limit size of the material we wish to pass through the mesh. The optimal amplitude for the meshes positioned inclined compared to the horizontal is given in the table bellow.

Table 1

Mesh size [mm]	Vibrations amplitude [mm]
0,8 …… 6,5	3
3 …… 19	6,5
12,5 …… 100	12,5
75 …… 150	19

The international companies specializing in the production of vibrating sieves generally recommend the values presented in table 2.

Table 2

Mesh size [mm]	Vibration amplitude [mm]
0 …… 1,5	1,00
1,6 …… 3	1,5
3,1 …… 7,5	2
7,6 …… 20	2,8
21 …… 40	3,5
41 …… 50	3,8
51 …… 75	4,4
76 …… 100	5
101 …… 150	6

From a careful analysis of the two tables we can see that there are no big differences for the amplitude of the vibrations function of the size of the mesh of the sieve.

2. TRANSMISSION OF THE MOVEMENT IN ELECTROMAGNETIC SIEVES

In the electromagnetic sieves, the meshes are laid on sieving frames. These are exposed to high frequency oscillations. There can be one or two nets in the sieves with reclined planes. The oscillating energy is applied directly on a sieving net in several points arranged pertinently and scattered on the entire surface of the net.

This functioning principle allows for a completely static machine to be built, machine that has no vibrations whatsoever in the net holding frame or in the body.

The oscillating energy is obtained by means of electromagnetic heads aligned on support bridges (fig. 1.), where these are connected with the rigid frame, situated above the net holding frame.

Figure 1. Actuating electromagnetic heads

The oscillating heads are made from a body with a magnet and a winding and, on the inferior side from an anchor and an oscillating bar. (fig. 2.).

1. Electromagnet
2. Electrical wire
3. Net holding frame
4. Sieving net
5. Oscillating bar
6. Net setting disks
7. Self-blocking nut

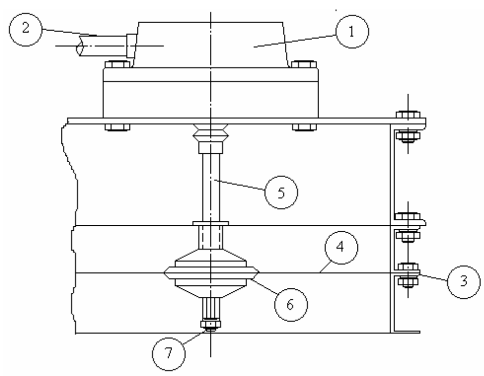


Figure 2. VEM actuating head

The oscillating bar is firmly connected to the anchor and transmits the oscillations to the sieving net.

3. THE POSSIBILITY OF ADAPTING THE SIEVE TO THE MATERIAL FED TO THEM

In the electromagnetic sieves, the excitation of the net acts mainly strictly normal to the surface of the net. The absence of the active force components necessary to transport and advance the material is compensated by the inclination of the sieving net. The net reclines more or less according to the friction angle of the material.

As general guidelines, the adjustment occurs as follows: The net is given an inclination equal to that of the friction angle. In choosing the net must be considered the fact that the inclination itself creates in the practical sorting effects a contraction of the mesh. For a certain value of the separation fraction a net with bigger meshes may be adopted. Nets with a rectangular mesh are preferable for a higher percent of empty then full, that is for a higher sieving efficiency. This thing is possible when the rectangular net is compatible with the geometric form of the grain and not when the problem of sieving requires the adoption of a square net.

The correct choice for the inclination of the net and having optimally adapted meshes lead to a very precise separation fraction with high specific feeding capabilities.

We must take into account the fact that, in general, with a square mesh net we get a more precise granulometric separation than with the rectangular one. However, the later allow for a higher efficiency and are preferred for materials that tend to clog the mesh. If wet materials were to be sieved, it is advisable to use nets from rustproof steel. Generally, the nets made out of iron wire are preferred for a better resistance to wear and for the harmonics they develop.

The problem of sieving implies a preliminary technical study of all the elements that may negatively impact on the process of granulometrical separation. Suppose that in the industrial sieving a dimensional separation is never mathematically exact, through experimental trials on the testing stall it will be possible to define an optimal sieving, the one that will have on the top of the net a quantity of granules inferior to the separation limit less then 5%. The condition for an optimal sieving it that the material has optimal sieving conditions:

- It is dry;
- Has a uniform granulometric curve
- Specific weight = 1;

When negative factors intervene, such as the presence of humidity, the possibility of clogging of the meshes, reduced specific weight and others, a priory examination of the technical characteristics of the material that is to be sieved must be made.

4. CRITERIA FOR CHOOSING THE MESH OF AN ELECTROMAGNETIC SIEVE

When sieves with a high inclination are adopted, that is the very high frequency with direct excitation on the sieving net through electromagnetic heads with oscillating bar, we must consider the following:

Suppose that with this type of machines, if the sieving plan would be horizontal there would be no translation movement of the material, so its movement must be obtain using gravity on a reclined plain. Thus the inclination of the sorting plan must correspond to the friction angle or to the natural slope of the material being sieved. A higher inclination will lead to a higher flowing speed of the material and thus a higher possible feeding capacity.

The influence of the sieve on the sorting process is taken into consideration through the probability of the passing of the particle through the sieve ([2], [3], [4]). In order to calculate this probability, we consider that a particle passes it its center falls within the hatched surfaces.

So, the probability of passage will be the ratio between the hatched surface and the total surface of a mesh:

$$p = \frac{(l-d)^2}{(l+a)^2} = \frac{l^2}{(l-a)^2} \cdot \left(1 - \frac{d}{l}\right)^2 \quad (1)$$

The first part of equation 1 is a ration between the active surface of the sieve and its total surface (the coefficient of the free section of the sieve). We can see from here that probability raises with the raise of the useful surface of the sieve. The second part of the expression shows that for those pieces of material that tend towards the nominal dimension of the mesh, the passage probability decreases towards zero.

