TEST case study

Wire drawing company

Developed under the framework of Med TEST II

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

switchmed

The SwitchMed Programme is funded by the European Union

Wire drawing company

SECTOR	Mechanics
SUBSECTOR:	Wire drawing
SIZE	200 employees
PRODUCTS	Drawn wire and pre-tensioned strands
MARKET	Local and international (USA, Arab states of the Persian Gulf, Africa)
CERTIFIED MANAGEMENT SYSTEMS	ISO 9001, ISO 14001

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Company Key Data

Reasons to join TEST project

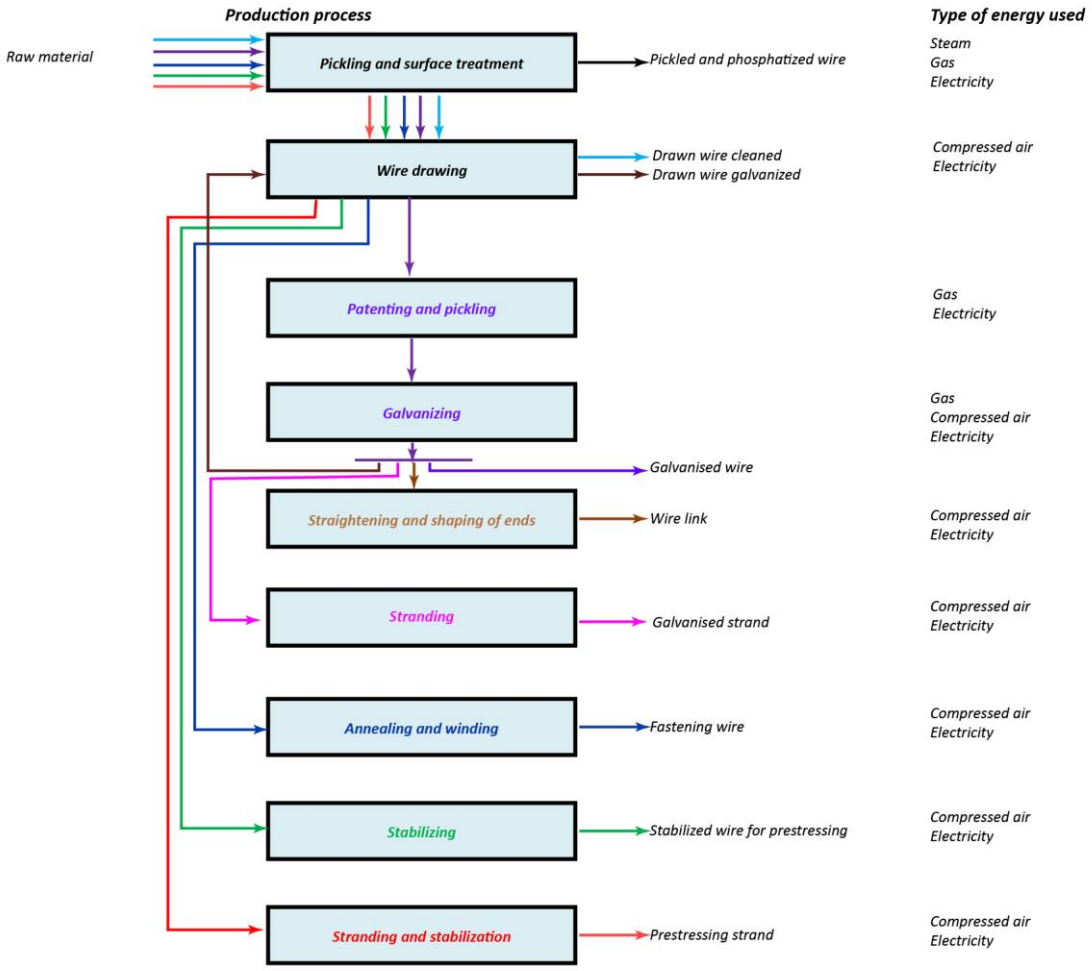
- Identify losses in the production system
- Optimise the use of resources
- Preserve the environment and comply with regulatory requirements
- Integrate sustainable development into the continuous improvement strategy

