GREEN STAR
GREEN skills for enterprises Sustainable Training for Automotive suppliers clusteR

Programma di apprendimento permanente

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S.C. SINTEROM S.A.

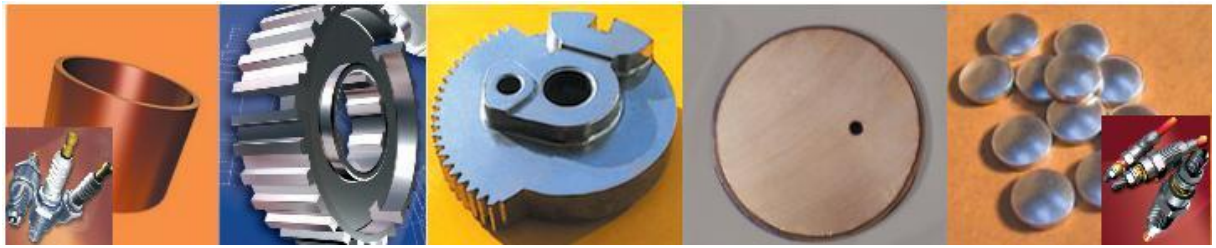
ENERGETIC EFFICIENCY ANALYSIS OF THE NEW EQUIPMENTS

21-22 SEPTEMBER 2015- VENICE

Investment Project from 2014

"Upgrading of the metallic sintered parts technology"

Cofinanced on European funds



Contained:

1	The main objectives of the audit . Action Plans
2	Normative elements –Romanian Standards
3	Assessment Procedures
4	Real balance of heating energy
5	Optimized balance
6	**Action plan and results. Conclusions**

Preliminary Explanation:

-During the sintering process the powder ferrous parts are heated and maintained at elevated temperatures in the oven (usually at 1120 °C), in accordance with technological requirements, after which they are cooled, astflel that ultimately arrive at ambient temperature, which has been placed in the furnace.

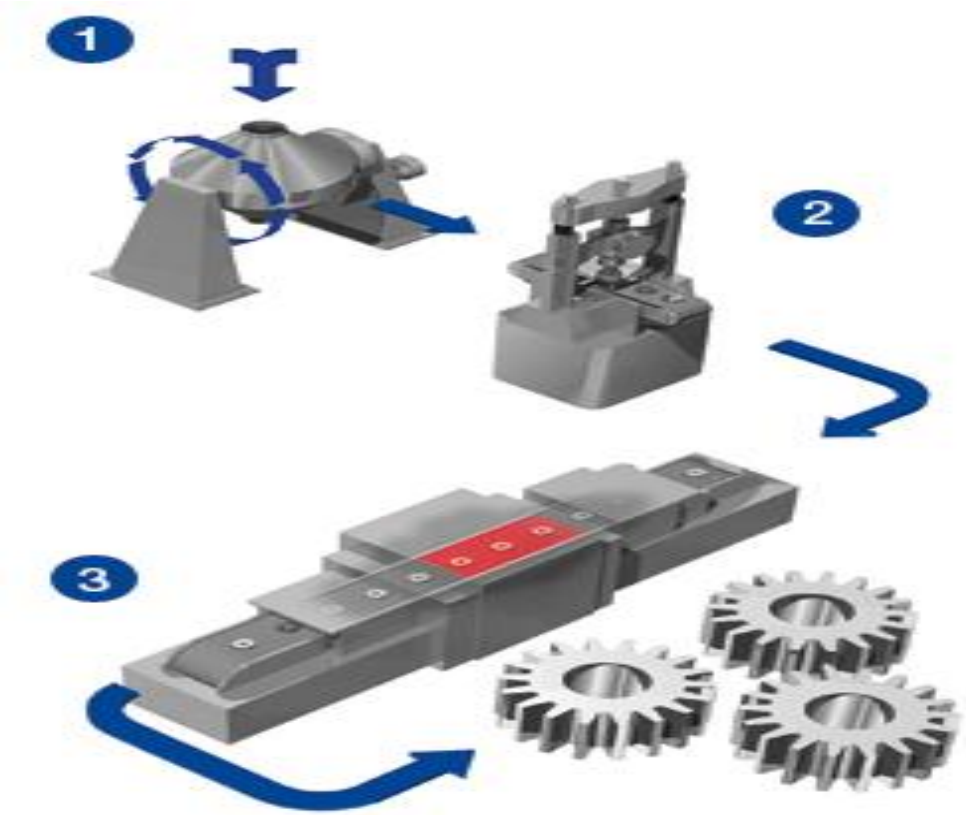
-Operating under stationary electric power consumption is mostly used for keeping the oven to the desired stationary thermal regime and the rest for training conveyor. Part of the electricity used for heating, is basically used to offset losses by convection and radiation, respectivelly the furnace cooling water.

