TEST case study

Processing of dates and dried fruits

Developed under the framework of Med TEST II

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

switchmed

The SwitchMed Programme is funded by the European Union

Processing of dates and dried fruits

SECTOR	Agri-foodstuffs
SUBSECTOR	Preparation for market of dates and dried fruits
SIZE	160 employees
PRODUCTS	Natural, standard, branched, and stoned dates, packaged in packs of 200 g to 5 kg. Date syrup (currently in testing phase)
MARKET	International
CERTIFIED MANAGEMENT SYSTEMS	ISO 22000 v2005

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Company key data

Reason to join TEST project

Increase the quality of our products while controlling production costs in order to be more competitive and to respond to the requirements of an international market.

YEAR 2016	Unit	Value
Production	tonnes/year	2,131,720
Electricity consumption	kWh/year	50,473
Gas oil consumption	Litres/year	332,377
Water consumption	m^3/year	4,178
CO_2 emissions	tonnes/year	893
BOD5	mg/l	N/A
COD	mg/l	N/A
Total cost of sales	€/year	2,559,015
Total cost of inputs (purchase value of raw materials, auxiliary materials, packaging energy and water)	€/year	1,766,754
	% vs. cost of sales	69.04%
Estimated non-product output	€/year	232,952
	% vs. cost of sales	9.10%

