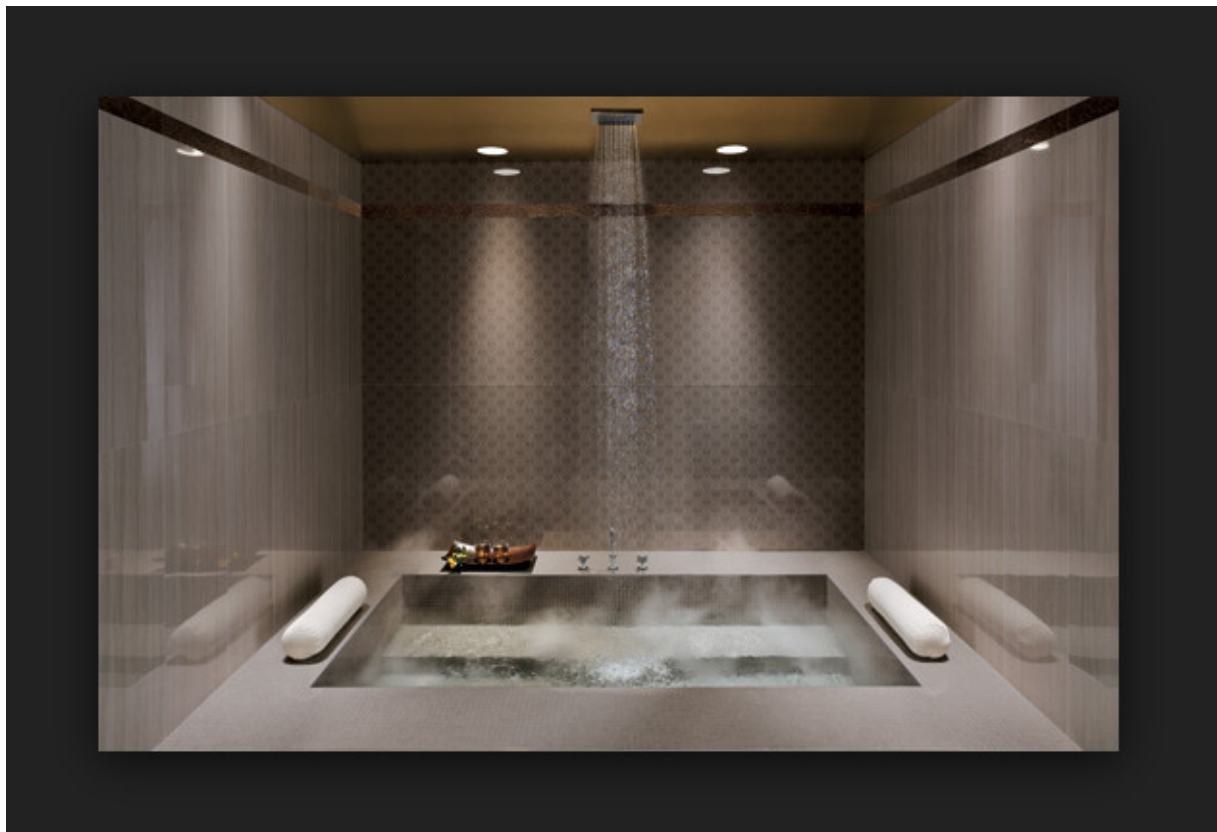