Principle of sintered part production:

-mixing powders (1);

-compacting products (2);

-sintering on continous conveyor belt furnaces (3);



Diferent tipe of sintered parts

Examples of sintered components:

-parts for automotive industry: cams, pulleys, sinchronizer hubs, sprockets, sinchronizer rings, caps, a.s.o;

-steering components, rocker arms parts, guiding pieces;

-locking systems for doors and automotive locks;

-parts for hand tools: gears, bevel gears, sliding pieces;

-household apliances (selflubricated bushes, bearings);

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Plan of measures and actions 2014:

-Improving the operation in running the furnaces by correct charges ;
-Optimal adjustment of burners gas in endogas generator;
-Optimization of belts loading with green parts;
-Heat recovery from flow gas – conveyor belt furnace / and endogas generator;
-Heat recovery from cooling water;
-Reducing pumping water for cooling tower;

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Plan of measures and actions 2014:

Using of modern equipment it minds the following advantages:

-Elimination of endothermic gas & reheating of it;
-Reduce heat loss by combining blocks and walls;
-Removing resintering by using TPC (Total Proces Control UNIT);
-Removing samples sintering getting reproductibility;
-Totally removing of AICHELIN installations – electrical & gas consumption substantially reduced;

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Plan of measures and actions 2014:

Using modern equipment:

-Reducing manufacturing costs-20-25%

-Reduce of maintenance costs with 30%;

-Installation of additional skylights - natural lighting-10% energy saving;

-Dimming the Hall voltage interior lighting sintering;

-Organizing production - limiting number starts furnace by optimization of production with 3 months launching products;

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Plan of measures and actions 2014:

General recommendations :

-Re-marks on the belt support plates;

-Compressed air network loss reduction;

-Optimal configuration mode transformer load;

-System rebates for implementing energy efficiency measures;

-Variable speed drive pumping systems for cooling towers;

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Plan of measures and actions 2015

New main planed activities in SINTEROM for reducing energy consumption in 2015 working also within "Green Star Project" are presented below:

- **1. MAHLER sintering furnace operation optimization No.1, reducing its energy consumption by:**
- **a) increasing conveyor speeds staggered bad for repeat-manufacturing program, with the redesign of training tools and putting them into operation, as decommissioning old existing tools.**
- **b) reduce the duration of load operation of the furnace, the parts forming batch scheduling quarterly, not monthly;**
- **2. Reducing electricity consumption and overall operating costs by upgrading recycled water pump station no.1 and its external distribution network.**

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Plan of measures and actions 2015

- **3. Reducing consumption at the electrical energy of the compressor station through the acquisition and installation of a compressor section Sintered low flow (100 l / h);**
- **4. Decreased consumption of electrical energy in heat treatment toolroom, through reinstatement of small ovens chamber from technical laboratories, oil hardening and tempering elements tooling, and their exploitation in place of old line salts batches or carbonitriding batch furnace with 300 kg/charge capacity.**
- **5. Replacing and modenizing of conveyor belt sintered furnace CST 300 for efficient sintering bronze parts (bushes and bearings).**

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Elimination of endothermic gas reheating

Electricity savings :

Measure	Economics / year			
	[MWh]	[t.e.p.]	[lei]	[euro]
Elimination of endothermic gas reheating	83,51	7,17	26 306	6 117

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Reducing heat loss through the joints and wall blocks

Electricity savings:

Measure	Economics / year			
	[MWh]	[t.e.p.]	[lei]	[euro]
Reducing heat loss through walls and muffle	79,53	6,83	25 052	5 826

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Electrical energy savings:

Measure	Economics / year			
	[MWh]	[t.e.p.]	[lei]	[euro]
Remove several sintering	183	15,72	57 645	13 405

Methane savings:

	Economics / year			
	[MWh]	[t.e.p.]	[lei]	[euro]
Remove several sintering	348,4	28,27	34 310	7 980

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1. *The main objectives of the energy audit :*

-Estimating technical and evaluated energy consumption of the sintering equipment;

-Setting absolute and specific quantities of energy analyzed processes;

-Evaluation of the possibility of upgrading the facilities, reducing operation and maintenance costs;

-Improving the efficiency of electricity and natural gas;

-Optimization of heat treatment processes.

