# Two-Product Formula: Recovery, Yield and Separation Efficiency

Concentrate and tailings rates, metal recovery, ratio of concentration, enrichment ratio and Schulz separation efficiency from three stream assays.

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

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Feed assay (metal) | 3.9300 | % |
| Concentrate assay | 52.070 | % |
| Tailings assay | 0.49000 | % |
| Feed rate (dry solids) | 100.00 | t/h |
| Metal content of the valuable mineral<br>Zn in sphalerite 67.1 %, Cu in chalcopyrite 34.6 %, Pb in galena 86.6 %, Sn in cassiterite 78.6 % | 67.098 | % |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| Yield (mass to concentrate) | 6.6693 | % |
| Ratio of concentration | 14.994 | |
| Enrichment ratio | 13.249 | |
| Metal recovery to concentrate | 88.363 | % |
| Concentrate rate | 6.6693 | t/h |
| Tailings rate | 93.331 | t/h |
| Gangue recovery to concentrate | 1.5866 | % |
| Separation efficiency (Schulz) | 86.777 | % |

**Notes for this case**

• Assays of the three streams taken at the same time; the formula assumes steady state and no other product. Separation efficiency is recovery of the mineral less recovery of gangue (Schulz), assuming the metal is in one mineral only.

## Formula and method

$$\frac{C}{F}=\frac{f-t}{c-t},\quad R=\frac{Cc}{Ff},\quad SE=R-R_g=\frac{C}{F}\frac{m(c-f)}{f(m-f)}$$

### Variables

| | | |
|---|---|---|
| $f$ | Feed assay (metal) | - |
| $c$ | Concentrate assay | - |
| $t$ | Tailings assay | - |
| $F$ | Feed rate (dry solids) | kg/s |
| $m$ | Metal content of the valuable mineral | - |
| $C/F$ | Yield (mass to concentrate) | - |
| $F/C$ | Ratio of concentration | - |
| $c/f$ | Enrichment ratio | - |
| $R$ | Metal recovery to concentrate | - |

| | | |
|---|---|---|
| $C$ | Concentrate rate | kg/s |
| $T$ | Tailings rate | kg/s |
| $R_g$ | Gangue recovery to concentrate | - |
| $SE$ | Separation efficiency (Schulz) | - |

### Method and standards

Two-product formula and Schulz separation efficiency.

### Assumptions and limits

- Steady state; metal in one mineral.

### References

- Wills and Finch
- Wills' Mineral Processing Technology
- 8th ed. (Butterworth-Heinemann, 2016)
- ch. 1
- eqs. 1.1-1.5 (Schulz, 1970) and ch. 3
- eqs. 3.23-3.27
- Examples 1.3 and 3.8

## 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/civil/mining-minerals/two-product-recovery-grade

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.