TEST case study

Batteries and Cables production company

Developed under the framework of Med TEST II

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

switchmed

The SwitchMed Programme is funded by the European Union

Batteries and cables production company

SECTOR	Mechanical & Electrical
SUBSECTOR:	Batteries, Cables
SIZE	200 employees
PRODUCTS	Starter battery and solar energy, telephone cables
MARKET	Local market, Export Asia Pacific, Africa
CERTIFIED MANAGEMENT SYSTEMS	ISO 9001/2008, ISO 14001 /2004, OHSAS 18001/2007 et ISO TS 16949/2009.

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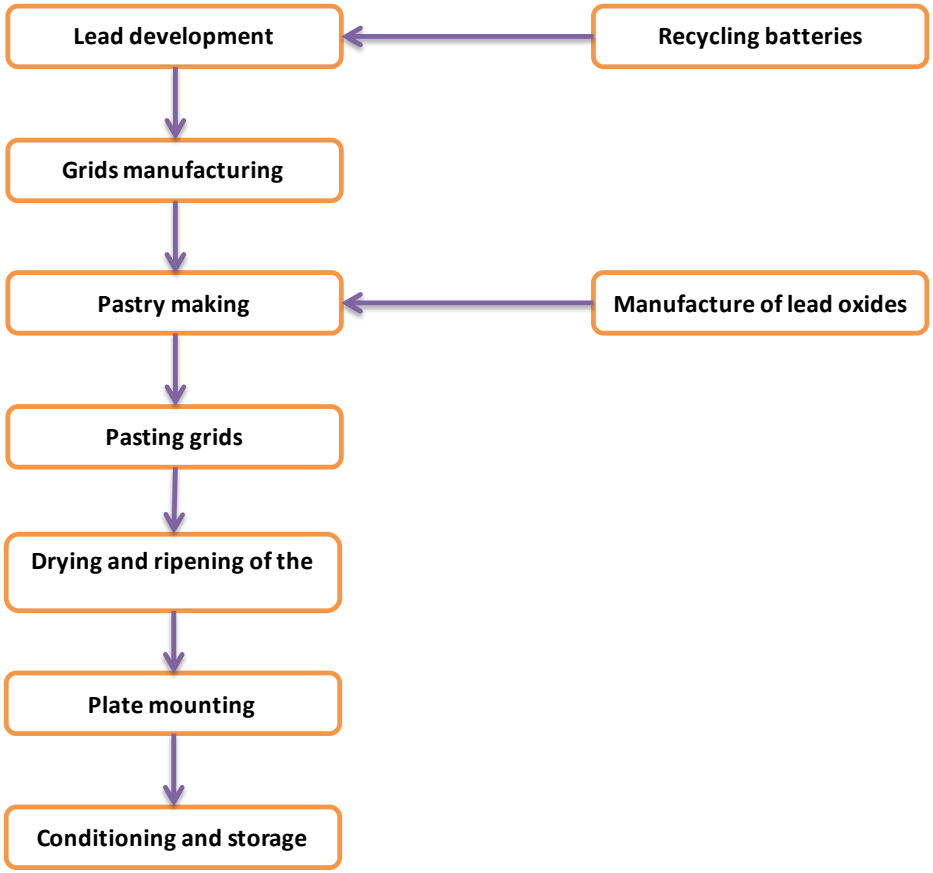
Company Key data

