STEP 1.7 CASE STUDY

Case studies from the dairy sector

A) FROM CAUSE ANALYSIS TO OPTIONS GENERATION

At the start of the TEST project, a Moroccan food company producing cheese was disposing high volumes of organic waste to landfill. This practice had some risks related to counterfeiting, product re-use or black market sales, which could have negatively impacted the company's brand. The company was therefore considering incineration as an alternative solution, although management was concerned about the costly investment required.

»The implementation of these measures reduced returns from clients and finished product losses by 50%. «

The detailed analysis which the TEST Team implemented in step 1.6 highlighted two priority raw material flows associated with high NPOs: butter and milk powder. These corresponded to 22% of total NPO costs. Several sources in the production process were identified as causing these material losses: tri blender, cutter, paste transfer storage tank, Filling & Packing Department. However, a more detailed analysis showed that the losses generated during the production process accounted for only a fraction of total losses, since only 10% of the total organic waste originated from the production process. The remaining 90% was made up of returns of expired and damaged products from clients, as the company was responsible for their collection and final disposal. As a result, options generation shifted to focus on the supply chain, and the following main causes were identified:

- temperature fluctuations during transportation of the final product;
- improper refrigeration during intermediate storage by wholesalers and by retailers;
- poor product shelf-life management; and
- inefficient handling of the final product inside the factory and during truck loading.

Once the above root causes were identified, the TEST team started a brainstorming process for generating ideas leading to the identification of possible options for reducing NPOs along the supply chain, such as:

- preparing work instructions for handling the final products during loading and unloading at the intermediate storage facilities;
- replacing the secondary packaging material with another type of higher strength to reduce breakages during loading/unloading of trucks;
- training truck drivers to minimize door openings during transportation and monitor the temperature control systems;
- preparing work instructions to improve in-company storage of the product on palettes and on racks;
- using a racking facility in the wholesalers' stores; and
- setting up a protocol to control the product shelf-life at retailers.

B) FROM OPTIONS GENERATION TO FEASIBILITY ANALYSIS

The detailed analysis at a dairy company in Tunisia, highlighted water as one of its priority flows. The water balance showed that after the cleaning-in-place operation, the second largest source of water consumption was the milk cooling stage after homogenisation (operating separately from pasteurisation). It was responsible for approximately 22% of total water use. The specific technology used at this stage was once-through cooling, consuming approximately 120,000 m^3/yr, that were discharged into the sewage system, generating a high volumetric load for the WWTP.

The TEST team's immediate reaction was to investigate possible solutions for eliminating once-through cooling by closing the loop with either a cooling tower circuit or a chilled water circuit. The latter appeared to be the most feasible due to the low temperature set point required after the homogenizing process. However, this solution would entail significant investment to increase the company's chiller capacity.

»The economic feasability study showed that a 65% reduction in operating costs could be achieved... «

Before further investigating the economic and technical feasibility of purchasing additional chiller units, an external expert suggested to the TEST Team to consider another option in more detail, "partial milk homogenization", which could reduce water use and cooling demand at the source (BAT in the EU BREF for Food, Drink and Milk Industries). This option recommends homogenizing cream with a small quantity of skimmed milk as an alternative to the current process design, which sends the total milk volume through the homogenizer. The economic feasibility analysis showed that a 65% reduction in operating costs (both electricity and water intake used for direct product cooling) could be achieved simply by reducing the number of existing homogenizers in operation without major technology modifications or investments (except for some piping and control system changes).

Implementing partial milk homogenization would dramatically reduce cooling demand, and direct cooling could be eliminated by linking to the existing chiller unit capacity. Consequently, the investment cost for eliminating direct cooling would be significantly reduced (only piping, valves and heat exchangers), and the payback period would be shortened by more than half. Table 1 illustrates how the parameters and baseline for calculating the economic savings of eliminating direct cooling changed through the implementation of partial milk homogenization.

PROCESS NEEDS (homogenizer) Water for direct cooling:	ELIMINATION OF DIRECT COOLING (closing the cooling water loop at homogenizer with chilled water circuit)	
	Without partial milk homogenization	In combination with partial milk homogenization
Volume (m^3/y)	120,299	42,105
Cost (EUR/y)	86,480	30,270
Cooling demand (chilled water):		
kWh/y	1,117,440	391,107
Cost (EUR/y)	21,140	7,400
Payback period (PBP)	>5 y	2.5 y
Process water (= 90 %)	0.72	EUR/m^3
Chilled water 3 °C (R717, COP = 3.2)	0.019	EUR/kWh
Cooling tower water	0.0017	EUR/kWh

TABLE 1: Feasibility analysis of eliminating direct cooling at homogenizer with and without partial milk homogenization

Table 2 summarises the overall results of the feasibility analysis at the company and provides key economic and environmental figures for the 10 feasible measures identified. The external expert recommended that the company start by implementing measures with the highest cost saving potential and increased productivity (reducing the process needs first) such as:

- reduction of product losses in processing and client returns;
- partial homogenization of milk; and
- management of ammonia chiller performance.

	MEASURE	Cost savings [EUR/y]	Investment [EUR]	Payback [y]	Reduced CO_2 emissions [t/y]	Reduced water consumption [m^3/y]	Reduced BOD_5 [kg/y]	Reduced COD [kg/y]	Reduced solid waste
1	Optimisation of cream separator and centrifuges	16,200	2,800	<1	92	3,709	57,456	92,232	-
2	Recovery of milk and fermented products sent to WWTP	27,060	-	immediate	165	-	104,241	167,334	-
3	Reduced product losses from product transfer	311,860	50,000	<1	151	-	94,392	151,524	-
4	Pasteurisation - heat recovery	92,588	TBD	TBD	3,506	19,165	-	-	-
5	Partial homogenization of milk	99,921	68,800	<1	385	78,194	-	-	-
6	Optimization of cleaning-in-place (CIP)	50,580	58,000	1	468	66,528	-	-	-
7	Cleaning of crates	43,494	6,000	<1	338	28,843	-	-	-
8	Optimisation of chilled water production	61,103	28,000	<1	538	1,740	-	-	-
9	Leak detection inspection programme	7,366	-	Immediate	39	-	-	-	-
10	Elimination of direct cooling (after implementation of option 5 above)	22,871	57,600	2.5	65	42,105	-	-	-

Table 2: Summary of feasibility analysis results for a dairy company