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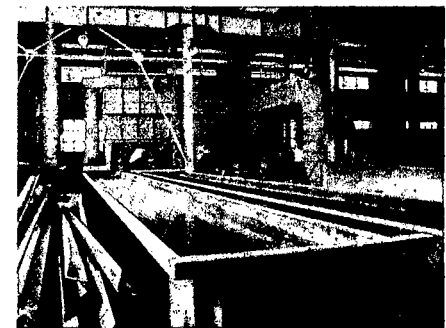
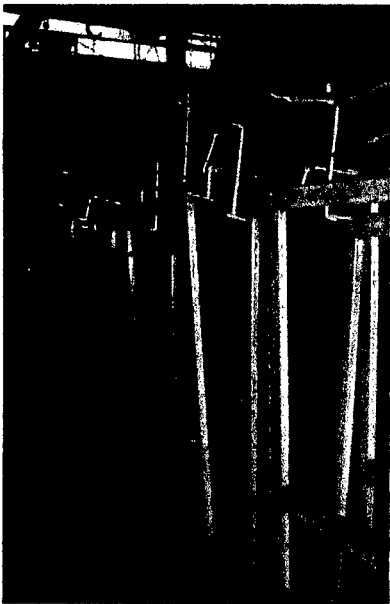
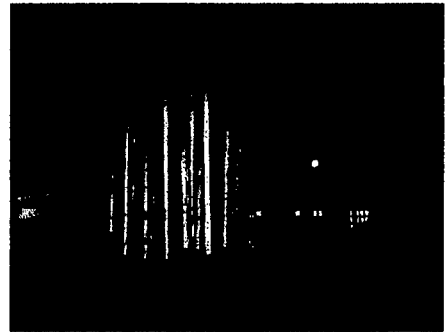
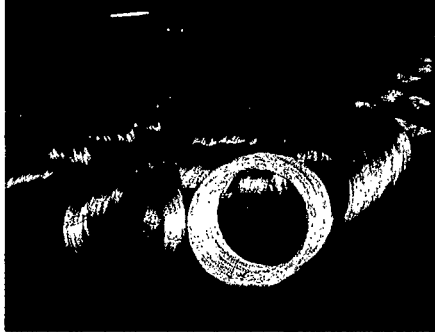
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Cleaner Production in Metal Finishing

ENCLOSURE 3



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Dissemination seminar on Cleaner Production and Metal Finishing Industry

Guoman Hotel, 9 November 2004

Time	Contents	Presenters
8:00-8:15	Registration	
8:15-8:30	Opening	Heinz Leuenberger, CTA
8:30-9:00	Demonstration program – Cleaner Production application in metal finishing industry	Ngo Thi Nga, Deputy Director
9:00-9:15	Coffee break	
9:15-9:35	Achievement and experience of Xuan Hoa Company	Representative of company
9:35-9:55	Achievement and experience of Binh Minh Mechanical Company	Representative of company <i>Unter anderem H₂O- Empfang Kaskade ↳ Training Kistler 2003</i>
9:55-10:15	Achievement and experience of Da Nang Steel Structure Manufacturing	Representative of company
10:15-10:35	Achievement and experience of Ha Noi Mechanical Company	Representative of company
10:35-11:00	Experience exchange / open discussion	VNCPC and experts
11:00-11:45	Cleaner production application in Switzerland – a case study	Roberto A. Kistler
11:45-11:55	Certificates handover	Heinz Leuenberger, CTA Philippe Scholtès, UNIDO representative
11:55-12:00	Closing and introduction of afternoon section.	Ngo Thi Nga
12:00-13:30	Lunch	
13:30-16:30	Metal Finishing Techniques in Switzerland Potentials for technology upgrading in Vietnam	Roberto A. Kistler

1 Acknowledgement

The programme "*Cleaner Production in Metal Finishing*" was initiated by the Viet Nam Cleaner Production Centre (VNCPC) in the middle of 2003 with the aim of helping industries not only to reduce their production costs, but also to prove that cleaner production is applicable in this sector. The programme also aims to initiate cleaner production application in demonstration companies and encourage them to implement and sustain continuous improvement by themselves.

The achievements are the results from efforts of the company staffs themselves. They have studied the methodology and applied it to their specific situation. They are the ones who could sustain the programme in their daily work and make it beneficial to their companies.