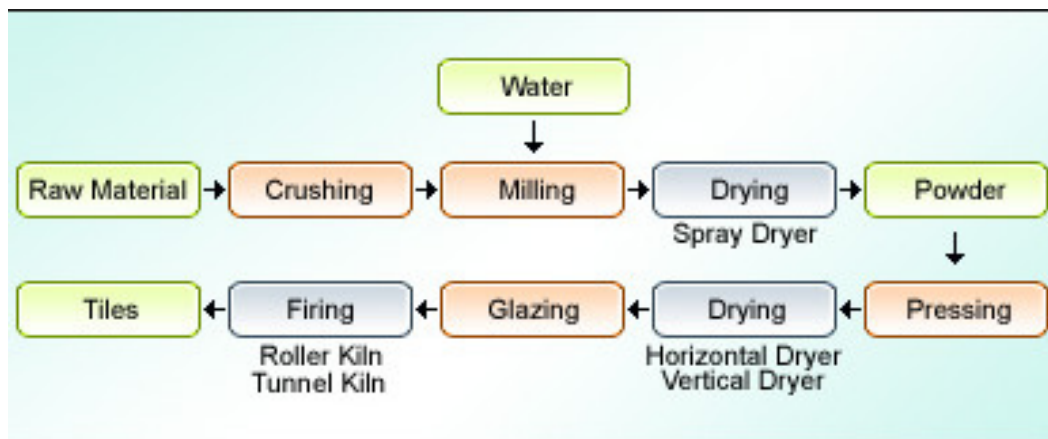
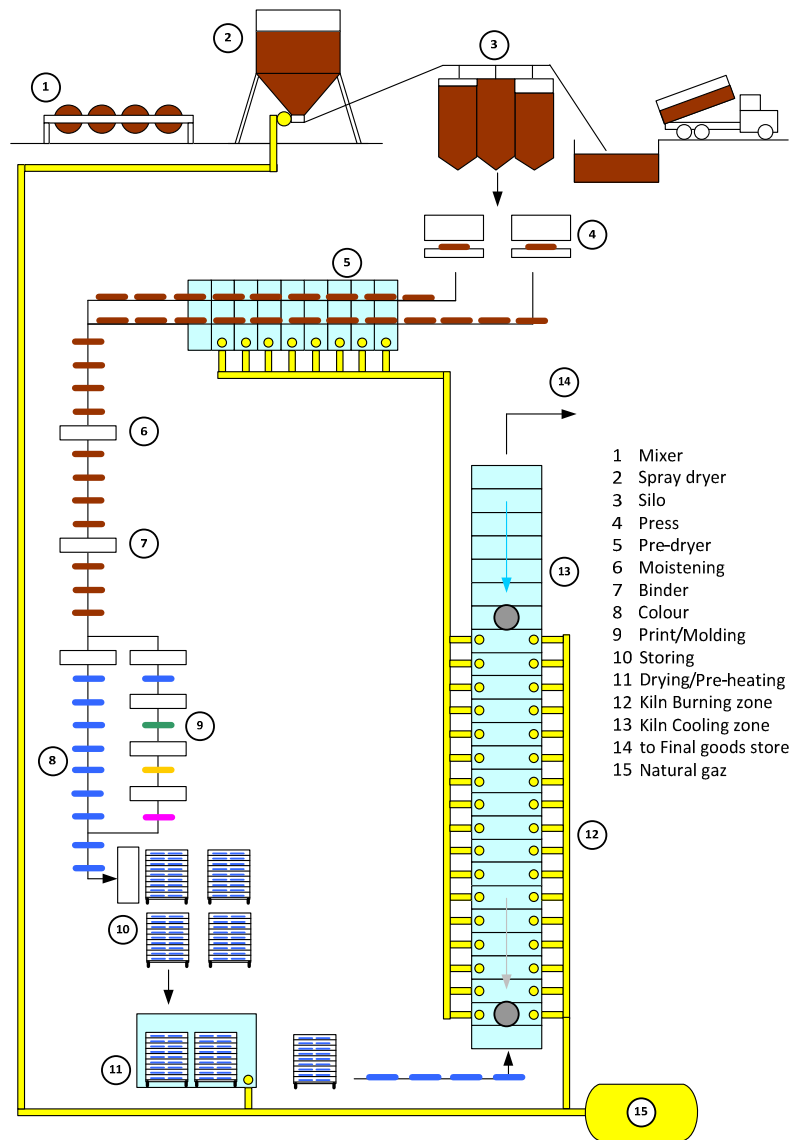