Reason to join TEST project

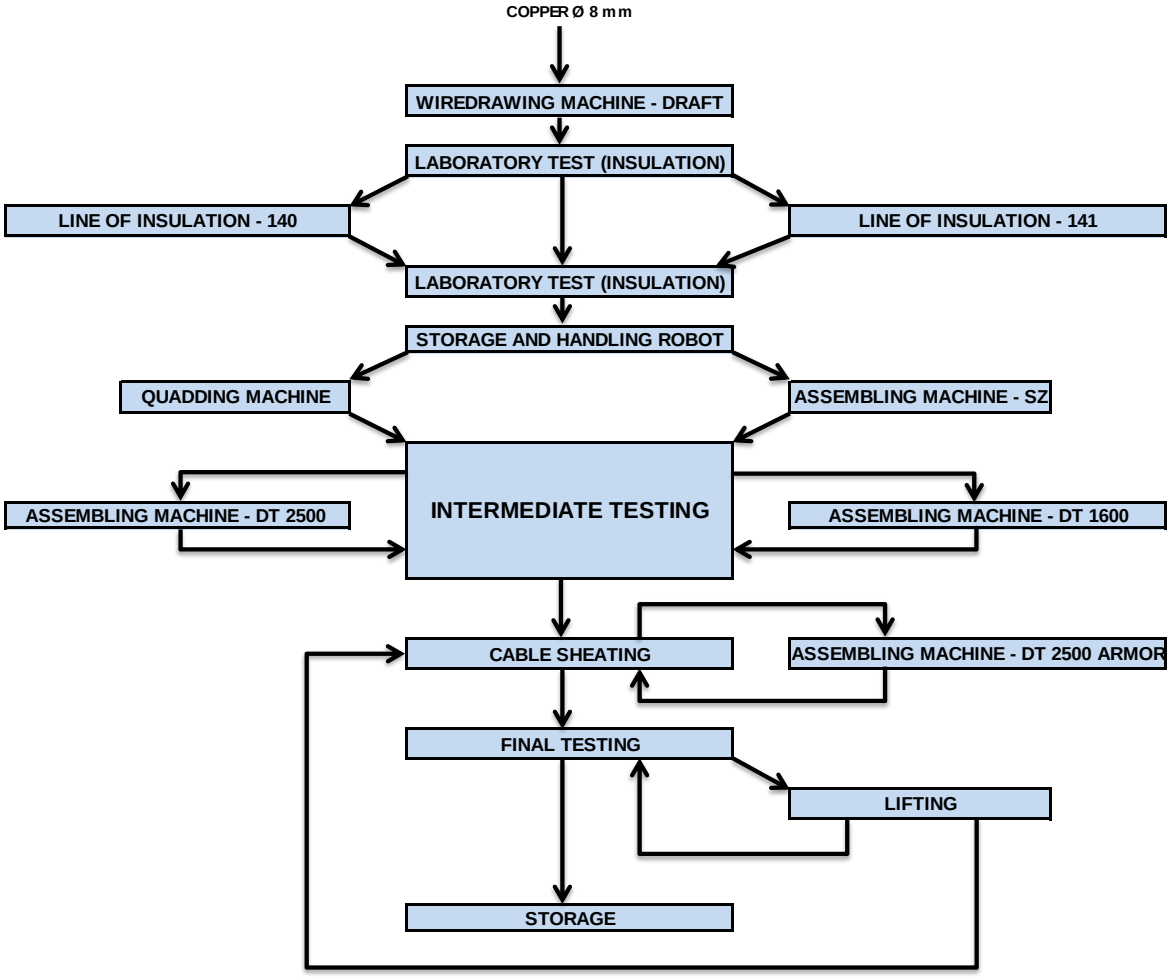
- The first reason for joining TEST project is to save resources in order to improve competitiveness and environmental performance.

YEAR 2015	Unit	Value
Production	Ton / year	Cables: 772 Batteries: 4 217
Electricity consumption	KWh/year	Cables: 2 206 220 Batteries: 2 424 463
Propane consumption	Ton/year	105.860
Butane consumption	Ton/year	110.560
Water consumption	m^3/year	14 805
CO_2 emission	Ton/year	5 527
BOD5	Kg/year	
COD	Kg/year	
Total cost of sales	€/year	11,941,564
Total cost of inputs (Purchase value of raw materials. auxiliary materials. packaging energy and water)	€/year	7,484,049
	% vs. cost of sales	62.7%
Estimated non-product output	€/year	979,299
	% vs. cost of sales	8.2%