Contributing to the success are International CP Experts, Prof. Dr. Heinz Leuenberger (Chief Technical Advisor of Viet Nam Cleaner Production) and Mr. Roberto Kistler, and National Experts, Prof. Dr. Tran Minh Hoang, and staff members of VNCPC who assisted companies in turning cleaner production into practice.

We would like to thank the United Nations Industrial Development Organization (UNIDO) and the United Nations Environment Programme (UNEP) for supporting the promotion of cleaner production in Viet Nam; and the Government of Switzerland for its financial support.

2 Cleaner Production Programme

In many countries, cleaner production has been proven to be beneficial in different sectors, independently from the size of the industries. In order to promote cleaner production in the metal finishing sector in Viet Nam, a programme called "*Cleaner Production in Metal Finishing*" was started in the middle of 2003 with the following objectives:

- to prove the cleaner production potential in Vietnamese metal finishing companies;
- to improve production efficiency with the existing machines;
- to reduce environmental emission;
- to demonstrate, that cleaner production can be applied through simple but effective measures;
- to give economic benefits to the companies in Viet Nam.

The programme has clearly shown that a strong commitment and continuous effort of the company are essential to achieve good results. Full productivity increase and pollution reduction potential can only be realized if the cleaner production programme is integrated as a part of the companies' daily activities.

Since July 2003, five participating companies have applied cleaner production in different production areas. Selected staff of participating companies received extensive cleaner production training (4 modules of three to four days each -see description below) and applied the know-how into their situation with supports from cleaner production and metal finishing experts. Four of the companies have so far achieved significant results (one of them dropped out due to relocation). It must be mentioned though that cleaner production is still in its beginning phase in all participating companies and much better results can be achieved, if they are pursuing their efforts in the next few months. The list of participating companies is attached in annex.

Module 1 : 4 days <i>Ha Noi</i> 15-18/7/2003	Introduction to cleaner production Production management Production processes in metal finishing Situation and experience of Switzerland Material balance
Module 2 : 3 days <i>Ha Noi</i> 16-18/9/2003	Company visit Best available techniques Cause analysis and opportunity development Cleaner production vs. end of pipe treatment
Module 3 : 3 days <i>Ho Chi Minh city:</i> 28-30/10/2003	Company visit Feasibility study Identification of feasible options Action plan Chemicals and auxiliaries in metal finishing
Module 4 : 3 days <i>Ha Noi</i> 11-13/2/2004	Environmental management in metal finishing ISO 14001 and cleaner production Analysis of cleaner production investment Maintaining cleaner production programme

Description of the CP training delivered to selected staff of the participating companies

Cleaner production approach

To be able to identify cleaner production options, it is necessary to carry out a cleaner production assessment. The cleaner production assessment is a useful tool to systematically investigate the existing production and to identify opportunities for improving the production or the products.

The cleaner production assessment focuses on:

WHERE waste and emissions are generated;

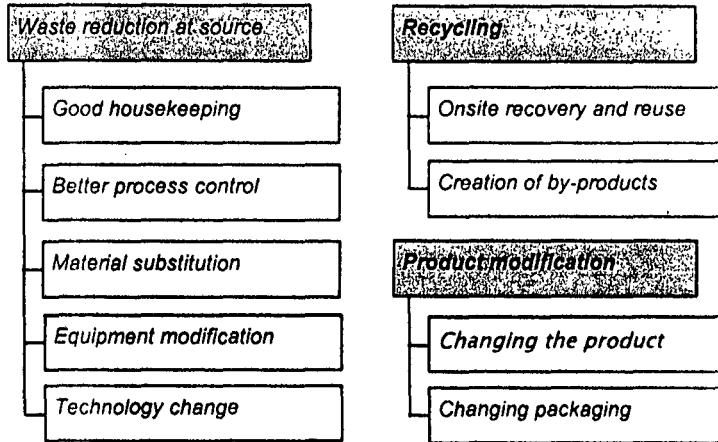
WHY waste and emissions are generated; and

HOW waste and emissions can be minimised in your company.

The result of cleaner production is a set of measures to improve production efficiency and environmental performance for company. After the assessment the company also has action plan to implement cleaner production measures and plan to monitor implementation.

The measures concern not only the equipment, but also the operation and management of the company. They can be grouped into:

- Waste reduction at source;
- Recycling; and
- Product modifications.



