



Design, Construction and Testing of a Dry Sand Sieving Machine

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ABSTRACT: This paper reports on the design, construction and Testing of a dry sand sieving machine. The sample to be sieved is uniformly graded. The coefficient of uniformity is 1.11, thus the machine design does not sieve larger particles such as gravel. The slip calculated is 36% which enabled the proper configuration of the V-belt. The theoretical efficiency of the machine calculated is 97%. @JASEM

Key Words: Sieving, Uniformly Graded, Coefficient of Uniformity, Slip, V-Belt, Efficiency

The size distribution is often of critical importance to the quality of the casting (product). A sieve analysis can be performed on any type of non – organic or organic granular materials including sands, crushed rock, clays, soil, granite, feldspar and coal, a wide range of manufactured powders, grains and seeds, down to a minimum size depending on the exact method. Being such a simple technique of particle sizing, it is probably the most common. This process can as well increase the production rate of cast products instead of the use of the manual traditional way of sand throwing method through a mesh tray more over up to six different sand sizes can be sample at a time depending on the arrangement of the trays. This design can take four different sizes of sand grains, meaning four different sizes of mesh arranged in layers of preference, from coarse on top to the finest at the bottom.

Theoretical Analysis: Sand sieve is of multiplayer and highly efficient. It can screen the materials into multiple levels products according to the different materials grain size. (McCave and Syvitcki, 1991).

The machine is to drive vibrator through v-belt under the power of ordinary motor, so that the screen body along the vibrating power direction to make a cyclical reciprocating, the material in the screen surface to make round movement, so as to make the materials sieved. (www.alibaba.com, June 2010).

Vibration absorbers are devices attached to flexible systems, or dynamic systems in order to minimize the vibration amplitudes at a specific set of points (Khurmi and Gupa, 2005). The use and design of vibration absorbers has long history. First, as proposed by Frahm in 1909, vibration absorbers consists of a second mass-spring device attached to the main device, also modeled as a mass-spring system, which prevents it from vibrating at the

frequency of the sinusoidal force acting on the main device (Den, 1956)

MATERIALS AND METHODS

The sand sieve features are as follows:

- The materials drop down the long line, and the machine bears the features of different specifications.
- Take the partial block as the exciter, which is strong.
- Screen cross-beam and box are connected by strong belt, which is with simple structure, and convenient maintenance.
- With small amplitude, high frequency, large-inclination structure, high efficiency, large capacity, long service life, low power consumption and noise.

In the dry sieve analysis, a suitable quantity of pulverized dry soil known weight is taken and sieved through a selected set of sieves arranged to their relative sizes, with the largest aperture sieve at the top and the smallest aperture sieve at the base. The amount of shaking depends on the shape and number of particles. (Mamlouk and Zanieswki, 1999)

On the basis of the total weight of sample taken and the weight of soil/sand retained on each sieve, the percentage of the total weight of soil passing through each sieve is as calculated below:

$$PFT = \frac{W_s}{W_T} \times 100 \dots 1$$

Where

PFT is the percent finer than, otherwise known as percentage of soil retained on a particular sieve.

W_s is the weight of sand retained on the sieve

W_T is the total weight of sand taken

The cumulative percent of sand retained is obtained as

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$$\text{CPFT} = (\text{PFT}_L + \text{PTF}) \quad \dots 2$$

Where in this nomenclatures

PFT_L denotes percent on all sieves of larger sizes

Also, another useful statistics in percentage analysis is the percentage finer than the sieve under reference (PFTR). This is calculated as:

$$\text{PFTR} = 100\% - \text{CPFT}$$

Shape Parameters

The grain-size distribution curves are widely used in particle shape analysis. The values of the shape parameters, Coefficient of Uniformity (C.O.U.) and Coefficient of Curvature (C.O.C.) are obtained as

$$\text{C.O.U.} = \frac{D_{60}}{D_{10}} \quad \dots 3$$

and

$$\text{C.O.U.} = \frac{D_{30}}{D_{10} \times D_{60}} \quad \dots 4$$

Remark: For a well-graded soil, C.O.C

Must lie between 1 and 3, and also C.O.U. > 4 for gravel and C.O.U. > 6 for sands (Gopal and Ruo, 2000).

The parts that are constructed are as follows:

The frame is made from angle iron, measured to sizes using tape rule/scraper which was cut using hacksaw and then welded together to give the desired shape of the mainframe design. The angle irons make the mainframe to be rigid.

Hopper Frame: The frame is made from angle iron which was cut to size using hacksaw and then welded
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together to give the desired shape the Hooper frame design.

