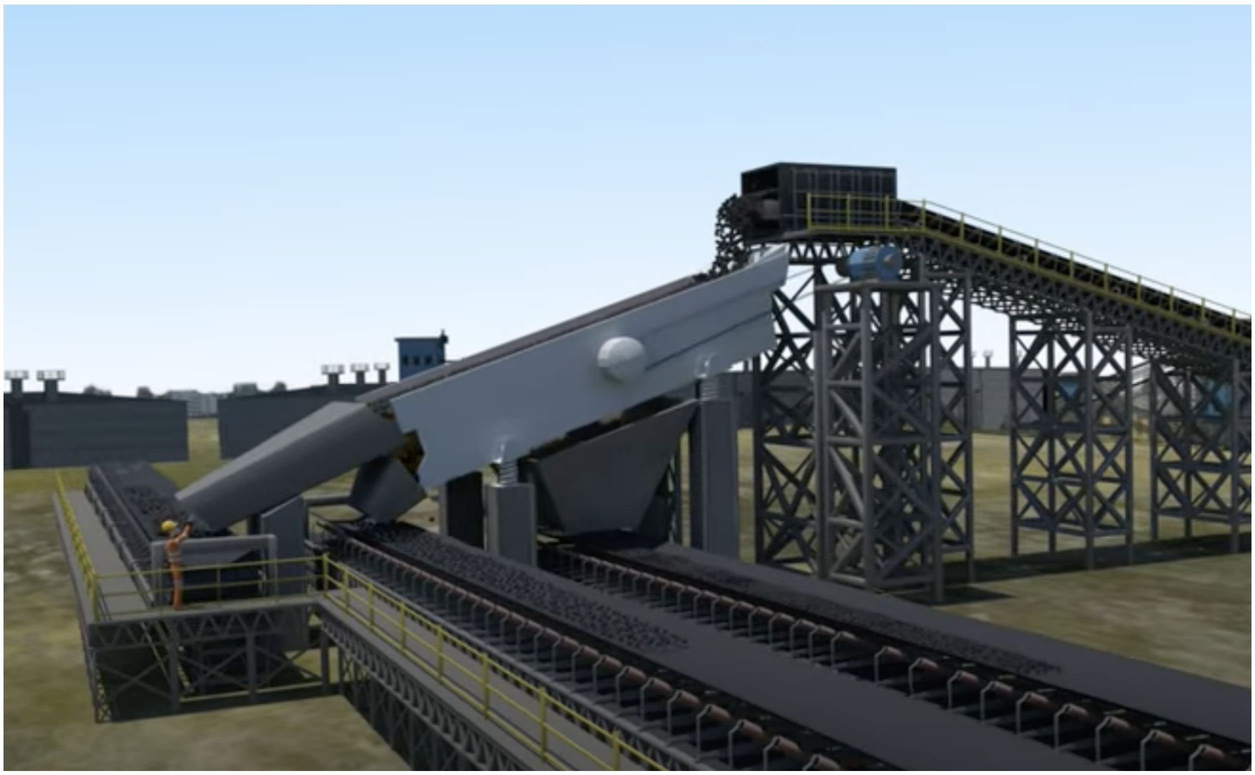
MECHANICAL OPERATIONS LAB REPORT

Experiment 1: Vibrating Screen



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AIM

- To understand the operating methodology of a Vibrating Screen
- To calculate the Efficiency of the Vibrating Screen and account for possible losses/ errors in the procedure

THEORY

In an Industry, in Ore and Mineral Processes, screening is considered the simplest and most convenient method of sizing particles. The screening process typically follows comminution processes such as primary crushing and secondary crushing. There are different types of screens available. Some are grizzlies, gyrating, vibratory, and wire mesh screens.

A vibrating Screen is an equipment consisting of multiple screens/beds with holes, placed on top of each other and mainly used in industrial operations like the separation of ores/minerals. These screens serve to classify the different particles by size, starting from a bulk product in a continuous process. The vibrating element in our equipment are 3 Beds (Screens) which have uniform diameter holes on them and the vibration is achieved with the help of a shaft. In general, Vertical/ Horizontal/ Elliptical vibrations are achieved by superimpositions of mutually perpendicular vibrations. In this experiment, we only use Horizontal vibrations. The shaft is attached eccentric to the rotator, due to which upon rotating, push and pull motion is generated, which gives a Horizontal vibration to each screen.

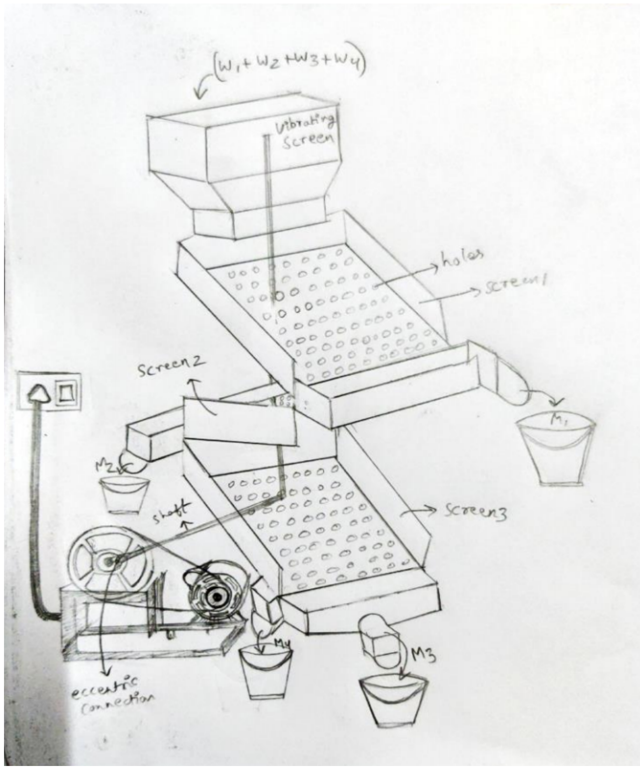
Screens allow us to separate the Coarser and Finer particles. Ideally, all particles of sizes smaller than that of hole size should pass through the screen and the remaining larger size particles should be leftover.

