TEST case study

DAIRY PLANT

Developed under the framework of Med TEST II

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

switchmed

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DAIRY PLANT

SECTOR	Agri-foodstuffs
SUBSECTOR	Milk and dairy products
SIZE	160 employees
PRODUCTS	Milk, fermented milk (L'ben), milk curd (Raïb), butter, crème fraîche, Smen
MARKET	Local, national
CERTIFIED MANAGEMENT SYSTEMS	ISO 22000 in process

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Company key data

Reason to join the TEST project

Improve the management process in order to increase competitiveness and reduce negative impacts on the environment, thus encouraging the accomplishment of our mission to shape the national dairy market and ensure its sustainability.

YEAR 2015	Unit	Value
Production	litres/year litres/year litres/year kg/year kg/year	Milk: **41,478,163** L'Ben: **1,618,344** Raïb: **107,515** Butter: **39,079** Fresh Cream: **3,219**
Electricity consumption	kWh/year	1,363,444
Gas consumption	m^3/year	246,934
Water consumption	m^3/year	123,129
CO_2 emissions	tonnes/year	2,506.3
BOD5	kg/year	N/A
COD	kg/year	359,170
Total cost of sales	€/year	9,130,259
Total cost of inputs (Purchase value of raw materials, auxiliary materials, packaging energy and water)	€/year	7,271,579
	% vs. cost of sales	79.64
Estimated non-product output	€/year	382,154
	% vs. cost of sales	4.18