What is Cleaner Production?

Traditional environmental thinking focuses on what to do with wastes and emissions after they have been created. Cleaner production avoids or minimises waste and pollution even before it is generated!

The key difference between pollution control and cleaner production is one of timing. Pollution control is an after-the-event, "react and treat" approach; cleaner production is a proactive, "anticipate and prevent philosophy". Prevention is, as is well known, always better than cure. When minimising waste and pollution through cleaner production a reduction in consumption of raw materials and energy is also achieved. Cleaner production strives to get as close to 100% resource efficiency as possible - within the barriers of what is economical viable.

It is important to stress that cleaner production is not simply a question of changing equipment: cleaner production is a matter of changing attitudes, applying know-how, and improving production processes as well as the product.

Other concepts similar to cleaner production are:

- Waste minimisation;
- Pollution prevention; and
- Green productivity.

These are fundamentally the same as cleaner production: with the basic idea to make companies more efficient and less polluting.

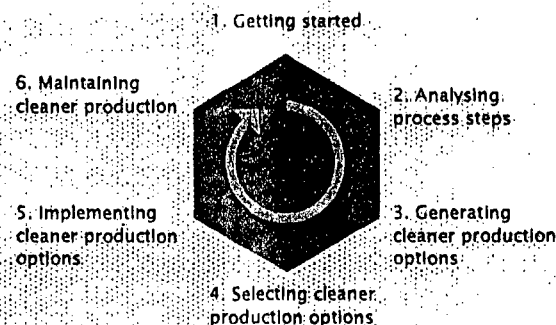
UNEP defines cleaner production as

...the continuous application of an integrated preventive environmental strategy applied to processes, products, and services in order to increase efficiency and reduce risks to humans and the environment.

- For production processes cleaner production includes conserving raw materials and energy, eliminating toxic raw materials, and reducing the quantity and toxicity of all emissions and wastes;
- For products cleaner production includes the reduction of negative impacts along the life cycle of a product, from raw material extraction to its ultimate disposal; and
- For services cleaner production is to incorporate environmental concerns into designing and delivering services.

Six steps towards cleaner production

The cleaner production assessment is carried out in the following six steps:



Cleaner production is an ongoing process. Once finished with one cleaner production assessment, the next should be started to improve even more or to continue with another focus area.

Waste reduction at source

Going to the source of pollution is the fundamental idea of cleaner production.

Good housekeeping is the simplest type of the cleaner production options. Good housekeeping requires no investments and can be implemented as soon as the options are identified. Good housekeeping is e.g. to repair all leaks and avoid losses by closing water taps and turning off equipment when not needed. Even though good housekeeping is simple, it requires focus from the management and training of staff.

Better process control is to ensure that the process conditions are optimal with respect to resource consumption, production and waste generation. Process parameters such as temperature, time, pressure, pH, processing speed, etc. have to be monitored and maintained as close to the optimum as possible. As with good housekeeping, better process control requires improved monitoring and management focus.

Material substitution is to purchase higher quality materials that give a higher efficiency. Often there is a direct relation between the quality of the raw materials and the amount and quality of the products. Material substitution is furthermore to replace existing materials with some that are environmentally better.

Equipment modification is to improve the existing equipment so less material is wasted. Equipment modification can be to adjust the speed of an engine, to optimise the size of a storage tank, to insulate hot and cold surfaces, or to improve the design of a crucial part of the equipment.

New process technology is to install modern and more efficient equipment, e.g. a higher efficiency spray gun with conventional one. New process technology requires higher investments than the other cleaner production options and should therefore be considered carefully. However, the potential savings and quality improvements often pays back the investment in a very short time.

Recycling

Waste streams that are unavoidable might be recycled within the company or might be sold as by-products.

On-site recovery and reuse is to collect "waste" and reuse it in the same or a different part of the production. One simple example is to reuse rinsing water from one process step to previous one (counter-current rinsing).

Creation of by-products is to collect (and treat) "waste-streams" so they can be sold to consumers or to other companies.

Product modification

Improving the products so they pollute less is also a fundamental idea of cleaner production.