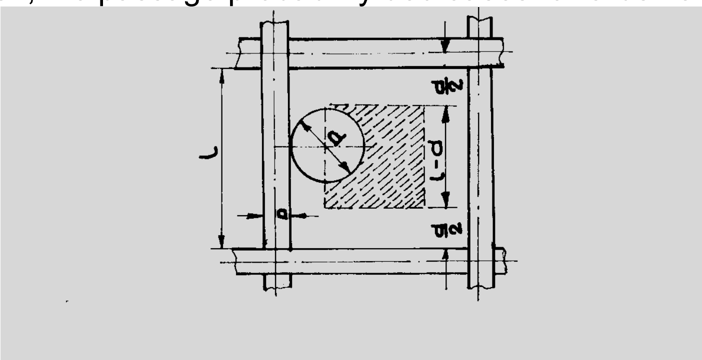


Figure 3. Diagram used to calculate the probability of the passage through the sieve

In reality, materials with a high percentage of particles close to the nominal separation dimension will be very hard to sieve.

That is why the chosen sieves will have meshes higher that the nominal separation dimension.

Until recently, graphs were used to choose the meshes of the sieve.

Lately however, a high number of completely new cases appeared, with high demands on the choosing of the sieve, such as:

- Rattles with cascading reclined sieves;
- Mesh forms different from the square form for most of the sieves (because those with a square form have a low active surface);
- Rise in the wants regarding the quality of the sieving;
- The necessity to choose quickly the sieve;
- The high diversity of the sieved materials.

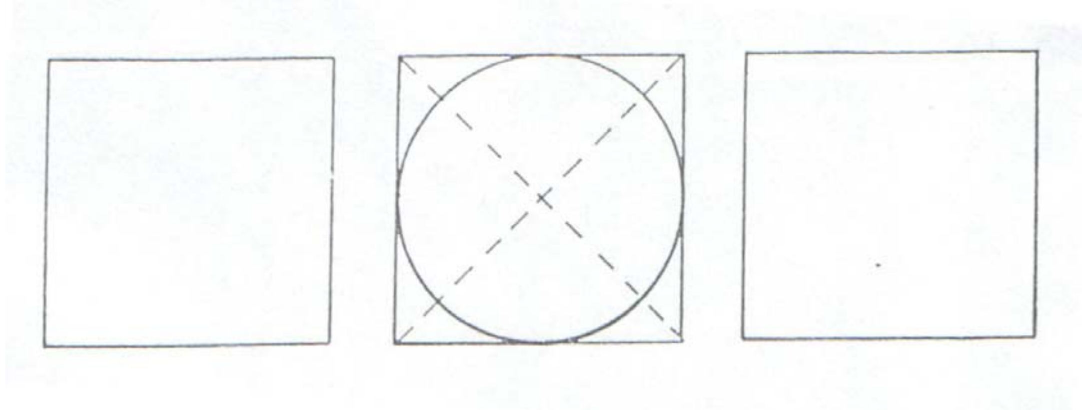
For all these factors, the necessity of tables arose in order to have directly the size of the mesh function of the granulometry desired:

In choosing the sieving net, it must taken into account that the inclination has as effect a contraction of the eye that will get larger as the inclination of the sieving plan increases (fig. 4). This contraction is more obvious on the square nets, rather then on the rectangular ones.

In fig. 4. It is represented a round grain that passes through the circle inscribed of a net of square form for the horizontal position of the sieve and also for an inclination of 40^0.

<u>THE EYE OF THE NET IN HORIZONTAL PLAN</u>

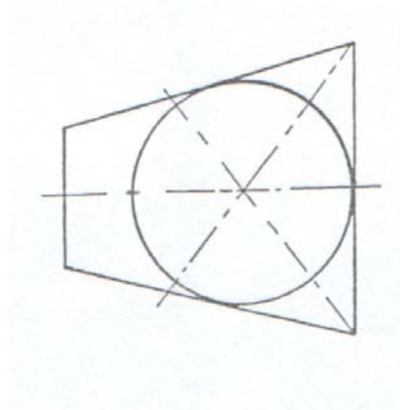
The circle inscribed in the square represents the round grain that passes through the net



Material advance direction

<u>THE EYE OF THE NET IN A PLAN INCLIED AT 40°</u>

The figure below represents the projection in an inclined plan and the inscribed circle represents the separation domain net inferior to the one presented earlier.



MATERIAL ADVANCE DIRECTION

Figure 4.

Following the calculations in an inclined plan, for sieves inclined at 40°, the following criteria for choosing the mesh of the net is proposed:

Table 3

Effective granulometric fraction [mm]	Rectangular meshes [mm]	Square meshes [mm]
0,15	-	0,2 x 0,2
0,34	0,4 x 1,2	0,45 x 0,45
0,75	1 x 3	1,2 x 1,2
1,0	1,25 x 3,75	1,5 x 1,5
1,5	2 x 6	2,5 x 2,5
2,0	2,5 x 7,5	3 x 3
4,0	5,0 x 15	6 x 6
5,0	6,0 x 18	7 x 7

These values are given for dry material. For wet material, larger meshes must be adopted in order to compensate the girth that is inevitable represented by the collar of dust that adheres to the wire of the net.

When the physical and granulometrical conditions of the material remain invariable in time, diminishing the inclination of the net we obtain a superior granulometric separation fraction, due to the different plan projection for the mesh of the net.

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