Process overview/flowchart

INPUTS

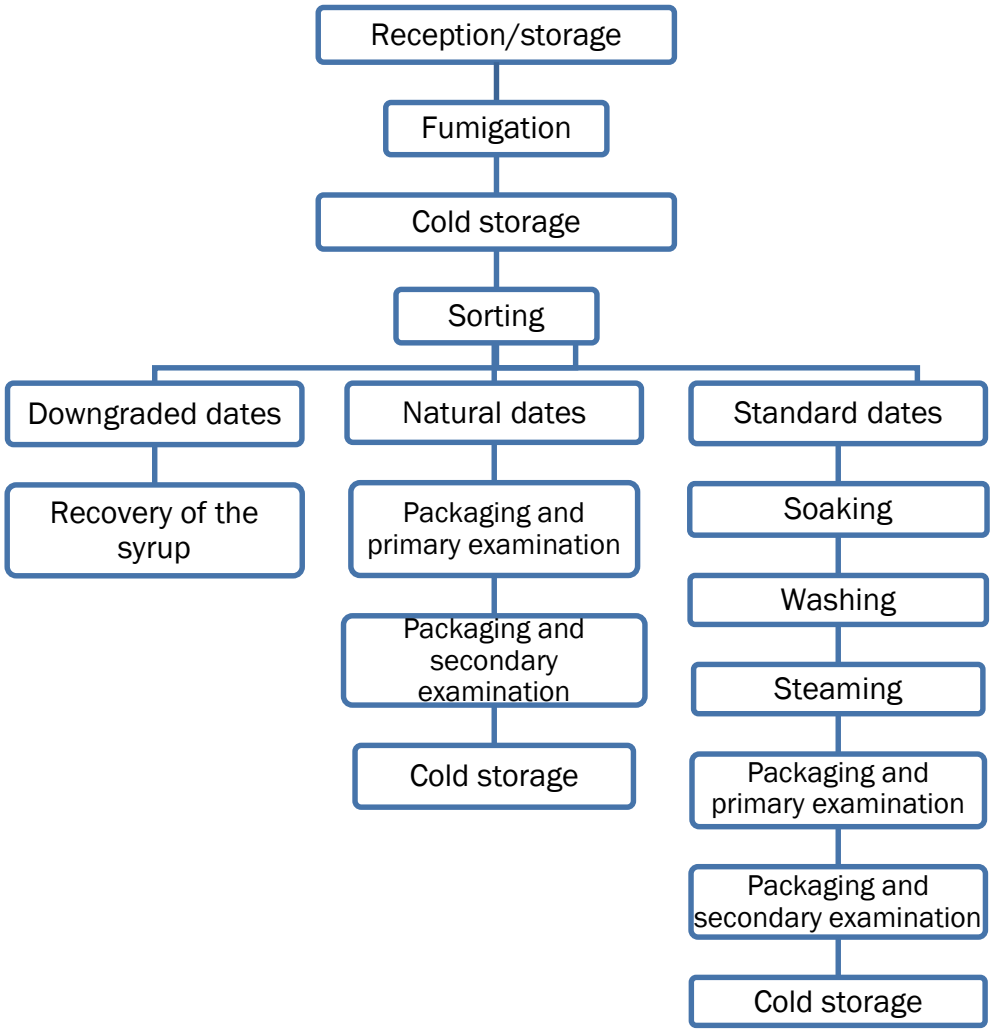
Dates

Boxes
Polystyrene trays
Plastic film
Pallets

Salt
PH_3/SO_2
Preservatives
Detergents
Oil and grease

Electricity
Gas oil

Water



OUTPUTS

Packaged dates

Waste water

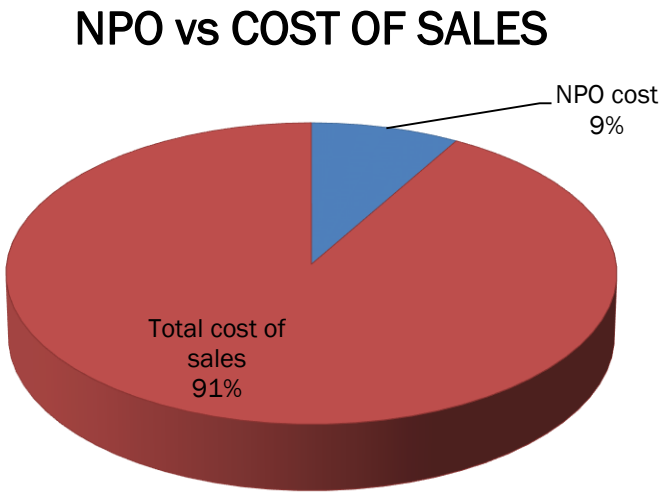
Air emissions:
CO_2; NOx; SOx; COV

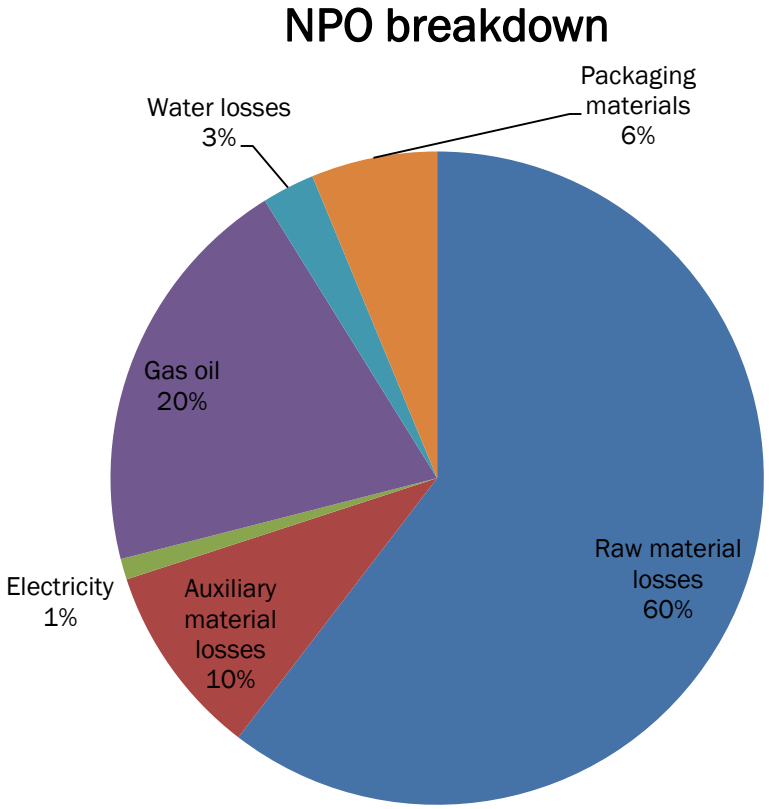
Solid waste
Used oil

Benchmarking

Benchmark type	Unit	Company	Best practice
Energy	kWh $_{elec+heat}$ / tonne of packaged dates	3,086	2,020
Water	m^3 / tonne of packaged dates	1.96	N/A
CO_2 emissions	t CO_2 / tonne of product	0.419	N/A
Packaging	kg / tonne of packaged dates	101.38	35.9
Waste	kg / tonne of packaged dates	4.46	N/A

Non-product output costs





Approximately 13% of input cost (9% of turnover) in 2016 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: selected on the basis of the following considerations:

- ✓ It represents 21% of NPO costs.
- ✓ A potential considerable reduction is possible as the comparison with best practices revealed that there was an overconsumption of around 52.8%.

