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A close-up photograph of a small, realistic globe of the Earth resting on a vibrant green leaf. A clear water droplet is visible on the leaf to the right of the globe. The background is a soft, out-of-focus green.

Chemical leasing: A global success story

Innovative business approaches for sound
and efficient chemicals management



UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna, 2011

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Foreword

Global environmental concerns, the economic crisis and the need for sound job creation are major elements of the business of the day. Encouraging innovative concepts that respond to new challenges constitute an integral element of UNIDO's Green Industry Initiative. Chemical leasing is one such important and innovative concept. It is a one-of-a-kind, service-based business model that supports sustainable chemicals management and responds to the latest changes in international chemical policies. It encourages progressive and environmentally sound industrial development while reducing the unnecessary consumption of hazardous chemicals.

In 2004, the Austrian Government and UNIDO came together to promote chemical leasing at the international level. Five years later, in 2009, the German Government also joined this global challenge.

This brochure presents selected projects that were implemented in close cooperation with the National Cleaner Production Centres of Colombia, Egypt, Russia, Serbia and Sri Lanka, and illustrates how this model helped participating companies reduce the ineffective use and over-consumption of chemicals, develop strong business partnerships, and enhance their economic and environmental performance.



Kandeh K. Yumkella
Director-General of the United Nations Industrial
Development Organization (UNIDO)

Contents

Foreword	iii
Introduction	1
Water purification and oil dehydration: oil and gas sectors	
Colombia	4
Integrated painting of washing machines: engineering and chemical sectors	
Egypt	7
Treatment of drinking water: water treatment sector	
Russia	11
Conveyor lubrication: beverage sector	
Serbia	14
Newspaper printing: printing and publishing sector	
Sri Lanka	17
Chemical leasing and green industry:	
A win-win approach for economic growth and environmental sustainability	20

Chemical leasing brings benefits for both supplier and user

- Innovative business approach: reducing chemicals increases the financial benefits of both partners
- Optimization of production process/less environmental impact
- Waste reduction and waste recycling is encouraged
- Long-term business relationships are formed/partnership development
- Improved competitiveness for both partners/continuous learning
- Sound technology transfer/sharing of know-how

UNIDO definition of chemical leasing

Chemical leasing is a service-oriented business model that shifts the focus from increasing sales volume of chemicals, toward a value-added approach.

The producer mainly sells the functions performed by the chemical, and functional units are the main basis for payment.*

Within chemical leasing business models, the responsibility of the producer and service provider is extended and may include the management of the entire life cycle.

Chemical leasing strives for a win-win situation. It aims to increase the efficient use of chemicals while reducing the risks of chemicals, and protecting human health. It improves the economic and environmental performance of participating companies, and enhances their access to new markets.

Key elements of successful chemical leasing business models are proper benefit sharing, high-quality standards and mutual trust between participating companies.

* Functions performed by a chemical might include: number of pieces cleaned; amount of area coated, etc.

UNIDO launches chemical leasing programme

Chemical leasing forms part of UNIDO's strategy to assist enterprises globally in a variety of aspects related to green industry. Over the past few years, this innovative approach has been implemented in a number of different sectors, processes and countries.

Experience has shown that it is best applied to processes that are not the core know-how of the chemical user, such as cleaning, degreasing and painting, etc.

Chemical leasing pilot projects were successfully introduced in following sectors/processes

INDUSTRY SECTORS/PROCESSES	CHEMICALS
Manufacture of electronic equipment	Powder coating
Car manufacture, food processing equipment and cleaning	Hydrocarbon solvents for cleaning Galvanizing and phosphating agents
Various industries/steel treatment	Lubricants for packaging conveyers
Mineral water production	Water treatment chemicals
Waste water treatment	Textile chemicals, dyes
Textile industry—pre-treatment and finishing	Glues for labelling
Brewery	Catalysts and water treatment chemicals
Petrochemical industry	Ink, printing chemicals
Printing Industry	

In 2005, UNIDO launched the Global Chemical Leasing Programme, which is presently supported by the Governments of Austria and Germany. At the national level, it is implemented in close cooperation with respective National Cleaner Production Centres (NCPCs). These Centres are partners of the UNIDO/UNEP Global Resource and Efficient Cleaner Production (RECP) Network, which presently includes nearly 50 National Cleaner Production Centres and Programmes globally.

