United Nations Environment Programme
Division of Technology, Industry and Economics
UNEP
Profiting from Cleaner Production

Strategies and Mechanisms For Promoting Cleaner Production Investments In Developing Countries

The Cleaner Production Investment Process

Case Study

Cleaner Production

The United Nations Environment Programme
Division of Technology, Industry and Economics
Production and Consumption Branch

Presents a Training Series

Strategies and Mechanisms for Promoting Cleaner Production in Developing Countries

The Cleaner Production Investment Process

Case Study

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Acme Electroplaters
(Case Study)

Contents

Introduction

This case study is based on a small electroplating company in a developing country, which has identified a potential Cleaner Production (CP) project. It wishes to evaluate whether the project is likely to be worthwhile, and if so, to seek finance for it. The case study is based on an actual project in a real company, though some of the details have been adapted to make it suitable for teaching purposes on this course.

The case is the same company and project as that used on an earlier course in the series, CP2 'Introduction to Capital Budgeting and Financing of Capital Projects'. In CP2, participants were requested to use the project in the case as the basis for identifying the operating costs that were likely to be affected by the project. The project was also used in other sessions of CP2 as the basis for the evaluation of the economic feasibility of the project by calculating present values, and other available investment appraisal methods such as Internal Rate of Return and Payback.

This course will take further the CP2 analysis of the project and consider the later stages of its development, in particular the stage of applying to a finance-provider for project finance (Part 2 of the case).

Acme - Company Background and electroplating process description

Established in the late 1970's, Acme ElectroPlaters is one of the few small companies operating in a heavily industrialised area of a medium-sized city in a developing country. The company has annual revenues of approximately US$200,000 and 75 employees who work an average of 8 hours per day.

Acme's products include metal items such as candlesticks, picture frames, screws, nuts, and bolts that have been electroplated. Acme's customers include both private individuals and other companies.

Electroplating involves the coating of a metal work piece such as a candlestick with a thin protective layer of another metal such as zinc, copper, nickel, bronze, tin, chromium, and brass. The purpose of the protective layer of metal is to improve the final product appearance and to increase the product lifetime by preventing rust formation. Acme has two production lines. One is a zinc electroplating line (also called a galvanising line), and one is a copper-nickel-chromium electroplating line.

The electroplating process consists of five main steps, which are described in more detail in Appendix 1. The step which is most relevant to this project is Step 3, the *rinsing step*, which is done to remove any residual electroplating chemicals from the newly electroplated workpiece. Proper rinsing with water is very important because any chemicals remaining on the parts will degrade the surface finish, or interfere with additional manufacturing steps. Therefore, the rinse tanks must be drained and refilled when they are too contaminated to rinse properly.

The rinsing step produces the largest volume of wastewater at Acme. This wastewater is contaminated by residual chemicals from the electroplating baths such as cyanide, heavy metal ions and complex ions. The rinsing step also produces some air emissions in the form of electroplating chemical vapours.

Acme's Financial Background

Joe Meca founded Acme Electroplaters in 1985, and with his wife owns 100% of the shares. Since then the business has generally been profitable, though profits have fluctuated from year to year. Acme has raised some small loans in the past, which have been repaid in full on the due dates, but has mainly financed its expansion through internal funds.

In the past, Mr Meca has assumed that if finance were needed it could probably either be raised externally at a cost of around 20% per year (before making any allowance for inflation) or from Mr and Mrs Meca's own funds (where they estimate that they could otherwise use the money elsewhere to earn a rate of return of approx. 20% per year).

Acme's annual revenues of approximately US$200,000 are expected to remain fairly stable in future since the firm has long-term contracts with its customers and is not subject to any significant seasonal factors. It has been trading with its current suppliers for over 8 years, and no major changes are expected in the supply of the materials and equipment that Acme needs in order to carry on its business. Acme's main suppliers are:

- the main supplier of the chemicals used in the electroplating process is Chemicolc*,* a multinational chemicals company from whom Acme makes average annual purchases of around $50,000;
- a local firm, EQ*,* and equipment supplier, supplies Acme with technical devices to keep the production process running. The average annual purchase by Acme from EQ is $10,000.

Acme's customers are companies from a range of different industry sectors. There are other suppliers of electroplating services who compete with Acme, but since but since across the market as a whole the demand for electroplating exceeds supply, electroplating companies such as Acme are in a strong market position. Acme's aim is to increase its revenues annually by 20% over the next 5 years, so long as it is able to finance this expansion through retained profits.

Although the book value of Acme's equipment is $73,000, its market value if it were to be sold would be only $45,000.