Process overview for batteries production



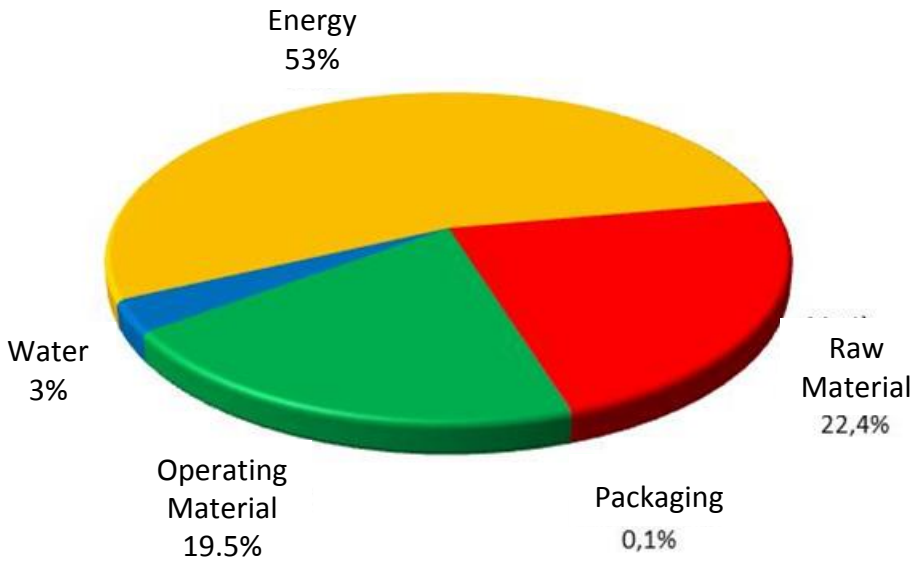
Process overview of telephone cabling production

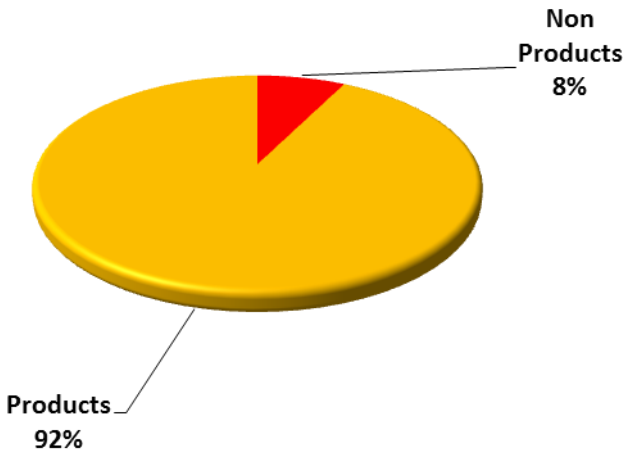


Benchmarking

Benchmark type	Unit	Company	Best practice
Electricity	Batteries: kWh/T. of product	574.97	420-550
	Cables: kWh/T. of product	2860	1710-1970
LPG	Batteries: Kg./T. of product	43.39	38-44
Water	l/T. of product	2968	2500-3000
Solid waste	Kg/T. of product	13.62	10-20

Non-Product output costs



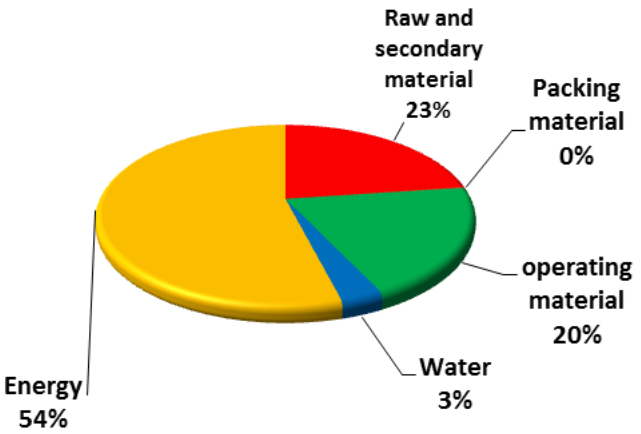


Approximately 8.2% of the sales value in 2015 (979,299 €/year) was lost due to product losses in manufacturing. energy. waste water and waste generation.
It represents also 13.1% of total inputs costs