Water purification and oil dehydration: oil and gas sectors

Background information

Oil dehydration and water treatment processes involve many variables regarding the quantity, quality and efficiency of the chemicals used which also represent an important part of the operation costs of a company. Proper monitoring is essential to avoid negative environmental impact and accidents caused by the waste water.

Usually, the following parameters are measured to define the efficiency of the process: water content in oil—if too high, customers may not accept the oil; oil content in waste water and suspended solids in waste water—if too high, environmental authorities may impose fines or even close the oil field.

CASE IN COLOMBIA



Colombia has seen an increase in oil production in recent years after a period of steady decline. The Colombian government has created a series of regulatory reforms to attract foreign investors. In 2009, the country produced an estimated 680,000 barrels per day of oil, up from 600,000 barrels per day in 2008. With oil consumption reaching an estimated 282,000 barrels per day in 2008, Colombia exports about half of its oil production, with much of it going to the United States.

Since 2006, a Colombian oil company, Ecopetrol S.A., was looking for new strategies to not only lower costs, but also consider the total economic balance of its crude oil drilling and water treatment operations. Acknowledging the potential environmental and economic benefits of implementing best practices in the chemical process, in 2008, Ecopetrol recognized the chemical leasing business model as the most suitable strategy. Their chemical leasing project was developed together with a supplier of Ecopetrol S.A., Nalco de Colombia Ltda., and implemented at the Castilla Oil Field in Colombia, with the assistance of UNIDO's National Cleaner Production Centre in Colombia.

Ecopetrol S.A. is Columbia's largest company, and the main producer of petrol in Colombia. It ranks among the top 40 oil companies in the world, and among the five largest oil companies in Latin America. Ecopetrol exploits hydrocarbon extraction fields throughout Colombia, and operates two refineries and a pipeline network of 8,500 km.

Nalco de Colombia Ltda. (chemicals supplier), is one of the world leaders in water treatment and process improvement applications, providing services, chemicals and equipment to industrial and institutional customers.

Results of the chemical leasing project

BEFORE CHEMICAL LEASING	AFTER CHEMICAL LEASING
<ul style="list-style-type: none"> • Operations with a high consumption of chemicals • Low efficiency and potential risks at the oil fields • Payment per gallon or kilo of chemicals • High storage and transport costs of chemicals • Limited incentives for reduction of chemicals consumption 	<p>Economic benefits:</p> <ul style="list-style-type: none"> • Decrease of oil and grease used in the cooling towers • Cost savings due to the recovery of oil in the stabilization pools and lower costs for maintenance of the pools and cooling towers • Reduction of the costs of the treatment process by almost 20 per cent • Reduction of drums used for the transport and storage of the chemicals from 4,900 to 3,500—savings for Ecopetrol: US\$ 1,8 millions (2008-2009) • Savings for Nalco: US\$ 164,630 (2008), US\$ 249,418 (2009) <p>Environmental benefits:</p> <ul style="list-style-type: none"> • Reduction in polymer consumption and fewer polymer residues in the stabilization pools and treated water • Reduction of the environmental impact of treated water • No subproducts in the chemicals production process due to a new methodology used by Nalco <p>Social benefits:</p> <ul style="list-style-type: none"> • Creation of jobs (in laboratories) • Long-term commercial relationship encouraging continuous process improvement • Risk reduction and better working conditions

The data illustrates that more oil and water is treated while, at the same time, the consumption of certain chemicals is reduced (emulsion breaker, water purifier). Moreover, less solid waste was generated.

