Mean Particle Sizes from a Size Distribution (Sauter and Others)

Sauter and mass-weighted mean sizes and specific surface area of a powder from up to six sieve fractions, with sphericity and particle density.

Method: Perry's Chemical Engineers' Handbook; 9th ed. (McGraw-Hill, 2019); ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Mean size of fraction 1	1,000.0	µm
Mass fraction 1	10.000	%
Mean size of fraction 2	600.00	µm
Mass fraction 2	30.000	%
Mean size of fraction 3	300.00	µm
Mass fraction 3	30.000	%
Mean size of fraction 4	150.00	µm
Mass fraction 4	20.000	%
Mean size of fraction 5	60.000	µm
Mass fraction 5	10.000	%
Mean size of fraction 6 (0 = none)	0	µm
Mass fraction 6	0	%
Particle density	2,650.0	kg/m³
Sphericity	80.000	%

Calculated results

Parameter	Value	Unit
Sauter mean (surface–volume)	217.39	µm
Mass-weighted mean	406.00	µm
Specific surface area	13.019	m²/kg
Sum of mass fractions	100.00	%

Formula and method

$$d_{32} = \frac{\sum x_i}{\sum x_i/d_i}, \quad d_{43} = \frac{\sum x_i d_i}{\sum x_i}, \quad S_m = \frac{6}{\phi_s \rho_p d_{32}}$$

Variables

d_1	Mean size of fraction 1	m
x_1	Mass fraction 1	-
d_2	Mean size of fraction 2	m
x_2	Mass fraction 2	-
d_3	Mean size of fraction 3	m
x_3	Mass fraction 3	-
d_4	Mean size of fraction 4	m

x_4	Mass fraction 4	-
d_5	Mean size of fraction 5	m
x_5	Mass fraction 5	-
d_6	Mean size of fraction 6 (0 = none)	m
x_6	Mass fraction 6	-
ρ_p	Particle density	kg/m³
ϕ_s	Sphericity	-
d_{32}	Sauter mean (surface–volume)	m
d_{43}	Mass-weighted mean	m
S_m	Specific surface area (m²/kg)	-
$\sum x$	Sum of mass fractions	-

Method and standards

Size statistics.

Assumptions and limits

- Fraction mean sizes represent each cut.
- The specific surface is shown in m²/kg in every unit system (there is no unit list for area per mass yet).

References

• Perry's Chemical Engineers' Handbook
• 9th ed. (McGraw-Hill, 2019)
• sec. 21 (particle size statistics; specific surface 6/(φρd))

Report details

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Release checks	2 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/chemical/unit-operations/mean-particle-sizes

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.