Process overview/flowchart

INPUTS

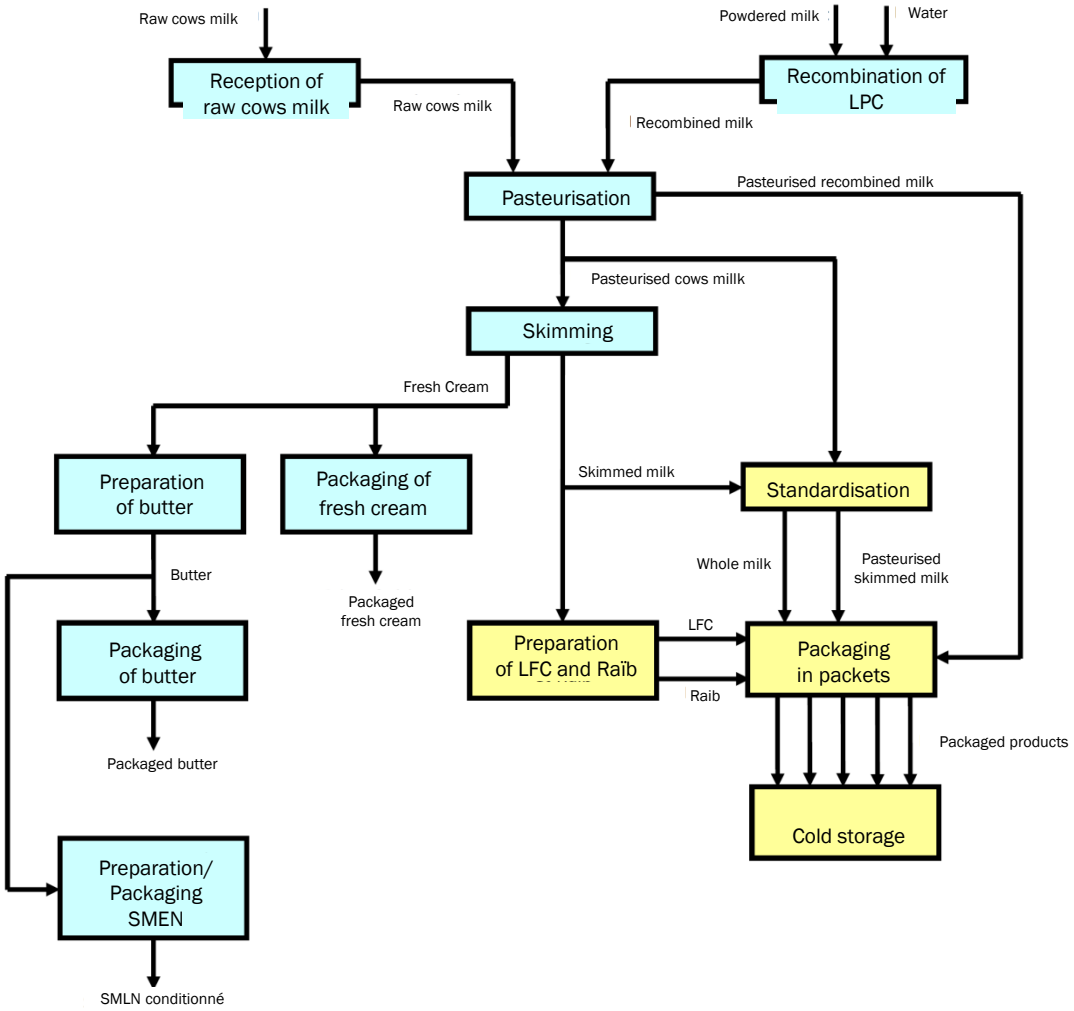
Milk powder
Cow's milk
MGLA
Enzymes

PE film
PE containers
Trays
Boxes

Refined salt
pastilles
Lab products
HNO_3; NaOH
Oil and fat

Electricity
Gas
Gas oil

Water



OUTPUTS

Products: milk, L'Ben, Raïb, butter, fresh cream, Smen

Waste water

Emissions: CO_2; NOx; SOx; H_2O

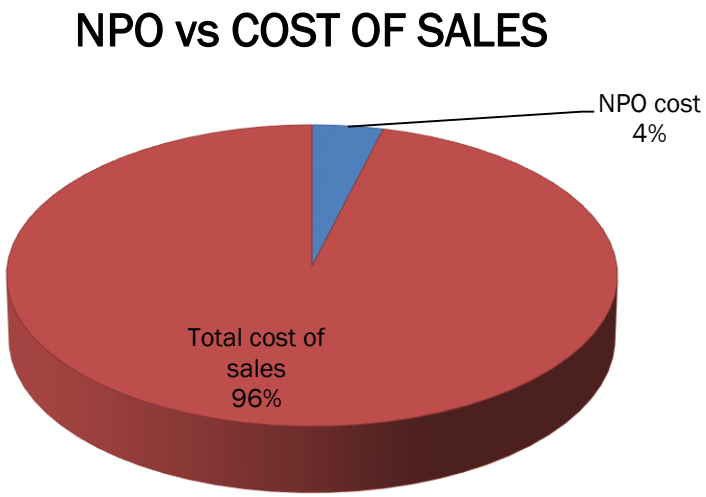
Waste:
Used packaging
Non-compliant products
Used oil