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2. Normative elements

- ***Guide development and energy balance analysis, published in the Official Gazette, Part I no. 792 bis of 11 November 2003, the guide includes requirements, recommendations, fundamental principles and general methodological guidance on the preparation of energy balances the energy consumers and energy efficiency assessment mode.***

  Normative IN 902/86 (reissued in 1995) for the preparation and analysis of energy balance is in force in accordance with regulations and technical requirements catalog available in the energy sector since 2002, recommended by the National Energy Regulator AGENCY, ANRE

  Certification by law to A.N.R.E. (ROMANIAN NATIONAL AUTHORITHY OF REGLEMENTATION OF ENERGY)

3. Assessment Procedures:

- **Technical documentation obtained from the supplier of technical energetic audit:**

  -Measurements on handsets - ovens, ENDO generator, engines, a.s.o.;

  -Surveying facilities / receivers;

  -Calculation sheets receivers;

  -Specific consumptions especially for the sintering furnace

4. Real balance - Sintering

The report of the audit:
Sintering furnace conveyor tunnel and controlled atmosphere CTS 450
ENDO-Gas production type ENDO AICHELIN -20 m too far from furnace

Old Sintering furnace - CTS 450

The input fume removal of zinc stearate + preheating

Sintering zone-old furnace:

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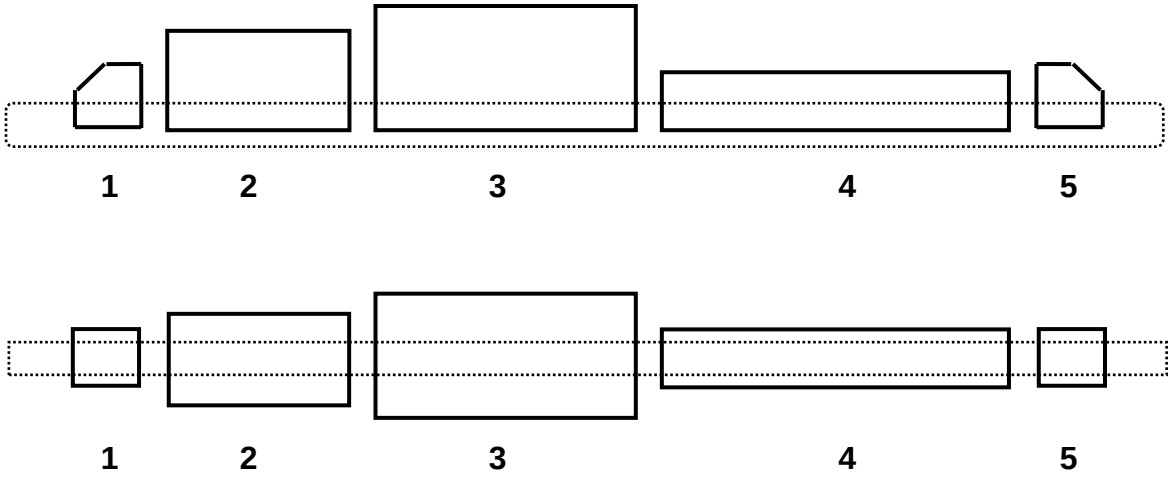
Cooling zone-old furnace:

4. Sintering real balance



The design principle of sintering furnace CTS 450

1 – Hood input area; 2 - Area presinteriing; 3 - Area of sintering; 4 - Cooling zone; 5 - hood exit area

The arrows indicate the direction of travel of the conveyor belt and related parts

Notes:

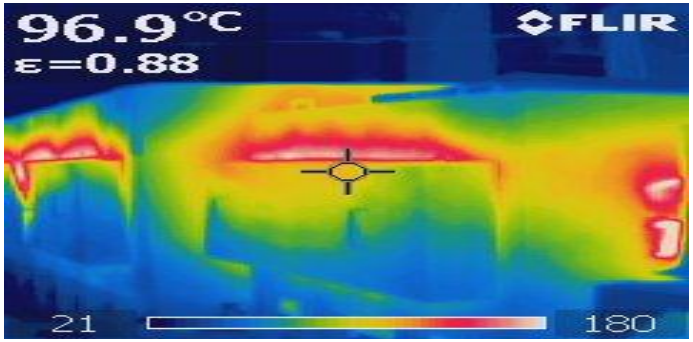
Sintering process is carried out continuously for 24 hours on 24, 7 days a week, so it can be considered that the energy flows involved in energy balance, are relatively constant, and the thermal and electricity, are relatively constant;

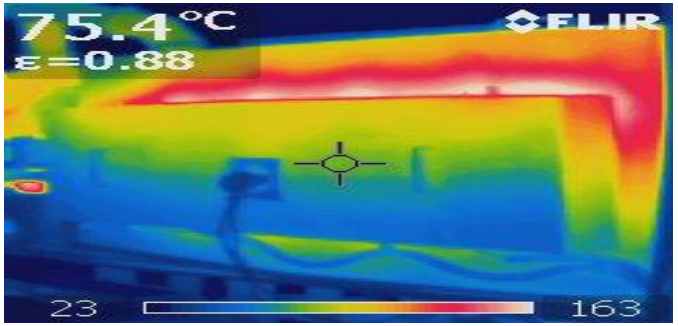
4. Real balance - Sintering

Dimensions and areas calculated in each zone of the furnace:

Name	Presintering		Sintering		Cooling	
	Value	u.in.	Value	u.m.	Value	u.m.
Lenght (L)	1.70	m	4.35	m	5.60	m
Width (1)	1.20	m	1.72	iu	1.00	ni
Hight (H)	1.00	ni	1.34	ni	0.5 5	ni
Surface SI	1"0	m^2	5.83	m^2	3.OS	m^2
Surface S2	2.04	m^2	7.48	m^2	5.60	m^2
Surface S3	1.20	m^2	2.3	m^2	0.5 5	m^2

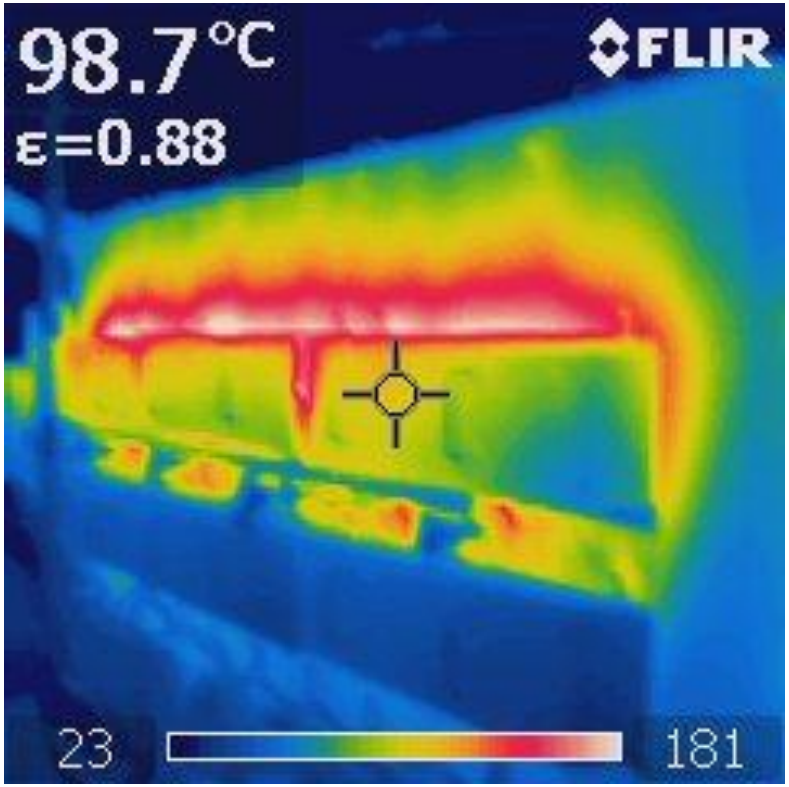
2 Sides (Lateral) surfaces conveyor belt furnace- Thermography