Chemicals applied for water purification and oil dehydration

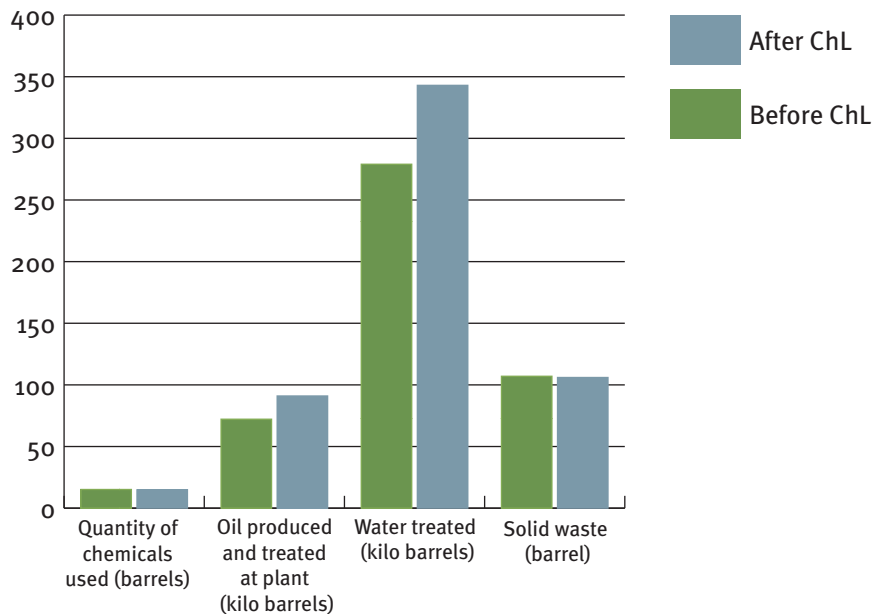
- Purifier • Reverse emulsion breaker • Antifoam

NOTE

Before chemical leasing: the basis for payment was United States dollars per gallons or kilos of chemicals purchased.

After chemical leasing: the basis for payment is United States dollars per kilo barrels (kbb) of oil with a specified quality.

Figure 1. Results table



“Ecopetrol is convinced: chemical leasing is an outstanding business model which supports the high competitiveness of the company”

Orlando Cortés Tulando, Coordinator, Strategic Supply Unit

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Integrated painting of washing machines: engineering and chemical sectors

Background information

The integrated process of painting is essential to ensure the high quality and durability of washing machines. It includes expensive metal pre-treatment (degreasing and phosphating) and electrostatic powder coating which may cause considerable negative environmental impacts.



CASE IN EGYPT

The chemical leasing project was implemented at Delta Electrical Equipment (DEA), which brought together three companies, and their respective knowledge: DEA, together with Akzo Nobel Powder Coating SAE (supplier of coating chemicals), and Chemetall Italy (supplier of surface pre-treatment chemicals). The project was developed in close cooperation with the Egyptian National Cleaner Production Centre.

Before becoming involved with chemical leasing, DEA faced various losses and high costs, mainly due to high amounts of waste and inefficient operational management. The knowledge of workers on chemicals and risk management was very limited, which also affected the overall performance of the company.

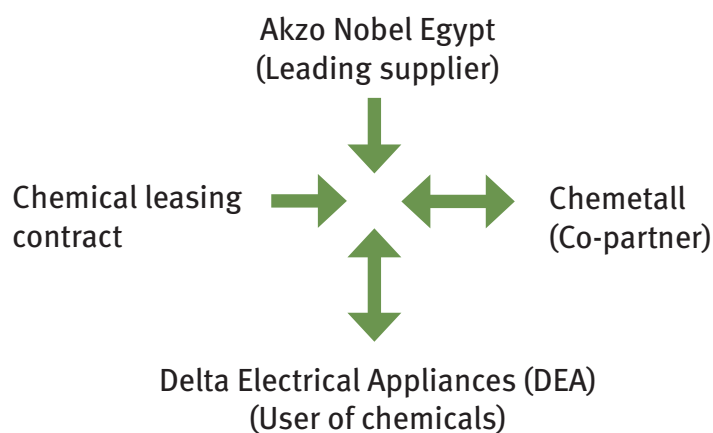
Delta Electrical Appliances is the leading Egyptian manufacturer of electrical equipment. It is part of the Olympic Group, one of Egypt's foremost companies. DEA mainly produces electrical appliances, refrigerators and washing machines.

Akzo Nobel Powder Coating SAE (leading supplier) is part of the international group Akzo Nobel and has a share of around 60 per cent of the Egyptian powder coating market. It operates mainly in the sectors of domestic appliances, electrical equipment and air-conditioners.

Chemetall Italy (subcontractor supplier and co-partner) is a global company in the field of specialty chemistry. The group's activities focus on products and processes for the chemical treatment of metal surfaces and plastics, as well as on selected fields of fine chemistry, such as lithium and caesium compounds. The company is represented in Egypt by its authorized agent Obegi Chemicals Egypt. Chemetall operates in a wide range of industrial sectors (automotive, domestic electrical appliances, and the aluminium and galvanization sectors).

