2. SCREENING: (lanjutan)

SCREEN di industri

Tujuan kuliah :
1. dapat memilih alat dan merancang sistem screening di industri.
2. dapat mengevaluasi efisiensi alat.

Materi:
- ✓ ALAT AYAKAN
- ✓ KAPASITAS SCREEN
- ✓ EFISIENSI SCREEN

Screen = ayakan.
Screening = operasi ayakan.

Ayakan digunakan untuk memisahkan bahan padatan berdasarkan ukurannya.
Tujuan ayakan:

A. untuk memisahkan bahan berdasar ukuran agar dapat diproses pada operasi berikutnya.
B. untuk memisahkan bahan berdasar ukuran agar sesuai kebutuhan konsumen.
C. Untuk memisahkan kontaminan yang ukurannya tidak diinginkan.

ALAT AYAKAN

Berdasarkan gerak pengayak, alat ayakan dibagi menjadi 2 jenis:

a. stationary screen .
b. dynamic screen.

Beberapa alat ayakan :

1. stationary
2. grizzly
3. vibrating
4. oscillating
5. reciprocating
6. tromel/revolving

Faktor yang harus diperhatikan dalam pemilihan screen:

a. kapasitas, kecepatan hasil yang diinginkan.
b. Kisaran ukuran (size range),
c. Sifat bahan : densitas, kemudahan mengalir (flowability),
d. Unsur bahaya bahan : mudah terbakar, berbahaya, debu yang ditimbulkan.
e. Ayakan kering atau basah.

Pemilihan screen berdasarkan ukuran disajikan di fig. 19 – 14 (Perry, 7th ed.).

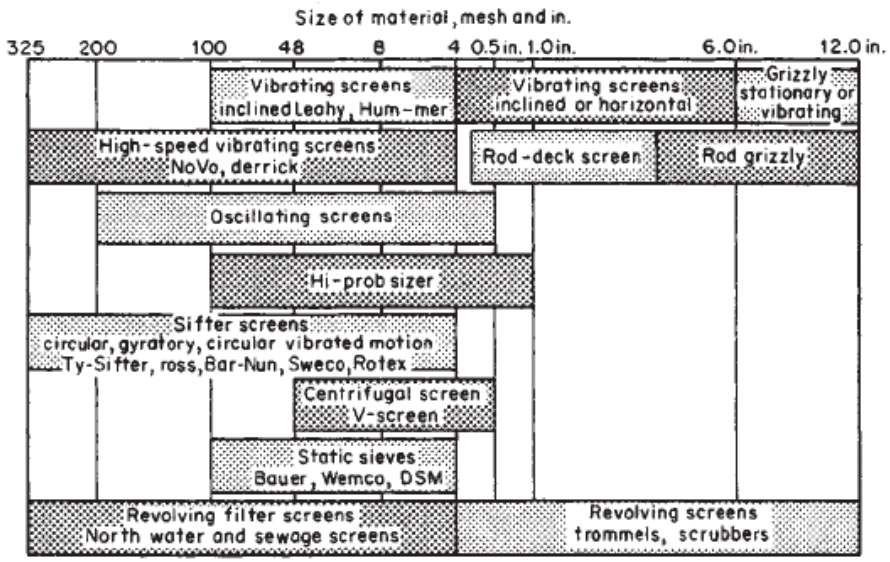


FIG. 19-14 Range of separations that can be obtained with various kinds of screens. To convert inches to meters, multiply by 0.0254. [*Matthews,* Chem. Eng. *(Feb. 15, 1971).*]

Tugas :

Paper dan dipresentasikan, materi:

a. Fungsi dan kemampuan alat.
b. Cara kerja alat.
c. Aplikasi di industri.
d. Pustaka : Brown, Perry, textbook lainnya, web.

KAPASISTAS SCREEN

1. Sumber Brown, 1950.
   Table 3.

Types of screen	Capacity range, $\frac{\text{Ton}}{\text{ft}^2 \text{ . mm aperture . 24hr}}$
grizzlies	1 - 6
Stationary	1-5
vibrating	5 - 20
Shaking & isolating	2 - 8
trommels	0,3 - 2

Contoh : Tersedia vibrating screen dengan luas permukaan= 6 ft^2 , aperture = 2 mm. Berapa kisaran kapasitas yang memungkinkan screen ini?

Penyelesaian :

Kapasitas = (5 s/d 20) x 6 x 2

= 60 s/d 240 Tons/24 hr.

SOAL: Suatu industri kimia baru akan membeli vibrating screen dengan spesifikasi seperti contoh di atas. Kapasitas bahan yang akan diayak industri itu adalah 1000 ton/ hari. Apa yang seharusnya dilakukan industri itu?