Acme's insurance policies are issued by a local insurance company (Insura), and its balance sheet and income statement (Appendix 4) have been prepared and audited by a local accountancy firm, Accountnow.

Rinse Step Project

A "Cleaner Production Assessment" which was conducted at Acme ElectroPlaters identified many possible areas for improvement that would simultaneously provide economic savings and environmental benefits. One of these was to increase the efficiency of water use during the rinse step of the process by modifying the *rinsing step* during electroplating. This would significantly reduce water use at the facility, and generate significant cost savings and also some additional income.

The change that was proposed to the process was to change from the present 2-rinse static rinse system to a new 3-tank counter-current rinsing system, where the same rinse water is cycled through three rinse tanks. Fresh water flows into the last tank and runs in the opposite direction of the flow of the workpieces being rinsed. This means that the fresh water supplied to the third rinse tank is subsequently reused in the second and first rinse tanks, producing a saving in water usage. Because of the nature of the piping for the new system, all new tanks are required. The water overflow from the first tank is sent to the wastewater treatment system. Appendix 2 describes in more detail the current and proposed systems for the Rinse Step.

In summary, the financial costs and benefits of the project have been estimated to be:-

Initial investment	$18,000
Annual cost saving	$8,100
Increased annual revenues due to fewer product rejects	$1,500
Total annual benefits of the project	$9,600

Note: for simplicity in calculation, it is assumed here that these cashflows will arise at the end of each year (rather than over the year as a whole, which would normally be more usual with industrial/commercial activities).

The project is expected to last for 3 years.

Appendix 3 provides more detail on these expected costs and benefits.

Based on these estimates, a calculation of the project's profitability has been done showing that the project has a Net Present Value of $2,221:-

end of year:-	net benefit	present value factors	present values
1	$9,600	0.8333	$8,000
2	$9,600	0.6944	$6,667
3	$9,600	0.5787	$5,555

			$20,221
less: initial investment			$18,000

Net Present Value			$2,221
			=====

Note: the 'present value factors' (or 'discount factors') were calculated based on Mr Meca's estimate that the cost to Acme of raising capital is around 20% per year. The factors are in effect a kind of exchange rate which indicates what money at a specific point of time in the future is worth today (e.g. $100 receivable in 1 year's time is worth $83.33 now - its present value).

The further indicators have also been calculated in respect of the project:-

payback period	22.5 months
discounted payback period	27.5 months
internal rate of return	27.76% per year

Note: these calculations were done as part of the CP2 course.

Part 1

Acme would like to go ahead with the project, but cannot finance it from their own internal sources so they wish to apply for a loan to a bank.

Each small group is requested to prepare an application on behalf of the company, using as a basis the standard small business loan application form which is provided; and then make a presentation of this proposal to the bank's representative.

Part 2

Acme would like to go ahead with the project, but before committing to try to raise the necessary finance from a commercial bank on the normal commercial terms, it would like to explore other possibilities.

Each group is requested to identify possible alternative sources of finance which Acme could approach, and in particular to identify:-

- the strengths in the project which might make it more attractive to the source, and which it should try to emphasise in its application
- any possible problems, and how these might be addressed
- any ways in which the project could be adapted, without damaging it, in order to make it more attractive to the source.

Part 3

The bank has agreed to finance the project, and the company has set up a small committee (your small group) to plan for its implementation and subsequent management. This should include plans on how to monitor progress of the project and subsequently to be able to evaluate whether it has actually turned out as successfully in practice as had been anticipated.

Each group is requested to prepare an action plan of how the project should be implemented and managed.

Appendix 1

ACME ELECTRO-PLATERS: electroplating process

The electroplating process consists of five main steps, which are shown in Figure 1 and described below:

(a) The *surface preparation step* insures that the surface of the metal workpiece (e.g., a candlestick) is clean so that the thin layer of plating metal will properly adhere. The first activity in surface preparation is the use of a bath of chemicals in water that removes organic contaminants such as grease, oil, paint markings, and dirt. A second chemical/water bath is then used to remove rust and scale. Finally, a third chemical/water bath is used to prevent rust from forming on the workpiece before the next manufacturing step.

The surface preparation step produces several forms of waste, including air emissions, solid sludge at the bottom of the bath tanks, and wastewater. The air emissions consist of chemical vapours from the surface preparation baths. The solid sludge and wastewater both contain oil and grease removed from the cleaned workpieces as well as residual surface preparation chemicals.

