

From Cleaner Production Assessment to Sustainable Enterprise - Romanian Case-study within UNIDO – TEST Project –

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A UNIDO regional project is being developed in five Danubian countries. Romania is being participating with four pilot-units, representing different industrial branches and also pollution “hot spots” at national level. More modules were developed in a sequential or integrated way in selected, representative facilities of the four enterprises. These modules refer mainly to Cleaner Production Assessment (CPA), Environmental Management System (EMS), Environmental Sound Technology (EST). The main target of the whole activity was to move the enterprise from improved environmental performance step to compliance with environmental regulations. Additional instruments also were provided (UNIDO software for pre-feasibility study, training on Environmental Management Accounting -EMA) to assist the units for both improving their competitiveness and their environmental status. One enterprise was selected for full demonstration of TEST strategy (Pulp & Paper SOMES Dej). The economical and environmental benefits quickly revealed through CP measures encouraged the unit to commit for EST transfer and replicate the activity within CP, EMS and EMA at the whole mill level. Quantitative data for both financial and environmental benefits are provided.

Introduction

The strategy of TEST (Transfer of Environmentally Sound Technology) Project implementation was developed for either integral or sequential implementation of more technical modules. Each module addressed at least one important tool for both increasing the competitiveness and improve the unit environmental performance.

They include: **Cleaner Production (CP)**, **Environmental Management System (EMS)**, **Environmental Management Accounting (EMA)** and **Environmentally Sound Technology (EST)** and **Sustainable Enterprise Strategy (SES)**.

SOMES Dej case-study represented the Pulp and Paper industry and TEST project focus was the Bleaching Unit of Somes mill.

1. CP Assessment

Somes Bleaching Plant was selected as CP focus, too. The CPA identified 18 measures for implementation (vs. two or three initially obvious).

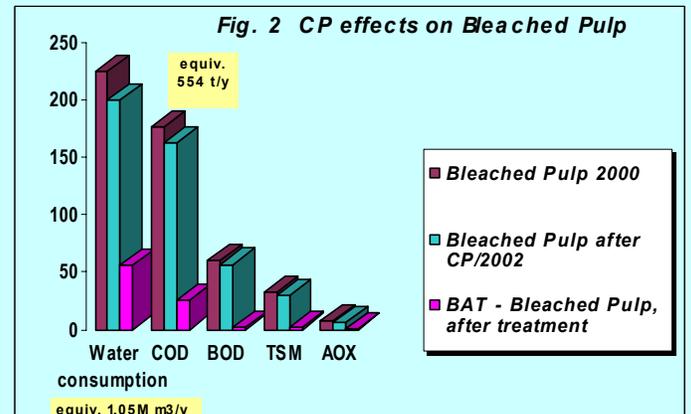
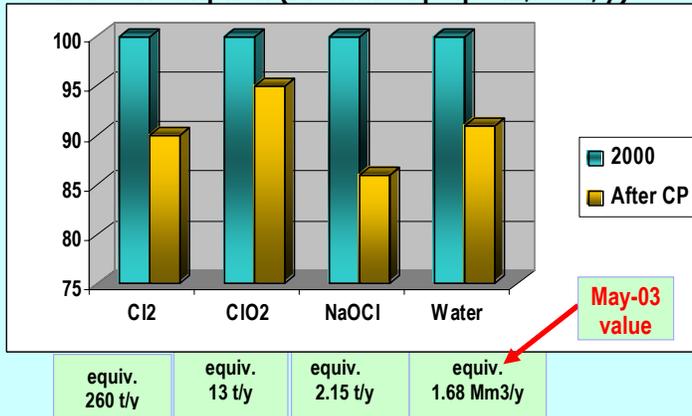
- ✚ Cost of CP measures varied from \$250 - \$31,500. Implementation costs for the proposed CP Action Plan was estimated at \$66,500 (\$8,000/2002 and \$58,500/2003);
- ✚ Five additional measures were identified and implemented by the unit (at costs of about \$34,000);
- ✚ High-cost measure (about \$300,000) was implemented (pre-investment, supporting the unit commitment to EST implementation);
- ✚ Monitored results of the implemented measures showed reduction in consumption of chemicals and water (Fig. 1) and reduced effluent discharged (Fig. 2);

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Fig. 1 CP effects on reduction of chemicals and water consumption (bleached pulp: 42,000 t/y) -



Associated financial savings and the saving structure after CP implementation are presented in Fig. 3 and 4. Specific contributions to the total saving show the significant weight of water/wastewater treatment and associated fees/penalties for its discharge (Fig. 4).