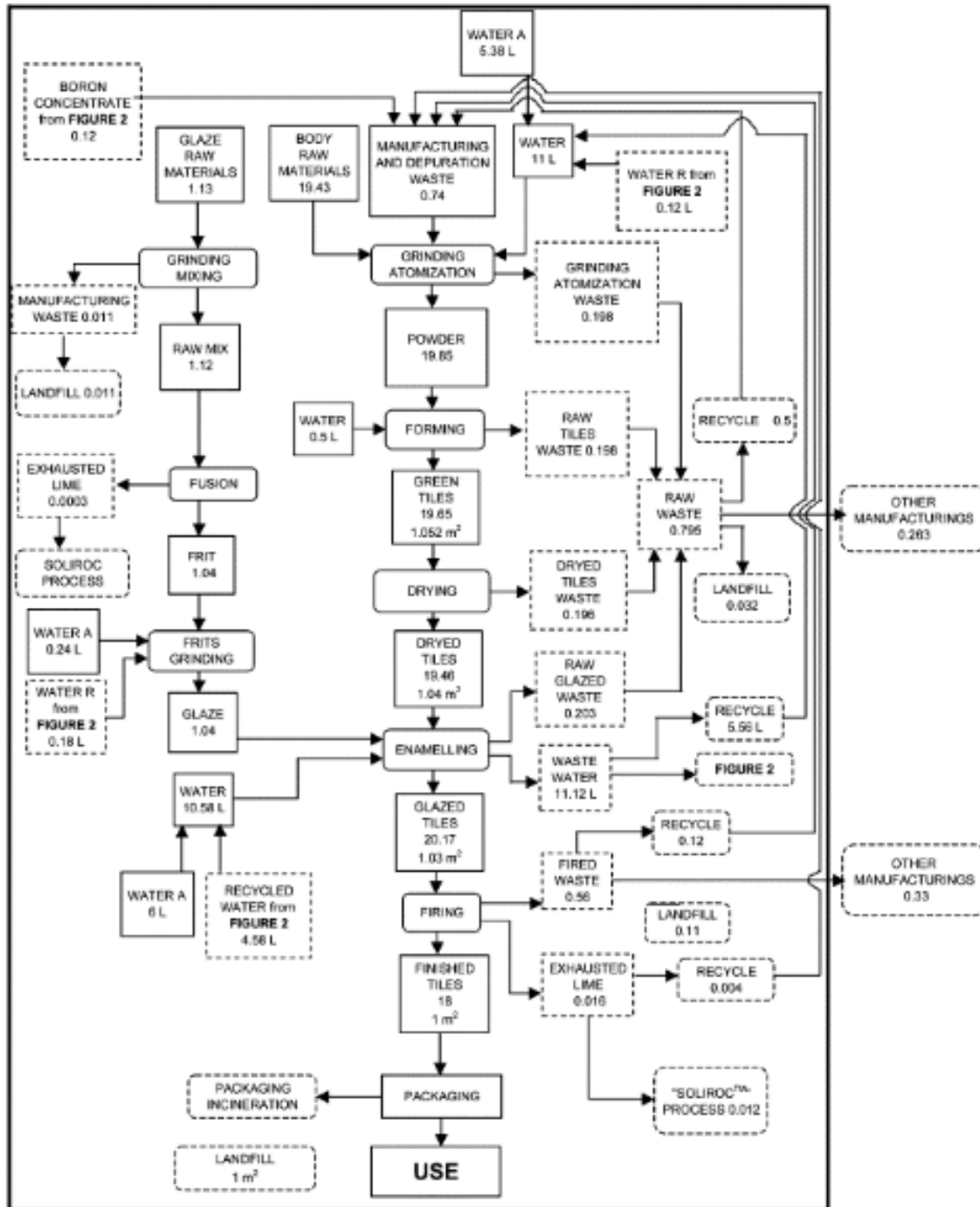


