OPTIMAL SCREENING OF NATURAL AGGREGATES

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ABSTRACT

Within a research project to optimize the screening of natural aggregates, tests were performed to determine a correlation factor between theoretical and experimental results, using current vibrating shakers. This paper presents the results of some of the tests performed and exemplifies for one case, the conclusions that can be achieved, concerning the jigging screen choice according to an optimal screening methodology.

1. INTRODUCTION

High quality concrete with high strength and improved durability is being used for important public works, namely bridges, water storage tanks, dams and atomic power plant.

The aggregates for this concrete need an high screening efficiency and studies of the jigging screen productivity must be performed.

The screening efficiency is mainly controlled by the three factors presented in figure 1.

- The first factor is associated with the mechanical vibration characteristics of the equipment where the jigging screen is installed. Its main control parameters are:

a) Amplitude and frequency of the vibrations;
b) Perturbing forces;
c) Relationship of the vibrations between the engine and the jigging screen.

- The second factor is defined by the geometry of the jig screen and it may include the following parameters:

a) Planar sieve shape (round and rectangular);
b) Sieve slope angle;
c) Total area;
d) Active area (opening sieve area of the screen frame);
e) Sieve mesh;
f) Sieve material (wire texture or thin plate pierced);
g) Wire thickness;
h) Sieve arrangement and clamping to jigging screen frame

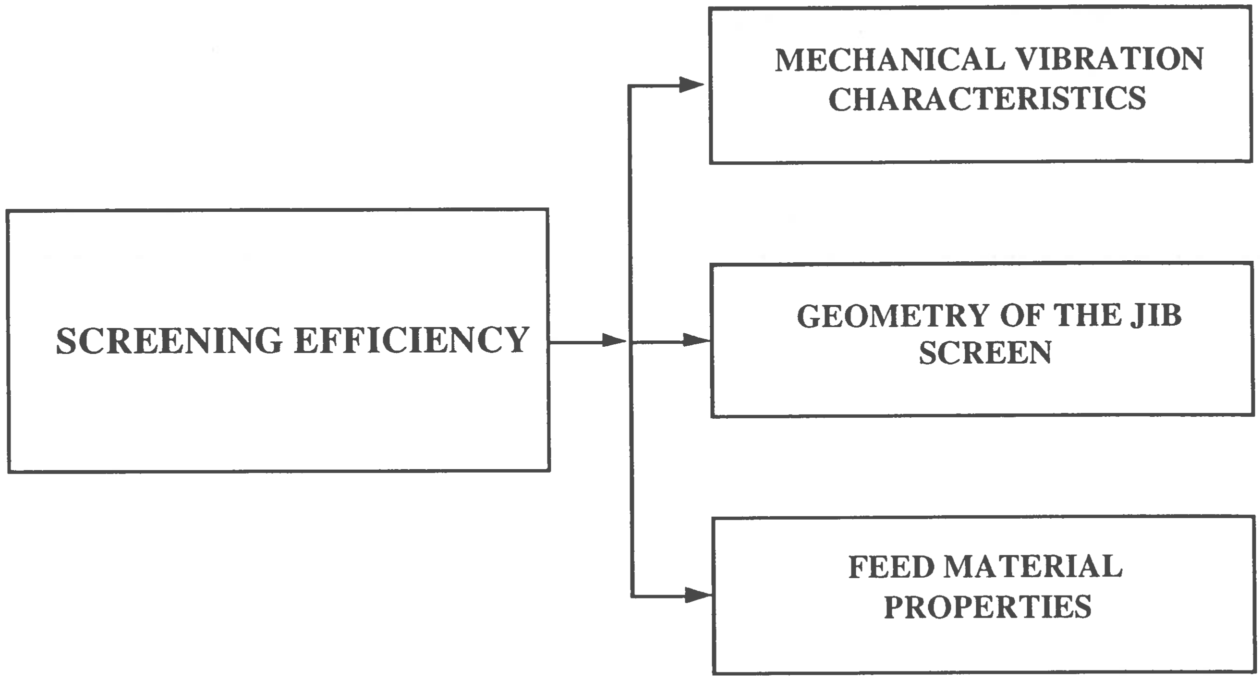

Fig.1 - Screening Efficiency

- The third factor is related to the material proprieties, namely to the following factors :

a) Grading;
b) Density and relative humidity of the materials;
c) Size and shape of the granules;
d) Friction coefficient;
e) Friction angle.