Raw material losses, as they represent 60% of NPO costs.

Packaging material losses, as they represent 6% of NPO costs.

Water, as 88% of water consumed is a non-product output. Scarcity of
the resource and supply difficulties.

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. Monitor the quantity of dates kept in cold storage each month
2. Monitor the target temperature
3. Install sub-meters to monitor the electricity consumption of each production line
4. Set up performance monitoring indicators:
   - Fully control the process for preparing date syrup: litres of syrup / kg of dates
   - Rate of recovery of the fibres obtained after extraction of the date syrup: kg of fibre / kg of waste
   - Reduce waste water: litres of waste water / kg of processed dates

Focus areas

	Cost centres (production process, key services, etc.)										
	Total €	Reception / storage	Fumigation	Sorting	Soaking	Washing the dates	Steaming	Processing	Cleaning the equipment	Cold storage	Utilities
TOTAL COST OF NPO	232,952										
1. Raw materials	140,737			88,045				52,692			
% of NPO	100%			62.6%				37.4%			
2. Packaging materials	14,530	5,817						8,713			
% of NPO	100%	40%						60%			
3. Operating materials	22,291		6,155			1,147			624		
% of NPO	100%		27.6%			5.1%			2.8%		
4. Water	6,078				2,845	647	647		1,940		
% of NPO	100%				46.8	10.6	10.6		31.9		
5. Energy	49,316							8,433		32,351	6,115
% of NPO	100%							17.1		65.6	12.4

Focus areas

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
Raw materials	Sorting
	Processing
Packaging materials	Reception / storage of inputs
	Processing
Water	Soaking the dates
	Cleaning the equipment
Energy	Cold storage
	Processing
	Utility: air compressor

Cause analysis

Priority flows	Focus areas	Primary and secondary causes
Raw materials	• Sorting operations • Processing inspection operations	• Poor quality control when purchasing dates • No treatment (anti-infestation) during transfer, which accelerates the rate of infestation prior to storage • Manual sorting during the operators' evaluation (visual) • No testing prior to soaking and steaming in the lab on representative samples in batches • No control or optimisation of soaking time and steaming of dates • Expertise of the personnel
Packaging materials	• Packaging machine	• The semi-automatic machine is not suitable for polystyrene trays • Vibration following the cutting of the film and movement of the blade to the centre of the tray • Film of poor quality in relation to the uneven thickness of the roll and inadequate dimensions for the machine • Fault with machine settings

Cause analysis

Priority flows	Focus areas	Primary and secondary causes
Water	• Manual soaking operations • Manual cleaning operations of all the equipment	• No reducer device for water flow • Waste of water and poor practise when filling palette boxes • No device for recovering the water used for soaking • Lack of employee awareness of how to save the resource • No device for water flow meter • No CIP system
Energy	• Power generators • Air compressors • Cooling unit of cold storage • Packaging lines 1 & 2	• Operate power generator at low charge • Air leaks in compressed air circuit • Over-dimensioning of cooling areas in relation to the quantities in storage • Distortion rate of current operation sometimes exceeds norms • Incorrect power factor

Savings catalogue – Identified projects

	Energy
1	Lowering of the pressure of the air compressor by 1 bar
2	Power supply from the 1,200 kVA power generator and place the 1,500 kVA generator on stand-by
3	Power supply for the company from the utility medium-voltage power grid
4	Set up a management procedure for the cold storage and raise employee awareness
	Raw materials
5	Install an optical sorting system
6	Optimise soaking/equilibration time
7	Eliminate sorbate treatment
8	Modify new cooking tunnel
9	Set up processes for producing date syrup
	Operating materials
10	Install monitoring systems for checking temperature, humidity and concentration in phosphine
11	Replace aluminium phosphide with magnesium phosphide
12	Install temperature and humidity probes in the CO_2 tunnel
	Water
13	Water recovery

Best Practice 1:

Power supply for the company from the utility medium voltage network – Energy

Description of the solution	The company is powered with medium-voltage power by two power generators fueled by gas oil. The company is not connected to the utility medium-voltage power grid due to the company's remote situation and to the subsequent high connection costs. Analysis of the operation of the generators revealed a low capacity factor which reduces their output and leads to an overconsumption of gas oil. The solution consists in connecting the factory to the medium-voltage power grid by replacing the power generators.
Economic benefits	The simulation of the energy costs, if the factory is connected to the utility medium-voltage power grid, and by comparing the current energy expenses, the annual savings represents 26,074 €.
Environmental benefits	• A reduction in CO_2 emissions of 365.6% TE-CO_2 • Reduction of noise pollution and pollution risk of soils by oil and gas oil
Capital investments	Cost: 14,991 € Pay-back period: 6 years
Other barriers	No technical barriers, no negative impact on the quality of the products

Best Practice 2:

Replace aluminium phosphide with magnesium phosphide – Operating materials

Description of the solution	The company uses fumigation chambers where aluminium phosphide (AlP) is introduced to create phosphine which kills insects and their larvae. The discharge of phosphine depends on the temperature and relative humidity, the fumigation time lasts about 3 to 5 days, which is too long. In addition, AlP is not completely consumed after fumigation, which results in a loss of product, and the residue has to be treated as special hazardous waste. The improvement measure consists in using magnesium phosphide (Mg_2P_3) instead of AlP in order to reduce the fumigation time as well as reduce residue.
Economic benefits	Gains in productivity during fumigation, possible reduction in time of more than 50% Annual savings of 3,988 €
Environmental benefits	Reduction in special hazardous waste (phosphine residue)
Capital investments	No investment
Other barriers	Difficult provision of magnesium phosphide locally

Best Practice 3:

Set up processes for producing date syrup – Raw materials

Description of the solution	The current yield of syrup production is about 45%. Thus, for a quantity of 64.3 tonnes of dates used for extracting syrup, the output of the process is 28.9 tonnes of syrup (noble product) and 35.4 tonnes of residue. The solution consists in improving the production process by improving: 1. Grinding: ensure finer grinding by changing the settings of the grinder or filter, or by adding an extra grinder 2. Extraction: optimise the extraction temperature, extract the syrup in two steps and thoroughly stir the mix of water and dates for 30 minutes
Economic benefits	The improvement measure will allow for an increase in yield during extraction of 45% to 70%. The resulting economic advantage amounts to 164 € per tonne of dates. For the potential processing of 214.5 tonnes of date per year, the overall economic benefit will amount to about 35,182 € per year.
Environmental benefits	25% reduction in losses of dates used for syrup production. 250 kg reduction of waste per tonne of dates used for the production of syrup, equivalent to 45.4%.
Capital investments	N/A
Other barriers	N/A

Management system integration

- Integration of the RECP into the current management system
- Integration of the MFCA as a management accounting tool
- 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

Performance monitoring

- Implementation of the improvement measures identified by the TEST approach will require a follow-up plan which will be defined at a later date.
- This plan includes the monitoring and follow-up of the economic savings forecast when putting the measures into place. This is done by monitoring the base indicators of the reference year for the project (2016).

Results

Measure	Investment (euros)	Savings (euros /yr)	PBP (years)	Water and raw materials /yr	Energy (MWh/yr)	Environmental impacts /yr
Energy efficiency	142,857	35,407	4		1,056	349 tonnes of CO_2 16,000 m^3 of waste water 61 tonnes of solid waste
Fumigation productivity and optimisation of soaking	2,000	48,737	Immediate	132 kg of AIP 32 t of dates		
New processes for producing date syrup	0	18,611	Immediate	29 t of dates (fibres & stones)		
Water recovery	300,000	59,000	5	16,000 m^3 of water		
TOTAL	**444,857**	**161,756**	**2.7**	**16,000 m^3 of water 61.1 t of RM**	**1,056**	

Conclusion

- 8 of the 13 improvement measures were considered by the company for implementation or further study.
- The potential savings amount to €161,756 with a pay-back period of 2.7 years.
- Annual water savings: 80%
- Annual energy savings: 30%
- Annual raw material savings: 3%

- 70.3% reduction in non-product output costs
- 40.8% reduction in CO_2 emissions