6.3.6.1 Production Rate Index [%] [by BDP]

Description

Production Rate Index is the actual production volume in relation to the theoretically achievable production.

Reference to Process

This indicator refers to:

- All relevant assets in all main cost centers up to and including 'Cement Grinding / Blending'
- Product sub-segment Clinker and Cement

Purpose

The Production Rate Index is used to identify production rate losses and to calculate Gross OEE and Net OEE.

Calculation

The Production Rate Index is the ratio of the actual production and the theoretically achievable production within the related operating time.
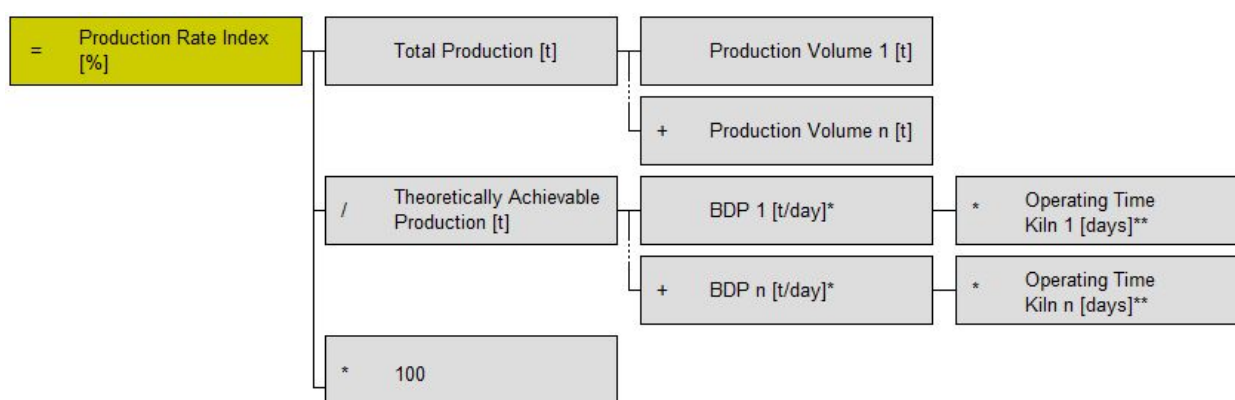
The theoretically achievable production equals to the Best Demonstrated Practice (BDP) Kiln BDP, Mill BDP multiplied with the operating time of the asset.

1. The generic formula to calculate and aggregate the indicator is:

Production rate

$$\text{Production Rate [t/h]} = \frac{\text{Volume Produced by the Main Equipment [t]}}{\text{Actual Operating Time [h]}}$$
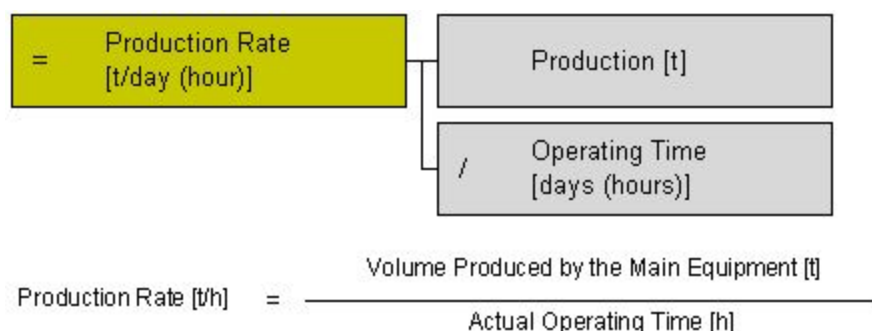
Production Rate Index

Please note that this is not the full diagram. For a printable version, see attachment below.

Production Volume 1...n and BDP 1..n refer to asset 1...n level production and composite BDP*.

The BDP kiln is generally traced in 'tons/day'. If the operating time is recorded in 'hours' a corresponding conversion of the time is necessary.

Aggregation rule

$$\text{Aggregated PRI [\%]} = \frac{\text{SUM Production}}{\text{SUM (Operating Time * BDP)}}$$

This generic formula also applies for aggregation of several assets, different reported periods like week, month to date (MTD), year to date (YTD), 12 months or others and different BDP's that may be applicable in time (for 12 month rolling calculation). For details see Kiln BDP and Mill BDP.

An aggregated 12 month roll PRI should be calculated for a further use in the aggregated 12 month roll OEE calculation

2. The particular application for an asset where one product type is produced (no aggregation over time):

$$\frac{\text{Production}}{\text{Rate Index [\%]}} = \frac{\text{Total Production [t]}}{\text{Total Operating Time [h]}} \times \frac{1}{\text{BDP [t/h]}} = \frac{\text{Production Rate [t/h]}}{\text{BDP [t/h]}}$$

For details to calculate BDP see Kiln BDP and Mill BDP.