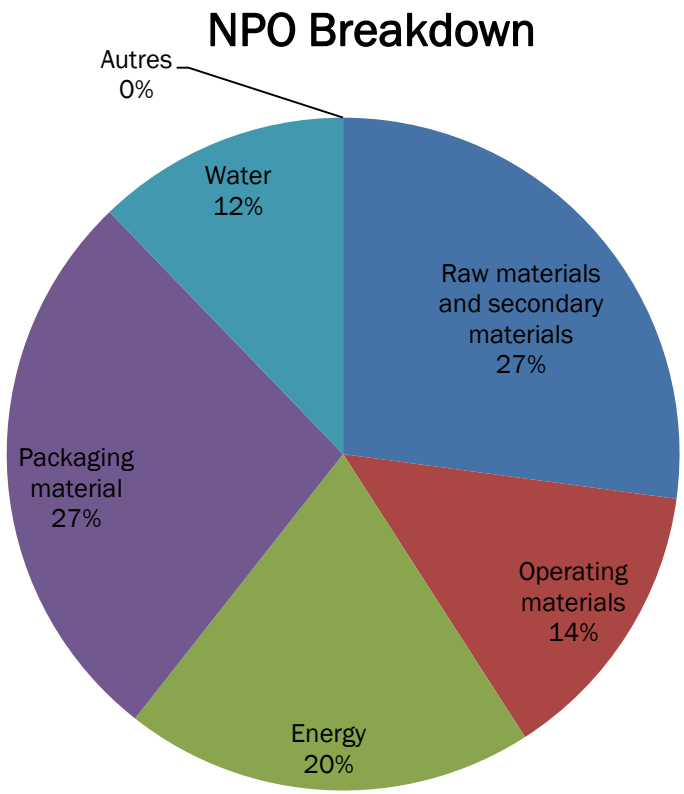
Benchmarking

Benchmark type	Unit	Company	Best practice[1]
Energy	kWh $_{elec+heat}$ / L $_{raw\ milk\ +\ PPM}$	0.099	0.07
Water	Litres / L $_{raw\ milk\ +\ PPM}$	2.83	0.6
PE packing	g / L $_{packaged\ product}$	6.09	5.02[2]
CO_2 emissions	g CO_2/L $_{raw\ milk\ +\ PPM}$	57.7	N/A
Solid waste	kg/m^3 $_{raw\ milk\ +\ PPM}$	1.73	1.7
COD	kg/m^3 $_{raw\ milk\ +\ PPM}$	8.27	1.5

(1): BREF FDM (2006)
(2): Supplier of packaging equipment

Non-product output costs





Approximately 5.25% of the input material (4% of turnover) for the year 2015 was lost due to losses of raw materials, packaging materials, operating materials and water, as well as for energy requirements.

Priority flows

The priority flows selected are:

Energy:

- ✓ It represents 20% of NPO costs
- ✓ A considerable reduction is possible as the comparison with best practices revealed that there was an overconsumption of around 41%
- ✓ A considerable reduction of GHG emissions is possible

Raw material and secondary material losses (mainly milk):

- ✓ They represent 27% of NPO costs
- ✓ They lead to a considerable increase in the pollution flow (COD) in waste water

Priority flows

Packaging material losses (polyethylene packaging):

- ✓ They represent 27% of NPO costs
- ✓ These losses represent more than 14% of the packaging costs and can be reduced to 5%, equivalent to an 64% reduction

Water:

- ✓ In comparison with the best practices of the sector, a reduction of 78% is possible
- ✓ Company location is characterised by considerable water stress

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

- 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. Install flow measurement devices to record:

- quantity of water used for the CIP station
- quantity of boiler water and water for cooling towers
- quantity of water used at each workshop

2. Improvement of the waste quantification system:

- Daily weighing of waste of plastic packaging materials
- Daily weighing of waste of paper and cardboard packaging materials

3. Improve performance monitoring indicators:

Besides the existing indicators (kWh/litre of product; litres of water/litre of product; grams of PE packing materials/litre of packaged product) set up a waste monitoring system using indicators such as kg of waste/m^3 of product

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:

Priority flows	Focus areas
Milk	Logistics/delivery
	CIP and cleaning
Polyethylene (PE) for packets and bags	Administrative (packaging purchase department)
	Logistics/delivery
	Storage warehouse for inputs
Water	CIP and cleaning
	Refrigeration
	Steam/heat
Energy	No focus area selected as there was a need to review the whole technology

Focus areas and cause analysis

	Cost centres (production process, key services, etc.)												
	Total €	Reception of raw milk	Skimming	Packaging in packets	Preparation / packaging of butter	Recombination storage PPM	Storage warehouse for RM and inputs	CIP and cleaning	Maintenance	Steam/ heat	Refrigeration	Storage PF/ delivery	Administration
NPO COSTS	382,154												
1. Raw materials	103,653		6,270		3,604	1,134		10,677				79,408	
% of NPO	100%		6.05		3.48	1.09		10.30				76.61	
2. Packaging materials	103,850			2,120			33,880					13,698	54,151
% of NPO	100%			2.04			32.62					13.19	52.14
3. Operating materials	52,662	10,106						30,115	3,493	3,182	2,323	3,444	
% of NPO	100%	19.19						57.18	6.63	6.04	4.41	6.54	
4. Water	46,679			752				37,413		2,959	5,555		
% of NPO	100%			1.61				80.15		6.34	11.90		
5. Energy	75,310									6,537		34,607	
% of NPO	100%									8.68		45.95	
Total	382,154												

