1.4.3. Industrial Screening Equipment

Grizzlies are the most rugged types of industrial screens. They are used for screening large sizes of rocks of 25 mm and above, as for example, for sizing the feed to a primary crushing unit. They consist of a set of parallel bars usually made of manganese steel and of trapezoidal in cross-section. Stationary grizzlies are the simplest, requiring no external power supply and needs little maintenance. They are used to handle dry materials of sizes 50 mm and above, but are not suitable for moist or sticky materials. Vibrating grizzlies use a cam arrangement or an eccentric to impart lengthwise reciprocal movement to alternate bars which permit easy flow of material and prevent clogging. Flat grizzlies are used above feed bins of coal and ores or below the unloading trestles to retain huge lumps. Inclined grizzlies maintain a slope of $20^0 - 50^0$ with the horizontal. Chain grizzlies in which the bars are replaced by endless chains passing over sheaves are used for handling sticky or clay-like material.

Vibrating screens are one of the most popular ones used in chemical industry. They can handle large tonnages of material, possess high efficiency, provide good accuracy of sizing, require less maintenance per ton of material handled and also provide a saving in weight and installation space. They can be mechanically vibrated using an eccentric or unbalanced flywheel which will constitute a circular motion in the vertical plane, or electrically vibrated using an electromagnet. The frequency or speed of vibration varies from 1500 to 7200 per minute. They can handle a wide variety of materials starting from 480 mesh to 4 mesh.

Oscillating screens are characterised by relatively low speed oscillations (300 to 400 per minute) in a plane parallel to the screen cloth. They are one of the cheapest types of industrial screens and are widely used for batch screening of coarse material of 5 to 15 mm and fine, light, free-flowing materials of 4 to 8 mesh.

Reciprocating screens are popularly used in the chemical industry for handling materials down upto 4 mesh. They are driven by an eccentric under the screen at the feed end. The motion varies from gyratory at the feed end to reciprocating motion at the discharge end. The speed varies from 500 to 600 per minute. They are usually kept inclined at around 5° with the horizontal. They are widely used for handling dry chemicals, light metal powders, powdered food and granular materials, but are not suitable for handling heavy tonnages of rock or gravel.

Gyratory screens are box-like machines either square or round with series of screen cloths nested one upon the other. Eccentrics impart oscillations in circular or near-circular orbits. Examples are the vibro-energy separators and the gyratory riddles (widely used in batch screening).

Trommels are revolving screens usually cylindrical or conical in shape, open at both ends and are normally inclined at 5 – 10° with the horizontal. They are rotated about their axis at around 15 – 20 rpm. Trommels have relatively low capacity and low efficiency. They are however quite efficient for coarse sizes. Conical trommels which have the shape of a truncated cone are normally mounted horizontal. Compound trommels can be constructed using a number of screens of gradually increasing aperture size along the length of the cylinder, the feed being introduced at the finest screen. Thus, a number of products of different sizes can be collected from a single trommel. However, it will be more efficient to use a number of simple trommels in series, with the undersize from one trommel passing to the next. In concentric trommels, a number of trommels are mounted one inside the other on

a common shaft. The innermost screen will be the coarsest and the outermost the finest, the feed being introduced into the innermost screen. Provisions are also made for separate removal of oversize from each screening surface. The capacity of a trommel increases with increase in speed of rotation upto a stage when blinding occurs due to overcrowding of particles at the screen surface. If the speed is further increased to the so-called "critical speed," then the material will no longer cascade over the screen surface but will be carried around by centrifugal force. Thus, there will be no size separation and the trommel becomes inoperative. Since the critical speed of rotation of a trommel is thus the speed at which the force of gravity on the particle just becomes equal to the centrifugal force acting on it, we can write,

$$mg = m\,\omega_c^2\,r \qquad \text{...(1.4.11)}$$

where m = mass of particle

g = acceleration due to gravity

ω_c = critical angular velocity of particle (equal to that of trommel)

$= \dfrac{2\pi N_c}{60}$

N_c = critical speed of rotation of trommel, rpm

r = radius of rotation of particle.

Since the maximum radius of rotation of particle (at critical speed) is the radius of the trommel, we can put $r = D/2$, where D is the diameter of the trommel. Thus, equation (1.4.11) becomes,

$$\left[\frac{4\pi^2 N_c^2}{3600}\right]\left(\frac{D}{2}\right) = g$$

or,
$$N_c = \frac{60}{2\pi}\sqrt{2g/D} \qquad \text{...(1.4.12)}$$

Thus, the critical speed is governed by the diameter of the trommel (for concentric trommels, diameter of the outermost screen). Obviously, the operating speed of trommel must be below its critical speed. Usually, 33 to 45% of N_c is preferred.

1.5. Computer-aided Analysis

Today's era is commonly called the "computer era." The computations discussed above involving specific surface of particle mixtures, screen effectiveness etc. can be made faster and more accurate if the help of high speed computers is sought.