TEST case study

Production of pasta and couscous

Developed under the framework of Med TEST II

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

switchmed

The SwitchMed Programme is funded by the European Union

Production of pasta and couscous

SECTOR	Agri-foodstuffs
SUBSECTOR	Production of pasta and couscous
SIZE	150 employees
PRODUCTS	Couscous (fine and average sized grain), short pasta (Mhamssa, Tlitli, pipe pasta of different sizes, vermicelli, macaroni, bird tongue, shells)
MARKET	
CERTIFIED MANAGEMENT SYSTEMS	ISO 22000 planned

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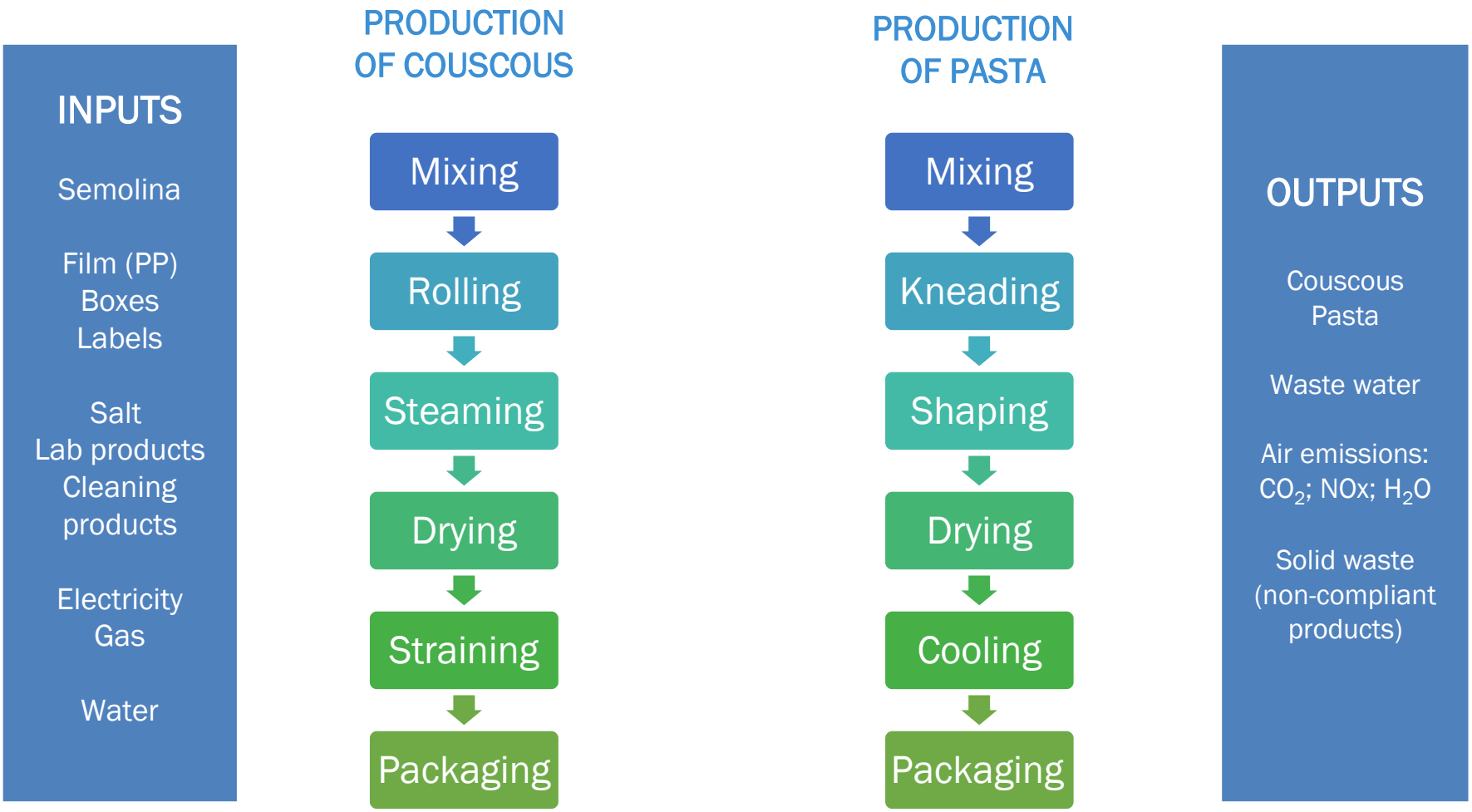
Company key data

Reason to join TEST project

To identify economical assets in terms of raw materials, water and energy in order to increase our productivity and to endorse a national policy of streamline expenses and competitiveness.