Chemicals applied

- Surface pre-treatment (degreasing chemicals, conditioning and activation chemicals, zinc phosphate)
- Electro-deposition chemicals
- Electrostatic powder coating



“Actually, in our case we can even speak of a win-win-win situation, since three companies are taking part in the project.”

Ashraf El Wassify, Deputy of the General Manager, Akzo Nobel Powder Coating SAE Egypt

Surface treatment

Electro-deposition coating

Electro-static powder coating

The scope of the chemical leasing model applied to the process of washing machine painting includes surface treatment, electro-deposition and electrostatic powder coating.

NOTE

Before chemical leasing: the basis for payment was Egyptian pounds (EGP) per unit (kg, etc.) of chemicals.

After chemical leasing: the basis for payment is Egyptian pounds (EGP) per washing machine produced.

Results of the chemical leasing project

BEFORE CHEMICAL LEASING

- High consumption of powder coating chemicals due to unnecessarily thick coating layers and a non-optimized coating process
- High production costs (costs of pre-treatment, coating and electrostatic powder coating) per washing machine
- Percentage of reworks and rejects amounts to 9 per cent
- Sludge waste generated during the phosphating process amounts to 0.021 grammes per unit (approx. 6 ton in 2008) and deposited at a nearby landfill site
- 30 m³ of waste water generated per day
- 10 per cent of fine powder wasted and dumped
- No full compliance with REACH or RoHS (Restriction of Hazardous Substances Directive)
- Workers have limited information on chemicals and risk management

AFTER CHEMICAL LEASING

Economic benefits:

- Reduced consumption of chemicals for pre-treatment chemicals by 15-20 per cent and for powder coating by 50 per cent
- Reduction of the total cost per washing machine by 15-20 per cent
- Percentage of reworks and rejects reduced to 1.5 per cent
- Losses reduced to 1 per cent

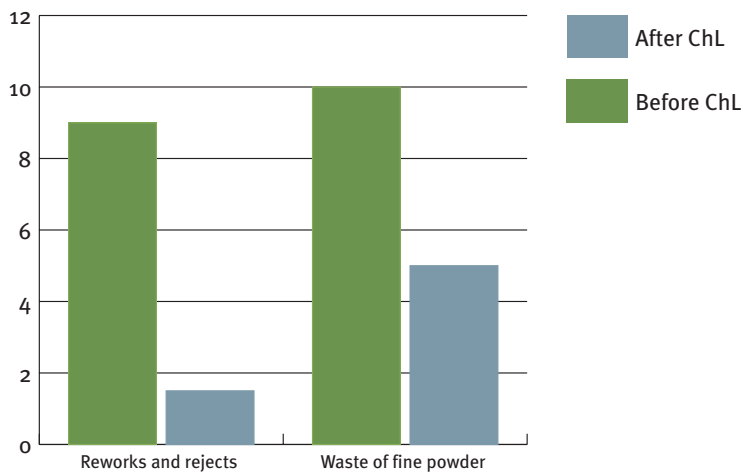
Environmental benefits:

- Elimination of sludge waste by using environmentally friendly pre-treatment process (e.g. non-cyanide and nickel-free phosphating technologies)
- Reduction of fine powder waste from 10-5 per cent
- Reuse of waste water
- Recycling of waste
- Compliance with REACH

Social benefits:

- Training and capacity-building for workers on chemicals management and chemical risks

Figure 2. Results table



The optimization of the pre-treatment and electrostatic powder coating process resulted in a more efficient use of chemicals. This brought significant cost reduction per unit produced and reduced the amount of chemical waste. In addition, the recycling of chemical waste has been enhanced and DEA's suppliers began registering their products under REACH, ensuring that they do not contain substances of very high concern (VHS).

Contact: Egypt National Cleaner Production Centre
Mr Ali Abo Sena, Deputy Director of the NCPC: abosena@yahoo.com or visit
www.tic.gov.eg/cleaner/main_ar.htm

Treatment of drinking water: water treatment sector

Background information

In many countries, water used to be disinfected with pure liquid chlorine. It was an effective way of fighting epidemics at the beginning of the nineteenth century, but caused serious problems, as chlorine is an extremely poisonous substance. Use of chlorine also meant high operational costs due to additional safety measures, including storage and transportation of significant quantities of the toxic chemical.