Priority flows

- NPOs cost analysis

Balance of material-energy flow: IN / OUT	Value [€]	Non Product Outputs NPO % [volume]	costs NPO [€]
1. Inputs (Consumption)			
1.1. Raw and secondary materials			
Subtotal	6,457,209	**3.46%**	223,600
1.2. Packing materials			
Labels	46,887	**1.00%**	467
Plastic rolls	10,554	**2.00%**	187
Drills and pallets	134,589	**0.00%**	0
Caps & Sleeves	4,110	**0.50%**	0
Drawing nails	1,961	**0.00%**	0
Subtotal	198,195		747
1.4. Operating materials			
Spare Parts and Consumables	194,832	**100.00%**	194,832
Subtotal	194,832		194,832
1.5. Water			
Water(m3)	33,904	**90%**	30,542
Subtotal	33,904		30,542
1.6. Energy			
Subtotal	599,908	**88.28%**	529,671
Total input	7,484,049	**13.1%**	979,299



Priority flows

The following table shows the distribution of non-product outputs

	€	Distribution
1. Costs of non product outputs	979,299	100%
1.1. Raw and secondary materials	223,600	22.80%
1.2. Packing materials	747	0.07%
1.4. Operating materials	194,832	19.9%
1.5. Water	30,542	3.12%
1.6. Energy	529,671	54.1%

The priority flows are the following:

1. Energy with 54.1% of NPO.
2. Raw materials with 22.8% of NPO
3. then operating materials with 19.9% of NPO

Priority flows

- Potential for improvement (e.g. vs. benchmarks)
  - Potential for improvement on electricity bill is around 45% . including part of renewable energy self-production for around 22%
  - Potential for reduction of solid waste is around 5%
- Environmental considerations
  - Reduction of GHG
  - Reduction of solid waste
  - Reduction of liquid pollutants (Sulphur acid)

Information system - MFCA

- Key findings

The MFCA methodology allows the company to know about its financial information system. the priority flows (energy. raw and operating material) and focus areas (plate manufacturing and battery assembly and finishing) that represent sources of cost reduction and therefore potential to realize additional savings.

- Experience with I/O analysis

The input-output analysis allowed the company to know the difference in costs and volume between inputs and outputs of the plant and consequently to quantify these non-product outputs (losses)

- Recommendations

It is recommended to use the balance accounts for all inputs at the material balance level.

It is recommended that the evaluation be repeated over the next few years. Thus. the improvements made would become visible.

Information system - Metering

- It is recommended to put in place a certain number of indicators in accordance with main flows and focus areas mentioned in the MFCA
- Put a monitoring /tracking plan on the ERP system
- Set up a sampling plan in the plant
- Adapt the automatic loading mode to all product references
- Exploit on real time the machine production data to calculate the operational performance.
- Add the required new meters needed to energy and Production Management System such meters for electricity, water, LPG, compressed air, and production data to facilitate the implementation of the monitoring on real time.

Selection of focus areas:

The focus areas were selected in relation with priority flows and based on the split of the NPO by key cost centers. The company top management has requested to focus on the battery unit which is strategic for the business.

CATEGORIES OF ENVIRONMENTAL COSTS	Cost centers (production process. key services. etc.)								
	Total K€	Foundry / Wire Drawing	Plate section / Insulation	Assembly / Assembly	Finishing / Sheathing	Couronnage	OPF Store	Store PF	After sales service
1. Non-Product Output (NPO) Cost	979	131	407	193	226	2	1	1	0.19
		13.36%	41.53%	19.71%	23.10%	0.22%	0.11%	0.11%	0.02%
1.1. Raw and secondary materials		2.7%	58.6%	18.5%	20.4%	0.0%	0.0%	0.0%	0.0%
Subtotal	224	6	131	41	46				
1.2. Packing materials		0.0%	0.0%	0.0%	99.1%	0.0%	0.0%	0.0%	0.9%
Subtotal	1				1				0.01
1.4. Operating materials		25.0%	25.0%	25.0%	25.0%	0.0%	0.0%	0.0%	0.0%
Subtotal	195	49	49	49	49				
1.5. Water		35.0%	10.0%	5.0%	50.0%	0.0%	0.0%	0.0%	0.0%
Subtotal	31	11	3	1	15				
1.6. Energy		12.34%	42.26%	19.14%	21.90%	0.41%	0.21%	0.21%	0.04%
Subtotal	530	65	224	101	116	2	1	1	0.01

