60.3.10.1 Compliance to clinker specification

Description

This indicator measures the percentage of the clinker volume where all clinker specifications have been fulfilled.

Purpose

This KPI measures the percentage of clinker meeting the specified quality requirements.

The indicator is used for internal benchmark.

Calculation

The indicator is normally calculated per kiln and per clinker type produced in each kiln, and then aggregated over all kilns and clinker types.

For kiln 1 and clinker A

For actual month k

$$Compliant\ clinker\ A\ in\ kiln\ 1 : CClin_{1Ak}\,[\%] = \frac{V_{cpl1Ak}}{V_{1Ak}} * 100$$

Where:
Total volume of clinker A in kiln 1 [t]: V_{1Ak}
Compliant volume of clinker A in Kiln 1[t]: V_{cpl1Ak}

For year to date (months 1 to k)

$$Compliant\ clinker\ A\ in\ kiln\ 1 : CClin_{1A\ YTD}\,[\%] = \frac{\sum_{1}^{k} V_{cpl1Ak}}{\sum_{1}^{k} V_{1Ak}} * 100$$

For 12 months rolling

$$Compliant\ clinker\ A\ in\ kiln\ 1 : CClin_{1A\ 12mr}\,[\%] = \frac{\sum_{k-12}^{i} V_{cpl1Ak}}{\sum_{k-12}^{i} V_{1Ak}} * 100$$

Aggregation to overall Compliance to Clinker Specification

For actual month k

Overall compliance of clinker A produced in kilns 1 to z

$$Overall\ compliant\ clinker\ A : CClin_{Ak}\,[\%] = \frac{\sum_{1}^{z} V_{zAk} * CClin_{zAk}}{\sum_{1}^{z} V_{zAk}}$$

Overall compliance of all clinker types A to M

$$Overall\ compliant\ clinker : CClin\,[\%] = \frac{\sum_{A}^{M} CClin_{Ak*} V_{A}}{\sum_{A}^{M} V_{Ak}}$$

For year to date

$$Total\ volume\ produced\ in\ month\ k : V_{k}\,[t] = \sum_{A}^{M}\sum_{1}^{z} V_{zAk}$$

Overall compliance of clinker in month k: $CClin_k$

$$Overall\ compliance\ of\ clinker\ for\ year\ to\ date : CClin_{YTD}\,[\%] = \frac{\sum_{1}^{k} CClin_{k*} V_{k}}{\sum_{1}^{k} V_{k}}$$

For 12 months rolling

$$Overall\ compliance\ of\ clinker\ for\ 12\ months\ rolling : CClin_{12mr}\,[\%] = \frac{\sum_{k-12}^{k} CClin_{k*} V_{k}}{\sum_{k-12}^{k} V_{k}}$$

Unit of measure:

Compliance to clinker Specifications is measured as a %.

Examples:

The indicator is normally calculated per kiln and per clinker type produced in each kiln. The main product per kiln as well as the overall compliance to clinker specification will be reported.

Quality criteria

The quality criteria and limits for acceptance have to be established for each clinker type on the following two levels:

First level (mandatory for all plants):

Kiln #	Clinker type	Free Lime			Lime saturation		
		target	Acceptance range		target	Acceptance range	
			min	max		min	max
Kiln 1	Clinker A	T_{FL}	T_{FL} – 0.5	T_{FL} + 1.0	T_{LS}	T_{LS} - 2.5	T_{LS} + 2.5

Target free lime T_{FL}: to be set by the plant
Typical targets for free lime are any values between 0.8 and1.6% CaO_f
Target lime saturation T_{LS}: to be set by the plant
Typical targets for lime saturation are any values between 92 and 100

Second level (plant-specific parameters and ranges)

Additional specifications of selected parameters, that are critical and relevant for the plant with regard to product quality or operations

Examples: C_3A, Na_2O-eq.,SO_3, alkali/sulfur ratio, MgO, P_2O_5, etc.

Example:

Kiln #	Clinker type	C_3A			Na_2O-eq		
		target	Acceptance range		target	Acceptance range	
			min	max		min	max
Kiln 1	Clinker A	7	5	8	0.50	n.d.	0.60

The percentage of compliant clinker has to be recorded independently of whether or not non-compliant clinker is stored separately. In case that non-compliant clinker is stored separately, it is usually re-introduced in small rates to the cement grinding process.

Sampling frequency

Clinker should be tested regularly (e.g. 1 hourly to 4 hourly) for the specified parameters. A pro-rata tonnage has to be allocated for each sample tested

Clinker volume

For each tested clinker sample, the clinker volume produced during the pertinent period has to be allocated (from production data records, or pro rata from daily production)

In case the clinker volume per individual clinker sample (1 hourly to 4 hourly) cannot readily be determined, it is acceptable to calculate the compliance to clinker specifications as the percentage of clinker samples tested and meeting all specifications with respect to the total number of clinker samples tested. Provided that a constant frequency of testing is maintained, the difference between volume compliance and sample compliance is typically within a few %.

				Previous year													
Kiln	Product			Month		1	2	3	4	5	6	7	8	9	10	11	12
Kiln 1	A	Volume produced		V_{1Ak}	1000 t	100	30	100	120	0	145	150	145	140	100	140	110
		Volume in compliance		$V_{compl1Ak}$	1000 t	100	25	95	118	0	140	140	145	140	95	135	108
	B	Volume produced		V_{1Bk}	1000 t	0	0	0	60	140	0	0	0	0	40	140	30
		Volume in compliance		$V_{compl1Bk}$	1000 t	0	0	0	55	135	0	0	0	0	40	135	26
Kiln 2	A	Volume produced		V_{2Ak}	1000 t	0	0	0	0	0	25	70	70	75	25	0	0
		Volume in compliance		$V_{compl2Ak}$	1000 t	0	0	0	0	0	25	68	68	75	20	0	0
	B	Volume produced		V_{2Bk}	1000 t	60	60	10	50	60	30	0	0	0	25	60	10
		Volume in compliance		$V_{compl2Bk}$	1000 t	58	60	10	48	58	30	0	0	0	23	59	9
		Total Volume		V_k		160	90	110	230	200	200	220	215	215	190	340	150
A	Compliance of clinker A	month	$CClin_{Ak}$	%	100.0	83.3	95.0	98.3		97.1	94.5	99.1	100.0	92.0	96.4	98.2	
		ytd	$CClin_{Aytd}$	%	100.0	96.2	95.7	96.6	96.6	96.7	96.1	96.8	97.4	96.8	96.8	96.9	
		12mr	$CClin_{Ak}$	%												96.9	
B	Compliance of clinker B	month	$CClin_{Bk}$	%	96.7	100.0	100.0	93.6	96.5	100.0				96.9	97.0	87.5	
		ytd	$CClin_{Bytd}$	%	96.7	98.3	98.5	96.3	96.4	96.6	96.6	96.6	96.6	96.6	96.7	96.3	
		12mr	$CClin_{B12mrk}$	%												96.3	
Overall	Overall compliance of clinker	month	$CClin_k$	%	98.8	94.4	95.5	96.1	96.5	97.5	94.5	99.1	100.0	93.7	96.8	95.3	
		ytd	$CClin_{ytd}$	%	98.8	97.2	96.7	96.4	96.5	96.7	96.3	96.7	97.1	96.8	96.8	96.7	
		12mr	$CClin_{12mrk}$	%												96.7	