Polymer Crystallinity from Density

Mass-fraction and volume-fraction crystallinity of a semicrystalline polymer from its density and the densities of the fully crystalline and fully amorphous polymer.

Method: Two-phase density model

Input parameters

Unit system: SI

Parameter	Value	Unit
Sample density	952.00	kg/m³
Fully crystalline density	1,000.0	kg/m³
Fully amorphous density	855.00	kg/m³

Calculated results

Parameter	Value	Unit
Crystallinity by mass	70.269	%
Crystallinity by volume	66.897	%

Notes for this case

• Treating the polymer as a two-phase mixture: by volume φ_c = (ρ_s − ρ_a)/(ρ_c − ρ_a); by mass X_c = ρ_c(ρ_s − ρ_a)/[ρ_s(ρ_c − ρ_a)]. Crystalline density comes from the unit cell; amorphous from quenched samples or extrapolation. Defaults are for polyethylene (1.000 and 0.855 g/cm³), here a high-density grade. DSC gives a separate estimate from the heat of fusion.

Formula and method

$$X_c = \frac{\rho_c(\rho_s - \rho_a)}{\rho_s(\rho_c - \rho_a)}, \quad \phi_c = \frac{\rho_s - \rho_a}{\rho_c - \rho_a}$$

Variables

ρ_s	Sample density	kg/m³
ρ_c	Fully crystalline density	kg/m³
ρ_a	Fully amorphous density	kg/m³
X_c	Crystallinity by mass	-
ϕ_c	Crystallinity by volume	-

Method and standards

Crystallinity.

Assumptions and limits

- Two phases only; no fillers or porosity.

References

Two-phase density model

Report details

Report reference	FCC-TPW9-E3K3 (the same inputs always give the same reference)
Generated	23 November 2026, 17:50 UTC
Calculator	Polymer Crystallinity from Density
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/materials/properties/polymer-crystallinity-density

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.