

Cement Clinker Evaluation Report

Revision 4.95
Date submitted: 24/02/2021
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Kiln Feed Parameters Provided		
% acid insoluble residue of +90 micron	1.00	
% +125 micron residue	6.00	
% +90 micron residue	12.00	
% +45 micron residue	21.00	
% quartz of +45 micron residue	6.00	
Clinker Composition Provided		
		Comments
CaO	63.93	Within typical range.
SiO ₂	20.22	Within typical range.
Al ₂ O ₃	4.39	Within typical range.
Fe ₂ O ₃	3.13	Within typical range.
Mn ₂ O ₃	1.47	High. Clinker will be darker in colour.
TiO ₂	0.38	Within typical range.
MgO	4.62	Reduced alite formation. Reduced late strength. Periclase will be present in clinker. Risk of delayed expansion.
K ₂ O	0.62	Slightly high. Possible syngenite formation in cement storage silos.
Na ₂ O	0.26	Within typical range.
SO ₃	0.06	Lower than typically expected.
Cl	0.00	Within typical range. No problems/issues expected.
P ₂ O ₅	0.00	Low.
SrO	0.00	Within typical range.
F	0.00	Low.
LOI	0.00	Within typical range.
Total	99.1	Within acceptable limits.
Clinker free lime	2.41	Lower than expected free lime. (3.6%) Too high. Expansion problems expected. Increase fuel rate/decrease kiln feed rate.
CALCULATED PARAMETERS		
Moduli	Value	Comments
LSF (international)	98.4	Too high. Difficult to burn mix. Higher alite and free lime expected. Higher early strength development expected. Increased kiln heat consumption expected - higher radiation losses from kiln shell and higher kiln exhaust gas temperature.
LSF (normal)	100.2	
Kalkstandard (incl MgO correction)	102.5	
LSF (incl minor, excl MgO correction)	98.0	
LCF	96.4	
Δ	1.1	
KN	0.98	Excess lime present.
SM	2.69	Within optimum range.
SM (incl minor)	2.16	
AM	1.40	Within typical range.
AM (incl minor)	1.04	
Na ₂ O _{eq}	0.67%	Slightly high alkali content clinker. Higher early cement strengths expected.
K ₂ O _{eq}	1.02%	
R2O3	7.52	High silicates expected.
Hydraulic modulus	2.30	Too high. Expansion expected. More energy required for burning required. Higher early cement strength expected. Increased heat of hydration expected.
Hydraulic index	0.36	Easy burnable mix.
Silicic acid modulus	4.61	Poor coating formation. Reduced liquid phase. Difficult to burn mix. Higher fuel usage required.
Hardening ratio	5.91	Typical.
Calorie module	3.43	Excessive hydration heat released. Cracking in concrete is expected.
Alkali Modulus (inverse of Sulphate Modulus)	14.39	Too high. Excess alkalies present. Shortage of sulphur. Sulphur input to kiln must be increased.
Alkali Sulphur Ratio	12.50	
Type and Phases in Clinker	Value	
Clinker type	OPC clinker	
C3S	62.8%	Within typical range. (expected Bogue = 73; Rietveld = 79)
C2S	10.6%	Within typical range.
C3A	6.3%	Within typical range.
C4AF	9.5%	Within typical range.
C3S + C2S	73.4%	
2C3A + C4AF	22.2%	
CaO _{free}	2.4%	Lower than expected free lime. (3.6%) Too high. Expansion problems expected. Increase fuel rate/decrease kiln feed rate.
MgO as periclase	2.6%	Too high. Concrete expansion expected.
Other	5.7%	
Expected Sulphate Phases (by mass)	Value	
SO ₃ as sulphates (except anhydrites)	0.06%	
K ₂ O as sulphates	0.05%	
Na ₂ O as sulphates	0.01%	
CaO as sulphates	0.00%	
Burning and Grinding Parameters	Value	Comments
Reaction Energy kJ/kg clinker	1 840	High. Difficult burning mix.
Burning Temperature [°C]	1 439	
Combinability Temperature [°C]	1 503	Too high. High energy input required.
% Liquid at 1338°C (standard)	22.0%	
% Liquid at 1338°C (incl minor)	30.9%	Dry mix. Clinker expected to be sandy. Difficult for clinkering reactions to occur.
% Liquid at 1400°C (standard)	22.7%	
% Liquid at 1400°C (incl minor)	27.1%	Wet mix. Easy for clinkering reactions to occur. Large clinker nodules formed. Possibility of snowman formation in grate coolers.
% Liquid at 1450°C (standard)	23.1%	Stable coating formation expected.
% Liquid at 1450°C (incl minor)	27.5%	Thick coating formation expected.
1,470°C: LP = 1.13 C3A + 1.35 C4AF + MgO +	22.9%	
Burning Index (standard)	3.96	Within typical range.
Burning Index (incl minor)	3.08	Within typical range.
Kuel Index	2.94	
Burning Factor (standard)	109	Easy burning mix.
Burning Factor (minor)	104	Typical.
Burning time	152	
Coating index (standard)	35.2	Acceptable coating and clinker granule formation expected.
Coating index (incl minor)	40.1	Excessive coating and clinker ball formation.
Grinding index (standard)	26.2	Somewhat difficult to grind. High specific grinding energy expected.
Grinding index (incl minor)	28.9	Somewhat difficult to grind. High specific power consumption expected.
Saturation factor (K _{S_k})	98.2	Easy to grind clinker.