YEAR 2016	Unit	Value
Production	tonnes/year	6,702.872 Pasta: 3,939.793 Couscous: 2,763.079
Electricity consumption	kWh/year	2,581,750
Gas consumption	m^3/year	1,637,233
Water consumption	m^3/year	6,525
CO_2 emissions	tonnes/year	5,508.5
BOD5	mg/l	70
COD	mg/l	217
Total cost of sales	€/year	2,791,165
Total cost of inputs (purchase value of raw materials, auxiliary materials, packaging energy and water)	€/year	2,223,004
	% vs. cost of sales	79.65%
Estimated non-product output	€/year	196,427
	% vs. cost of sales	7.04%

Process overview/flowchart

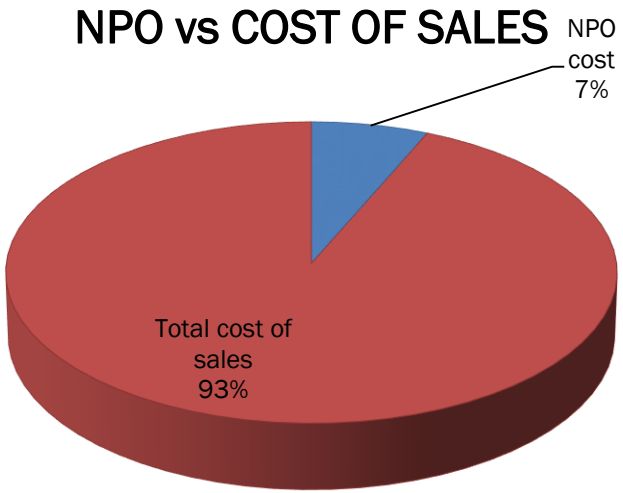


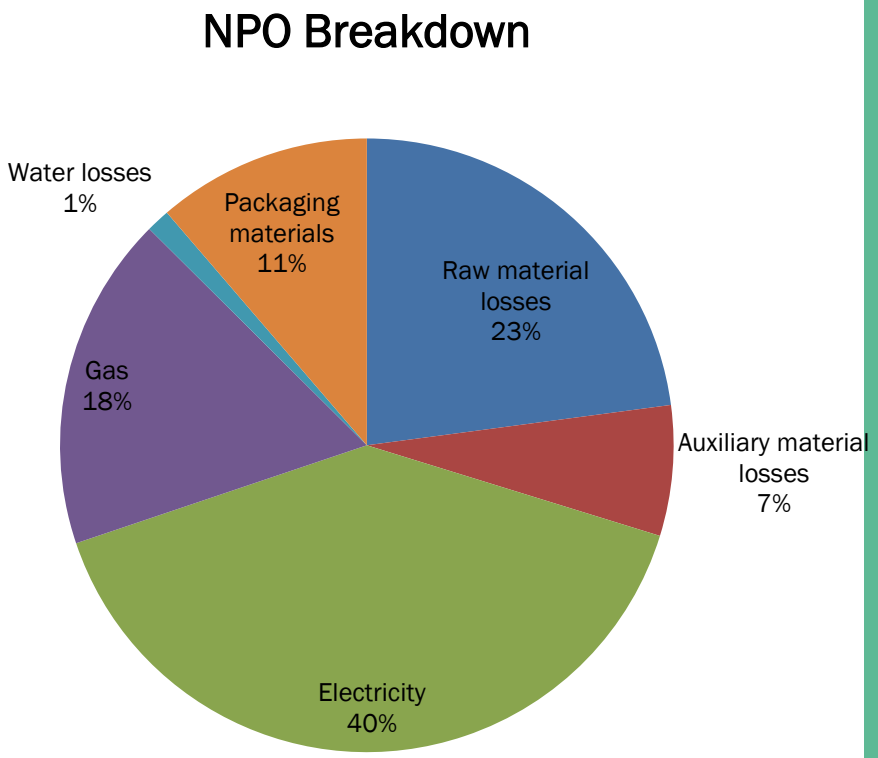
Benchmarking

Benchmark type	Unit	Company	Best practice
Electric power	kWh/kg of product	0.385	0.140[(1)]
Thermal energy	kWh/kg of product	2.684	0.417[(1)]
Water	Litres/kg of product	0.97	0.25 (pasta)[(2)] 0.85 (couscous)[(2)]
CO_2 emissions	t CO_2/tonne of product	0.822	0.130[(1)]
BOD5	mg/l of waste water	70	35[(3)]
COD	mg/l of waste water	217	120[(3)]

(1): BREF FDM (2006)
(2): Equipment provider
(3): National legislation

Non-product output costs





Approximately 8.8% of input cost (7% of turnover) in 2016 was lost due to losses of raw materials, packaging materials, operating materials and water, as well as to energy requirements.