Year 2015	Unit	Value
Production	t/year	26,702
Electricity consumption	MWh/year	9,795,353
Gas consumption	thm/year	12,536,551
Water consumption	m^3/year	66,274
CO_2 emissions	Tonnes/year	9,322,775
BOD	kg/year	28,800
COD	kg/year	14,200
Total cost of sales	€	17,004,186
Total cost of inputs (purchase value of raw materials, auxiliary materials, energy, packaging and water)	€/year	10,447,422
	% vs cost of sale	61.44%
Estimated non-product outputs	€/year	1,909,250
	% vs cost of sale	11.23%

Process overview/flowchart

INPUTS

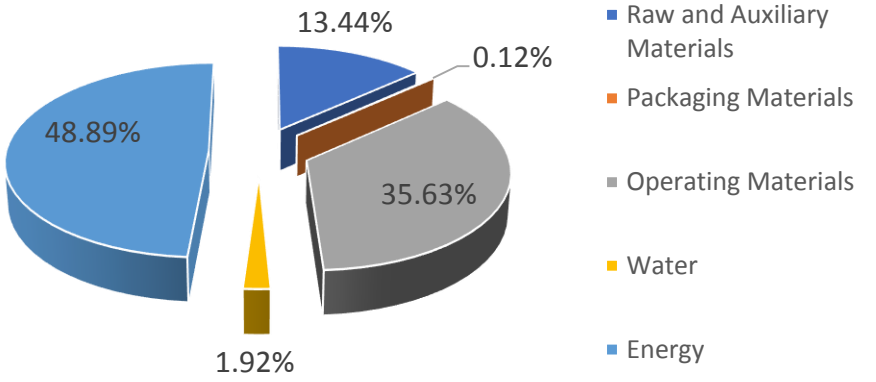
High carbon steel wire stock
Mild carbon steel wire stock
Zinc
Hydrochloric acid (HCl)
Sulphuric acid (H_2SO_4)
Phosphate
Borax
Sodium carbonate
Lubricants
HDPE duct
Crêpe paper
Strip steel for palettes
Plastic
Municipal Water
Electricity
Gas
Gas oil

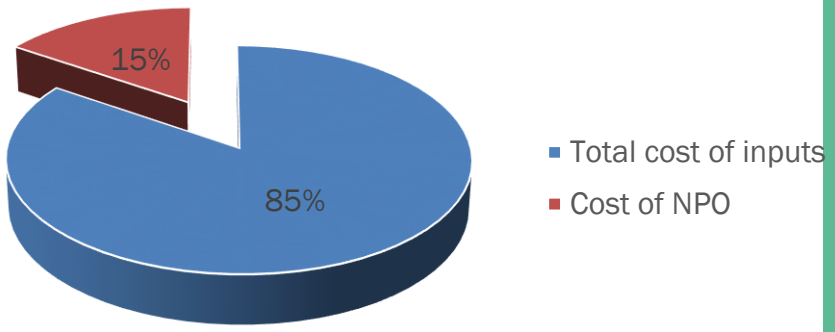


OUTPUTS

Metal waste
Strip steel
Boxes
Wood
Plastics
Crêpe paper
Zinc
Household waste
Pallets
Phosphate sludge
Wire drawing soap
Pickling and treatment sludge
Used cloths
Used gloves
Lubricants
Waste water

Non-product output (NPO)





Distribution of NPO per flow (%)

Distribution of NPO RM per product flow (t)

Approximately 15% of the purchase value in 2015, equivalent to €1,909,250 is lost in the form of NPOs (energy, water, materials etc.)

Information system – MFCA

The general accounting data are global and not precise; they don't allow for an apportionment of expenses for the production process. They don't fulfil their standard purpose of allocating expenses by nature.