Selection of focus areas:

For battery unit, the focus areas are the following:

1. The production section of batteries plates has been selected as the first focus area with (41.53% of NPO)
2. The finishing section of batteries has been selected as second focus area with 23.1% of NPO
3. The battery assembling section has been selected as third focus area with an NPO of 19.7%

Saving Catalogue – identified projects

Category	N°	Projects
Energy	1	Improvement of the cos phi and optimization of the subscribed power- Battery unit
	2	Improvement of the cos phi and optimization of the subscribed power- Cabling unit
	3	Improvement of interior lighting system (offices, factories) – Battery unit
	4	Improvement of interior lighting system (offices, factories) – cabling unit
	5	Improved outdoor lighting system (& large interior volume) – Battery unit
	6	Improved exterior lighting system (& large interior volume) – Cabling unit
	7	Improvement of the compressed air system by installing a variable speed compressor and a leak detection and repair campaign - Cable unit
	8	Improvement of the compressed air system by installing a variable speed compressor and a leak detection and repair campaign - Battery Unit
	9	Stand-alone PV electricity production in self-consumption (4,000 m2 - 620 kWp)
	10	Replacement of current engines with high efficiency motors
	11	Installation of an electrical, thermal and water energy management system to implement the ISO 50001 standard

Saving Catalogue – identified projects

Category	N°	Projects
Environment	12	Recover and reuse the acid solution generated at the finition unit when washing the batteries
	13	Improve the storage area for used batteries
	14	Eliminate acid leakage
	15	Conforming liquid discharges in terms of sulphate content - variant 1: replacement of soda with lime milk
	16	Conforming liquid discharges in terms of sulphate content - variant 2: recovery of sulfuric acid from used batteries
	17	Air purification at the recycling facility and the neutralization unit.
Process	18	Optimize the COS station
	19	Implementation of the 5S approach
	20	Implementation of the TPM approach
international expert	21	Replace the lead pot "COS" with electric heating with lead level control and automatic lead feeding and improve the COS process (mold preparation and casting)
	22	Improvement of the hardening process
	23	Wrapped Plate Handling / Battery Alignment
	24	Recycling plant - Introduction of the pulp desulfurization stage (battery)
	25	Renovation of IC welding (compression welding)

Installation of a PV electricity generation system in self-consumption mode

Description of the solution	It is proposed to install a photovoltaic system on the terrace (4,000m2) operating over the sun consisting mainly of photovoltaic panels for the direct conversion of solar energy into electrical energy, the structure carrying solar panels and a converter of the direct current generated by alternating current.
Economic benefits	The annual savings are 96,310€
Environmental benefits	The 1,035 MWh saved will avoid the emissions of 756 T.eCO2
Capital investments	The investment was calculated based on the price of solar panels. inverters and cabling. It is around 487,840 €.
Other barriers	

Wrapped Plate Handling / Battery Alignment– Raw materials

Description of the solution	Proposed actions: 1. rework the plate divider to minimize sharp edges / wires (adjustment, introduce extra roll and guide) alternatively: replace the plate divider with modern plate divider to obtain a more precise plate cut 2. Rework plate stacking technology on drying (see action sheet 2) 3. Install a stacking conveyor with a smooth surface to transport the stack of plates from the envelope to the Cast-On-Strap (COS) machine 4. Perform tests / adjust the wrapping machine (change crimping and tension on the rollers) 5. Rework the setting of the COS machine; create and install tooling for machine tuning 6. Adjust lug aligner and vibration table (adjustment. manometer) 7. Check the setting and closing of the junction box (optional: change to scissors junction boxes) 8. Rework operating manuals and train staff 9. Check the battery design to make it robust against the perforation of the separator 10. Rework the canning procedure / create tools to support 11. Canning without damaging the elements

