

60.3.10.7 Clinker Mineral Phases (C_3S ; C_2S ; C_3A ; C_4AF)

Description

Modified Bogue equations are used to calculate the potential amount of the four main mineral phases - C_3S , C_2S , C_3A and C_4AF - in clinker. The calculations are based on chemical analyses of the four major oxides SiO_2 , Al_2O_3 , Fe_2O_3 and CaO , readily available from X-ray fluorescence (XRF).

Purpose

The equations below provide a reasonable approximation in case the direct analysis of the mineral phases by X-ray diffraction (XRD) is not available (see TR – [Clinker optimization guideline](#)).

Quality targets for clinker often include C_3S ; occasionally it is also used for raw meal (or kiln feed).

Calculations

Clinker; free lime (CaO) corrected

$$C_3S = 4.07 C - 7.6 S - 6.72 A - 1.43 F$$

$$C_2S = 2.87 S - 0.75 C_3S$$

$$C_3A = 2.65 A - 1.69 F$$

$$C_4AF = 3.04 F$$

Where : $C = CaO - CaOf$; $S = SiO_2$; $A = Al_2O_3$; $F = Fe_2O_3$; (all oxides on clinker basis)

and : $AR = \frac{A}{F} > 0.64$

Raw meal and kiln feed:

$C = CaO$

All oxides on clinker basis (loss on ignition free; e.g. $C = C_{RM/KF} * 100 / (100 - LOI)$).

Cement:

Modified/other formulas may apply; the local cement standards have to be followed.

Unit of measure:

Oxides and clinker minerals in [%]

Examples:

	LOI	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	CaOf	C ₃ S	C ₂ S	C ₃ A	C ₄ AF
Clinker A		21.73	4.16	4.73	64.50	1.95	54.7	21.3	3.0	8.0
Clinker B		21.73	4.16	4.73	64.50	0.5	60.6	16.9	3.0	8.0
Raw meal	35.02	13.94	2.66	2.89	42.81		71.2	8.1	3.3	7.5