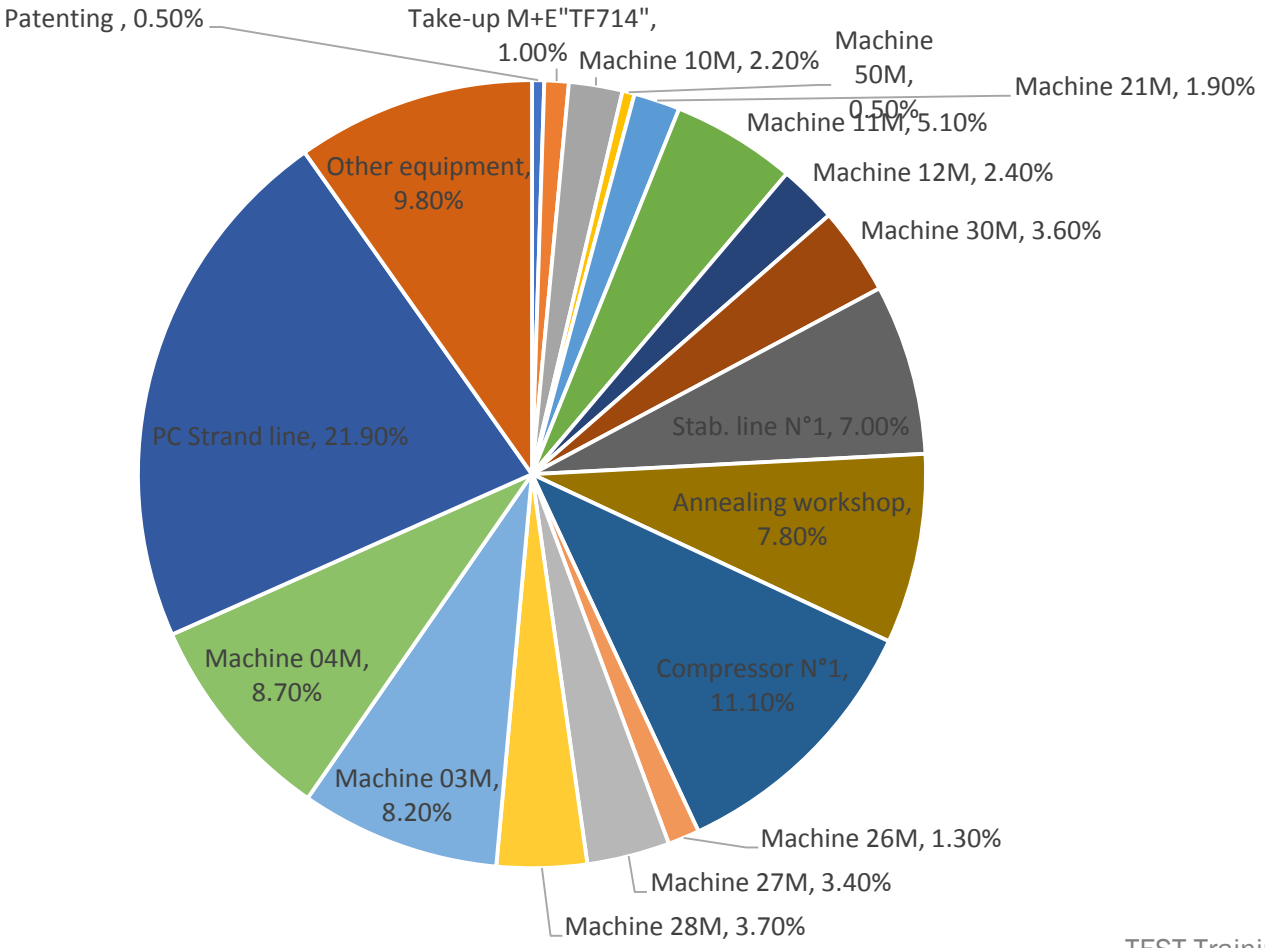
The main recommendations are:

- Set up accounting and daily input system on the ERP with the details of the composition of NPOs
- Plan a project for weighing all references of articles produced
- Install secondary meters for water and energy to allow for a correct breakdown of costs
- Set up a cost accounting system

Analysis of energy use

Electricity use	Average monthly electricity consumption in 2016 (kWh)	Percentage [%]
Patenting	3,948	0.5%
Take-up M+E"TF714"	8,333	1.0%
Machine 10M	18,485	2.2%
Machine 50M	4,593	0.5%
Machine 21M	16,229	1.9%
Machine 11M	43,185	**5.1%**
Machine 12M	20,309	2.4%
Machine 30M	29,945	3.6%
Stab. line N°1	58,886	**7.0%**
Annealing workshop	65,185	**7.8%**
Compressor N°1	92,769	**11.1%**
Compressor N°2		
Compressor N°3		
Machine 26M	10,575	1.3%
Machine 27M	28,275	3.4%
Machine 28M	30,718	3.7%
Machine 03M	68,956	**8.2%**
Machine 04M	72,628	**8.7%**
PC Strand line	183,871	**21.9%**
Other equipment	82,213	9.8%
Total monthly average	839,103	100.0%