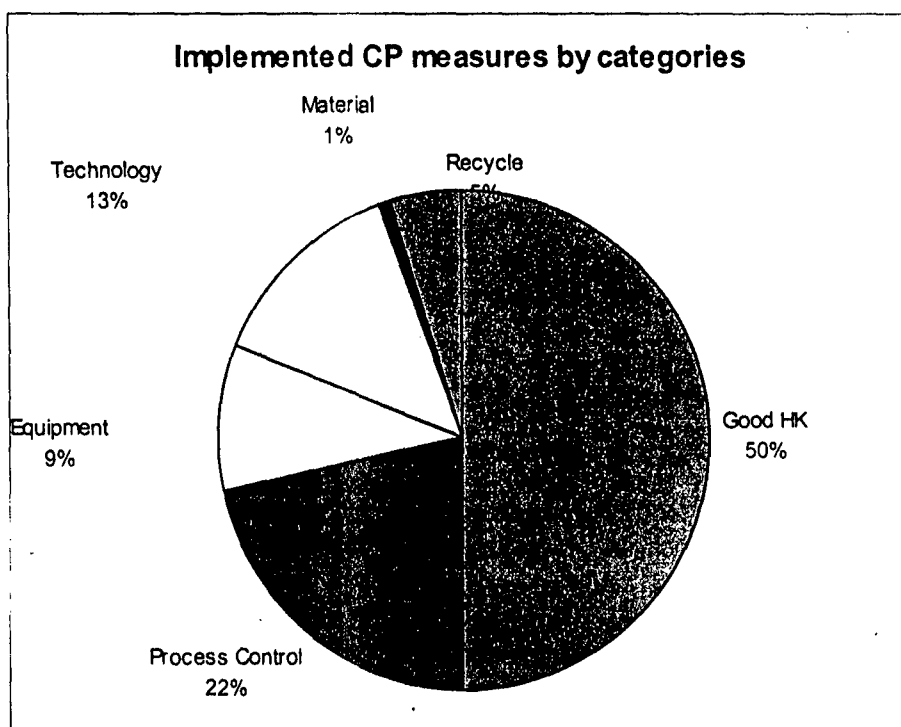
Changing the product is to re-think the product and the requirements to the product.

Improved product design can result in large savings on material consumption and use of hazardous chemicals. Changing packaging can be just as important. The key word is to minimise the packaging and maintaining the protection of the product.

3 Results

The participating companies started the programme with data collection, material balance, and benchmarking and followed with the steps described in the above methodology. As mentioned earlier, during the programme, one of five companies dropped out due to relocation

In February 2004, the participating companies had developed 122 cleaner production options, of which 103 options were implemented, 15 were under implementation, and four were rejected. The distribution of implemented measures by category is as follows:

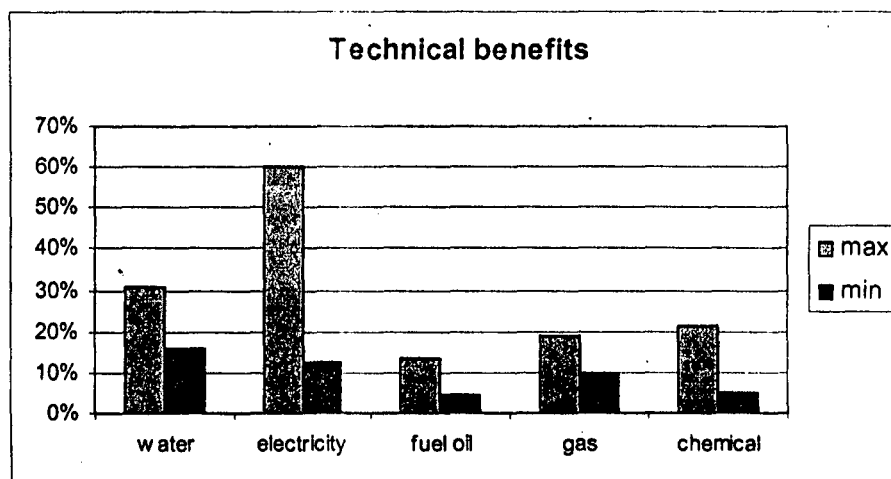


As the diagram shows, most of the options fall into the group of "Good Housekeeping" and "Better Process Control". These are no or low cost measures. Besides these options, some companies went to high cost measures to exploit the potential of cleaner production more thoroughly.

