Floc Aggregate Size from Primary Particles and Porosity

Diameter of a spherical floc built from primary particles at a given porosity, in one step or by clumping in stages, and its fractal dimension.

Input parameters

Unit system: SI

Parameter	Value	Unit
Primary particle diameter	1.0000	µm
Primary particles in the floc	1,000,000	
Floc porosity at each stage	70.000	%
Particles per clump in the first stage (0 for single-stage packing)	1,000.0	

Calculated results

Parameter	Value	Unit
Floc diameter, single-stage packing	149.38	µm
Diameter of a first-stage clump	14.938	µm
Floc diameter, two-stage clumping	223.14	µm
Effective porosity of the two-stage floc	91.000	%
Fractal dimension of the two-stage floc ln n / ln(d_a/d_p)	2.5547	

Notes for this case

• Each stage packs spheres into a larger sphere with the given porosity: V_a = n V_p/(1 − ε). Building flocs from clumps leaves larger voids, so the floc is bigger, more porous and has a lower fractal dimension than one built particle by particle.

Formula and method

$$d_a = d_p \left(\frac{n}{1-\varepsilon}\right)^{1/3}$$

$$d_{clump} = d_p \left(\frac{m}{1-\varepsilon}\right)^{1/3}, \quad d_{a,2} = d_{clump} \left(\frac{n/m}{1-\varepsilon}\right)^{1/3}, \quad D_f = \frac{\ln n}{\ln(d_{a,2}/d_p)}$$

Variables

d_p	Primary particle diameter	m
n	Primary particles in the floc	-
ε	Floc porosity at each stage	-
m	Particles per clump in the first stage (0 for single-stage packing)	-
$d_{a,1}$	Floc diameter, single-stage packing	m
d_{clump}	Diameter of a first-stage clump	m
$d_{a,2}$	Floc diameter, two-stage clumping	m
ε_{eff}	Effective porosity of the two-stage floc	-
D_f	Fractal dimension of the two-stage floc ln n / ln(d_a/d_p)	-

Method and standards

Geometric packing of spheres into porous aggregates.

Assumptions and limits

- Equal spheres; same porosity at every stage.

Report details

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

This calculator online

https://calc.firecad.com/environmental/drinking-water/floc-aggregate-size

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Reopens the calculator with the inputs of this report.