Distribution of energy consumption per use



Focus areas and cause analysis (1/2)

Focus areas	% in relation to NPO costs	Cause analysis
Wire drawing	50%	Release of thermal energy from fumes from the annealing furnace without recycling; the wire drawing process consumes a lot of electricity (40% of total consumption).
Pickling	18 %	The pickling process consists in eliminating iron oxides from the steel wire by using a solution of hot sulphuric acid. The more it is used, the more the amount of iron increases in the vat of acid, which results in a decrease in the acidity levels required for pickling. Consequently, the vat of acid needs to be replaced, which results in the generation of a lot of acid waste and a greater acid consumption.
Phosphating	10%	Wire drawing requires that the steel wire be coated in a layer of phosphate. This generates a lot of sludge to eliminate, and an overconsumption of phosphate.

Focus areas and cause analysis (2/2)

Focus areas	% in relation to NPO costs	Cause analysis
Compressed air	10 %	Presence of leaks in the compressed-air circuit and various manufacturing machinery, as well as a lack of staff awareness, and lack of monitoring of compressed-air usage in the different workshops. The current set-up of the factory's three compressors doesn't enable the optimisation of compressed-air consumption, considering that the demand for compressed air varies from one sector to another.
Presence of high current harmonics	5 %	Transformer 2 of TGBT3 mainly powers two machines with the same technical characteristics, 11M and 12M, which are identified as being two sources of harmonics with very high levels. This leads to an overconsumption of energy.

Catalogue of identified measures

N°	Name of action	Investment (in €)	Economic benefits (in €)	PBP (years)
1	Installation of an acid purification unit on the pickling bath	75,000	36,500	2
2	Set up a press filter for the phosphate coating process	10,000	4,200	2.4
3	Recovery and re-use of thermal energy from the fumes from the annealing furnace for wire drawing	36,000	254,400	0.2
4	Purchase and implementation of an energy monitoring system and an energy management system (ISO 50001)	39,300	40,500	1
5	Optimisation of the use of compressed air (reparation of leaks, storage volumes and demands in air)	5,000	26,200	0.2
6	Purchase and installation of harmonic filters for cut-out switches on machines 11M and 12M	60,000	20,400	3

Best Practice 1:

(Installation of an acid purification unit on the pickling bath) – Materials/water/waste

Description of the solution	The acid purification unit on the pickling bath ensures its continuous filtering, without interrupting production or regeneration of the bath. Acid retardation makes it possible to separate free acids from metal salts in a solution by using ion-exchange resins and by operating intermittently. The acid retardation process is based on the fact that in a mix of salts/strong acids, the acid anions are capable of penetrating into the anion-exchange resin, while the metallic cations are eliminated by electrostatic repulsion. This technique makes it possible to save 80% of acid and to minimise water consumption, waste and sludge.
Economic benefits	€36,400: • Acid savings: 2.5 m^3 acid/week* 80/100* 1.84 kg/l = 3,680 kg/week Cost 3,680 kg €0.110/kg = €405/week (estimated (48 weeks) €20,000/year) • Estimated waste management savings: 7 m^3 (9 m^3 pickling bath -2 m^3 plate discharge)/week * €49/m3 = €343/week (€16,400/year)
Environmental benefits	Savings of 176.64 t of sulphuric acid Savings of 3,000 m^3 of water Reduction of 80 t of pickling sludge
Capital investments	€75,000 Pay-back period: 2 years
Other barriers	-

Best Practice 2:
(Set up a press filter for the phosphate coating process) – Materials/water/energy

Description of the solution	**The filter press on the phosphate bath allows for continuous filtering by eliminating sludge from the bath, and consequently minimising water and phosphate consumption.**
Economic benefits	**€4,205:** **• Water consumption savings: In the initial situation, the phosphate bath (9,000 l) is renewed every 3 months, which leads to estimated annual water losses of 10 m^3 of water per year, with an associated cost of €8.00.** **• Productivity and energy savings: The time required for cleaning the bath is estimated to be approximately 100 hours per year, and if energy consumption costs for cleaning are included, the costs amount to approximately €4,000.00 per year.** **•Phosphate consumption savings: Consumption per m^3 of bath is 720 kg/year, and annually, 36 m^3 of the bath is renewed, which represents costs amounting to approximately €200.00/year**
Environmental benefits	**• Reduction of 10 m^3 of water per year** **• Reduction of 26 tonnes of phosphate per year** **• Reduction of 25 t of CO_2**
Capital investments	**€10,000** **Pay-back period: 2.4 years**
Other barriers	**Nothing to report**