Economic benefits

As most of the developed options have been implemented, the participating companies have already received positive results in terms of economics and

environment. All participating companies achieved reduction in material consumption. The overview of the results in the different aspects is shown below:



The programme is expected to save the participating companies 4.35 billion VND (277,000 USD) annually from a total investment of 326 million VND (21,000 USD). The following table shows an overview of the economic benefits in the participating companies.

	Minimum (VND)	Maximum (VND)
Total Investment	25,000,000	212,000,000
Expected annual savings	72,775,000	2,589,690,000

Environmental benefits

Cleaner production does not only help to reduce production costs, but also saves the environment.

Through the implementation in four companies, it is expected that they will reduce annually their consumption by:

- Waste water: 129,000 m³
- Chemicals: 36 ton
- Electricity: 1,000 Mwh
- Fuel oil (FO): 3,100 l
- DO: 58,000 l
- LPG: 66,000 l
- CO₂ emission 1,118 ton

Beside the quantitative benefits, the participating companies achieved better product quality (based on their customer's feedback). The programme does not only save the company's money and the environment, but also changes the attitude of employees toward production.

4 Examples of cleaner production measures in metal finishing

As mentioned, most of the no and low cost options were put into implementation. However, the medium cost options were also considered and implemented in some companies. A few examples of cleaner production measures that were already implemented or are currently under implementation in participating companies and other metal finishing companies in Viet Nam are given below.

4.1 Good house keeping

Aware of this low and no cost opportunities, the participating companies immediately implemented good house keeping measures, including: the installation of meters to monitor the water and electricity consumptions; the insulation of steam pipes, fixing of leakages and old pipes...

This group of options requires very limited investment, but changes in the companies' staff care and attitude are essential for their effectiveness. Although savings from this group are often difficult to quantify, their contribution to the overall results should not be underestimated.

- A company invested 5 million VND to implement good house keeping measures as better material storage to avoid corrosion of objects to be plated, and setting up incentive/penalty mechanisms for the workers. Trainings were also delivered to ensure the workers' commitment to the programme. The company saved 100 million VND annually from these measures.
- Another company invested 100 million VND for checking and maintaining equipment, installation of gas, water and electric meters as well as improved worker management, including the introduction of a bonus scheme for workers. After the campaign, the company saved annually 348 million VND in electricity, 336 million VND in water, 20 million VND in gas and 20 million VND in chemicals.
- A company was faced with a high rate of re-processing due to weak adherence of a coating layer. During the maintenance programme, the cause was discovered: the piping for phosphate treatment was blocked and therefore the process was not carried out properly. The piping system was immediately cleaned and fixed. Since then, the company has no problem with quality of this production line and saves the related re-processing costs.
- A galvanising company started with good house-keeping measures from the beginning of the cleaner production programme. These included training and the provision of clear instructions such as: picking up objects immediately if they unintentionally fall into the galvanising bath; drying the objects completely before galvanising; clear specifications of the drop-down angle and duration of the bath. This reduced significantly the amount of zinc deposit in the galvanising tank, thereby reducing zinc consumption significantly???
- A Vietnamese mechanical company producing BBQ ovens from sheet metal participated in the cleaner production programme. They identified the roles and responsibilities of each supervisor and provided sorting trays for pressing machine. This measure helped reduce defect products and saved 2% of metal sheets, equivalent to 400 million VND per year. Beside this, the processed accessories are better protected and less corrosive. This also saves acid consumption in the following steps – pickling.

Maintenance is another important aspect of good housekeeping. Lack of regular maintenance might indeed cause damage to equipment. Despite of this, the equipment or production line is often considered for maintenance only when it ceases to work, requiring reparation works, which are often significantly more expensive than regular maintenance. Leaking from pipes or tanks are another consequence of insufficient maintenance. This does not only cost money due to increased material consumption, but it also releases pollutants to the environment.

It is recommended to determine specific indicators (like material consumption per unit of product) for critical production steps and to follow their evolution throughout the programme in order to monitor the benefits achieved. The comparison with benchmarks and best practices allows to set the objectives to be reached.

4.2 Material substitution

This group of options was explored by participating companies after realizing that many chemicals suppliers recommend using high quantity or high concentration of their products for safety purpose

("safety factor"). With the exception of the coating agents, the chemicals will not remain on the products, but they will be discharged in the following production steps. The over-usage of chemicals will result not only in increased material cost, but also in additional costs for the removal of excess chemicals and corresponding waste water treatment. However, this is a habit existing in many companies and the application of Cleaner Production is a chance for them to look at the availability of more effective and more environmentally friendly materials.