CASE IN RUSSIA

Vodokanal of St. Petersburg is the State enterprise that supplies drinking water to more than 4.5 million inhabitants. The company was looking for cost-effective, sustainable and safe drinking water treatment solutions to reduce costs and increase the safety of drinking water. In cooperation with the North-Western International Cleaner Production Centre, the company made the switch to chemical leasing.

Vodokanal partnered with Aquatechservice Ltd. in 2006, and began to replace liquid chlorine with diluted sodium hypochlorite (produced from sodium chloride—NaCl), which is as effective and significantly less harmful.

Vodokanal of St. Petersburg is the user of the chemicals, and specializes in treating and disinfecting water. Vodokanal of St. Petersburg provides drinking water and waste water services to over 4.5 million people in private households, as well as to more than 17,500 customers in both industrial settings, and providers of municipal services.

Aquatechservice Ltd is the chemicals supplier, specializing in the development and implementation of innovative water purification processes, and in the exploration and maintenance of equipment, as well.



In 2007, a new production process for the disinfecting solution was introduced. The official ceremony of discarding the last chlorine container was held at the Northern Waterworks on June 26, 2009. Two plants for the production of low-concentrate sodium hypochlorite began operation in St. Petersburg, at the Southern Waterworks (since 2006) and at the Northern Waterworks (since 2008).

Stages of water treatment and chemicals applied

FUNCTION	DESCRIPTION
Water ammonation	Ammonium sulphate
Water disinfection	Sodium hypochlorite
Coagulation of pollutants	Aluminium sulphate
Flocculation	Cationic flocculant
Sand filtration	
Sedimentation and sand filtration in rapid filters	
UV disinfection	

By introducing the new process based on the production of diluted hypochlorite solution on-site, water treatment costs were optimized. Aquatechservice Ltd produces sodium hypochlorite for water treatment from a 3 per cent sodium chloride solution.

“Some 4.5 million people as well as industrial customers are now getting purer water, and the new technology helps guarantee that there will be no accidents.”

Feliks V. Karmazinov, General Director, Vodokanal of St. Petersburg

Electrolytic installation and sodium chloride storage



NOTE

Before chemical leasing: the basis for payment was Russian roubles per kg/ton of chemicals used for water treatment.

After chemical leasing: the basis for payment is Russian roubles per 1,000 cubic metres of purified water.

Results of the chemical leasing project

BEFORE CHEMICAL LEASING	AFTER CHEMICAL LEASING
<ul style="list-style-type: none"> • 5.7 tons of poisonous liquid chlorine used for water disinfection every day • Chlorine is a highly toxic substance (2nd hazard class) • Risk of accidents during the transportation of the chlorine in the city (in special containers under pressure) 	<p>Economic benefits:</p> <ul style="list-style-type: none"> • Reduction of water disinfection costs by almost 33 per cent • Reduction of the price for one ton of hypochlorite solution due to optimization of the process • Reduction of the cost for 1,000 tons of purified water due to the optimization of the sodium hypochlorite flow <p>Environmental benefits:</p> <ul style="list-style-type: none"> • 640 m³ of sodium hypochlorite solution at a low concentration (environmentally safe) are used for water disinfection every day • Safe transportation and storage of the solid substance (NaCl) which is used for the production of NaOCl • Automation of the process • High reliability of the equipment used for the production of NaOCl <p>Social benefits:</p> <ul style="list-style-type: none"> • Improved health and safety of workers

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Conveyor lubrication: beverage sector

Background information

The production and sales of bottled water is one of the fastest growing industries in the world. According to the research of the Worldwatch Institute, the global rate of consumption has more than quadrupled between 1990 and 2005. Spring water and purified tap water are the leading sellers globally, and around 200 billion bottles are consumed per year.¹

One critical point within production of bottled-water is the packaging process. Bottled water is commonly packaged in bottles made of polyethylene terephthalate (PET) and this requires a significant amount of energy. In addition, companies face problems ensuring packaging conveyors stay lubricated, due namely to outdated equipment. Many beverage companies still use old packaging lines with so-called “wet lubrication”, resulting in high consumption of water, usage of hazardous chemicals for water pre-treatment, high generation of waste water and high operational risks.

The chemical used as a lubricant usually has hazardous properties to prevent the natural growth of microbes in this environment. It causes eye and skin irritation, and is toxic to aquatic organisms.

