



Mill Heat Balance and Water Spray · hold the gypsum window

The mill outlet temperature, the water spray that holds the target, and where every kilocalorie goes.

Licensed to: Sample file · worked example on a demonstration plant

OUTLET GAS	GYPSUM
97.5 °C	IN THE WINDOW

WATER TO HOLD THE TARGET	CEMENT LEAVES AT
156 l/h	110.5 °C

YOUR FIGURES

	Today	What if	
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The target

Mill outlet gas temperature wanted	96		°C
Water sprayed now	0	300	l/h
Gypsum window from	95		°C
Gypsum window to	120		°C
Highest cement temperature allowed	110		°C

The feed

Cement output	91.0		t/h
Clinker in it	81.1		t/h
Gypsum in it	4.5		t/h
Free water in the gypsum	3.0		%
Free water in the additive	17.0		%
Clinker temperature	95		°C
Separator returns per ton of fresh feed	1.709		t/t
Returns temperature	110		°C

The air

Ambient air	25		°C
Ambient humidity	60		%
Gas through the mill	50,000		Nm³/h
False air in it	7.5		%

The mill

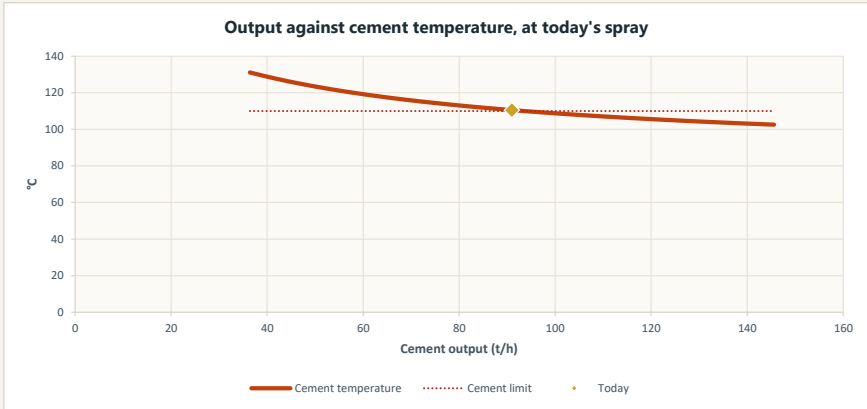
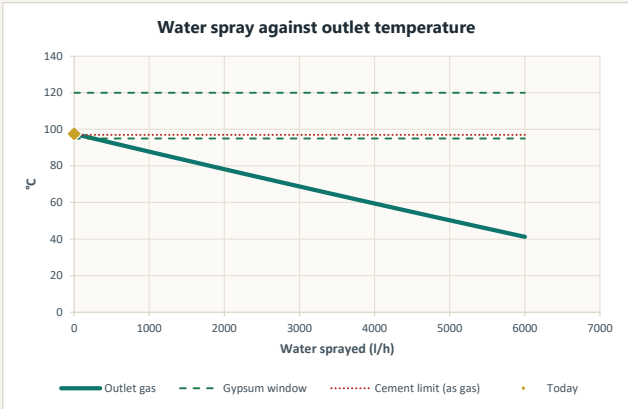
Mill motor power	3,660		kW
Share of it that becomes heat	90		%
Shell diameter	4.40		m
Shell length	13.75		m
Shell loss	750		kcal/h per m²

RESULTS

	Today		What if	Change	What it means
Mill outlet gas temperature (°C)	97.5	GOOD	94.6	-2.9	Inside the gypsum window part of the gypsum becomes hemihydrate, which controls the setting.
Cement leaving the mill (°C)	110.5	ACT	107.6	-2.9	Above the limit it lumps in the silo and blinds the filter.
Water that holds the target (l/h)	156		156	0	Zero when the mill cannot reach the target even without water.
Change of spray needed (l/h)	156		-144	-300	
Temperature without any spray (°C)	97.5		97.5	0	
Heat entering the circuit (new heat) (kcal/h)	3,960,091		3,960,091	0	
Share of it from the grinding (%)	72		72	0	
Heat per kg of cement (kcal/kg)	43.5		43.5	0	
Water evaporated (kg/h)	1,955		2,255	+300	
Water brought by the air (kg/h)	707		707	0	The term most balances get wrong: humid air cools the mill for free.
Output at which the cement hits its limit (t/h)	93.6		79.3	-14.3	
Extra sweep air to do the water's job (kg/h)	3,911				
Measured against calculated (°C)					

Cement leaves hotter than the gas by	13		°C
Spray water temperature	25		°C
Outlet temperature measured (optional)			°C

Yellow cells are yours. Leave a What-if cell empty to keep today's figure; type a new one to see what changes, before anything is changed in the plant.



WHAT TO DO FIRST

WATCH	WATER SPRAY · SHORT To hold 96 °C the mill needs 156 litres an hour and gets 0: 156 l/h short. Do: Raise the spray by 156 l/h and watch the outlet for twenty minutes before moving it again. Why: Every litre carries away about 614 kcal: heating it, boiling it and heating the steam. That is why a little water goes a long way.
GOOD	THE GYPSUM · IN THE WINDOW At 97.5 °C the mill is inside the 95 to 120 °C window. Part of the gypsum gives up its crystal water as hemihydrate, which is what controls the setting time. Do: Hold it here; check the setting time whenever the outlet moves more than five degrees. Why: This window is the reason mill temperature is controlled at all.
ACT	THE CEMENT It leaves the mill at 110.5 °C, above the 110 °C limit. Hot cement lumps in the silo, blinds the bag filter and is hard to load. Do: Cool the mill until the cement is under the limit; check the cooler on the way to the silo if there is one. Why: The silo cannot lose that heat. Whatever goes in hot stays hot for days.
READ	WHERE THE HEAT IS The grinding itself is 72 % of the heat entering this circuit; the clinker brings only 27 %. Do: When the mill runs hot, look at the power draw and the ventilation before the clinker temperature. Why: Very little of the grinding power ends up as new surface. Nearly all of it comes back as heat, which is why a mill heats itself even on cold clinker.
READ	THE SEPARATOR RETURNS The returns arrive at 110 °C carrying 2,238,030 kcal/h and leave again with the discharge carrying 2,251,964. Net they are worth -13,934 kcal/h: a loop, not a source. Do: Read the grinding share against the new heat only. Why: Counted as an input the returns look like 36 % of the heat, which makes the grinding look far smaller than it is.

READ**THE WEATHER**

At 25 °C and 60 % humidity the air alone brings 707 kg of water an hour into the mill. Evaporating it takes 433,677 kcal/h.

Do: Re-run this for a hot humid afternoon and a cold dry night: the spray setting is not the same number all year.

Why: Air at 35 °C and 80 % humidity carries ten times the water of cold dry air, and it cools the mill for free.

ACT**THE FEED RATE**

The motor puts the same heat into this mill whatever it is fed, so slowing down makes the cement hotter, not cooler. At today's spray the cement passes 110 °C below 93.6 t/h, and the mill runs 91.0.

Do: Keep the rate above 93.6 t/h; if it must slow down for the separator, raise the spray at the same time.

Why: A mill throttled back for a quality problem overheats, and the gypsum problem arrives on top of the first one.

READ**WATER OR AIR**

The same cooling as 156 l/h of water would take about 3,911 kg/h more sweep air on top of the 64,650 pulled now: about 6 % more.

Do: Compare the fan power for that with the cost of the water, and check that the outlet can pass that much gas.

Why: Water is nearly free but wets the cement and can make the mill coat. Air is clean but costs fan power.