Cement Heat of Hydration from Bogue Composition

Heat of complete hydration of a cement from its Bogue compounds, and the adiabatic temperature rise of concrete for a cement content.

Method: Heats of complete hydration of the clinker compounds

Input parameters

Unit system: SI

Parameter	Value	Unit
Tricalcium silicate	58.000	%
Dicalcium silicate	16.000	%
Tricalcium aluminate	8.0000	%
Tetracalcium aluminoferrite	10.000	%
Cement content of the concrete	3.5000e+08	mg/Nm³
Volumetric heat capacity of the concrete J/(m³·K); about 2.3–2.6 MJ/(m³·K).	2,400,000	

Calculated results

Parameter	Value	Unit
Heat of complete hydration	444.02	kJ/kg
Adiabatic temperature rise of the concrete at complete hydration	64.753	K

Notes for this case

• Each clinker compound releases a characteristic heat on complete hydration: about 502 J/g for C_3S, 260 for C_2S, 867 for C_3A and 419 for C_4AF. Their weighted sum is the heat the cement can release; most of it comes in the first week, faster for fine, C_3S- and C_3A-rich cement. Multiplied by the cement content and divided by the concrete's volumetric heat capacity, it gives the upper bound of temperature rise in a large pour with no heat loss, used to judge thermal cracking risk. Blended cements release less.

Formula and method

$$H = 502\,C_3S + 260\,C_2S + 867\,C_3A + 419\,C_4AF\ \text{(J/g)}, \quad \Delta T_{ad} = \frac{H\,c}{\rho c_p}$$

Variables

C_3S	Tricalcium silicate	-
C_2S	Dicalcium silicate	-
C_3A	Tricalcium aluminate	-
C_4AF	Tetracalcium aluminoferrite	-
c	Cement content of the concrete	kg/m³
ρc_p	Volumetric heat capacity of the concrete	-
H	Heat of complete hydration	J/kg
ΔT_{ad}	Adiabatic temperature rise of the concrete at complete hydration	K

Method and standards

Heat of hydration.

Assumptions and limits

- Complete hydration; adiabatic concrete.

References

Heats of complete hydration of the clinker compounds

Report details

Report reference	FCC-9RHY-GRAM (the same inputs always give the same reference)
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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/chemical/cement/cement-heat-of-hydration

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.