When a BDP is adjusted, all Production Rate Index figures used in the YTD (and rolling average) calculations have to be similarly adjusted, as well as the Net OEE and Gross OEE, in order to maintain consistency of the figures. See example A for further details.

For kilns:
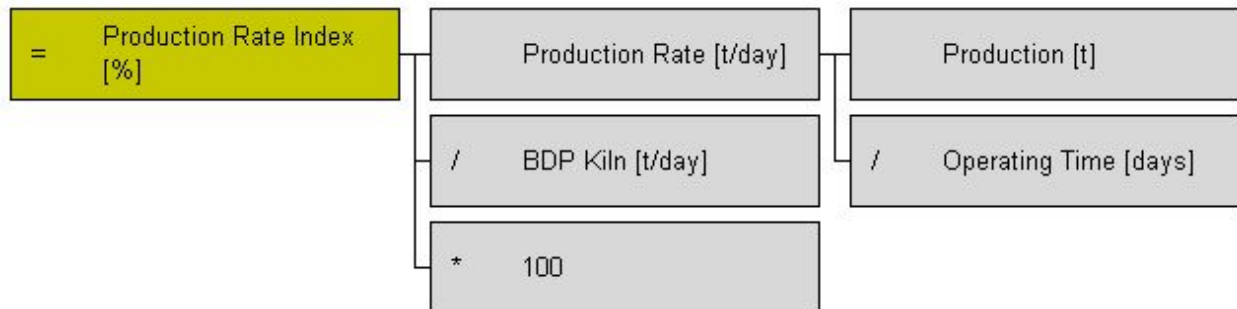
$$\text{Production Rate Index [\%]} = \frac{\text{Production Rate [t/day]}}{\text{BDP [t/day]}} \times 100$$

For Mill / Other Equipment:
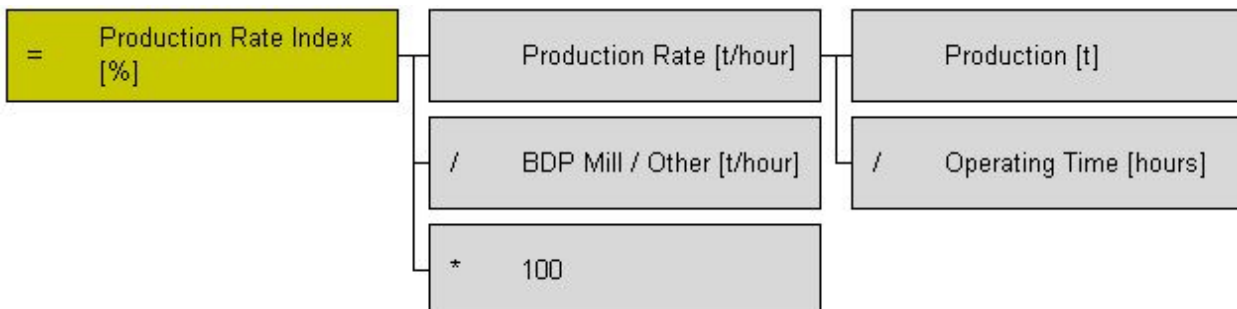
$$\text{Production Rate Index [\%]} = \frac{\text{Production Rate [t/h]}}{\text{BDP [t/h]}} \times 100$$

In all instances above BDP is the composite BDP* of the asset we refer to.

Production Rate Index may also be calculated for the relevant assets in Distribution (e.g. for bagging equipment).

Comments and Examples

TIS data normalization code: ICS Code ACS*-PRI (* per kilns, per mill).

A. Calculation of PRI for a kiln with budgeted change in BDP (due to major CAPEX):

The BDP of a kiln had changed from 1'250 t/day to 2'000 t/day in, June 1 - July 15, then the YTD (and rolling) Production rate index must be based on 1250 t/day. No change of the BDP until the end of the year applies.

B. Calculation example for a mill with two products:

Assuming that two different cement types are produced in a mill (e.g. Type 1., BDP = 64 t/hour and Type 2., BDP = 70 t/hour resulted (by the planned Operating Time) in a time weighted composite BDP* of 67 t/hour) the only BDP used to calculate the production rate index is 67 t/hour).