$$Efficiency = \frac{Actual\ Experimental\ Output}{Expected\ Theoritical\ Output} \times 100$$

Screening Efficiency based on the Undersize Recovery:

$$\eta_{under\ size} = \frac{Undersize\ feed\ passing\ through}{Undersize\ feed\ expected\ to\ passing\ through} \times 100$$

EXPERIMENTAL SET-UP



Hand drew Schematic of the Vibrating Screen

Vibrating Screen

EXPERIMENTAL SET-UP

Feed Specifications: -

Feed Type	Weight
M1 (>12.7mm)	200gm
M2(<12.7mm >9.5mm)	200gm
M3(<9.5mm >6.3mm)	200gm
M4(<6.3mm)	200gm

Products Obtained

Sl No	Feed Type	Collecting Bin Number	Weight of Product (in gm)
1	W1	1 (>12.7mm)	204.2
2	W2	2 (>9.5mm)	211
3	W3	3 (>6.3mm)	187
4	W4	4 (<6.3mm)	185.5

CALCULATIONS

Screens	Screening Efficiency based on the Undersize	Screening Efficiency based on the Oversize
Screen 1	92.75%	102.1%
Screen 2	93.125%	105.5%
Screen 3	92.75%	93.5%
Overall	92.75%	93.5%

M_1, M_2, M_3, M_4 are weights of particles in the feed, where $M_1 > M_2 > M_3 > M_4$

W_1 : Oversized particle from 1^{st} screen
W_2 : Oversized particle from 2^{nd} screen
W_3 : Oversized particle from 3^{rd} screen
W_4 : Undersized particle from 3^{rd} screen

	Screening Efficiency Based on the Undersize	Screening Efficiency Based on Oversize
Screen 1 :	$\eta = \dfrac{W_2 + W_3 + W_4}{M_2 + M_3 + M_4}$	$\eta = \dfrac{W_1}{M_1}$
	$\therefore \eta = \dfrac{211+187+185}{200+200+200} = 97.25\%$	$\therefore \eta = \dfrac{204.2}{200} = 102.10\%$
Screen 2 :	$\eta = \dfrac{W_3 + W_4}{M_3 + M_4}$	$\eta = \dfrac{W_2}{M_2}$
	$\therefore \eta = \dfrac{187 + 185.5}{200 + 200} = 93.125\%$	$\therefore \eta = \dfrac{211}{200} = 105.50\%$
Screen 3 :	$\eta = \dfrac{W_4}{M_4}$	$\eta = \dfrac{W_3}{M_3}$
	$\therefore \eta = \dfrac{185}{200} = 92.75\%$	$\therefore \eta = \dfrac{187}{200} = 93.5\%$
Overall :	$\eta = \dfrac{W_4}{M_4}$	$\eta = \dfrac{W_1 + W_2 + W_3}{M_1 + M_2 + M_3}$
	$\therefore \eta = \dfrac{185}{200} = 92.75\%$	$\therefore \eta = \dfrac{204.2+211+187}{200+200+200} = 93.5\%$

RESULTS

1. Overall Undersize efficiency = 92.75%
2. Overall Oversize efficiency = 93.5%

DISCUSSION

The estimated oversize efficiency of 1st and 2nd screens turns out to be greater than 100%. This can be because of the vibration of the screen causing some undersize particles as well to be carried away with the oversize particles in the product. Thus, M1 turned out to be larger than W1 and the same as M2 and W2. Hence, efficiency turns out to be greater than 100%.

While mixing, first we should pour heavier sets into a bucket and then followed by lighter sets, this allows to make the mixture homogeneous. Otherwise, lighter particles may remain beneath while mixing. Due to the vibrations, the masses collected using buckets might not be fully correct as some may throw out of the range and have fallen on the ground. Using buckets with larger diameters will help to reduce this error. Some particles might also get stuck & clogged to the grooves, edges of the screen beds because of their irregular oversizes, so the result due to these might lead to disparities in efficiencies. Large vibrations may result in loss of efficiency. Particles may directly fall onto the grounds and would not be included in any of the undersized and oversize products. Thus, we have to ensure optimal vibrating speed.

Efficiencies can be increased if:

- We use longer screen lengths, as it gives a larger spread area, reducing bed width and letting particles go into groves precisely.
- We can also adjust the angle of screens, generally, around 30 degrees with horizontal elevation gives better results.
- We set the Amplitude of vibration to a higher value (under limits).

We could get better results by increasing the time for the experiment. However, the performance increment saturates with respect to experiment duration after some time.

The Overall Undersize efficiency is 92.75% and Overall Oversize efficiency is 93.5%