Priority flows

The priority flows selected are:

Energy: selected on the basis of the following considerations:

- ✓ It represents 58% of NPO costs
- ✓ There is a considerable potential for reduction as the comparison with best pasta production facilities revealed that there was an overconsumption of around 275%
- ✓ A considerable reduction of GHG emissions is possible

Raw material losses, as they represent 23% of NPO costs

Packaging material losses, as they represent 11% of NPO costs

Information system – MFCA

- Key findings:

✓ The TEST approach has the advantage of focussing on the most important sources of financial loss

✓ Comparative analysis with international best practices makes it possible for the company to quantify their potential for improvement

✓ Minimising non-product outputs leads to an improvement of productivity

- Experience with I/O analysis

I/O analysis makes it possible to quantify non-product outputs in physical terms, and to finance and quickly identify the priority flows.

- Recommendations

Integrate MFCA analysis as a management accounting tool.

Information system – Metering

Recommendations:

1. Installation of flow meters and software for recording:

- Output of finished products
- Output of products recycled after mixing
- Output of steam for cooking
- Temperature during mixing and rolling

2. Set up performance monitoring indicators:

- For energy use: kWh/ kg of product
- For the reduction of packing material waste: kg of packaging / kg of product
- For the reduction of raw material losses: kg of RM / kg of product

Focus areas and cause analysis

	Cost centres (production process, key services, etc.)											
	Total $	Pressing	Drying	Trabanto	Rodante 1	Rodante 2	Cooling	Packaging	Maintenance	Steam / heat	Logistics	Administration
NON-PRODUCT OUTPUT (NPO)												
Raw materials and secondary materials	44,983		36,037	369	1,847	4,580		591			1,558	
% of NPO	100%		80.11%	0.82%	4.11%	10.18%		1.64%			3.46%	
Packaging materials	22,198							10,227			3,885	8,086
% of NPO	100%							46%			18%	36%
Operating materials	13,495											
Water	2,445											
Energy	113,305											
Total	196,427											

Focus areas and cause analysis

The breakdown of NPO costs for priority flows on the different cost centres made it possible to identify the focus areas:

- In terms of raw material losses, drying appears to be the focus area where the losses are the most significant
- In terms of packaging material losses, the supply of packaging as well as the packaging processes are focus areas
- The focus areas for energy have not been defined

Focus areas and cause analysis

Priority flows	Sources	Primary and secondary causes
Electric power	• Current transformers • Production process of making couscous and pasta	• Transformers operating at low load • No reactive energy compensation • Many power units have varying motor speeds, and there is no variable frequency drive • Use of resistors for heating the water for preparing the dough • No flow-meter system • Packaging machines (boxing) operate when empty
Thermal energy	• Steam boilers • Production process of couscous and pasta • Control system • Steam supply system	• No return of condensate from couscous cooker • No steam flow meter for produced and circulating steam • Loss of heat and steam through distribution manifolds (valves, flanges, steam collectors, etc.) • Excessive need for pressure • No heat recovery from air used to dry the couscous and pasta, and no recovery of combustion gases

Focus areas and cause analysis

Priority flows	Focus areas	Source	Primary and secondary causes
Plastic film	Packaging	• Machinery • Returns from customers • Purchasing department	• Settings not fully mastered • Por quality of cardboard • Purchase by the weight: the weight of the spindle is counted
Raw materials (semolina)	Pasta production	• Drying • Moulding (extruder dies)	• Moisture of inputs and outputs not fully mastered • Frequent changing of the moulds • Malfunctions

Savings catalogue – Identified projects

	Energy
1	Install compensation batteries
2	Improve the natural lighting in the storage hangar by cleaning the windows
3	Examine with the energy supplier the possibility of reducing authorised maximum demand from 1,000 kW to 500 or 650 kW
4	Use presence detectors to prevent the boxing conveyor belt from running when empty
5	Reduce the copper losses of transformers by unplugging one of the two transformers in operation as one is enough
6	Replace the 12 kW resistor used for heating water for preparing the dough with the heat recovered
7	Installation of instruments necessary for managing the energy of the different facilities
8	Reduce steam losses and surface heat losses (flanges, valves and collectors)
9	Reduce excessive need for steam pressure
10	Automatic continuous purge
11	Improvement of boiler combustion efficiency
12	Install an economiser for combustion gas
13	Return of cooking steam towards the boiler