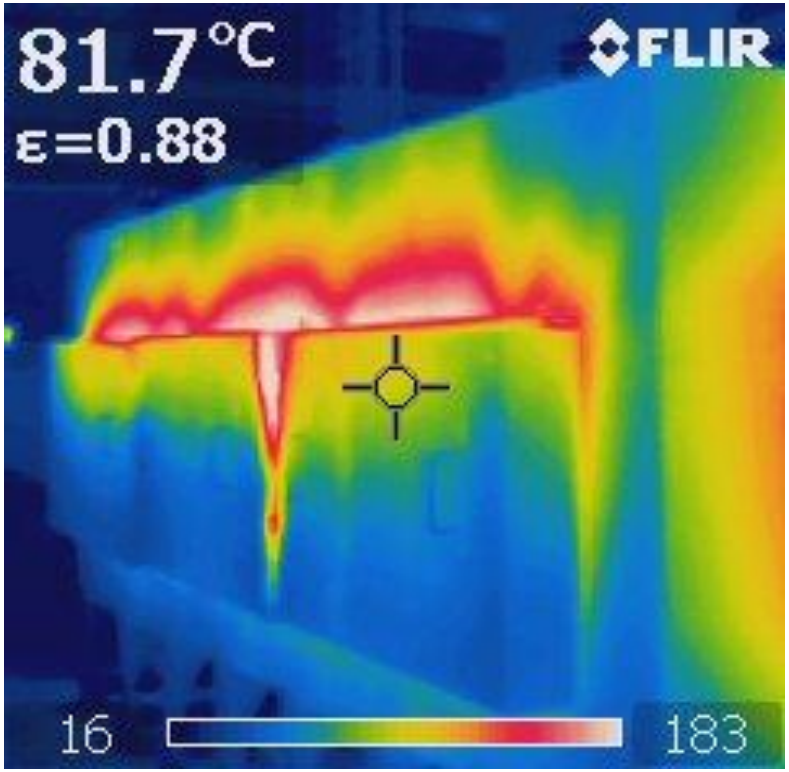




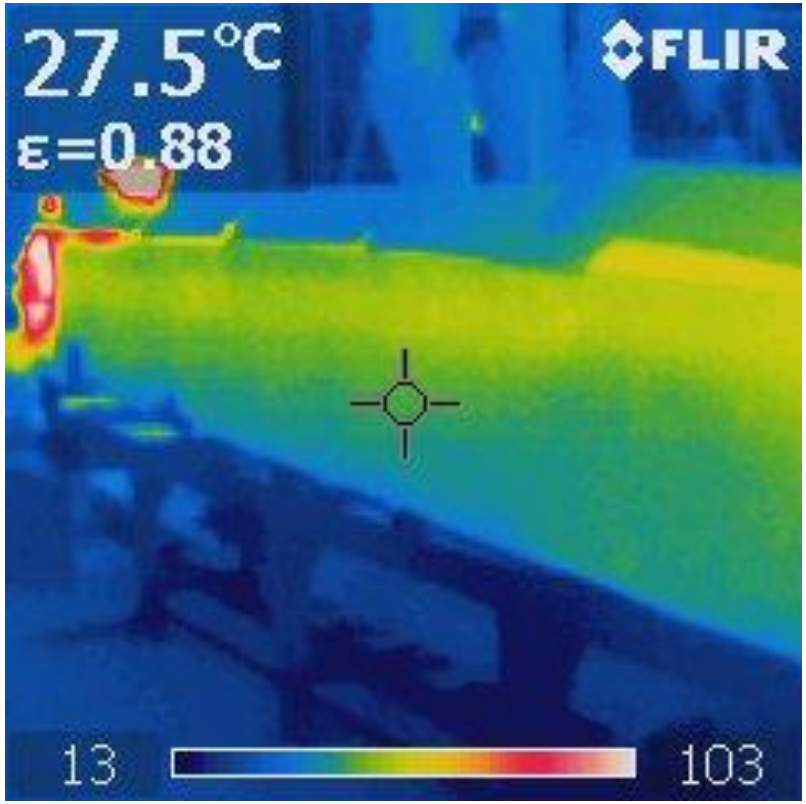
Presintering

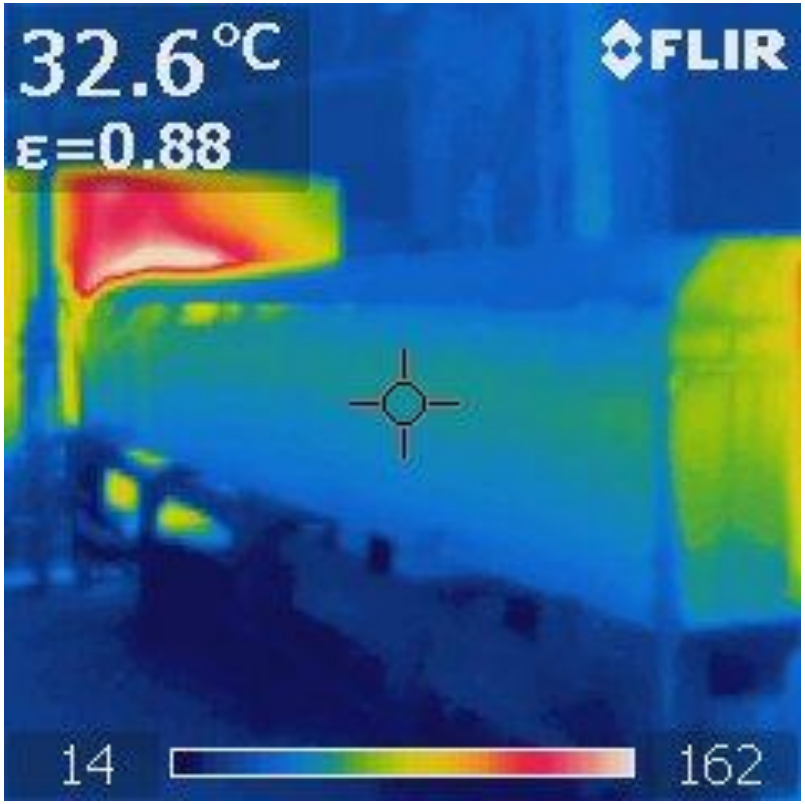
Sintering Zone-external temperature:





The temperature values on external Cooling Zone:





4. Real balance of sintering

The mean temperature of the side surface for each zone of the furnace

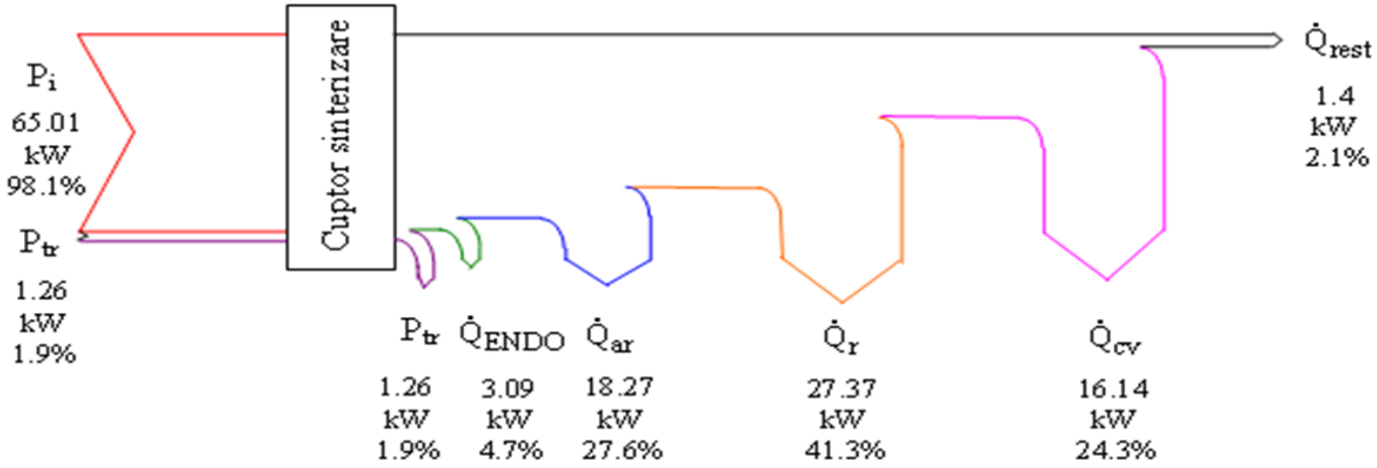
Name	Presintering		Sintering		Cooling	
	Temp.	u.m.	Temp.	u.m.	Temp.	u.m.
Surface S1 left	85	*C	91	°C	29	*C
	358	K	364	K	302	K
Surface S1, right	83	°C	90	°C	29	°C
	356	K	363	K	302	K
Surface S2 up	54	°C	56	°C	29	°C
	32"	K	329	K	302	K
Surface S2, down	45	°C	49	°C	29	°C
	31S	K	322	K	302	K
Surface S3 in.	86	°C	92	°C	29	°C
	359	K	365	K	302	K
Surface S3, out.	SS	°C	9"	°C	29	°C
	361	K	3"0	K	302	K

Radiant heat loss by muffle: 1.03 kW

Total radiant losses : 27.37 kW

4. Real balance - Sinter

Sankey diagram of thermal balance for sintering furnace CTS 450



Sankey diagram of power balance for the sintering furnace CTE 450

The participating powers in the balace are shown booth in absolute value, as in percentages.

Pi - Electric power for heating;

Ptr – Electric power for driving the conveyor belt system;

Qendo – Thermal power for Endo gas heating;

Qar- Thermal power evacuated thrue the cooling water;

Qr - Thermal power lost thrugh radiant effect;

Qcv Thermal power lost thrugh convective effect ;

Qrest“ Rest of the thermal balance

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5. Optimized balance - Sintering

The improvements in the operating condition of the existing furnaces and cracking plant for producing Endo gas, could bring the following beneficial effects:

-Optimization of the furnace loading rate(there were noticet brakes in loading with parts the conveor belt may result in a reduction of electric energy specific consumption with approx. 5%.

-The adjusting of cracking plant burners will reduce the combustion gas combustion gas consumption by approx. (5 ... 10)%, which means a reduction of about (2..5)% of the total consumption of methane (CH_4)

-At least a partial recovery of the thermal energy contained in the exhaust gases through the hoods of the inlet and outlet zones of the furnace. The recovery potential is maximum (10 ... 15) kW and can result in a reduction of methan consumption.

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-The production scheduling, in order to reduce to a minimum the number of furnaces stopping. The estimated potential to reduce the energy consumption by this measure is of about. (2 ... 3)%;
-The integral recovery of the heat contained in the cooling water, through the heat pump, which increases the thermal potential of the cooling water from (37 ... 40) ° C to (50 ... 55) ° C.
-It is estimated that a heat pump could prepare by recovering the heat from the cooling water of a single furnace, the entire amount of hot water consumed daily by the our company in approx 10:00 hours, with a consumption of approx. 5 kWh electrical energy, which can fully replace the current methane consumption for hot water. It is estimated a cost savings in producing the hot water approx. 20%
-Reducing the energy losses of the control cabinet .

5. Optimized balance - Sintering

The replacement of the existing furnace with one more modern, already bring the following benefits:

- Reduction of the specific energy consumption by using of a more efficient technology with 25-30%.