(b) The *electroplating step* is an electrochemical process, which coats the thin protective layer of metal onto the workpiece using an electric current. The workpiece is submerged into a water-based bath containing the dissolved metal (or metals) that will be used to coat the workpiece. The electroplating baths also contain other chemicals (e.g., cyanide) that assist the electroplating process. An electric current is run through the bath, and the current pulls the dissolved metals out of the bath solution and deposits them onto the surface of the workpiece. As more workpieces are coated, the dissolved metals in the plating bath are steadily used up. The bath must therefore be regularly replaced in order to assure proper coating of the workpieces.

The electroplating step produces the most significant air emissions at Acme, consisting of chemical vapours from the electroplating baths. The electroplating step also produces solid sludge at the bottom of the electroplating tanks and wastewater, both of which contain oil, grease, and residual electroplating chemicals.

(c) The *rinsing step* is done to remove any residual electroplating chemicals from the newly electroplated workpiece. Proper rinsing with water is very important because any bath chemicals remaining on the parts will degrade the surface finish or interfere with additional manufacturing steps. Therefore, the rinse tanks must be drained and refilled when they are too contaminated to rinse properly.

The rinsing step produces the largest volume of wastewater at Acme. This wastewater is contaminated by residual chemicals from the electroplating baths such as cyanide, heavy metal ions and complex ions. The rinsing step also produces some air emissions in the form of electroplating chemical vapours.

(d) The *post-treatment step* is a series of final activities that further protect the electroplated and rinsed part from moisture attack, tarnishing, and rusting. A chemical/water bath is used to remove any residual cyanide and heavy metals. Finally, the workpiece is put through a heat treatment process to improve its hardness.

The post-treatment step produces wastewater containing residual post-treatment chemicals, as well as air emissions in the form of post-treatment chemical vapours.

(e) The *wastewater treatment step* is used to treat the large volumes of wastewater that are generated by all four of the manufacturing steps described above. During the wastewater treatment step, treatment chemicals are added to the wastewater, and the treatment chemicals interact with the contaminant chemicals. As a result, some of the combined chemicals settle out in the form of solids, called sludge. The chemical sludge is separated from the wastewater, and the treated wastewater is then released to the municipal sewer system.

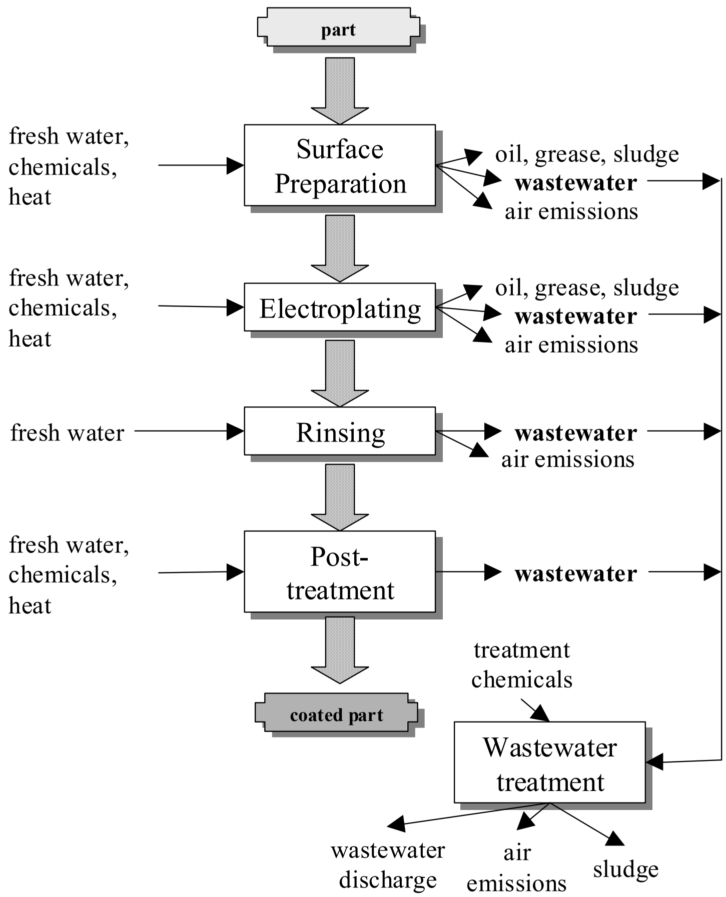

Figure 1 Overall Process Flow Diagram

Appendix 2

ACME ELECTRO-PLATERS: the proposed Rinse Step project

THE EXISTING RINSE STEP

Currently, Acme uses a two-tank static rinse system for rinsing the newly electroplated workpieces. In this system, each rinse tank is filled with fresh water at the beginning of the day, and used all day to rinse workpieces. At the end of the day, the contaminated bath water is sent to the wastewater treatment step. The static rinse system is shown in Figure 2 below.