The results show that many participating companies are now looking for more effective auxiliaries (anti-rusting, carriers...) so that they can use less chemicals and shorten processing time. Using smaller quantities of chemicals also means reducing the treatment costs.

A company changed water source from well to city supply for the rinsing process of its Ni-Cr plating line. This measure reduced the plating defect rate from 5% to 2%, saving 280 million VND per year. Investment costs amounted to 5 million VND per year.

4.3 Better process control

As mentioned in the group "good housekeeping", after checking and maintaining the equipment, and installing missing meters, a company can control its process much better, thereby reducing the percentage of re-processing.

Parallel to this, the companies need to re-study their process to determine the exact quantity of chemicals to be used and avoid over-use, e.g. checking consumption of salt in plating bath or solvent in coating. The quantity of chemicals actually used should subsequently be measured and not left to the feeling or habit of the operator. Other production conditions to be studied and monitored include: contents and concentration of different baths, pH, temperature, duration, dripping time...

- A company uses a gas-fired dryer for its powder-coated products. During the programme, the company insulated the dryer and adjusted the position of the temperature sensor in order to better control the temperature. The company also change the size of the drying batch. This combined measure saved 20% in gas consumption, corresponding to 3 ton CO₂/year. The payback period for the investment of 500,000 VND is less than two months.
- A company adjusted the air/oil ratio of its boilers (4 boilers of 0.75 ton/hour each), thereby reducing its Diesel Oil costs by 8%, equivalent to 80 million VND/year. This measure didn't require any investment.

This type of options were carried out immediately in participating companies as they allow for significant achievements with almost no investment.

4.4 Equipment modification and change

Re-studying the equipment used helps many companies to find options for more effective production, mainly in energy reduction. Sometimes the costs for replacement or modification seems high at first sight, but the payback is actually short as can be seen in the examples below.

- A BBQ oven producer replaced the cyclon-bag filter of its powder-coating room with an automatic filtering system. This measure saved more than 30 million VND per year thanks to the recovery of powder and at the same time improved working conditions. This measure cost 5 million VND.
- A company uses an automatic gas-fired dryer for coating products. During the programme, it was found that a big amount of heat was lost due to improper design and unsealed door of the drier. The company carried out several modifications of the dryer with a cost of 11 million VND. This measure resulted in savings of 3% in gas consumption, or 30 million VND per year, with a payback period of only 5 months. Beside this, the temperature in the working environment dropped from 35-37°C to below 32°C and the measure allowed for a reduction of 14 tons in CO₂ emission.
- A company with an automatic Cr-Ni plating process line invested 23 million VND to install a recycling system for its cooling water. This saved 400m³ water per month, equivalent to 45 million VND per year. The payback period of this measure is 7 months.

- A company with a Cr-Ni plating process line was using a badly designed rack to hang objects. As a result, a lot of metal (Cr, Ni) was progressively accumulating on the rack. During the programme, the company used powder coating to prevent this accumulation. The investment of 2 million VND is saving the company 28 million VND per year in Cr and Ni consumption.
- A company reused a solvent paint production line for electrostatic powder coating. During the cleaner production programme, the company shortened the length of the conveyor and increased the number of hooks on racks. This measure allowed the company to increase its capacity 2.5 times. The investment of 53.5 million VND leads to savings of 111.6 million VND per year. The payback period is thus 4.8 months. The measure also reduced the emission of CO₂ by 60 ton per year.
- A company replaced the brick inner coating of its dryer with a more efficient metallic one. This measure reduced the electric consumption for drying by 60%, saving 60 million VND per year from an investment of 25 million VND with a payback period of only 4 months.

4.5 Technology change

The plating line in some companies is obsolete and therefore not so effective. Beside looking for technology improvement and renovation, some companies showed interests in completely new technologies. Some participating companies changed from overflow rinsing to counter-current rinsing, saving significant amounts of water (and reducing wastewater discharge to the environment)

- An electro-plating company changed from overflow to counter-current rinsing for its zinc plating line. This measure saved 7500 m³ water per year, amounting to 30 million VND from an investment of 700,000 VND. The payback period is 0.5 month.