Fig. 3
Financial effects of CP measures implementation

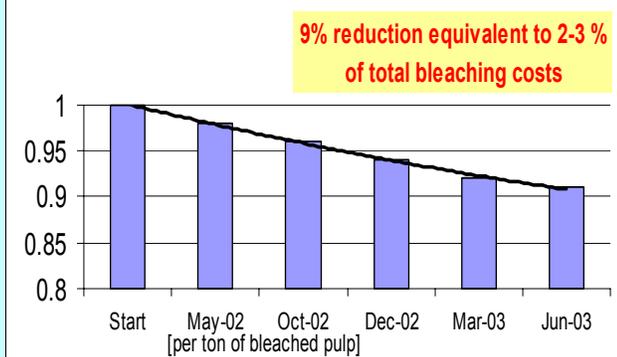
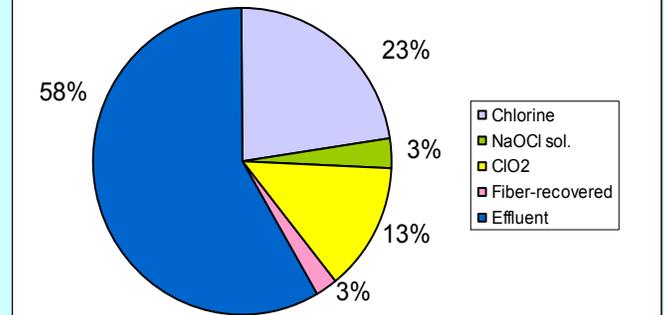


Fig. 4 Reduction of production costs:
contribution of raw material, water and recovered fiber cost categories to total savings
Total savings = 43,000 USD/y



CP measures have been further implemented and the effects of the measures implemented at the Bleaching process are to be found at both the Bleached Pulp process and mill level (Fig. 5 and 6).

Fig. 5 Effects on decrease on pollution load in General Effluent (6% production increase)

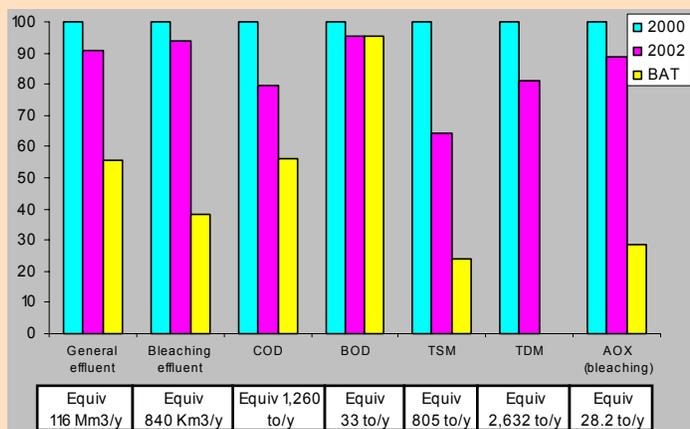
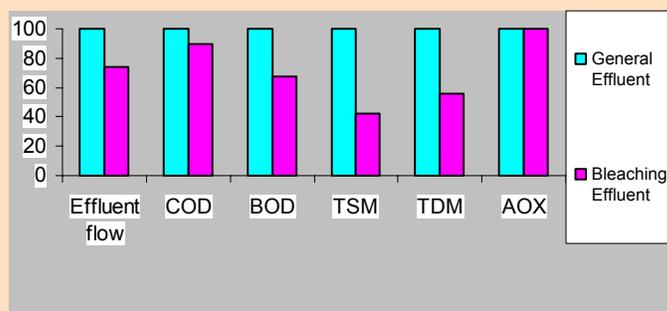


Fig. 6 Contribution of the Bleaching Effluent to discharges through the General Effluent (flow represented 65%/2002)