**ENERGY RECOVERY  
IN  
CERAMIC TILES PRODUCTION**



**GENERAL**





Water A: water coming from the aqueduct  
 Water R: recycled water



Drum mill: milling and mixing raw material



Out of Drum mill: slurried raw material



Spray Dryer: Gas heated air, 500°C, cyclone injected slur, water evaporates



Spray Dryer: output = homogenized granulate



Tile press



Vertical Dryer: raw tiles are dried to ~3% humidity    Horizontal Multi Layer Dryer



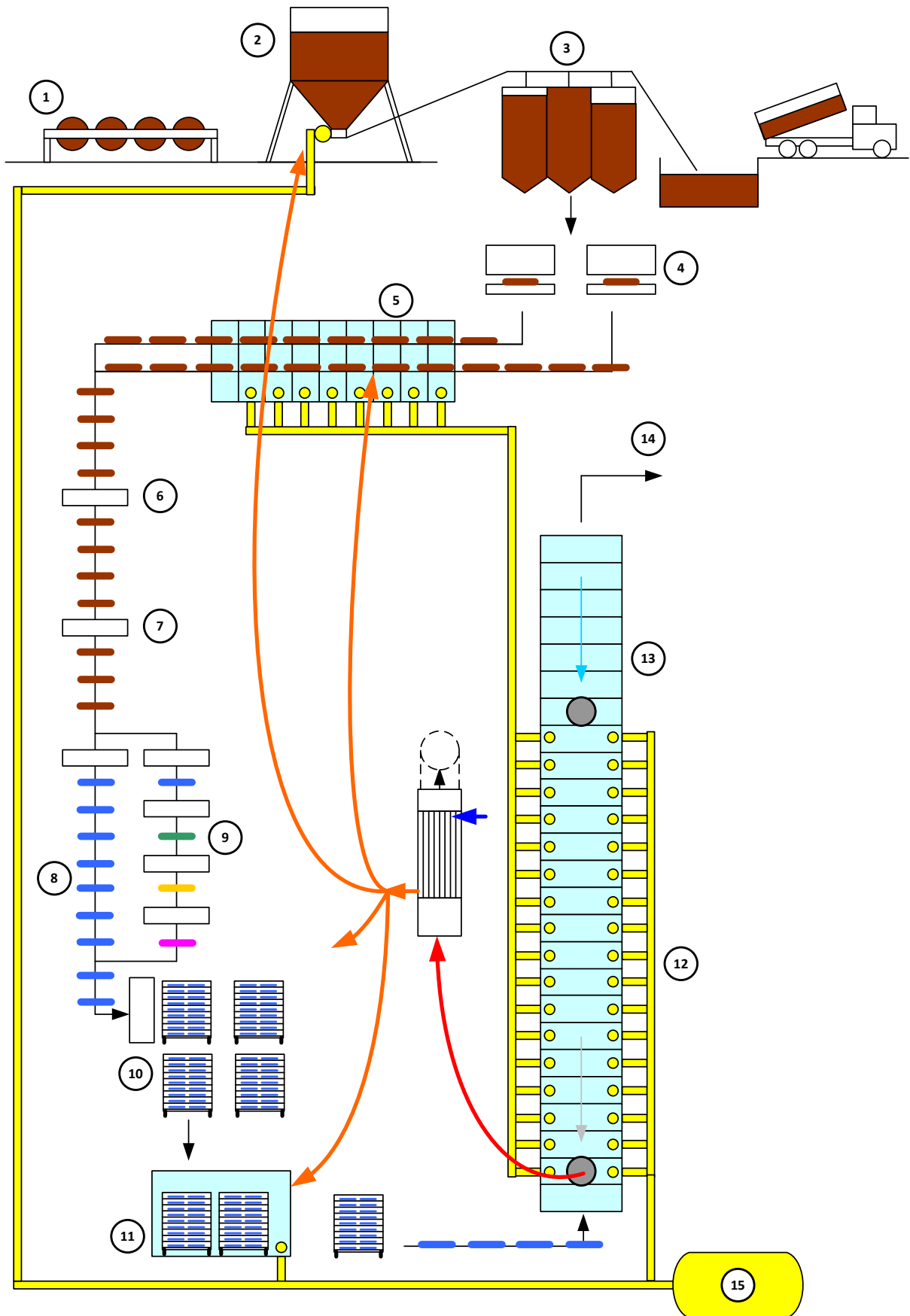
Colouring and glazing line: Moistening, Binder, Colour, Print/Molding, Decoration



