Dispersion Number from a Tracer Test

Dispersion number d from the mean and variance of a tracer curve (open and closed vessel), equivalent tanks in series and the coefficient of dispersion.

Input parameters

Unit system: SI

Parameter	Value	Unit
Mean residence time of the tracer curve	1.6000	h
Variance of the tracer curve (min²)	600.00	
Flow through the basin	2,400.0	m³/d
Basin volume	200.00	m³
Flow path length	60.000	m

Calculated results

Parameter	Value	Unit
Theoretical detention time	2.0000	h
Normalised mean time	0.80000	
Normalised variance	0.041667	
Dispersion number (open vessel, σθ² = 2d)	0.020833	
Dispersion number (closed vessel)	0.021286	
Equivalent tanks in series	24.000	
Coefficient of dispersion (closed d)	0.010643	m²/s

Notes for this case

• Dispersion numbers below 0.05 mean low dispersion (close to plug flow); above 0.25 the basin behaves more like a mixed tank. The coefficient of dispersion uses the mean velocity along the actual flow path, L/τ.

Formula and method

$$\sigma_\theta^2 = \frac{\sigma^2}{\tau^2}, \quad d_{open} = \frac{\sigma_\theta^2}{2}, \quad \sigma_\theta^2 = 2d - 2d^2\left(1 - e^{-1/d}\right), \quad N = \frac{1}{\sigma_\theta^2}, \quad D = d\frac{L^2}{\tau}$$

Variables

$\bar{t}$	Mean residence time of the tracer curve	s
σ^2	Variance of the tracer curve (min²)	-
Q	Flow through the basin	m³/s
V	Basin volume	m³
L	Flow path length	m
τ	Theoretical detention time	s
$\bar{\theta}$	Normalised mean time	-
σ_θ^2	Normalised variance	-
d_{open}	Dispersion number (open vessel, σθ² = 2d)	-
d_{closed}	Dispersion number (closed vessel)	-
N	Equivalent tanks in series	-
D	Coefficient of dispersion (closed d)	m²/s

Method and standards

Dispersion model of non-ideal flow.

Assumptions and limits

- Pulse tracer; first and second moments from a complete curve.

Report details

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Release checks	3 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/environmental/wastewater/tracer-dispersion-number

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.