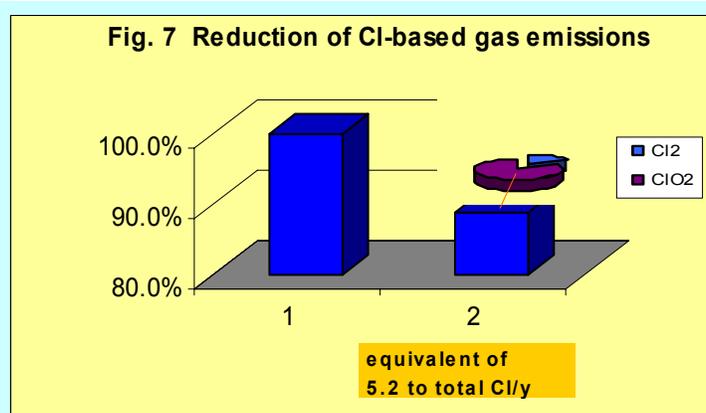
Different weight of Bleaching operation discharges in the discharged contaminants at the mill level (Fig. 6) is a good indication for directions of further improvement.

Note: the Adsorbable Organic Halogens (AOX) are produced at the bleaching step only (when Chlorine-based agents are used).

The max. BAT value is 2 kg/t without Oxygen-delignification and 0.25 kg/t with Oxygen-delignification.

A quite proportional reduction of Chlorine-based gas emission, result of both reagent dosing and better process control, was measured (Fig. 7).

Fig. 7 Reduction of Cl-based gas emissions



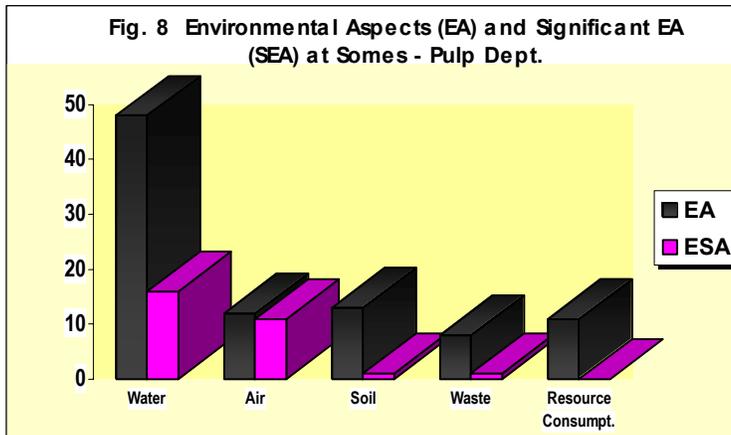
- the emission reduction was over 10% (as Chlorine, total);
- ClO₂ is analyzed (for the first time) and its prevalence in final emissions (over 80%) reveals further CP potential.

2. EMS implementation /Implementare Sistem de Management al Mediului:

Somes Dej began their EMS when TEST project started.