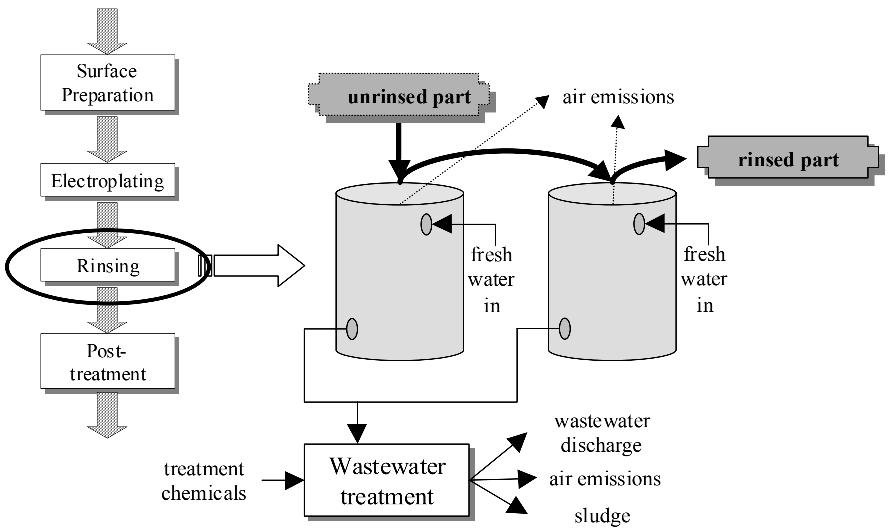

Figure 2 Existing Rinse Step (2-tank static rinse system)

THE PROPOSED NEW RINSE STEP

Water consumption at Acme can be reduced considerably by replacing the existing 2-tank static rinse system currently used with a 3-tank counter-current rinsing system where the same rinse water is cycled through three rinse tanks. Fresh water flows into the last tank and runs in the opposite direction of the flow of the workpieces being rinsed. In other words, the fresh water supplied to the third rinse tank is subsequently reused in the second and first rinse tanks. Because of the nature of the piping for the new system, all new tanks are required. The water overflow from the first tank is sent to the wastewater treatment system. This 3-tank counter-current rinse system is shown in Figure 3. Figures 4a and 4b show the water useage under both systems.

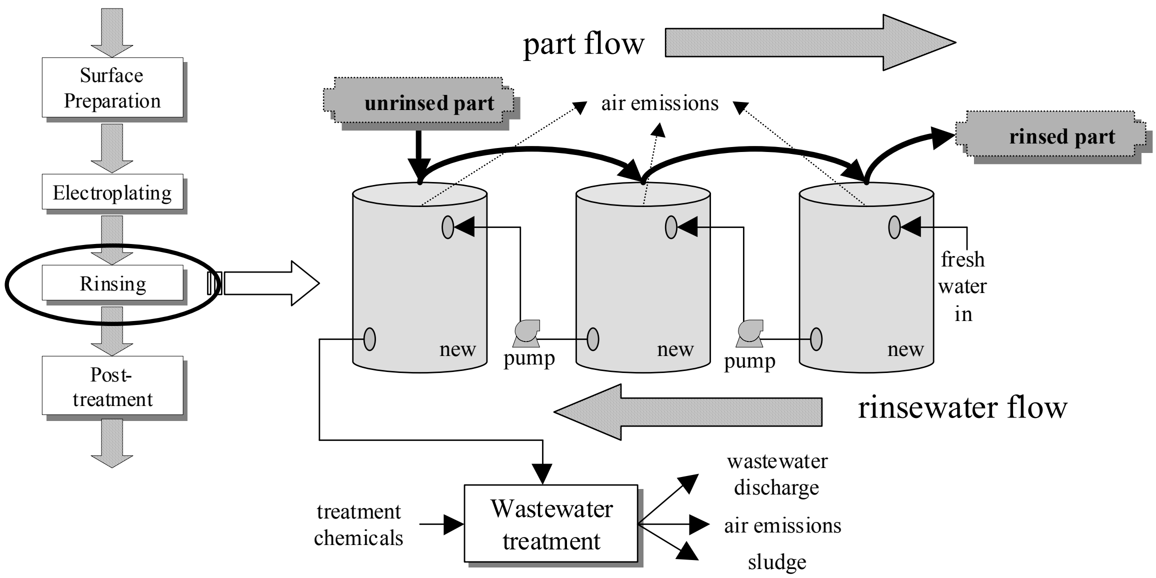

Figure 3 Proposed New Rinse Step (3-tank counter-current rinse system)