CASE IN SERBIA

In Serbia today, there are over 30 producers of mineral water in the country’s market. In 2009, roughly 635 million litres of mineral water were manufactured, and 560 million litres were filled in PET bottles.

One third of the national mineral water is produced by Knjaz Milos. To increase efficiency on the production line, improve the company’s performance and strengthen its leading position on the market, Knjaz Milos was looking for innovative solutions to make the production process easier, more efficient and safer. Together with its supplier, Ecolab, and in close cooperation with the Cleaner Production Centre in Serbia, a chemical leasing project was developed and implemented.

As a first step, the production process was modified and the lubricant was substituted by a non-hazardous dry lubricant. New equipment, such as dosage systems and spraying nozzles, were installed. As a result, the efficiency of the line has increased, and the working life of the conveyor has been extended. Furthermore, a downtime of about 15 minutes per shift before chemical leasing was eliminated with the new equipment, and the costs of packaging can now be accurately calculated.

¹ New York Times. Find A Fountain, May 23, 2008

Knjaz Milos, founded in 1811, is the largest producer of mineral water and beverages in the Republic of Serbia. The annual production capacity amounts to 300 million litres of beverages. In 2008, 220 million litres of mineral water and beverages were produced. The company has about 900 employees and is ISO 9001, ISO 14001 and ISO 22000 certified.

Ecolab is the global leader in cleaning, sanitizing, food safety and infection prevention products and services with sales of US\$ 6 billion and more than 26,000 associates. It delivers comprehensive programmes and services to foodservice, food and beverage processing, health-care and hospitality markets in more than 160 countries. The company is certified according to ISO 9001/14001 and EN 46001 (for medical devices).

Chemicals applied

- A lubricant containing alkyl amines and acetic acid was used (corrosive and toxic)
- The chemical was substituted by an alternative one with fewer negative effects*

* According to the material safety data sheet, no significant effects or critical hazards on human health are known and no information on ecotoxicity is available.

Results of the chemical leasing project

BEFORE CHEMICAL LEASING

- High chemical consumption for water pre-treatment and waste water treatment
- 1,500 m³ of water contaminated annually (the chemical had to be dissolved in water) per production line
- 6,000 kg of lubrication (chemical with hazardous properties) were used per year per production line
- Risk of injuries due to slippery floors

AFTER CHEMICAL LEASING

Economic benefits:

- Total cost savings per packaging line amount to EUR 5,700 per year
- Reduced costs for the lubrication of the packaging line
- Higher performance of packaging line and reduced handling costs

Environmental benefits:

- No water or chemicals required for pre-treatment and waste water treatment
- 30 per cent reduction of chemicals used for lubrication

Social benefits:

- Improved occupational health and safety due to reduced quantity of aerosols in the air, better working environment, reduced risk of injuries

NOTE

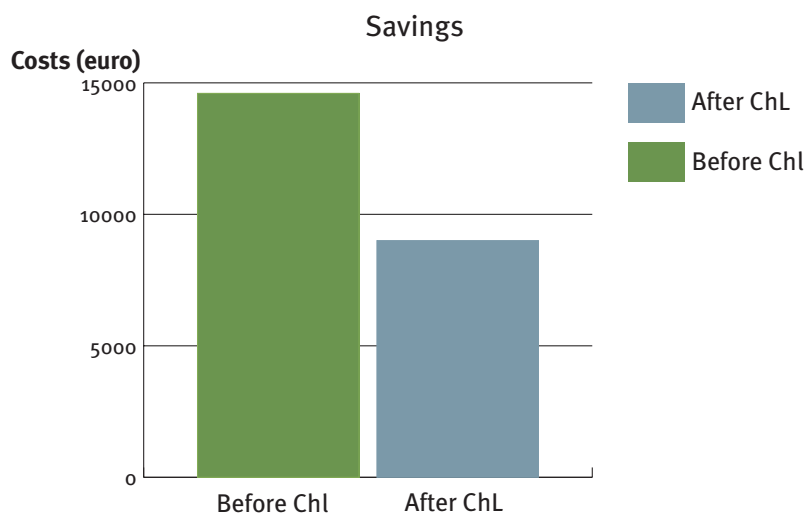
Before chemical leasing: the basis for payment was Euro per amount of chemicals (litres, kilograms).

After chemical leasing: the basis for payment now is Euro per number of working hours of the conveyor.