Intermediate storage and automated transport



Kiln: Preheating-, Burning- and Cooling Section; Burning- and Cooling sections with chimneys



**ENERGY RECOVERY IN THE TILES INDUSTRY**

Energy sources:

Kiln	Burning zone	Exhaust air dirty	up to 300°C	
	Cooling zone	Exh.air rel clean	up to 250°C	
Spray dryer	Chimney	Exh.air very humid		no experience yet
Dryers	Chimney	too small volume		

Energy consumers:

Kiln	Burning zone	not recommended	possible influence on the climate
	Burners	maybe possible	check burners; check %age Oxygen
	Cooling zone	no	requires cold air
Spray dryer	Machine	possible	best possibility
	Burner	possible	check burner, no real value
Dryers	Machine	possible	check injection point
	Burners	possible	check burners

Technical possibilities:

Air direct	only exhaust air from Kiln Cooling zone	Danger for contamination !
Air-Air	Air from Kiln Burning- and/or Cooling zone	expensive, temperature loss
Air-Water-Air	Air from Kiln Burning- and/or Cooling zone	best possibility

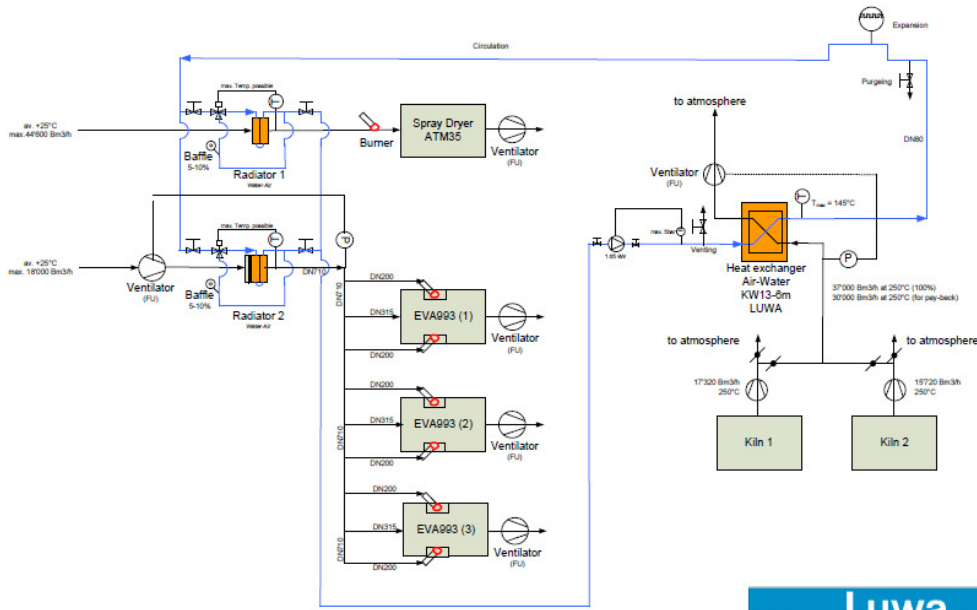
Typical features :

- Long distances between energy sources and energy consumers
- Everywhere very fine dust
- Very sensitive climate inside of kilns = hot air injection only through burners
- Potentially corrosive substances in the exhaust air