Wrapped Plate Handling / Battery Alignment– Raw materials

Economic benefits	According to data of October 2017: - Internal rejection: 1,125 batteries / year at costs (calculated) of 26,853 € / year - Warranty claim caused by short circuits: 3,235 batteries / year at costs (calculated): 3,235 batteries x 47.15 € / battery = 152,528 € / year Assumption: the guarantee and internal rejection can be reduced by 50% each. Total savings: 89,690 € / year
Environmental benefits	Calculation of energy and lead gains: 1. Energy saving (energy consumption of 20.48 kWh per battery produced): (3,235 + 1,125) x 0.5 batteries x 20.48kWh / battery = 44,646 kWh per year -> 32.8 T.ECO2 2. Lead saving (10 kg Pb / battery): (3,235 + 1,125) x 0.5 batteries x 10 kg Pb / battery = 21,800 kg of lead per year which is recycled
Capital investments	Costs for the improvement of the COS machine. handling of the plates / batteries and separation of the plates: 7,000 € Estimated costs for process testing. operator training and consulting: **25,000 €**
Other barriers	No

Recover and reuse the acid solution generated at the finisher when washing the batteries

Description of the solution	The batteries produced are washed so that there is no trace of acid. The generated acidic water is sent to the loading and finishing plant to be neutralized and evacuated to the city sewerage network. Solution is the establishment of an appropriate collection system of this acid solution for recovery and use in the production (by dilution) of acid of different concentrations necessary for the batteries produced. This will avoid the costs of its treatment and bring an economy in the optimization of the quantities of acid and demineralized water consumed (use of demineralized water as washing water).
Economic benefits	Saving the operating costs of the treatment step and those of the treatment of rejects. The actual operating cost is about 60,710 €, if we reduce it by 50%, the estimated saving is 29,500 €
Environmental benefits	-Recovery and demineralized water and sulfuric acid through their reuse in the manufacturing process. -Not production of liquid waste or waste resulting from the treatment of this solution. If we consider that we can reduce the actual sulfuric acid & water consumption by 20%, the saving will be 60 Tons by year for sulfuric acid and 2,960 m3 for water
Capital investments	Cost of the adaptation works of the current washing water recovery system and a storage tank of the recovered solution We estimate the requested investment for this project to 55,000€. The PBP is less than 2 years
Other barriers	No

Management system integration

- Impact on potentially reduced environmental compliance costs (reduction of 444 m3 of liquid waste. and 120 tons of solid waste)
- Integration of RECP into ISO 9001 existing management systems
- Positive behavior change for the employees and management
- Systematic use of TEST tools such MFCA
- Other tangible benefits gained by company such the reduction of thermal & electrical energy consumption, optimization of the dyeing process and the technological upgrading of the winding equipments

Performance Monitoring

Following the installation of a metering system for RECP

- The company have started the implementation of an Energy Management System through an external service provider .
- They will have to add other resource consumption and production data into the local solution management system
- So they will be able to produce all KPI and OPIs.

Results

Action	Investment euro	Savings euro /Yr	PBP Years	Water and Raw Materials /Yr	Energy MWh/Yr	Environmental Impacts /Yr.
Electric energy and compressed air	73,530	55,265	1.3	-	435	Total: 2,084 t CO2 444m3 waste water 120 t Solid waste
Desulphurization in the recycling plant and environmental compliance	854,580	73,548	11.6	40 t Solid waste	2,679	
Energy management system	46,790	21,355	2.1	-	263	
Improving technology and optimizing production	197,490	271,400	0.7	444 m3 water 80 t Solid waste	114	
Stand-alone power generation	477,505	94,269	5.1	-	1,035	
TOTAL	**1,649,895 €**	**515,837 €**	**3.2**	**444 m3 water 120 tons Solid waste**	**4,526 MWh**	

Conclusion

- 25 RECP opportunities under implementation
- Economic Savings 515,837 € with an average PBP of 3.2 years
- Total annual Water savings : 3%
- Total annual Energy savings : 36%
- Total annual Raw Material savings : 2%

- Non-Product output costs reduced by more than 50%
- CO_2 emission reduction by 38%