2. Sumber: Perry, chap. 19 .

Persamaan Matthews :

$$A = 0{,}4Ct / (Cu \,.\, Foa \,.\, Fs)$$

A =screen area, ft^2
Ct=throughflow rate, Ton.hr.
Cu=unit capacity, Ton/(hr . ft^2) Figure 19 -21.
Foa=open-area factor; Fig. 19 – 22.
Fs=slotted-area factor, Table 19-7.

TABLE 19-7 Slotted-Opening Factors

Screen type	Length-to-width ratio
Square and slightly rectangular openings	Less than 2
Rectangular openings	Equal to or greater than 2 but less than 4
Slotted openings	Equal to or greater than 4 but less than 25
Parallel-rod decks	Equal to or greater than 25

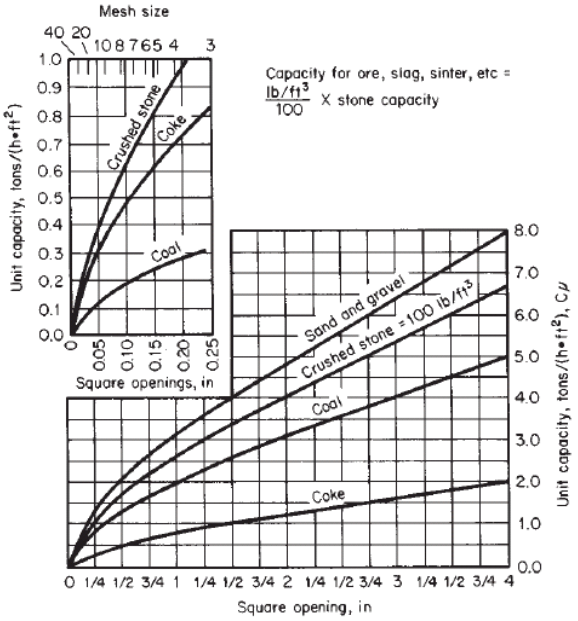


FIG. 19-21 Unit capacity (C_u) for square-opening screens. To convert inches to meters, multiply by 0.0254; to convert tons per hour-square foot to kilograms per second-square meter, multiply by 2.7182.

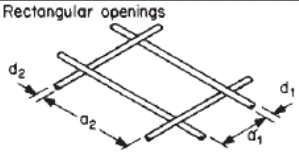
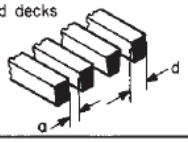
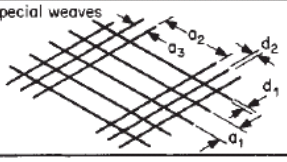
Aperture	Formula	
Rectangular openings 	$F_{oa} = \frac{a_1 a_2}{(a_1 + d_1)(a_2 + d_2)} \times 100$ F_{oa} is open area, %; d is diameter of wire, or horizontal width of bar (for plate); a is clear opening dimension	(21-4)
Square openings Specified by opening size	$F_{oa} = 100\left(\frac{a}{a+d}\right)^2$ $a_1 = a_2 = a$ $d_1 = d_2 = d$	(21-5)
Square openings Specified in mesh, m	$F_{oa} = 100a^2m^2$ $m = \frac{1}{a+d}$	(21-6)
Parallel-rod decks 	$F_{oa} = \frac{100a}{(a+d)}$	(21-7)
Special weaves 	Assuming $a_3 = a_1$; $F_{oa} = 100\left[\frac{a_1(a_2 + 2a_1)}{(a_2 + 2a_1 + 3d_2)(a_1 + d_1)}\right]$	(21-8)

FIG. 19-22 Open-area factor (F_{oa}) for flow-through screen-capacity calculation.

EFISIENSI SCREEN

Effectiveness of screen

Efektivitas ayakan dihitung berdasarkan rekoveri desired material dalam produk dan rekoveri undesired material di arus reject.

Desired mat'l = mat'l dengan ukuran yang diinginkan.