The cost savings were achieved because water and chemicals for pre-treatment and waste water treatment were eliminated from the process.

Figure 3. Results table



“This concept helps us to maintain our leading position”

Srdjan Jovic, Sales Manager, Ecolab

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Newspaper printing: printing and publishing sector

Background information

Newspaper printing requires several types of ink consisting of volatile organic compounds which can affect both the environment and the health of workers in the company. The optimization of ink usage is highly complex since ink is wasted in a number of different ways, for example, spills, residues in containers and trays, and in the printing process itself. This leads to high costs for energy, waste water treatment and solid waste.

Since the printing area is often closed and air-conditioned, the evaporation of solvents contained in the ink can cause health risks for the employees.

CASE IN SRI LANKA

The chemical leasing business model is implemented at a medium-size printing workshop of the Wijeya Newspapers Ltd, where the leading national newspaper, Sinhala Daily, is printed. The newspaper is sold in various geographical areas of Sri Lanka.

In 2009, to improve operations, Wijeya Newspapers Ltd decided to join hands with its supplier, General Ink Ltd, to develop a chemical leasing project, supported by the National Cleaner Production Centre of Sri-Lanka.

Wijeya Newspapers Ltd, the ink user, is the leading Sri Lankan newspaper printing company (15 million newspapers per month) and has 1,500 employees.

General Ink Ltd, the ink supplier, is a medium-sized Sri Lankan company with about 50 employees. The supplier has a strong market share, especially in newspaper printing.



Within the project, a number of options were identified to improve the quality of the printed product, which included increasing productivity and reducing the consumption and waste of ink (since ink is the main raw material used for printing). First, ink waste streams occurring during spraying, drum spills and duct cleaning were analysed. Improvements were implemented to reduce ink waste during the process and a drum rubber beading wiper was installed to stop drum spills.

NOTE

Before chemical leasing: the basis for payment was costs per kilogram of ink.

After the full introduction of chemical leasing: the basis for payment is Sri Lanka rupees per printed copies of newspaper.

Chemicals applied

The inks are water-based/solvent-based. The chemicals used in the process are:

- Phenolic resins
- Hydrocarbon resins
- Alkyd resins
- Linseed oil
- Aromatic rubber process oil
- Petroleum distillate
- Pigments
- Carbon black

Results of the chemical leasing project

BEFORE CHEMICAL LEASING

- Waste of considerable amounts of ink (solvent) during the printing process (about 15 per cent of total ink)
- The ink for the initial copies of the run (400 copies) is wasted until the print image is corrected.
- High amount of ink consumption to print one square metre
- The ink consumption amounts to 14,000 kg per month.
- Ink penetration from machine speed
- The floors have to be cleaned once or twice every day (ink penetration).
- Occupational health problems
- Increased waste water generation and treatment costs

AFTER CHEMICAL LEASING*

Economic benefits:

- Reduction in ink consumption by up to 7 per cent (three year target)
- Annual ink savings: 14,976 kg
- Direct ink cost savings: Sri Lanka rupee 5,091,840 = US\$ 50,000 per year

Environmental benefits:

- Reduction of ink waste
- Improvement of occupational health and safety
- Reduction of waste water generation
- Improved Environmental Management System
- Compliance with environmental regulations on waste management and workplace environment

Social benefits:

- Improved working conditions
- Better occupational health and safety of employees
- Employee motivation improved
- Long-term business relationship between the partners leading to process improvement and innovation.

*Estimation: after the full introduction of ChL

The pilot project has demonstrated that both ink suppliers and printers can benefit from optimized ink usage in newspaper printing.

“By applying the Chemical Leasing business model, the printing industry can achieve considerable benefits”

Janaka Rathnakumara, Plant Engineer, Wijeya Newspapers Ltd

Contact:

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www.ncpcsrilanka.org

Chemical leasing and green industry: a win-win approach for the economy and the environment

