



## Protecting the Environment

### Pollution prevention through Cleaner Production

Environmental protection through pollution prevention is one of the primary objectives of Cleaner Production (CP). Pollution can be reduced in virtually any older industrial facility by applying five basic CP approaches:

- Reduce water consumption
- Use raw materials and energy more efficiently
- Recover, reuse or recycle losses of raw materials and/or finished products from the process
- Improve procedures (called good housekeeping)
- Handle all materials carefully and safely.

### Benefits for the environment

The main environmental benefits of CP are improved air quality, improved water quality, greater resource conservation, and reduced human exposure to toxins and hazardous substances. Some specific environmental impacts are reduced through the application of CP. They include the following:

- Fibre is discharged from pulp mills, smothering habitat and consuming oxygen that is essential to fish and other organisms.
- Chemical contaminants in the effluent of pulp and paper mills are known to cause diseases (including cancer and reproductive failure) in fish and in people who eat large quantities of contaminated fish.
- Ammonia from fertiliser plants can be toxic in the environment, where it may have a severe impact on aquatic species.
- Sulphur emissions contribute to acid rain, and all the problems associated with it.
- Chlorine releases from chlor-alkali plants are of immediate concern because of their serious impact on human health. Long-term concerns about chlorine pollution relate to it being a very versatile chemical that combines readily with many of the other chemicals found in industrial effluents to form compounds that are toxic and often persistent in the environment.
- Vinyl chloride monomers (VCMs) can cause cancer and other serious problems when released into the environment.



*Downstream from pulp mill: simple CP measures recovered fibre and reduced suspended solids discharged to the river.*

Photo by Mark Osterman

## The role of the project

The China Canada Co-operation Project in Cleaner Production was initiated in October 1996 with the goal of introducing Cleaner Production into key industrial sectors, and demonstrating its feasibility and benefits. The Project is funded by the Canadian International Development Agency and is implemented by the Canadian Executing Agency consisting of PricewaterhouseCoopers, SNC-Lavalin and ESSA Technologies. Reductions in pollution are being achieved through the implementation of CP at demonstration plants, then disseminated to other facilities in the sector.



Photo by Mark Osterman

*Canadians and Chinese working together to implement CP.*

## How is pollution prevention achieved at the factory level?

A factory conducts a CP audit to identify a range of possible pollution prevention measures, then categorizes them by cost. No- and low-cost measures are those that will pay for themselves in less than a year, or cost the equivalent of less than one day of production. Specific measures will vary from sector to sector and from plant to plant, but many of the common low and medium cost measures can be applied in most older Chinese industrial facilities. These include:

- re-use process water;
- recover raw materials and pollutants from re-circulated water;
- re-use heated water to conserve energy;
- insulate equipment and pipes;
- improve process control to reduce waste and spills;
- improve handling and storage of hazardous and toxic materials;
- good housekeeping (e.g. maintain equipment in good condition, handle toxic substances safely, monitor gauges and valves, observe good operating procedures).

More expensive measures (those that take more than five years to pay for themselves or cost more than ten days of production) include adding pre-and post treatment facilities, major process changes, and major equipment upgrades.

## What are the results?

By the end of 2000, the Project has expanded from project-lead demonstration to sector-lead implementation of Cleaner Production in two sectors: fertiliser, and pulp and paper. A demonstration of CP in a third sector, chlor-alkali/PVC, is underway, and is being initiated in a fourth sector, brewing.

## Fertiliser sector

Based on the success of the demonstration at the Fuyang Chemical General Works, CP has been introduced in eight fertiliser plants and has progressed to the implementation stage in four. Thirty-five percent of the fertiliser plants in Anhui province are now involved. The main foci of environmental protection are:

- water conservation;
- energy conservation (use less coal which in turn reduces air pollution);
- less ammonia pollution of air and water;
- less sulphur pollution of air (i.e. less acidic precipitation); and
- recovery if used-oil from water.

## Pulp and paper sector

Older Chinese pulp and paper mills typically use more than ten times more water than modern mills: a modern paper mill may discharge virtually no water (closed loop) while a modern pulp mill will discharge less than 30 m<sup>3</sup> per tonne of pulp produced. One major way to conserve water is by re-using it. Re-circulating water not only saves water, but also creates opportunities to recover raw material (fibre) and to reduce energy consumption.

In addition to implementation in one demonstration plant, CP has been adopted by six paper or pulp and paper mills in Anhui Province, accounting for 50% of the pulp and paper production in the province.

Most of the measures adopted will pay for themselves through savings in less than five years. Environmental improvements and economic benefits are summarized below. (Some data—for measures in early stages of implementation—are projections.)

Mill operating capacity tonnes/year	Water conserved tonnes/ year	Energy (Coal) conserved tonnes/year	Oil recovered litres/year	Fibre recovered tonnes/year	Renmimbi** saved RMB/year
96,728 <sup>1</sup>	870,552	*	960	1,450	4,824,110
30,600 <sup>2</sup>	822,936	*		1,224	1,836,302
30,000 <sup>1</sup>	- - -	3,120		5,000	11,525,200
48,247 <sup>2</sup>	354,852	2,970		6,420	8,075,134
17,000 <sup>1</sup>	526,400	4,163		680	6,255,860
10,200 <sup>1</sup>	336,600	1,020		211	2,440,309
232,775	5,911,340	11,350	960	14,985	34,956,915
<sup>1</sup> paper	* not reported				
<sup>2</sup> pulp and paper	** 1 renmimbi = 0.18 Canadian dollars = 0.12 US dollars				

*Environmental benefits and monetary savings of implementing CP in six pulp and paper mills.*

Source: Participating mills and SNC-Lavalin



Photo from SNC-Lavalin files

*Labelling the equipment is part of Good Housekeeping. In this factory in Fuyang, workers discovered and corrected many leaking valves and other equipment problems. Correcting these problems reduced ammonia and sulphur losses to the environment.*

## Chlor/alkali-PVC

CP audits in two units—chlor-alkali plant and PVC plant—of a large, complex facility have identified potential savings of 6.3 million RMB/year, and a total recovery of materials of 500 tonnes per year. Full implementation would reduce water consumption by fifty percent.

In the chlor-alkali/PVC plant, a CP solution to re-circulate water has already been implemented at virtually no cost, reducing water consumption by 50,000 m<sup>3</sup> per year, and eliminating 245 tonnes per year of chlorine from the wastewater. A Canadian technology for detecting leaks of a toxic, cancer-causing, volatile compound (VCM), DEFI, was demonstrated in the PVC facility. As the leaks are repaired, exposures to VCM will decline dramatically. The facility is planning to acquire leak detection equipment, enabling it to continue to detect and repair leaks in future.

Although it is too early for conclusive results from these demonstrations, results to date indicate a huge potential for improving both the quality of environment as well as the health and safety of workers and neighbors through relatively low-cost CP measures in chlor-alkali and PVC plants.



Photo from SNC-Lavalin files

*Juhua industrial complex in Quzhou, Zhejiang Province.*

### **Chinese Project Office:**

Environmental Protection Research Institute  
Beijing Research Institute of Chemical Industry  
China Petroleum & Chemical Corporation

P.O. Box 1442, Beisanhuan Donglu  
Haoyang District, Beijing, P.R. China 100013

Tel: 86 10 64287757, 86 10 64216131 ext. 2203

Fax: 86 10 64287757, 86 10 64228661

E-mail: cccpcp@public.bta.net.cn

[www.chinacp.com](http://www.chinacp.com)

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