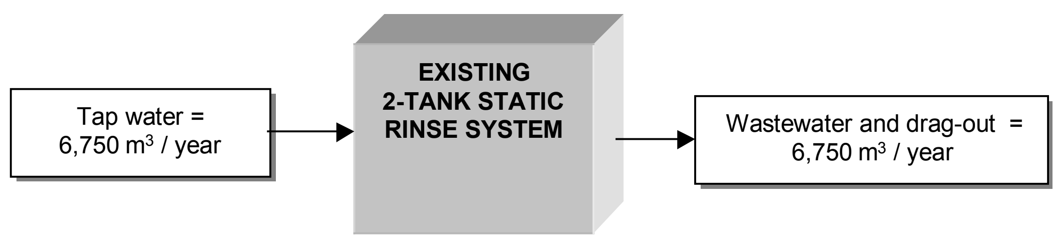

Figure 4a Water flow **before** cleaner production project implementation

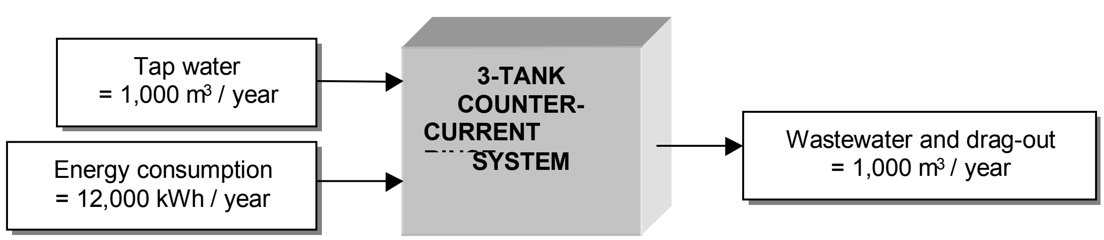

Figure 4b Water flow **after** cleaner production project implementation

Appendix 3

ACME ELECTRO-PLATERS: project costs and benefits

Annual operating costs before and after project

Before project implementation	**Costs (USD)**
Fresh water consumption 6,750 m^3 / year @ $0.75/$m^3$	$ 5,063
Wastewater treatment 6,750 m^3 / year @ $0.85/$m^3$	$ 5,737
Labour: 8 employees @ $0.40/hour × 44 hours per week x 52 weeks / year	$ 7,322
Total annual costs	**$ 18,122**
After project implementation	**Costs (USD)**
Fresh water consumption 1,000 m^3 / year @ $ 0.75/m^3	$ 750
Wastewater treatment 1,000 m^3 / year @ $0.85/$m^3$	$ 850
Energy consumption 12,000 kWh / year @ $0.05/kWh	$ 600
Labour: 8 employees @ $0.40/hr for 44hrs/week x 52 weeks/year	$ 7,322
Annual maintenance costs	$ 500
Total annual costs	**$ 10,022**
Increased annual revenues due to fewer product rejects	**$1,500**
Annual Cost Saving	**$ 9,600**

Table 3 shows the actual initial investment costs for the Acme project.

Table 3 Initial investment costs of the proposed counter-current rinsing system

Item	**Cost (USD)**
6 new steel tanks	$ 5,400
Rubber lining of 6 tanks	$ 3,800
Steel pipe, brass water taps	$ 1,000
1 large overhead storage tank, lined, with cork	$ 2,300
Overhead tank construction materials	$ 1,000
4 small pumps, one per production line	$ 2,200
Subtotal:	**$ 15,700**
Installation costs (5%)	$ 800
Contingencies (10%)	$ 1,500
Total initial investment costs:	**$ 18,000**

Appendix 4

ACME ELECTROPLATERS

Balance Sheet as at 31 December 2000 (in $000)

Capital and liabilities		**Assets**	
Share capital	60	Equipment	73
Retained profits	42	Inventory	21
Accounts payable	23	Accounts receivable	29
		Cash	2
	----------		----------
	125		125
	======		======

Income Statement for the year to 31 December 2000 (in $000)

Sales revenue	203	
less: Cost of goods sold	156 ------	
GROSS PROFIT	47	
less; Overhead (indirect) costs e.g. staff costs, rent, maintenance, etc.	35	
NET PROFIT	-----	
	12	
	===	