2. LABORATORY TESTS

The analysis and simulation of the sieving process is usually very difficult because there are not clear relationships between intervening parameters within or among the three factors above referred.

To perform an optimization of the parameters, the usual approach consists in performing theoretical and experimental studies step by step. For a good sieving monitoring it is not necessary to make a ballast-pit measurement.

In the present study, the direct research method of "in situ" continuum screening was replaced by a periodical screening, considering only the influence of some of the parameters.

The tests were performed in the Construction Laboratory, Instituto Superior Técnico, Lisboa.

3. TESTING EQUIPMENT

The experimental testing sieving equipment used in the tests is presented in figure 2. It was produced by CONTROL - Italy (model - 15-D406).

This equipment was used to perform grain size analysis and has the components presented in fig.2.

This equipment can be used with one or several sieves. The sieves are manufactured with interweave wire with 38 µm - 100 mm diameter.

A	A_1=0,10 mm	A_2 = 0,15 mm	A_3 = 0,35 mm	A_4 = 1 mm
q	2.43	2.84	3.17	3.25
	0.060	0.16	0.182	0.284
	0.04	0.04	0.06	0.081
	0.02	0.02	0.03	0.042

Table 1 . Screening Intensity Values [$kg/m^2.s$]

Fig.2. Experimental Testing Equipment

An electrical engine induces round vibrations in an horizontal plane, and via cams batch, vertical vibrations are also simultaneous produced.

The experimental testing equipment has a controlling time chronometer for 0-30 min periods and an amplitude controller from 0 to 1 mm.

All the vibration characteristics of the equipment were monitored with accelerometers, that allowed the measurement of the frequencies and amplitudes.

4. EXPERIMENTAL PROCEDURE

In the experimental analysis four material types were used: three white sands with different grain size and a gravel material.

The tests were performed with one sieve attached to the equipment and considering always 1 kg of mass.

The amplitude range values were 0,1; 0,15; 0,35; 1mm. The time intervals were: 15s; 30 s; 45 s; 60 s; 2 min.; 6 min; 8 min; 10 min; 12 min; 15 min.

According to the materials tested, sieves with : 150 μm; 300 μm; 600 μm; 1,18 mm; 2,36 mm; 4,75 mm, 9,5 mm diameter were used.

For each test the vibration time, the amplitude and the mass passed through the sieve were monitored.

5. SCREENING INTENSITY ANALYSIS

The screening intensity (I) is related with the vibration time by :

$$I = \frac{m}{t . S_{ef}} \qquad [kg/m^2.s] \qquad (1)$$

where :

m - mass passing the sieve [kg]
t - time of vibration [s]
S_{ef} - sieve's active area [m^2]

River sand with 0,49-2,38 mm grain and mesh sieve d_s = 1,19 mm were considered in the tests with respect to four amplitude values A : 0,10 mm; 0,15 mm; 0,35 mm; 1,00 mm.

The results of some of the tests are presented in Table 1 and plotted in figure 3.

The analysis of tests leads to the following conclusions:

1. For the materials tested, the efficiency time sieving value was between 30 s and 60 s. After this interval the screening intensity and jigging screen productivity becomes insignificant for sieving analysis;

2. The example of intensity variation I = I(t), presented in Fig.3, shows that the screening can be finished after 30 s;

3. Screening intensity increases with the vibration amplitude;

4. The optimal vibration amplitude and frequencies are function of the material grain size.

6. CONCLUSIONS

The analysis of all experimental tests performed leads to the following criteria, used for the choice of the optimal jigging screening of natural aggregates :

- The screening intensity allows the definition of the optimal screening characteristics (time and vibrations);

- For fine fractions of sieving aggregates small amplitudes and high frequency sieving can be used. For rough fractions high amplitudes and small frequencies are better.