Savings catalogue – Identified projects

	Raw materials
14	Recruit a maintenance supervisor to set up a preventive maintenance plan
15	Planning and production management
16	Introduce analysis of gluten index
17	Introduction of NIR analysis (protein, moisture)
18	Measurement of output of finished product and recycled products
19	Increase productivity by monitoring processes based on statistical analysis
	Water
20	Eliminate reverse osmosis
	Packaging materials
21	Manage purchasing process for packaging film and boxes

Best Practice 1:

Reduce steam losses and surface heat loss – Energy

Description of the solution	It was noticed that there was no thermal insulation on the steam ducts, valves, flanges and collectors, and that there were steam leaks in the steam supply system. The improvement measure consists in: • Adding thermal insulation to the two valves, two flanges, two collectors as well as to 20 m of steam ducts, from the boiler to the different installations • Renewing two distribution manifolds, the source of the steam leaks
Economic benefits	2% reduction of thermal energy consumption, equivalent to 320 MWh/year. The financial savings represent 690 €/year.
Environmental benefits	• 2% reduction of thermal energy consumption, equivalent to 320 MWh/year. • 2% reduction in the consumption of non-renewable resources of natural gas, equivalent to 32,745 m^3/year. • Reduction in GHG emissions of 67 TE-CO_2/year
Capital investments	Cost: 1,499 € Pay-back period: 2.2 years
Other barriers	No technical barriers, no negative impact on the quality of the products

Best Practice 2:

Introduction of NIR analysis (protein, moisture) – Raw materials – Energy and water

Description of the solution	It was noticed that the moisture of the finished products varied. This variability leads to a reduction of productivity and an increase in specific water and energy consumption. The humidity of finished products must be optimised by taking into account the characteristics of the raw materials and the parameters of the process. The improvement measure consists in installing NIR rapid analysis for analysing the humidity and proteins in order to quickly and precisely distinguish the raw materials and finished products, and to adapt the production parameters according to the quality of the semolina, and stabilise the quality of products based on optimal values.
Economic benefits	An increase in productivity, a reduction of specific energy and water consumption as well as a reduction of material losses amounting to 2% for couscous. The economic benefit is estimated to be 2% of turnover, equivalent to €29,600.
Environmental benefits	2% reduction in energy consumption, equivalent to 169 MWh per year. 2% reduction in water consumption, equivalent to 53.6 m^3 per year. 2% reduction in the consumption of raw materials, equivalent to 55.3 tonnes per year. Reduction in GHG emissions of 45 TE-CO_2/year.
Capital investments	Cost: €55,000 with a pay-back period of 1.9 years
Other barriers	No technical barriers. Requires staff training.

Best Practice 3:

Switch off one of the two transformers in operation – Energy

Description of the solution	The company is powered by two 630 kVA transformers. For the current running speed of the unit, just one transformer is sufficient. It is recommended to unplug one of the two transformers in order to reduce the copper losses of these transformers.
Economic benefits	The no-load losses of a transformer amount to about 6 kW. Over one year, the no-load losses represent 52,560 kWh of energy. Thus, by unplugging a transformer, the company will be able to save this energy, which corresponds to financial savings amounting to 1,574 € per year.
Environmental benefits	Reduction in thermal energy consumption of 52.56 MWh/year Reduction in GHG emissions of 35.21 TE-CO_2/year
Capital investments	No investment
Other barriers	No technical barriers. Study the current wiring diagram of the two transformers.

Management system integration

- Reduce regulatory conformance costs by reducing the waste generated and waste water discharge
- Integration of the RECP into the current management system
- Change of culture: from now on, the TOP management considers environmental management and cleaner production, according to
  the TEST approach, as a means of increasing the company's financial return
- Integration of the MFCA as a management accounting tool

Results

Measure	Investment (euros)	Savings (euros/yr)	PBP (years)	Water and raw materials /yr	Energy (MWh/yr)	Environmental impacts /yr
Energy efficiency	20,300	11,119	1.8		3,208	703 tonnes of CO_2 1,400 m^3 of waste water 7.4 tonnes of solid waste
Planning of production and control of packaging purchases	8,571	4,342	2	23.8 t of RM		
Eliminate reverse osmosis	0	3,965	Immediate	1,400 m^3 of water		
Increase productivity by monitoring the processes	105,000	66,428	1.6	7.4 t of RM		
TOTAL	**133,871**	**85,854**	**1.6**	**1,400 m^3 of water** **31.2 t of RM**	**3,208**	

Conclusion

- 16 of the 21 improvement measures were considered by the company for implementation or further study
- The potential savings amount to €85,854 with a pay-back period of 1.6 years
- Annual water savings represent 12.1%
- Annual energy savings represent 16.1%
- Annual raw material savings represent 0.4%

- 13.7% reduction of non-product output costs
- 12.8% reduction in CO_2 emissions