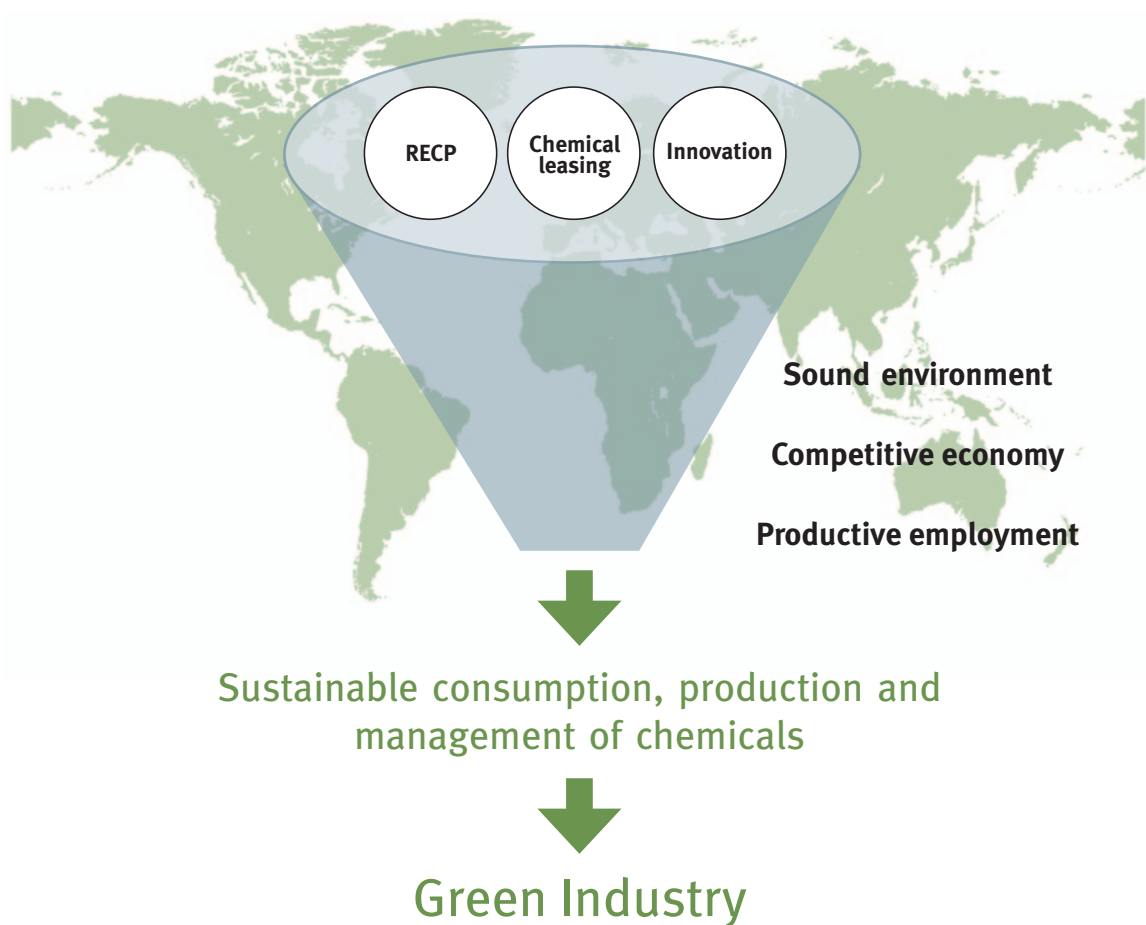
The role of UNIDO in chemical leasing is to:

- Promote chemical leasing through its global network of National Cleaner Production Centres and Programmes (NCPCs and NCPPs)*
- Develop tools for the implementation of chemical leasing business models in small- and medium-sized enterprises, adapted to developing countries and countries with economies in transition
- Be an independent facilitator among the different actors to ensure relations based on mutual trust and proper benefits' share

* NCPCs and NCPPs Network: The centres and programmes work to raise awareness on resource efficient and cleaner production, train company staff and other professionals, conduct in-plant technical assessments, lobby for policy improvements and support the transfer of environmentally sound technologies.

Chemical leasing, based on the preventive resource efficient and cleaner production concept, provides practical solutions for industry to become more efficient, as well as reduce unnecessary hazardous chemical consumption, and protect human health and the environment. Chemical leasing is thus in line with the UNIDO Green Industry approach, which strives to decouple resource use and pollution from industrial development and promote the sustainable growth of productive sectors and entrepreneurship in developing and transition countries.

In 2009, in order to enhance the visibility of chemical leasing worldwide, the Global Chemical Leasing Award was jointly developed by UNIDO and the Austrian Federal Ministry for Agriculture, Forestry, Environment and Water Management.



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