4.6 Recycle

These attractive opportunities combine economic benefits with the reduction of toxic effluents.

- A company installed a recycling system for the cooling water coming from its compressor, with an investment of 20 million VND. This measure saved the company 20,000m³ water per year, equivalent to 82 million VND, with a payback period of less than 3 months
- Another company invested 3 million VND to set up a system to recover chromium from a rinsing bath. The measure helped avoid the discharge of 64 kg heavy metal to the environment annually. This did not only save the company 2 million VND in material cost per year, but also unquantifiable amounts in waste water treatment and environmental fee.
- Similarly, a participating company spent 7.2 million VND for a system to condensate chromium. With operating costs of 24 million VND per year, the system saved the company 360 kg chromium per year, equivalent to 30 million VND. The payback period is 13 months.

5 Lesson learned

- Management support and commitment is as important as shop floor worker commitment for the success of a cleaner production programme;
- Cleaner production is a voluntary management tool. It is difficult to get the commitment of companies when cleaner production is not well known;
- Companies having better record and management system were able to reap better benefits from cleaner production compared to companies with poor recording and reporting;
- The Cleaner Production programme also results in improving occupational health and safety by improving working environment;
- Better and more in-depth trainings in cleaner technologies are necessary to help companies to go beyond good housekeeping measures and implement cleaner technologies in their production process;
- Enterprises in Viet Nam are not yet willing to invest in high technology due to the lack of financial resources. Finding a proper financial support would bring advantages in implementing cleaner production;
- Economic benefits are the first priority in production business, however the environmental laws and regulation will become more and more strict. This will require enterprises to improve their environmental performance at the same time as their production efficiency. Cleaner production will help them.

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Annex

List of companies participating in demonstration programme

Name	Contact person	Address
Xuan Hoa Company (Electro plating, powder coating)	Ms. Đặng Thanh Thủy, Chief of Administration	Thị trấn Xuân hoà, Mê Linh, Vĩnh phúc Tel: 0211-863-244 Fax: 0211-863-019
Binh Minh Mechanical Company (Electro plating)	Mr Phạm Cao Việt Director	Phường Tiến Phong, thị xã Thái Bình, tỉnh Thái Bình Tel: 036-830-362 Fax: 036-831-796
Da Nang Metal Construction Manufacturing (Zinc galvanizing)	Mr. Hồ Thái Hoà Director	Khu Công nghiệp Hoà khánh, quận Liên Chiểu, thành phố Đà Nẵng Tel: 0511-732-775 Fax: 0511-732-489
Binh Tay Wire Company (Zinc galvanizing)	Mr Phan Văn Chính Deputy Director of Technical Department	56 Thủ Khoa Huân, quận 1, TP Hồ Chí Minh Tel: 08-8299-675 Fax: 08-8227-610
Ha Noi Mechanical Joint-Stock Company (Electro plating)	Mr. Phạm Văn Ngo Director	229 Tây Sơn, Đống Đa, Hà Nội Tel: 04-563-1633 Fax: 04-563-1633

Note: During the programme, Binh Tay Wire Company dropped out due to relocation programme.

Xuan Hoa Company

Company: Company No 1 and office: Xuân Hoà - Mê Linh - Vĩnh Phúc

Company No 2: Cầu Diễn - Từ Liêm - Hà Nội

Tel: 0211.863244 Fax: 0211 863019

Number of employees: 932

Number of sections: 6

Products Xuan Hoa Company produces over 300 types of products, including bicycle accessories, tables, chairs, beds...for domestic and international market.

Industrial value: ~200 billion VND/year

Focus of CP assessment:

Automatic Ni-Cr plating line number 3 and powder coating line. Other production processes as zinc plating, compressor... were also checked.

Number of options developed: 49

Number of option implemented: 45

Number of options requiring further study: 4

Implemented options by category

Good house keeping 28

Better process control: 6

Equipment modification 3

Process modification 4

Reuse, recycle, recover: 4

Results:

Total investment: 212.000.000 VND

Expected annual savings: 1.176.427.115 VND/year

Technical benefits:

Reduction of water consumption 30%

Reduction of electric consumption 12,6%

Reduction of fuel consumption 13,3%

Reduction of gas consumption 9,3%

Reduction of chemical consumption 3-5%

Environmental benefits

Reduction of wastewater 30%

Reduction of CO₂ emission 10%