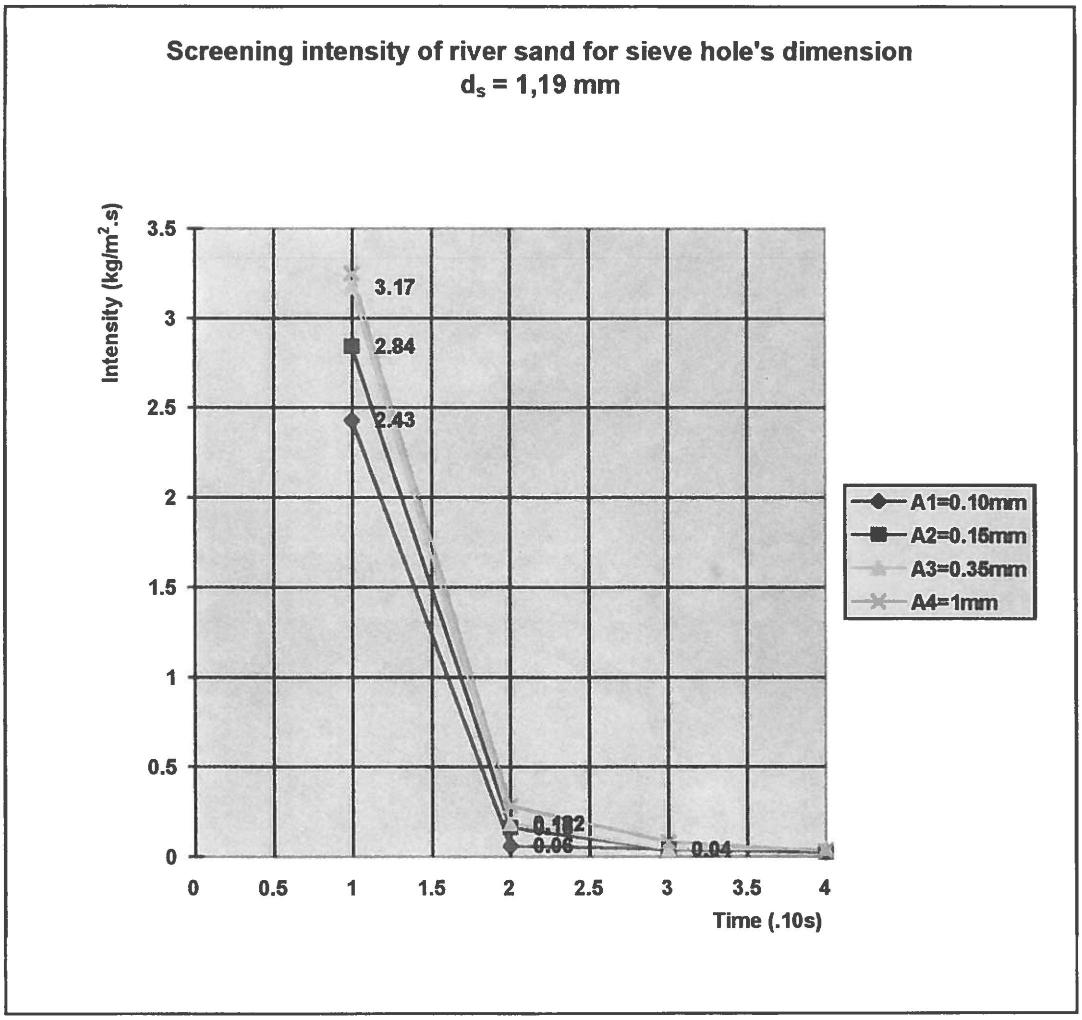

Fig.3. Screening Intensity Function of Processing Time

7. REFERENCES

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