Three-Product Formula: Mass Split from Two Metal Assays

Mass split of a feed into two concentrates and a tailing from the assays of two metals on all four streams, with the recovery of each metal to its concentrate.

Method: Wills and Finch; Wills' Mineral Processing Technology; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Feed rate (dry solids)	120.00	t/h
Metal A in the feed	4.7800	%
Metal A in concentrate 1	60.000	%
Metal A in concentrate 2	2.0000	%
Metal A in the tailings	0.40000	%
Metal B in the feed	7.6600	%
Metal B in concentrate 1	6.0000	%
Metal B in concentrate 2	52.000	%
Metal B in the tailings	0.60000	%

Calculated results

Parameter	Value	Unit
Concentrate 1 yield	7.0000	%
Concentrate 2 yield	13.000	%
Tailings yield	80.000	%
Concentrate 1 rate	8.4000	t/h
Concentrate 2 rate	15.600	t/h
Tailings rate	96.000	t/h
Recovery of metal A to concentrate 1	87.866	%
Recovery of metal B to concentrate 2	88.251	%

Notes for this case

- Exact solution of the three balances; with more assays than unknowns, reconcile the data by least squares instead. The split is sensitive to assay errors when the two metals separate in a similar way.

Formula and method

$$W_1 + W_2 + W_3 = F, \quad W_1 a_1 + W_2 a_2 + W_3 a_3 = F a_f, \quad W_1 b_1 + W_2 b_2 + W_3 b_3 = F b_f$$

Variables

F	Feed rate (dry solids)	kg/s
a_f	Metal A in the feed	-
a_1	Metal A in concentrate 1	-
a_2	Metal A in concentrate 2	-
a_3	Metal A in the tailings	-
b_f	Metal B in the feed	-
b_1	Metal B in concentrate 1	-
b_2	Metal B in concentrate 2	-

b_3	Metal B in the tailings	-
W_1/F	Concentrate 1 yield	-
W_2/F	Concentrate 2 yield	-
W_3/F	Tailings yield	-
W_1	Concentrate 1 rate	kg/s
W_2	Concentrate 2 rate	kg/s
W_3	Tailings rate	kg/s
R_{A1}	Recovery of metal A to concentrate 1	-
R_{B2}	Recovery of metal B to concentrate 2	-

Method and standards

n-product formula for three products.

Assumptions and limits

- Steady state; exact assays.

References

• Wills and Finch
• Wills' Mineral Processing Technology
• 8th ed. (Butterworth-Heinemann, 2016)
• ch. 3
• eqs. 3.28-3.29 and Table 3.1 (n-product formula)

Report details

Report reference	FCC-VZKW-WK5Z (the same inputs always give the same reference)
Generated	17 November 2026, 19:49 UTC
Calculator	Three-Product Formula: Mass Split from Two Metal Assays
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 17 November 2026
Release checks	3 reference cases of this calculator, computed independently, are checked on every release

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This calculator online

https://calc.firecad.com/civil/mining-minerals/three-product-formula

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