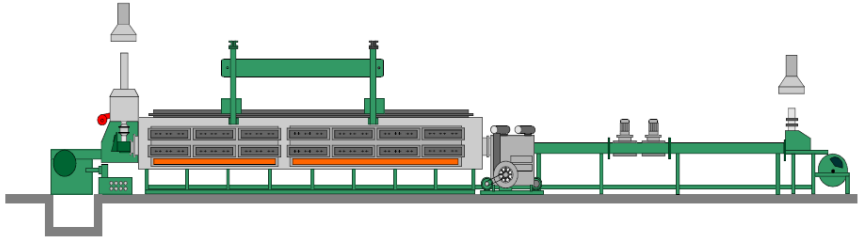
-Reduction of the energy consumption by reducing the need of resintering some of the parts –about 5%.

-Reduction of methane consumption by including the cracking in the furnace design-about 10%.

-Reduction of radiant and convective heat losses through the surfaces of the furnace about 10%.

-Reduction of the energy losses in the control cabinet-about 1%.

5. Optimized balance - Sintering



A simple chart of a modern sintering furnace:

Name	Old Furnace CST 450		Upgraded-MAHLER	
	Value	u.m.	Value	u.m.
Production capacity	43.45	kg/h	180-200	kg/h
Intalled power	2 x 1 24 = 248	kW	185	kW
Real average measured power	2x 66.27 = 132.5	kW	_	kW
Real average power consummed on long term	2 x 78 = 156	kW	-	kW
Conummed power in nominal duty /installed power	53.44…63	%	60...70	%
Methane consumption	13.5	Nm3/h	25..30	Nm3/h
Methane consumption	145-	kWh	268... 322-	kWh
Cooling water consumption	2.7	Nmc/h	1.5...2	Nmc/h

**Whith out carbon restoration and without rapid cooling
***1 Nm^3/h CH_4 = 10.45[kwH]

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New sintering furnace DLMGE 450/100 / 800-4500G

- MAHLER sintering furnace DLMGE 450/100 / 800-4500G -operating safety
- Continuous conveyor belt type furnace with electric heating with TPC
- For sintering of metallic powder parts in protective atmosphere
  The method of treatment: dewaxing and sintering
  Parts to be treated: different ferrous PM parts
  The output date: Maximum load on the conveyorbelt 34kg/m
  Working temperatures:
  Dewaxing zone: 650-900 degrees C
  Sintering zone: 950- 1150 degrees C
  Nominal capacity: 290 kg/h
  The actual capacity depends on the shape of the parts and their loading on the belt.
  For sinter-hardening the capacity is lower, because normally, the parts are placed only on a single layer on the conveyor belt.
  Data of the furnace :
  Conveyor belt width 450 mm ; 100 mm headroom above the belt
  Presintering (dewaxing) zone: 800mm
  Sintering zone: 4500mm
  Dewaxing zone - 1.group resistence
  Sintering zone - 5 group resistence
  Speed of the conveyor belt control: 50-500 mm/min

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Inlet zone and sintering zone:

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Cooling zone:

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Control Panel-TPC-Total Process Control

Hood of the outlet zone:

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*Reduction of electric energy consumption in our manufacture of sintered parts of metallic powders through the acquisition and operation of an **hydraulic CNC PM press**, of last generation*

In the frame of investment program, cofinanced with European funds, *" The modernization of technology in SINTEROM manufacture of high complexity and precision metallic sintered parts"*, SINTEROM commissioned, in June 2014, an automatic hydraulic CNC press of 250 tones, for the compacting of metallic sintered parts, type TPA250/3HP, DORST-Germany. It represents a press of last generation in this field, whose multi-plate adapter, hydraulically CNC driven, assures independent bilateral movements of up to six punches, plus core and die, so, the compacting of high complexity and precision parts with up to six compacting levels.

This new press doubles our manufacturing capacity of high complexity and precision sintered parts requiring compacting forces of 150-250 tones. The initial capacity was represented by a similar pres of 250 tones, DORST TPA250-HMP, acquired and commissioned in 1998, representing an older generation of such presses, with lower energetic and productivity performances, in comparison with the new one.

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Reduction of electric energy consumption in our manufacture of sintered parts of metallic powders through the acquisition and operation of an **hydraulic CNC PM press**, of last generation

In our decision of acquiring the new DORST press, through a competition of offers, with evaluating criteria clearly established in the task book of the assessment documentation, it has weighed much its energetic performances too, respectively its specific electric energy consumption, related to the number of compacted parts.

It could be noticed that the producer, DORST Technologies Co- Germany, was intensely concerned with the increase, among others, of the energetic performances of its new generations of PM presses, optimizing their compacting cycle, by appeasing the load peaks, with much more uniformity in their distribution.

In comparison with the total installed power of the old press, TPA 250- HMP 1988, of 130 Kw, the same technical characteristic of the new press, TPA 250/3HP 2014, is of only 75 Kw.

