DAF Saturator Air and Bubble Concentration in the Contact Zone

Air dissolved in the DAF saturator by Henry's law, air released in the contact zone, bubble volume and number concentrations and bubble-to-floc ratios.

Input parameters

Unit system: SI

Parameter	Value	Unit
Saturator absolute pressure	500.00	kPa
Water temperature	4.0000	°C
Henry's constant coefficient for air	3,368.0	
Enthalpy of dissolution for air	10.280	kJ/mol
Recycle ratio	8.0000	%
Saturator-to-release transfer efficiency	85.000	%
Air deficit of the flocculated water	1.0000	mg/L
Mean bubble diameter	50.000	µm
Floc particle concentration, particles/mL	4,000.0	
Floc volume concentration, ppm (mL/m³)	5.0000	

Calculated results

Parameter	Value	Unit
Air density at 1 atm and T	1.2736	kg/m³
Dimensionless Henry's constant	38.898	
Air in water saturated at 1 atm	32.742	mg/L
Air in the saturated recycle	161.57	mg/L
Air released in the contact zone	7.1855	mg/L
Bubble volume concentration, ppm	5,641.8	
Bubble number concentration, bubbles/mL	86,200	
Bubbles per floc particle	21.550	
Bubble-to-floc volume ratio	1,128.4	

Notes for this case

- Henry's law with H_YC = K_C exp(−ΔH/RT) (air: K_C 3368, ΔH 10.28 kJ/mol); dry-air density at 1 atm. Air released C_b = [e(C_r − C_fl)r − k]/(1 + r) with the flocculated water saturated at 1 atm less its deficit k (Edzwald's white-water model).

Formula and method

$$H_{YC} = K_C \exp\left(-\frac{\Delta H_{dis}}{RT}\right), \quad C_{fl} = \frac{\rho_{air}}{H_{YC}}, \quad C_r = C_{fl}\frac{P_{sat}}{P_{atm}}$$

$$C_b = \frac{e(C_r - C_{fl})r - k}{1 + r}, \quad \phi_b = \frac{C_b}{\rho_{air}}, \quad N_b = \frac{6\phi_b}{\pi d_b^3}$$

Variables

P_{sat}	Saturator absolute pressure	Pa

T	Water temperature	K
K_C	Henry's constant coefficient for air	-
ΔH_{dis}	Enthalpy of dissolution for air	J/mol
r	Recycle ratio	-
e	Saturator-to-release transfer efficiency	-
k	Air deficit of the flocculated water	kg/m³
d_b	Mean bubble diameter	m
N_p	Floc particle concentration, particles/mL	-
ϕ_p	Floc volume concentration, ppm (mL/m³)	-
ρ_{air}	Air density at 1 atm and T	kg/m³
H_{YC}	Dimensionless Henry's constant	-
C_{fl}	Air in water saturated at 1 atm	kg/m³
C_r	Air in the saturated recycle	kg/m³
C_b	Air released in the contact zone	kg/m³
ϕ_b	Bubble volume concentration, ppm	-
N_b	Bubble number concentration, bubbles/mL	-
N_b/N_p	Bubbles per floc particle	-
ϕ_b/ϕ_p	Bubble-to-floc volume ratio	-

Method and standards

Henry's-law saturation and an air mass balance on the DAF contact zone.

Assumptions and limits

- Equilibrium saturation scaled linearly with pressure; air treated as one gas.

Report details

Report reference	FCC-VJCX-XJX6 (the same inputs always give the same reference)
Generated	23 November 2026, 17:34 UTC
Calculator	DAF Saturator Air and Bubble Concentration in the Contact Zone
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 November 2026
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/drinking-water/daf-air-saturation-bubbles

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Reopens the calculator with the inputs of this report.