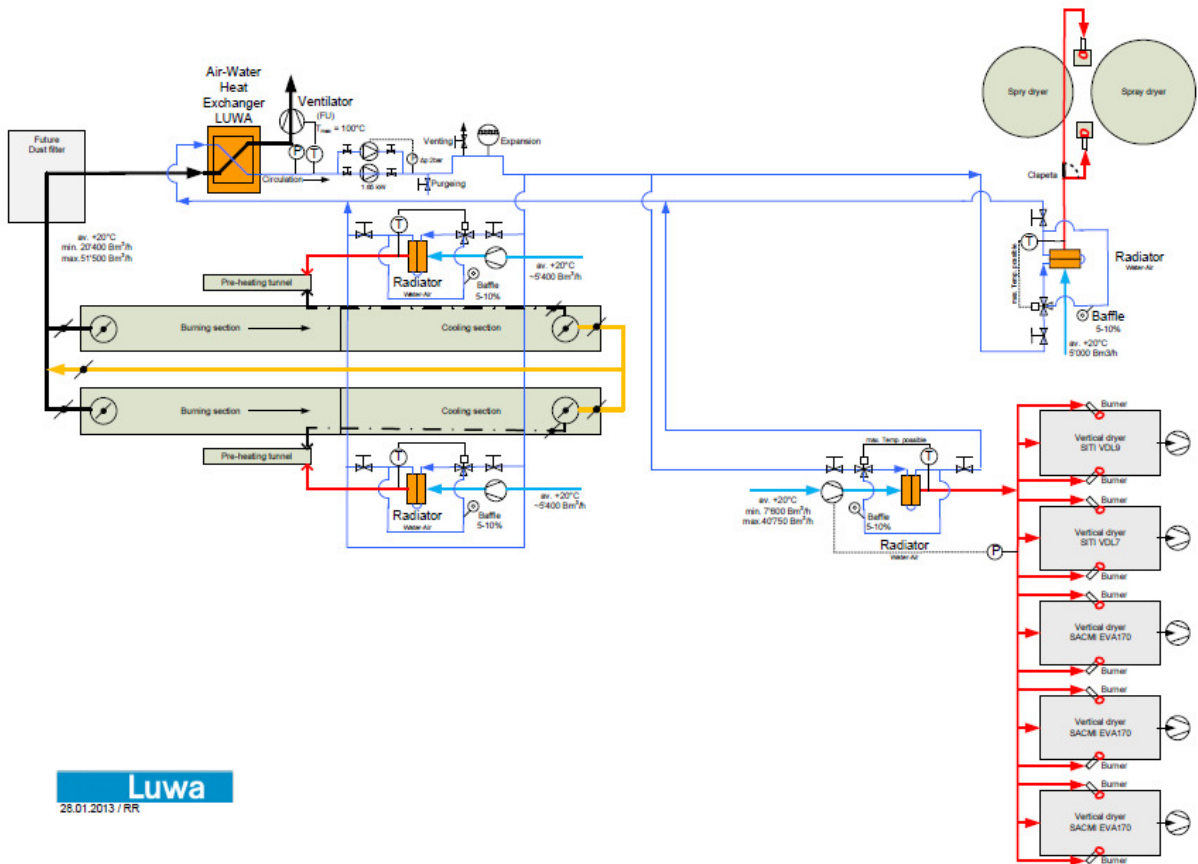


Poluente	PTS	NOx	CO	SO <sub>2</sub>	COV	F <sup>-</sup>	Metais I	Metais II	Metais III	As+Ni	Cd+Hg	Pb+Cr+Cu	Metais Pesado
O <sub>2</sub> Referência (%)	18	18	18	18	18	8	18	18	18	18	18	18	18
VLE (mg/Nm <sup>3</sup> )	300	1500	1000	2700	50	50				1	0.2	5	8
LMmáx-LMmin (kg/h)	5-0,5	30-2	100-5	50-2	30-2	0,5-0,05	NE-0,001	NE-0,005	NE-0,025	NE-NE	NE-NE	NE-NE	NE-NE
Conc. (mg/Nm <sup>3</sup> )									-			5	5
Caudal (kg/h)									0.078			-	-
Conc. (mg/Nm <sup>3</sup> )									4.0262			1.4877	5.3
Caudal (kg/h)									0.0535			0.0198	0.054
Conc. (mg/Nm <sup>3</sup> )	8	43	39	<7	1	7	<0,0026	<0,0274	4.92	<0,0274	<0,0026	4.8857	4.8857
Caudal (kg/h)	0.11	0.59	0.5	<0,1	<0,04	0.024	<0,0001	<0,0004	0.0683	<0,0004	<0,0001	0.0678	0.0678
Conc. (mg/Nm <sup>3</sup> )	7	43	39	<8	1	8	<l.q.	<l.q.	0.07	<l.q.	<l.q.	5.05	5.08
Caudal (kg/h)	0.1	0.6	0.5	<0,1	0.01	0.03							
Conc. (mg/Nm <sup>3</sup> )	<15,9	51	103		1.4	1.1				0.026	0.004	0.102	
Caudal (kg/h)	<0,18	0.71	1.42		0.02	0.004							
Conc. (mg/Nm <sup>3</sup> )	17.5	39.8	30.5		7.2	45					0.01	0.7	
