Polymer Number- and Weight-Average Molecular Weight

Number-average and weight-average molecular weight, polydispersity index and degree of polymerisation from up to five molecular weight fractions.

Method: Molecular weight averages of a distribution

Input parameters

Unit system: SI

Parameter	Value	Unit
Fraction 1 molecular weight	10,000	kg/kmol
Fraction 1 mass share	10.000	%
Fraction 2 molecular weight	30,000	kg/kmol
Fraction 2 mass share	30.000	%
Fraction 3 molecular weight	50,000	kg/kmol
Fraction 3 mass share	35.000	%
Fraction 4 molecular weight	80,000	kg/kmol
Fraction 4 mass share	20.000	%
Fraction 5 molecular weight	120,000	kg/kmol
Fraction 5 mass share	5.0000	%
Repeat unit molar mass	28.054	kg/kmol

Calculated results

Parameter	Value	Unit
Number-average molecular weight	33,426	kg/kmol
Weight-average molecular weight	49,500	kg/kmol
Polydispersity index	1.4809	
Degree of polymerisation (number average)	1,191.5	

Notes for this case

• With mass fractions w_i (normalised to their sum): M̄_n = 1/Σ(w_i/M_i) (equivalent to Σx_iM_i with number fractions) and M̄_w = Σw_iM_i. PDI = M̄_w/M̄_n ≥ 1; about 2 for many step-growth and free-radical polymers, near 1 for living polymerisation. Degree of polymerisation = M̄_n/m_r. Leave unused fractions at zero share.

Formula and method

$$\bar{M}_n = \frac{1}{\sum w_i / M_i}, \quad \bar{M}_w = \sum w_i M_i, \quad PDI = \frac{\bar{M}_w}{\bar{M}_n}$$

Variables

M_1	Fraction 1 molecular weight	kg/kmol
w_1	Fraction 1 mass share	-
M_2	Fraction 2 molecular weight	kg/kmol
w_2	Fraction 2 mass share	-
M_3	Fraction 3 molecular weight	kg/kmol
w_3	Fraction 3 mass share	-
M_4	Fraction 4 molecular weight	kg/kmol
w_4	Fraction 4 mass share	-

M_5	Fraction 5 molecular weight	kg/kmol
w_5	Fraction 5 mass share	-
m_r	Repeat unit molar mass	kg/kmol
$\bar{M}_n$	Number-average molecular weight	kg/kmol
$\bar{M}_w$	Weight-average molecular weight	kg/kmol
PDI	Polydispersity index	-
DP	Degree of polymerisation (number average)	-

Method and standards

Molecular weight.

Assumptions and limits

- Discrete fractions; linear polymer.

References

Molecular weight averages of a distribution

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/materials/properties/polymer-molecular-weight-averages

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.