Sample focus areas and cause analysis

Priority flows	Focus areas	Sources	Primary and secondary causes
Milk	Logistics/ delivery	Damaging of finished products at delivery stations and on reception by customers	• Pierced packets by the containers when loading/unloading • High production speed of packaging machines which leads to a poor arrangement of the packets in the containers • Packets squashed by the containers during transportation • Packets incorrectly filled (excess air in the packets = swollen packets = increases the risk of bursting with pressure from containers) • Containers incorrectly stacked in the lorry • Containers of poor quality which no longer slot into each other or which become deformed when stacked • Burr defects at container bottoms which lead to packets being pierced • Old or broken containers • Insufficient checking of the packaging machine and production defects going unnoticed (soldering defects, micro-cracks) • Poor stacking in cold storage
	CIP and cleaning	CIP of objects and circuits	• Release of white water into the sewer system • No device for recovering white water

Sample focus areas and cause analysis

Priority flows	Focus areas	Sources	Primary and secondary causes
PE for packets	Administration	Purchasing department	• Imprecise product specifications provided for purchasing PE film, and relatively large dimension leeway compared to the packet norms • Compliance with product specification not respected by supplier • No quality control of the film on delivery
	Logistics/delivery	Damaging of finished products at delivery stations and on reception by customers	Identical to those with milk losses
PE containers	Storage warehouse for inputs	Unloading of empty containers	• No appropriate unloading device • Poor handling conditions • Poor quality of containers which break after being used a few times
	Logistics/delivery	During delivery from resellers	• Poor handling conditions which increases wear • Poor quality of containers which break after being used a few times • No deposit system for containers which results in losses and breakages • No checking of containers when delivering to customers • Poor monitoring of containers when entering the factory

Sample focus areas and cause analysis

Priority flows	Focus areas	Sources	Primary and secondary causes
Water	CIP and cleaning	CIP station	• Discharge of initial, intermediate and final rinsing water • No device for recovering rinsing water
		CIP of pasteuriser	Pasteuriser is rinsed while waiting for the product due to the product consignment time being greater than the release time of the BNC, and low storage capacity of raw milk
		Cleaning of floors and outside of equipment	Spillage of milk on the floor, leaks in the circuits, damaged products requiring frequent cleaning
	Refrigeration	Cooling tower	No draining device for controlling concentration
	Steam / heat	Boilers	Loss of water when no condensate return circuit present

Savings catalogue – Identified projects

	Energy
1	Reduction of the maximum power demand (MPD)
2	Remove active energy consumption at peak-load hours
3	Installation of condenser batteries to improve the power factor
4	Insulation of steam circuits
5	Increase the heat recovery ratio (HRR) in the heat exchanger
6	Conformity of equipment for pasteurisation of raw cow's milk
7	Conformity of equipment for pasteurisation of PPM (produced using milk powder)
	Raw materials
8	Recovery of white water and reuse in the reconstruction of PPM
9	Installation of a new conveyor for finished products
10	Use pallets and electric forklifts for loading lorries

Savings catalogue – Identified projects

	Packaging materials
11	Use of PE packaging in compliance with strict requirements of the ASTM standard
12	Create a technical information sheet on the quality of containers for purchases
13	Use hooks which are more suitable for pulling the containers
14	Use a forklift for unloading containers
	Water
15	Recovery of cooling tower blowdown
16	Recovery of final rinsing water from the CIP station
17	Eliminate intermediary rinsing of the pasteuriser when switching between PPM / raw milk or when awaiting products
18	Ensure the return of condensate to the boiler feed tank
19	Equip all pipes for cleaning water with pressure nozzles
20	Use a pressure washer for cleaning the outside of machines and floors

Best practice 1:

Use of PE packaging in compliance with strict requirements of the ASTM standard – Packaging materials