Caudal (kg/h)	0.21	0.47	0.36			0.13							
Conc. (mg/Nm <sup>3</sup> )	4.5	38	42			32					0.01	1.94	
Caudal (kg/h)	0.06	0.5	0.55			0.1							
Conc. (mg/Nm <sup>3</sup> )	16	136 (O <sub>2</sub> 8%)	135 (O <sub>2</sub> 8%)			11.6					0.02	1.49	
Caudal (kg/h)	0.21	0.41	0.41			0.04							
Conc. (mg/Nm <sup>3</sup> )													
Caudal (kg/h)													

ENERGY RECOVERY AIR-WATER-AIR



Luwa  
16.03.2011 / RR



Luwa  
28.01.2013 / RR



Kiln: Exhaust air burning section ; Connection to chimney, flaps ; Exhaust air to Luwa Heat exchanger



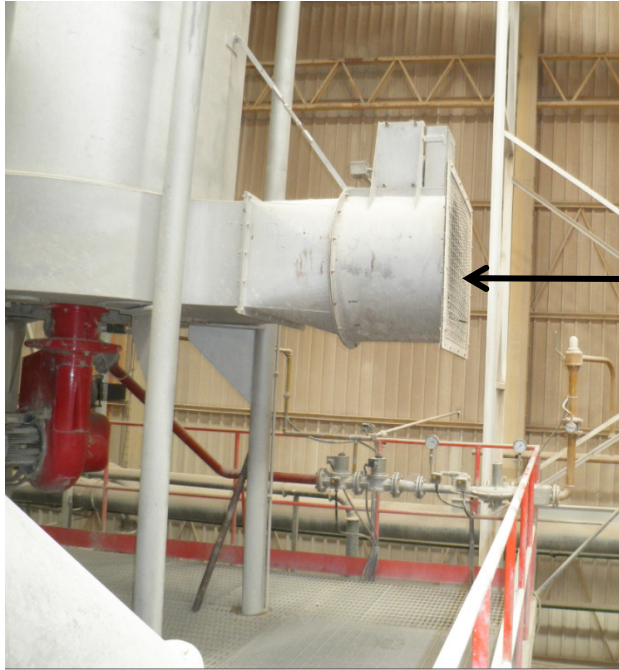
Luwa Air-Water Heat Exchanger : Hot water (140°C) is pumped in circulation to various Water-Air Heat exchangers at energy consumers (e.g. Spray dryer, Dryers)



Air-Water Heat Exchanger: Fresh air flap (opens when Kilns on Bypass, or in case of emergency)



Spray Dryer : General view with Water-Air Heat Exchanger



Spray Dryer: Air Ventilator, Burner ; Fresh air sucked in via burner by own ventilator



Spray Dryer: Heat Exchanger Water-Air ; Fresh air is sucked trough the Water-Air heat exchanger and heated to ~120°C