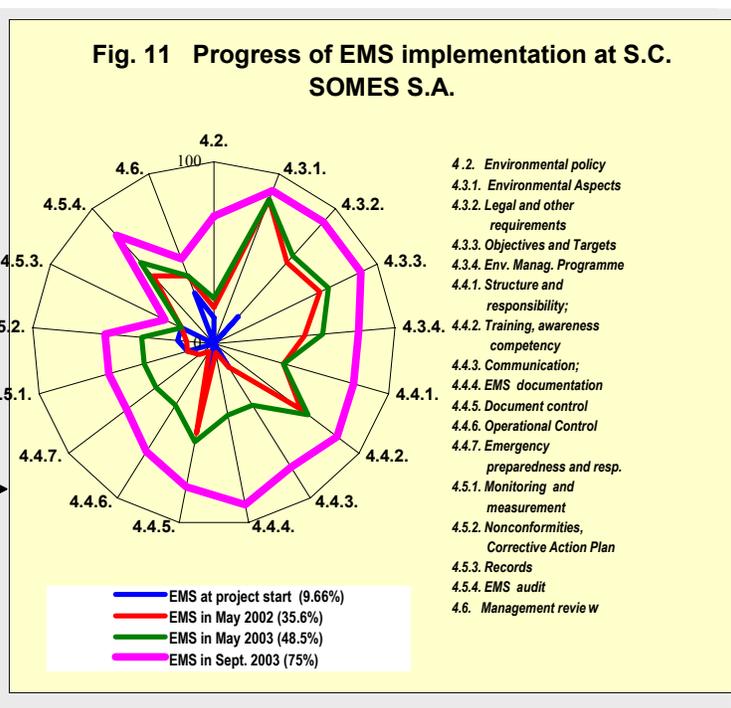
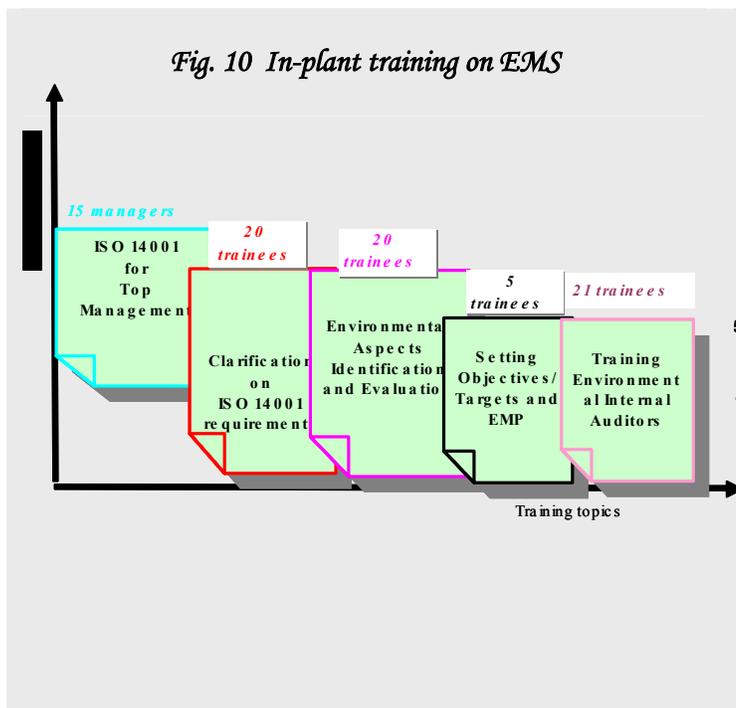
The unit was extending its QMS (initially certified at Paper Dept. level) and it was decided that the EMS would be developed at Pulp Dept. level (TEST focus) and then extended for the whole mill.

The main EMS outcomes are related to Preliminary Environmental Review (PER) with the list of Environmental Aspects (Fig. 8), training activities (Fig. 10), intergration with CP and QMS. The organizational changes are reflected in Fig. 9 and the overall progress of the EMS is presented in Fig.11:



**Example of CP-EMS integration: Environment Protection Programme (EMP)/
Integrated CP Targets and Activities**

Environmental Objectives	EMS Targets/CP Targets	CP Activities
1. Reduction of raw material consumption and prevention of environmental accidents/	Reduction of Cl ₂ consumption with 20%	Reduction of Chlorine dosage at all chlorination steps
	Minimization of NaOH losses	Measuring the pulp consistency at Bleaching inlet
	Reduction of NaOCl consumption with 15%	Measuring the pulp flow at Bleaching inlet
	Reduction of ClO ₂ consumption with cu 10%	Reduction of NaOCl dosage
	Reduction of water consumption with 30%	Use of fresh (cold) water for ClO ₂ solution preparation
	Increase the process efficiency at Bleaching	Ensuring over-pressure at shower-washing
		Use of white water (instead of fresh water) at shower-washing
		Introduction of frequency converters at filters in Bleaching unit



The EMS-QMS integration is a process under development, the EMS being integrated within the recently re-certified QMS.

3. EST/BAT module at SOMES Dej

consisted in replacing the present bleaching technology (using free Chlorine and Sodium Hypochlorite) with **Oxygen Delignification (ECF – Elementary Chlorine Free)** process, a BAT option.

The two flow diagrams (the present one, emphasizing the technological steps where CP measures were implemented) and the flow diagram of the EST for Bleaching are presented in the attached Fig. 12 and 13, respectively.