Period	Mill 1/Type 1: BDP 64.0 t/h			Mill 1/Type 2: BDP 70.0 t/h			Mill 1: BDP				67 t/h	
	Output (t)	OT (h)	PR (t/h)	Output (t)	OT (h)	PR (t/h)	Output (t)	OT (h)	PR (t/h)	PR YTD (t/h)	PRI M (%)	PRI YTD (%)
January	36000	640	56.3	2200	32	68.8	38200	672	56.8	56.8	84.8	84.8
February	32000	570	56.1	2800	48	58.3	34800	618	56.3	56.6	84.0	84.5
March	34000	720	47.2	0.0	0.0	0.0	34000	720	47.2	53.2	70.5	79.5
March YTD	102000	1930	52.8	5000	80.0	62.5	107000	2010		53.2		79.5

The Production Rate of the mill system is calculated by mill composite BDP* = 67 [t/h] Production Rate and Production Rate Index may also be calculated for special and individual purposes but not for the calculation of Overall Equipment Efficiency (OEE).

C. Aggregation example for PRI:

The following example is to illustrate the aggregation over:

- several assets (Kiln 1 and Kiln 2),
- several products in Kiln 2 (clinker type I with BDP=2350 and clinker type II with BDP=2500)
- time (12 months)

Assuming that two different clinker types are produced in Kiln 2 (e.g. type I., BDP = 2'552 t/day and type II., BDP = 2'470 t/day resulted in a composite BDP* of 2'490 t/day) the only BDP used to calculate the production rate index is 2'490 t/day).

	Kiln 1							Kiln 2							Aggregated
	Output [t]	OT [d]	PR [t/d]	PRI MTD [%]	PRI TTD [%]	PRI 12 mr [%]	BDP [t/d]	Output [t]	OT [d]	PR [t/d]	PRI MTD [%]	PRI TTD [%]	PRI 12 mr [%]	BDP [t/d]	PRI 12 mr [%]
Nov 2007	29000	20	1450	96%	-		1505	70000	30	2333	94%	-		2490	
Dec 2007	14700	10	1470	98%	-		1505	0	0	0	0%	-		2490	
Jan 2008	7200	5	1440	96%	96%		1505	0	0	0	0%	0%		2490	
Feb 2008	41500	28	1482	98%	98%		1505	32000	15	2133	86%	86%		2490	
Mar 2008	47000	31	1516	101%	99%		1505	68800	31	2219	89%	88%		2490	
Apr 2008	37000	25	1480	98%	99%		1505	65000	30	2167	87%	88%		2490	
May 2008	46500	31	1500	100%	99%		1505	66000	31	2129	86%	87%		2490	
Jun 2008	45000	30	1500	100%	99%		1505	64800	30	2160	87%	87%		2490	
Jul 2008	46000	31	1484	99%	99%		1505	60000	27	2222	89%	87%		2490	
Aug 2008	45700	31	1474	98%	99%		1505	65000	31	2097	84%	87%		2490	
Sept 2008	41500	28	1482	98%	99%		1505	65000	30	2167	87%	87%		2490	
Oct 2008	46900	31	1513	101%	99%		1505	65500	31	2113	85%	87%		2490	
12 mr Oct 2008	448'000	301	1'488			98.9%	1505	622'100	286	2'175			87.4%	2490	91.8%

The **Production Rate Index** 12 month roll, aggregated for Kiln 1 and Kiln 2, October 2008
=
= (448'000 + 622'100) / ((301 * 1'505) + (286 * 2'490)) = 91.8 [%]

D. Mill Production Rate Example

Mill Production Rate is a component to compute Standard Cement Capacity. The example below features an overview of possible scenarios.

			2015 Budget		2016 Budget No change of equipment No change of cement type		2017 Budget Additional cement type		2018 Budget One cement type removed New mill II		2019 Budget No change of equipment No change of cement type		2020 Budget Mill I upgrade Mill II unchanged		2021 Budget No change of equipment No change of cement type	
Example for Mill PR [12m]			PR [12m] 1)	Operating Time	PR [12m] 1)	Operating Time	PR [12m] 1)	Operating Time	PR [12m] 1)	Operating Time	PR [12m] 1)	Operating Time	PR [12m] 1)	Operating Time	PR [12m] 1)	Operating Time
Mill System I	Per cement type	I	120	2500	125	2700	125	3400	125	2200	125	3200	150	4080	150	4416
		II (removed in 2018)	85	2000	85	1700	85	100	-	-	-	-	-	-	-	-
		III (new in 2017)	-	-	-	-	95	1500	95	3860	95	2860	120	2880	120	3648
	Mill system	PR [12m]* (calculated)	104		110		115		106		111		138		136	
		Mill PR [12m]*	104		104		115		106		106		138		138	
Mill System II	Per cement	I							130	2500	130	1900	130	2750	130	2800
		IV							110	1800	110	1500	110	1650	110	1800
	Mill system	PR [12m]* (calculated)							122		121		123		122	
		Mill PR [12m]*							122		122		122		122	
Plant level		PR [12m]*	104		104		115		228		228		259		259	

Reporting Requirements

Month and 12 month rolling values of the indicator are reported in SAP FC.