Description of the solution	The dimension requirements of the procurement contracts of PE lack precision, which results in an unnecessary overconsumption of packaging materials. The improvement measure consists in reviewing these contracts and including the new dimension requirements in compliance with the ASTM standard. Moreover, systematic checking of the packaging dimensions should be carried out by employees on packaging machines. Non-compliant packaging will be returned to the supplier.
Economic benefits	According to the MFCA, PE material losses amount to 33.1 tonnes per year, equivalent to 14.4% of the PE purchased. This value can be reduced to 11.5 tonnes per year, equivalent to 5%. Potential savings of 21.6 tonnes/year, equivalent to 36,728 €/year
Environmental benefits	• Savings in packaging materials amounting to 21.6 tonnes/year, equivalent to 9.4% • Reduction in PE packaging material waste, also amounting to 9.4%, equivalent to 1.6 tonnes/year
Capital investments	No investment ROI (not applicable)
Other barriers	No technical barriers, no negative impact on the quality of the products

Best practice 2:

New conveyor belt for loading finished products – Raw materials

Description of the solution	The current conveyors, being discontinued, require multiple handling operations to load the containers of finished products onto delivery vehicles. These manipulations increase the risk of the packets being pierced by the containers, and thus the loss of product and packaging materials. Examination of customer feedback revealed that 65% of damage was due to piercing. The solution consists in eliminating the current conveyors and investing in a new conveyor which transports the containers from the packaging machines to the delivery vehicles, thus reducing handling operations.
Economic benefits	The MFCA has shown that the non-recoverable damage amounts to 545,383 l/year, equivalent to a total loss of 115,366 € per year. 65% of this damage is due to handling operations, equivalent to 74,988 €/year. The new conveyor will reduce losses by 50%. Potential savings could amount to 37,477 €/year. Moreover, this new line makes it possible to achieve a 20% gain in productivity.
Environmental benefits	Reduction in COD of liquid waste of 60 tonnes, equivalent to 16.7% of the current pollution flow (damaged products being discharged into the internal waste water disposal network). Savings in polyethylene packaging materials of 1.58 tonnes/year.
Capital investments	Investment: 52,468 € with a PBP of 1.4 years
Other barriers	No technical barriers.

Best practice 3:

Recovery of final rinsing water from the CIP station – Water

Description of the solution	The CIP station consumes 640 litres for each final rinsing which are entirely discharged into the sewerage system. This is relatively clean water which is lost when it can be used for other things. The improvement measure consists in recovering the water and reusing it for initial rinsing in the CIP station. For this, a simple collection system will be installed next to the CIP station, with a container, a pump, a three-way valve and pipes, to recover the rinsing water and pump it towards the initial rinsing water compartment of the CIP station.
Economic benefits	Potential savings of 3,005 m^3 of water per year, which represents gross savings of 1,498 €/ year. The costs of operating the recovery system (electricity and maintenance) is estimated at 113 €/year. This amounts to net savings of 1,385 €/year.
Environmental benefits	Reduction in water consumption of 3,005 m^3/year Reduction in waste water requiring treatment of 3,005 m^3/year
Capital investments	Investment: 375 € with a PBP of 0.27 years
Other barriers	No technical barriers

Management system integration

- 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 an additional management accounting tool

Results

Measure	Investment (euros)	Savings (euros/yr)	PBP (years)	Water and raw materials/yr	Energy (MWh/yr)	Environmental impacts/yr
Reducing thermal energy consumption	9,613	2,657	3.6	902 m^3 of water 0.9 t of RM	904	224 t CO_2 20.1 t of solid waste 66 t COD 11,384 m^3 of waste water
Optimisation of electric energy consumption	1,378	1,172	1.2	23.8 t of RM	6	
Modification of handling systems and procedures	79,339	71,678	1.1	273 m3 of milk 9.6 t of RM		
Improve technical specifications of packaging	10,427	46135	0.2	32.1 t of RM 27 m^3 of milk		
Reduction in water consumption	10,636	4,294	2.5	10,182 m^3 of water		
TOTAL	**111,393**	**125,936**	**0.9**	**11,084 m^3 of water 342.6 t of RM**	**910**	

Conclusion

- 15 of the 20 suggested improvement measures were considered by the company for implementation or further study
- The potential savings amount to €125,936 with a pay-back period of 0.9 years
- Annual water savings: 9%
- Annual energy savings: 4.1%
- Annual raw materials savings: 1.74%

- 34.6% reduction of non-product output costs
- 9.52% reduction in CO_2 emissions
- 18.4% reduction in pollution flow in waste water
- 18.3% reduction in solid waste