Hopper: The hopper is made from mild steel plate 2mm thickness. The length are market using scriber and steel rule then cut to size (828mm x 444mm) and folded to shape, welded at both ends.

Screens or Mesh: This is mild steel wire mesh, measured to length with steel rule and cut to size. It may interest you to note there are four different sizes of the net welded to a frame at the ends to give rigidity. Produced from medium carbon steel on a lathe machine, cutting the measured piece to size with electric hacksaw, the plain surface, face on lathe machine and the v-groove was made from formed tool. The key-way was made on a horizontal milling machine.

RESULTS AND DISCUSSION

The automatic sand sieving machine has been designed mainly for dry sand of size between 0.9mm – 0.01mm. The operation of this machine is very straight forward, simple and does not require any special expertise, skill or knowledge. To set up the machine for operation:

- i. Fill the sample of sand into hopper through the funnel. (20kg)
- ii. Turn on the electric motor after ensuring that there is no loosed part on the machine.
- iii. The movement of the hopper does the shaking of the entire place in different segmentation.
- iv. Dis-assemble the hopper and remove each segment of the trays.
- v. The finer ones will be at the bottom while the coarsest will be on top.
- vi. The left-over which cannot find its way through the screen is the remove and throws away.

Table 1: Results of the analysis

S/N	Trays	First test (mm)	Second test (mm)
1.	First tray	0.09	0.09
2.	Second tray	0.06	0.06
3.	Third tray	0.04	0.04
4.	Fourth tray	0.01	0.01

The design factors, calculations and construction are consistent. The machine was tested in the workshop and it was confirmed in good working condition. The length of the belt calculated as 422mm was considered the minimum. An allowable excess of 8mm was added to avoid losses. The construction

was carried out under adequate precautionary measures, thus no accident occurred. The cost, as estimated, is considerable affordable and the machine is economical, in terms of time and effort. The efficiency, calculated, is 97%, thus the machines durability is high, based on the discussion of results.

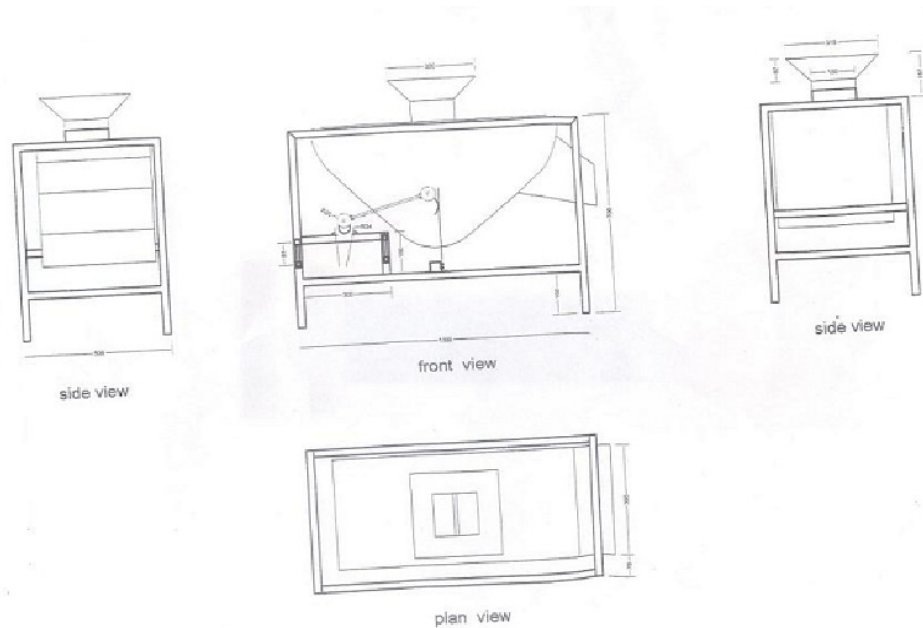


Fig 1: First Angle Projection of the Dry Sand Sieving Machine

REFERENCE

- Den Hurto J. P. (1956), Mechanical Vibrations, 4th Edition, McGraw Hill, UK.
- Gopal R., Rao A. S. R. (2000), Basic and Applied Soil Mechanics, Revised 2nd Edition, New Age International Publishers, New Delhi, India.
- Khurmi R. S., Gupta J. K. (2005), Machine Design, 14th Edition, Eurasia Publishing House Ltd., New Delhi.
- Mamlouk M. S., Zaniewski J. P. (1999), Materials for Civil and Construction Engineering, Addison Wesley, Menlo Park, California, USA.
- McCave I. N., Syvitcki J. P. M. (1991), Principles and Methods of Particle Size Analysis, Cambridge University Press, New York, Pg 3 – 21.