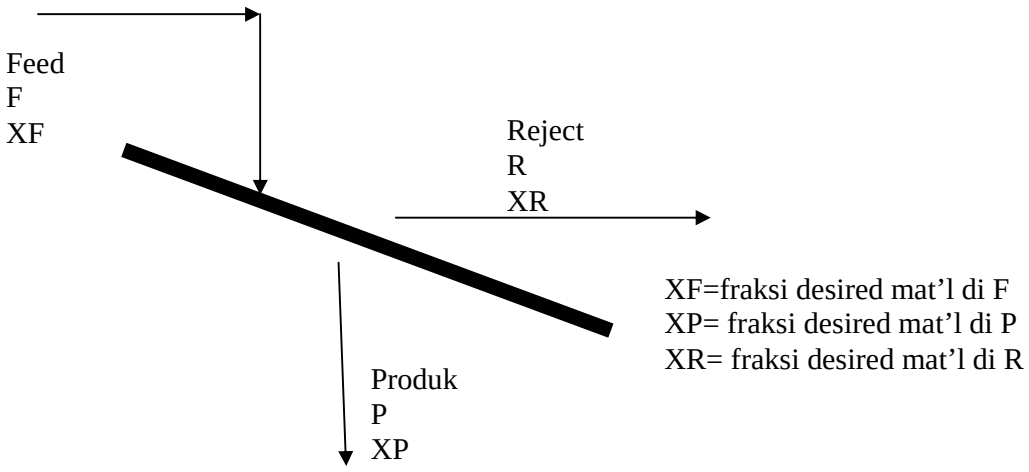
Contoh : Suatu produk dengan spek tidak lebih dari 10% berat berukuran tidak lebih besar dari 200 mesh.

Tampak, batasannya adalah partikel dengan ukuran > 200 mesh maksimum 10%.

Jadi, desired mat'l = partikel lolos 200 mesh.

Menentukan efektivitas ayakan.

Ditinjau suatu ayakan:



Efektivitas = Recovery x Rejection

Dengan,

$$\text{Recovery} = \frac{\text{banyaknya desired mat'l di P}}{\text{banyaknya desired mat'l di F}}$$

$$\text{Rejection} = 1 - \frac{\text{banyaknya undesired mat'l di P}}{\text{banyaknya undesired mat'l di F}}$$

$$\text{Rejection} = \frac{\text{banyaknya undesired mat'l di R}}{\text{banyaknya undesired mat'l di F}}$$

maka efektivitas ayakan itu :

$$\eta = \frac{P \,.\, XP}{F \,.\, XF} \frac{(1 - XR).\ R}{(1 - XF).\ F}$$

Di lapangan, penimbangan F, P & R tidak mudah dan tidak praktis, maka perlu dicari persamaan lain yang menggunakan data analisis cuplikan (sample) distribusi ukuran pada arus F, P dan R.

NM desired mat'l di sekitasr screen:

$$XF.\ F = XP\,.\,P + XR\ .\,R \qquad (1)$$

NM undesired mat'l di sekitar screen :

$$(1 - XF)\ F = (\ 1\text{-}\ XP\ )\ P + (\ 1\text{-}XR\ )\,R \qquad (2)$$

NM total di sekitar screen :

$$F = P + R \qquad (3)$$

Menggunakan persamaan (1) dan (3), buktikan bahwa :

$$\eta = \frac{(XF - XR)\ XP}{(XP - XR)\ XF}\left[1 - \frac{(1 - XP)}{(1 - XF)}\frac{(XF - XR)}{(XP - XR)}\right]$$

PROBLEM (BROWN, P.23)

4. Powdered coal with the screen analysis given below as "Feed" is fed to a vibrating 48-mesh screen in an attempt to remove the undesired fine material. When the screen was new the oversize and undersize analyses were as listed under columns headed "New". After 3 months' operation, the analyses are as headed "Old". What is the effectiveness of the screen (a) when new and (b) when old.

Screen analyses – mass fractions :

mesh	feed	Oversize		Undersize	
		new	old	new	old
-3 + 4	0.010	0.012	0.014	-	-
-4 + 6	0.022	0.027	0.031	-	-
-6 + 8	0.063	0.073	0.088	-	-
-8 + 10	0.081	0.100	0.112	-	-
-10 + 14	0.102	0.126	0.142	-	-
-14 + 20	0.165	0.204	0.229	-	-
-20 + 28	0.131	0.162	0.182	-	-
-28 + 35	0.101	0.125	0.104	-	0.093
-35 + 48	0.095	0.117	0.065	-	0.171
-48 + 65	0.070	0.029	0.025	0.246	0.186
-65 + 100	0.047	0.015	0.008	0.183	0.146
-100 + 150	0.031	0.005	-	0.141	0.111
-150 + 200	0.020	-	-	0.105	0.071
-200	0.062	-	-	0.325	0.222

6. One ton per hour of dolomite is produced by chrushing and then screening through a 14-mesh screen. According to the screen analysis below, calculate :

a. the total load to crusher,

b. the effectiveness of the screen.

Tyler mesh	Feed to screen, %	Screen undersize, Product, %	Screen Oversize, Circulating Load, %
4 on	14.3	-	20
8 on	20.0	-	28
14 on	20.0	0.0	28
28 on	28.5	40.0	24
48 on	8.6	30.0	0 through 28 mesh
100 on	5.7	20.0	
100 through	2.86	10.0	