Fig. 12 Bleaching flow diagram - present situation -

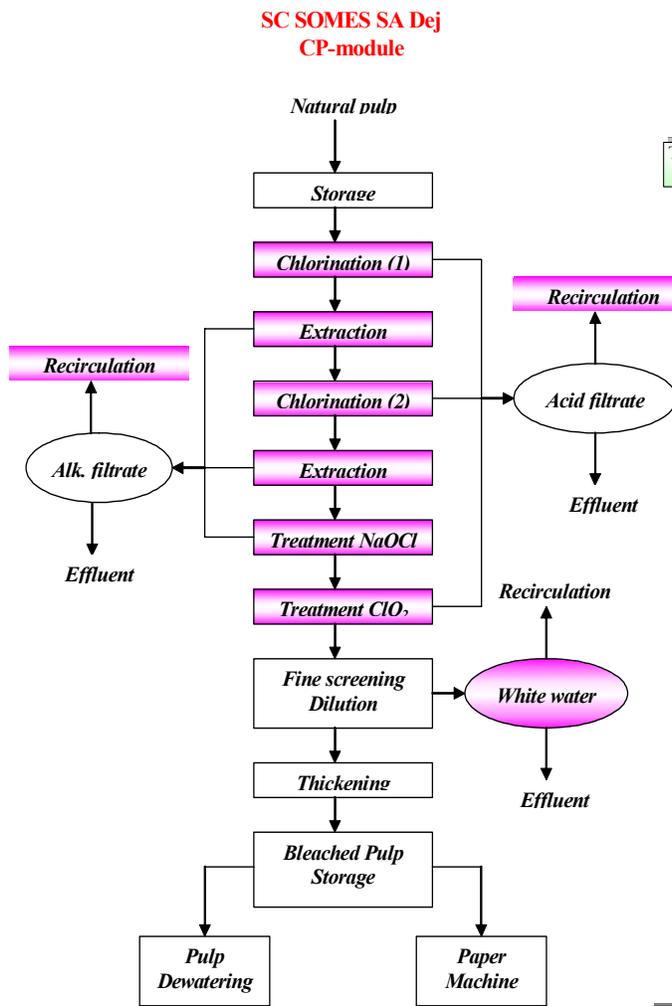
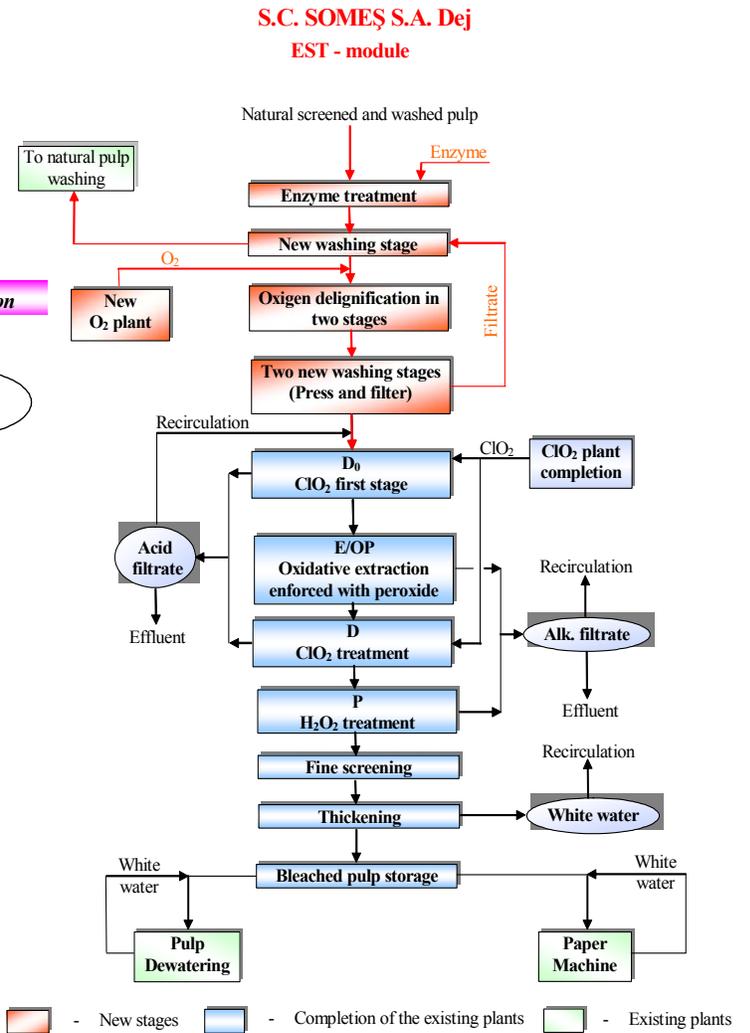


