

Unit Operations Involving Particulate Solids for Chemical Engineers (CHE 454A)

Assignment-1 (2023-24 II)

1. Calculate the equivalent volume sphere diameter, the surface-volume equivalent sphere diameter and the projected area diameters of a cuboid particle of side length 1, 2, 4 mm.

Ans: 2.481 mm, 1.714 mm

2. Calculate the sphericity of a short cube having length is equal to diameter, i.e. $L = D$

Ans: $\Phi_s = 0.806$

3. A sand mixture was screened through a standard 12 mesh screen. The mass fraction of the oversize material in feed, overflow, and underflow were found to be 0.4, 0.8, and 0.2, respectively. Calculate the screen effectiveness based on the oversize materials.

Ans: 59.3 %

4. A sponge-iron industry uses a reciprocating screen of 5-mm aperture to separate oversize from undersize fines which is then recycled to the furnace. The screen analysis of the furnace output was found to contain 25% fines. The screen efficiency was known to be 50%. The underflow from the screen contains around 95% fines. If the furnace production rate is 100 tonne/h, find the product rate and the amount of fines present in it.

Ans: 86.6 tonne/h, 14.5 %

5. A crushed ore was screened, using a 3.35-mm (340 mesh) screen to separate the oversize material to be recycled for further crushing. The screen analysis of feed, overflow, and underflow are given below. Find the input to the crusher for 100 kg/h of product and the screen effectiveness.

ISS mesh	Feed	Overflow	Underflow
+480	0.548	0.596	0.00
-480 + 340	0.146	0.168	0.113
- 340 + 120	0.109	0.096	0.147
- 120 + 60	0.045	0.039	0.086
- 60 + 30	0.034	0.029	0.037
- 30	0.118	0.072	0.621

Ans: 30.6 %

6. Dolomite is produced at a rate of 2 tonne/h by crushing and then screening through a 16-mesh screen. Calculate the total load to the crusher and the effectiveness of the screen for the following screen analysis (weight percent).

Mesh	Feed (%)	Undersize (%)	Oversize (%)
4	12	-	22
8	21	-	26
16	22	0	28
32	30	42	24
60	8	28	-
100	5	18	-
100 through	2	12	-

Ans: 61.4%

7. A sample of pyrite powder has the screen analysis given below. Calculate the specific surface in cm^2/g . Specific gravity of pyrite = 5.0.

Mesh no.	Percentage retained
-4 + 6	5.0
-6 + 8	6.2
-8 + 10	13.0
-10 + 14	16.6
-14 + 20	15.0
-20 + 28	12.4
-28 + 35	9.0
-35 + 48	8.2
-48 + 65	5.0
-65 + 100	4.8
-100 + 150	3.3
-150 + 200	1.5

Ans: 59.4 cm^2/g