Spray dryer : Hot water control



Vertical Dryers: Hot air distribution



Vertical dryers : Fresh air flap, open if HE idle



Vertical Dryers: Hot air supply to Burner



Water softening

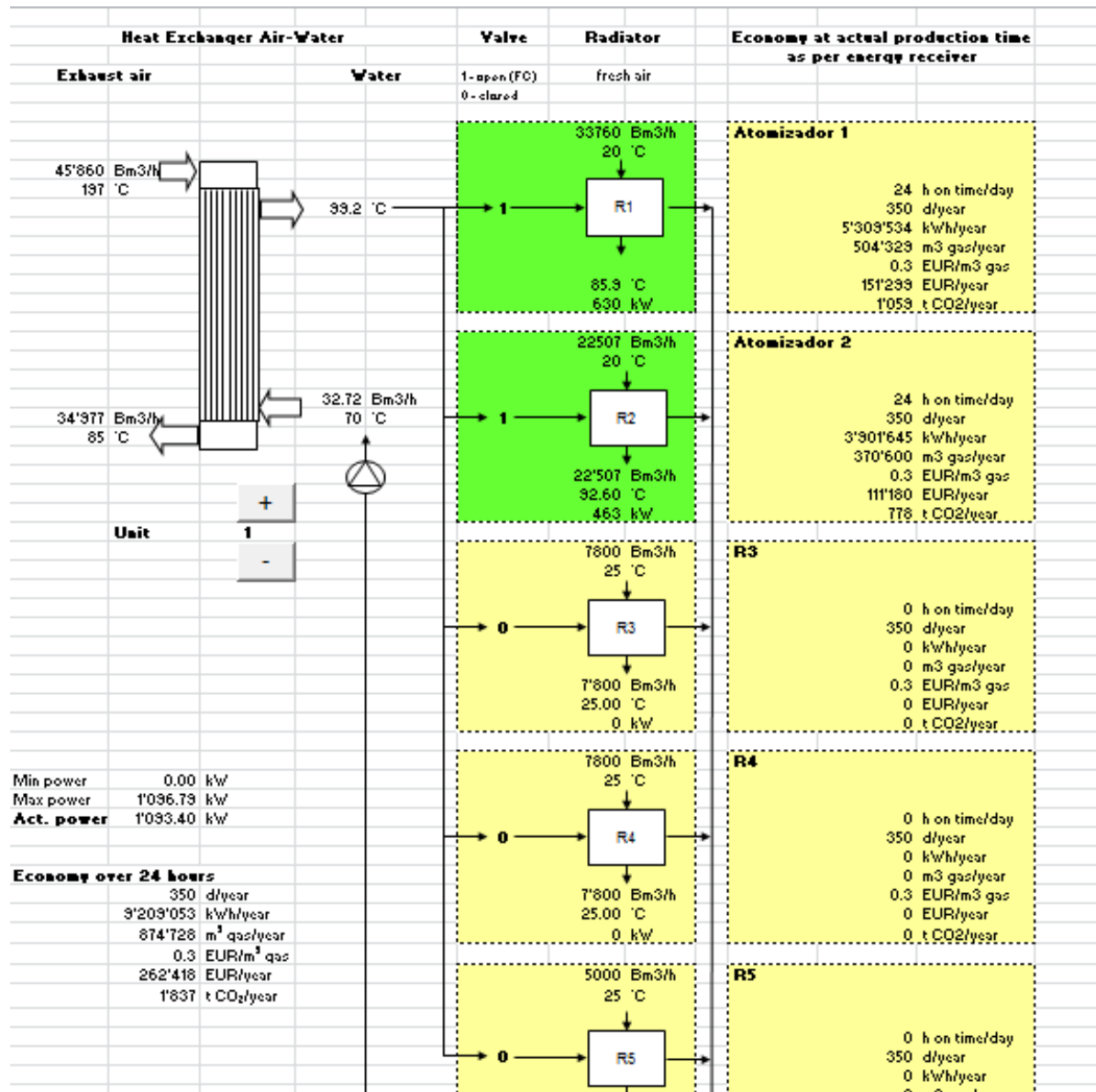


Expansion Tank



Caustic Soda injection for neutralization of acids

**SAVING POTENTIAL**



- Energy source : Exhaust air from 2 Kilns ; Burning zone = polluted air
- Energy consumers : 2 Spray dryers