Fig.13 ECF Bleaching flow diagram - EST/BAT option -



Legend: - New stages - Completion of the existing plants - Existing plants

- CP implemented

The technical – economical analysis of the proposed technology (pre-feasibility study) showed the followings:

Total required investment is 11.500 Mill EURO;

An external loan of 11,500 Mill EURO (four instalments/three years) is to be applied for.

The input data were processed with COMFAR - UNIDO (also CEPROHART) software and the main financial indicators, for the less optimistic scenario, are as follows:

✚ Pay Back Period (PBP): 6 years (Dynamic: 10 y) at 12% Discount Rate;

✚ NPV: 3,340,000 EURO

IRR: 15.18% (interest 10%)

The sensitivity analysis for IRR, when increasing various cost categories, showed constantly values >14%.

In 2002 CEPROHART (Pulp&Paper R&D Institute) – Braila completed a study for cost evaluation of BAT (IPPC Directive) implementation in all Pulp and Paper - IPPC type mills in Romania. The total cost at branch level is about Euro170 Mill.

For **SOMES mill** the corresponding cost is about Euro63 mill., out of which 18.2% represents the bleaching part.

Under the present over-enforcing discharge conditions (Romanian laws), even with the BAT implemented, Somes Dej will not comply with the present, unrealistic effluent ELVs.

The main EST effects in terms of both consumption and discharge reductions are presented in Fig. 14 and the financial effects in Fig. 15. The toxic chemicals that generate hazardous compounds are either replaced or reduced. The reduction of emission/discharges at bleaching (Fig. 16) and for the bleached pulp (Fig. 17) show that more steps are to be taken to reach BAT values.

Fig. 14 Effects of EST- implemented for Bleaching - on reduction of consumptions at the Bleached Pulp process