Much more, the improvements in the new press, give the possibility to increase its compacting stroke rate, (number of compacted parts per minute),.for a certain compacted part, in comparison with the old one.

In the manufacturing program on the new press, starting with June 2014, its commissioning date, we have compacted on it both new assimilated sintered parts, as well as parts partially or totally transferred from the old press, on the reasons of urgencies in delivery.

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Reduction of electric energy consumption in our manufacture of sintered parts of metallic powders through the acquisition and operation of an **hydraulic CNC PM press**, of last generation

Having an urgent order of **140.000 pieces** of a ferrous powder sintered part , Chain pulley, from a german company producing injection pumps and their driven systems, we have distributed its compacting operation on both DORST presses, registering, at the same time, their operating times and electric consumptions.

On the old press, there were compacted 60.000 pieces of chain pulleys, during 166, 6 hours, with a total electric consumption of 15.160 Kwh..

On the new press, there were compacted 80.000 pieces of the same part, during 185,2 hours, with a total electric consumption of 12.856 Kwh.

The electric specific consumptions on the two presses were of :

- old press 15.160 Kwh / 60.000 pcs. = 0,2527 Kwh/pc;

- new press 12856 Kwh /80.000 pcs = 0,1607 Kwh/ pc,

with a difference of 0,0920 Kwh/ pc, an economy by the transfer of the compacted part from the old press to the new one, respectively 36.4%.

To be noticed that the chain pulley was compacted on the new press with a stroke rate of 7,2 pieces/ minute, with 20% higher than the stroke rate on the old press, of 6,0 pieces/minute.

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Reduction of electric energy consumption in our manufacture of sintered parts of metallic powders through the acquisition and operation of an a **hydraulic CNC PM press**, of last generation

In the presumed situation of fully loading the new press with this part, at a stroke rate of 7,2 pieces/ minute, in an operating program of 250 working days/year with two shifts/ day of 400 minutes effective run /shift, the yearly production of chain pulleys will be of:

7, 2 pieces/minute * 250 days/ year * 800 minutes/day = 1.440.000 pieces/year.

The yearly electric economy obtained by transferring this part on the new press, will be of:

1.440.000 pieces/year * 0,092 Kwh/pc = 132480 Kwh/year, namely 132.5 Mwh, an important economy.

Beside the advantages in productivity and product quality,(narrow allowances, more uniform density our presentation shows clearly the energetic advantages of the new CNC press, of last generation.

OLD DORST TPA 250[tf]:

Manufacturing year: 1998.

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NEW DORST TPA 250[tf] 3 HP

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CNC -TPA 250/ 3HP DORST PRESS

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1. Final conclusion:

FOR THE CONVEYOR BELT FURNACES: *approach economy on 2015-9.750 euro*	Old Furnace CST 450		Upgraded-MAHLER	
Name	Value	u.m.	Value	u.m.
Production capacity	43.45	kg/h	200	kg/h
Intalled power	2 x 1 24 = 248	kW	185	kW
Conummed power in nominal duty /installed power	53.44…63	%	60...70	%
Methane consumption	13.5	Nm3/h	25..30	Nm3/h
Methane consumption	145-	kWh	268... 322-	kWh
Cooling water consumption	2.7	Nmc/h	1.5...2	Nmc/h

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2. Final conclusion:

FOR THE COMPACTING PRESSES:

On the old press, there were compacted 60.000 pieces of chain pulleys, during 166, 6 hours, with a total electric consumption of 15.160 Kwh.

On the new press, there were compacted 80.000 pieces of the same part, during 185,2 hours, with a total electric consumption of 12.856 Kwh.

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with a difference of 0,0920 Kwh/ pc, an economy by the transfer of the compacted part from the old press to the new one, respectively 36.4%;

- Approach economy on 2015-4.550 euro;

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3. Final conclusion:

For other new measures-2015- ***total economy approach-9.600 euro:***

-Reducing electricity consumption and overall operating costs by upgrading recycled water pump station no.1 and its external distribution network- economy approach on 2015- 3.750 euro.

-Reducing consumption at the electrical energy of the compressor station through the acquisition and installation of a compressor section Sintered low flow (100 l / h); economy approach on 2015- 1.100 euro

-Decreased consumption of electrical energy in heat treatment toolroom, through reinstatement of small ovens chamber from technical laboratories, oil hardening and tempering elements tooling, and their exploitation in place of old line salts batches or carbonitriding batch furnace with 300 kg/charge capacity; economy approach on 2015- 3.200 euro

-Replacing and modenizing of conveyor belt sintered furnace CST 300 for efficient sintering bronze parts (bushes and bearings; economy approach on 2015- 1.550 euro

THANK YOU FOR YOUR KIND ATTENTION !