Ash Fusion Temperature from Ash Analysis

Quick estimate of the ash melting temperature of a coal from its oxide analysis (Al_2O_3, SiO_2 + TiO_2, CaO + MgO, Fe_2O_3 + Na_2O + K_2O) by Ganapathy's Eq. (13).

Method: Ganapathy; Steam Plant Calculations Manual; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Al_2O_3	20.000	%
SiO_2 + TiO_2	30.000	%
CaO + MgO	15.000	%
Fe_2O_3 + Na_2O + K_2O	20.000	%

Calculated results

Parameter	Value	Unit
Estimated ash melting temperature (indicative, not a specific ASTM point)	1,100.0	°C

Notes for this case

- A quick estimate only; ASTM D1857 or ISO 540 fusion tests give the deformation, softening, hemispherical and flow temperatures.
- The listed oxides add to only 85.0 % of the ash; check the analysis, since the estimate assumes they make up nearly all of it.

Formula and method

$$t_m = 19\,Al_2O_3 + 15\,(SiO_2 + TiO_2) + 10\,(CaO + MgO) + 6\,(Fe_2O_3 + Na_2O + K_2O) \quad (°C,\ \%)$$

Variables

Al_2O_3	Al_2O_3	-
$SiO_2 + TiO_2$	SiO_2 + TiO_2	-
$CaO + MgO$	CaO + MgO	-
$Fe_2O_3 + Na_2O + K_2O$	Fe_2O_3 + Na_2O + K_2O	-
t_m	Estimated ash fusion temperature	K

Method and standards

Ganapathy's Eq. (13).

Assumptions and limits

- Oxides in % of ash; coal ashes. Results outside about 1000–1600 °C, as for a single pure oxide, are flagged as unreliable.
- The source gives one "ash melting" temperature; it is not tied to the deformation, softening, hemispherical or flow temperature of ASTM D1857 or ISO 540, nor to a reducing or oxidising atmosphere. Use it to rank coals, not for design.
- The listed oxides should make up nearly all the ash: a sum above 100 % is rejected and a sum below 90 % gives a warning.

References

- Ganapathy
- Steam Plant Calculations Manual
- 2nd ed. (Marcel Dekker, 1993)
- Q2.17
- Eq. (13)

Report details

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Software release	FireCAD Calc, release of 17 November 2026
Release checks	2 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/boilers-power-plant/fuel-ash-handling/ash-fusion-temperature-estimate

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.