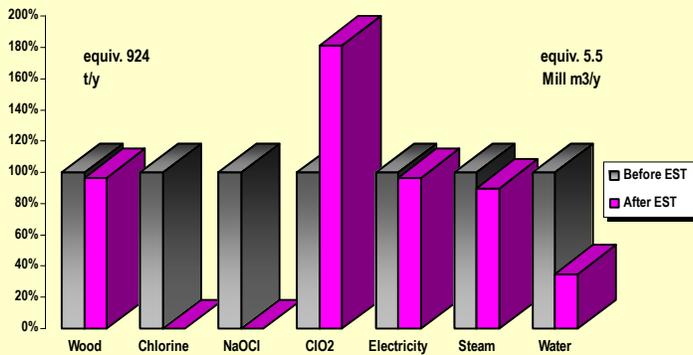


Fig. 15 Bleached pulp cost reduction after EST implementation Total 22.8 Euro/to

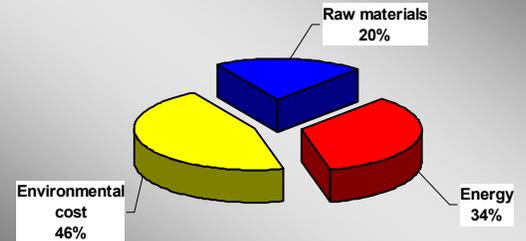


Fig. 16

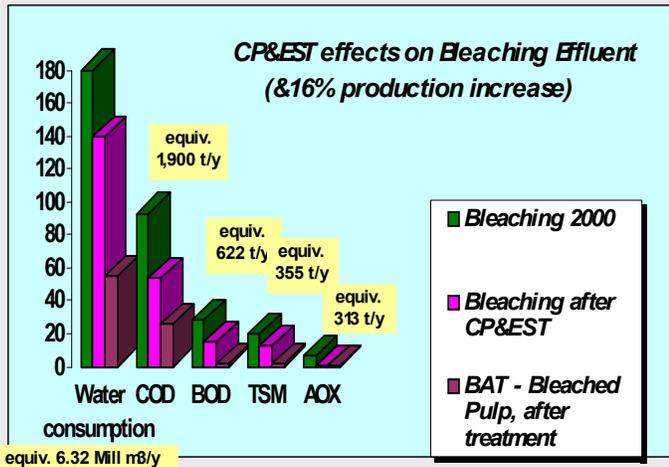
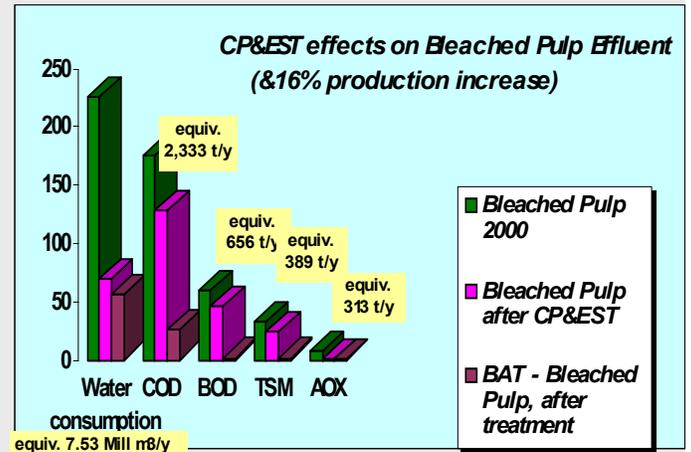


Fig. 17



4. EMA (Environmental Management Accounting) was initially implemented at one cost centre.

Unit implemented a new system for cost calculation and the followings *environmental costs* were calculated and allocated:

- material costs that are not final products;
- the material used in excess due to poor operation practices;
- the material used in excess vs. technological or theoretical norms (e.g. chemical reactions);
- the material used in excess vs. BAT values.

It was agreed at Some that, for defining the *non-product costs*, a) was the best option for some cost centers and c) for other cost centers (the case where chemical reactions are involved).

An information system was developed and integrated within the existing unit system. New accounts, for environmental costs, were added, thus changing the record structure of the present management accounting.

The structure of *Bleached Pulp* production cost (Fig. 18) shows that the non-products cost represents 4%, vs. 3%, the classically accepted “environmental – related” (treatment, fees & penalties).

Breakdown of non-products cost (Fig. 19) emphasizes the high weight (about 83%) of raw material loss (including chemicals).

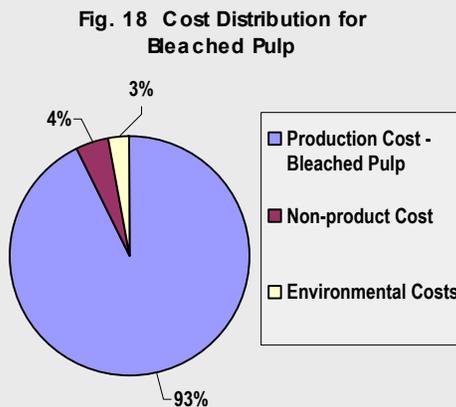
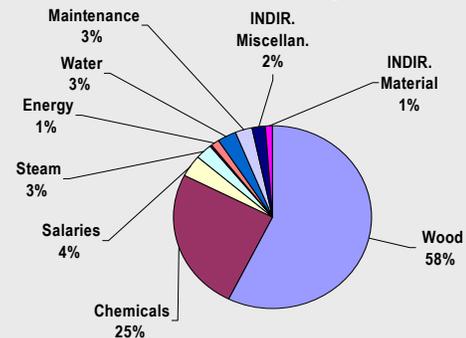


Fig. 19 Breakdown of Non-product Costs for Bleached Pulp



EMA was extended and implemented at the mill level: the environmental costs were allocated to cost-centers and then to products, as they result in the unit cost-flow.