Best Practice 3:

(Recovery and re-use of the thermal energy from the annealing furnace for wire drawing) – Energy

Description of the solution	The recovery and re-use of the thermal energy of fumes from the annealing furnaces for wire drawing to compensate for the use of eclectic energy, which represents 40% of overall electricity consumption
Economic benefits	€254,376
Environmental benefits	• Reduction of 3,918 MWh of electricity • Reduction of 25.50 t of CO_2
Capital investments	€20,000 Pay-back period: 1 month
Other barriers	Nothing to report

Best Practice 4:
(Optimisation of use of compressed air) – Energy

Description of the solution	Optimisation of compressed air system: • Repair the leaks in the compressed-air circuit and various manufacturing machinery, raise workforce awareness, and management of compressed-air usage in the different workshops. • Improve the performance of the compressors by improving preventive maintenance and the ventilation of the two compressor rooms • Increase the volume of the compressor SIA1 from 900 L to 2,000 L • Purchase a small compressor just for the chroming-plating machine during interruption in production
Economic benefits	26 200 €/ year
Environmental benefits	Reduction of 238.5 tonnes of CO_2 per year
Capital investments	Investment: €5,000 / PBP: 0.2 years
Other barriers	Nothing to report

Best Practice 5:
(Purchase and install harmonic filters) – Energy

Description of the solution	The installation of a filter will enable the filtering of the harmonics generated by the current rectification system and by frequency variation (10 for each machine) and will protect all types of equipment (variable frequency drives, electronic boards, cables, circuit-breakers, contactors…) connected to this low-voltage master distribution panel against harmonic. It will free up kVA of the transformer rating, and increase the availability rate of the machines 11M and 12M.
Economic benefits	20 400 €/ year
Environmental benefits	Reduction of 15 tonnes of CO_2 per year
Capital investments	Investment: €60,000 / PBP: 3 years
Other barriers	Workforce awareness

Management system integration

Topics	Measure	Document
Training on the requirements of ISO 14001, version 2015	Training day on the new requirements of ISO 14001 version 2015 for the benefit of the TEST team.	Training documents
Understanding the organisation and the context	Identify internal and external challenges for the company	Analyses of challenges
Understanding of needs and expectations of the interested parties	Identify the relevant interested parties, their needs and expectations	Analyses of the needs and expectations of the interested parties
Environmental policy	Set up an environmental policy, taking into consideration the internal and external implications, the requirements of interested parties and the environmental aspects	Policy validated and signed by the senior management

Results

Measure	Investment (euros)	Economic savings (euros/year)	PBP (year)	Water and raw materials	Energy (MWh)	Environmental impact
Installation of an acid purification unit on the pickling bath	75,000	36,437.4	2	176.64 t of sulphuric acid 3,000 m^3 of water	-	80 t of pickling sludge 31.5 kg BOD/year 285 kg COD/year 3,762.5 t CO_2
Set up a press filter for the phosphate coating process	10,000	4,205	2.4	10 m^3 of water 26 t of phosphate	Reduction of 40.3 MWh of electricity	
Conservation and energy efficiency measures: optimisation of compressed air, energy management education system, harmonic filter, recovery and re-use of thermal energy	149,286	386,555	0.4	-	4797.56 MWh electric 626,827.55 MWh thm	
TOTAL	**234,286**	**427,197.4**	**Average PBP** **0.6**	**202.64 t of materials** **3,010 m^3 of water**	**5,567 MW/year**	

Conclusion

- 8 RECP measures identified with 75% implementation (two measures are planned)
- Total annual economic savings identified amount to approximately **427,197.40 euros** with an average pay-back period of **0.6 years**
- Total in % of annual energy savings in relation to annual consumption: **35.5%**
- Total in % of annual savings of raw materials and operating materials in relation to annual consumption: **1%**
- Total in % of annual water savings in relation to annual consumption: **4.5%**
- Reduction of 1,303 kg/year of BOD and 642 kg/year of COD
- A 3,762.5% reduction in CO_2 emissions
- ISO 14001:2015 certification