# Vacuum (Agitated or Tray) Dryer Batch Drying Time

Batch drying time of a jacketed vacuum dryer from water to remove, boiling temperature at the vacuum (IF97), jacket temperature, area and coefficient.

**Method:** Contact drying under vacuum with IAPWS-IF97 boiling temperature

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Dry solids in the batch | 1,000.0 | kg |
| Initial moisture (dry basis) | 40.000 | % |
| Final moisture (dry basis) | 2.0000 | % |
| Dryer pressure (absolute) | 10.000 | kPa |
| Jacket (heating medium) temperature | 120.00 | °C |
| Heated area | 10.000 | m² |
| Mean overall heat transfer coefficient | 60.000 | W/(m²·K) |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| Water to remove | 380.00 | kg |
| Boiling temperature at the dryer pressure | 45.808 | °C |
| Heat flow | 44.515 | kW |
| Drying time | 5.6721 | h |
| Latent heat at the boiling temperature | 2,392.1 | kJ/kg |

### Notes for this case

• Under vacuum the moisture boils at a low temperature (from IAPWS-IF97 at the dryer pressure), so heat-sensitive products dry quickly at a mild jacket temperature. The heat flow U A (T_j − T_b) supplies the latent heat of the water removed. U falls as the product dries and loses contact with the wall, so the mean value used should come from trials; this estimate ignores heating up the batch and the slower final stage.

## Formula and method

$$m_w = m_d(X_0 - X_1), \quad \dot{Q} = UA(T_j - T_b(p)), \quad t = \frac{m_w \lambda}{\dot{Q}}$$

### Variables

| | | |
|---|---|---|
| $m_d$ | Dry solids in the batch | kg |
| $X_0$ | Initial moisture (dry basis) | - |
| $X_1$ | Final moisture (dry basis) | - |
| $p$ | Dryer pressure (absolute) | Pa |
| $T_j$ | Jacket (heating medium) temperature | K |
| $A$ | Heated area | m² |
| $U$ | Mean overall heat transfer coefficient | W/(m²·K) |
| $m_w$ | Water to remove | kg |
| $T_b$ | Boiling temperature at the dryer pressure | K |
| $\dot{Q}$ | Heat flow | W |
| $t$ | Drying time | s |

| | | |
|---|---|---|
| $\lambda$ | Latent heat at the boiling temperature | J/kg |

### Method and standards

Vacuum dryer.

### Assumptions and limits

- Water as the liquid; mean U over the batch.

### References

Contact drying under vacuum with IAPWS-IF97 boiling temperature

## Report details

| | |
|---|---|
| Report reference | FCC-0TZZ-XXK0 (the same inputs always give the same reference) |
| Generated | 23 November 2026, 17:34 UTC |
| Calculator | Vacuum (Agitated or Tray) Dryer Batch Drying Time |
| 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/chemical/drying/vacuum-dryer-batch-time

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.