Chapter 3: Case Study of Decreasing Burdens on the Environment by Improving Manufacturing Processes

"Clean technology," quite different from the so-called "end-of-pipe" countermeasures against pollution in traditional control, is attracting great attention. This new technology involves preventing pollutants from being discharged by changing the raw materials and processes in the manufacturing process. This approach not only eliminates pollutants, but is cost-effective in many cases. This chapter introduces a case where a company reduced the burden on the environment by improving its manufacturing process.

Case 5: Environmental Conservation with the Use of Clean Technology and the Thorough Processing of Waste Water

1) Profile of the company

Company E	
Business activities:	Manufacture and sale of automobiles
Number of employees:	Approximately 1,900
Start of operation:	1988 (a factory in Metropolitan Manila), 1997 (a factory in a suburb of Manila)
Location:	One in Metropolitan Manila and another in a suburb of Manila
Ownership ratio of headquarters in Japan: 40 percent	

2) Background

Company E is involved in the waste water treatment measure and a wide variety of other projects to reduce the environmental burden. These projects are carried out not only to prevent pollution by the so-called "end-of-pipe" measures, but also from the viewpoint of "clean technology," which prevents the generation of burdens on the environment by improving the relevant processes and modifying raw materials and other elements. The measures can be classified into three categories; the improvement of conventional production processes, measures to control the source of waste emissions through the implementation of source reduction schemes, and the other forms of improvement.

3) Improvement of the conventional production processes

①Reductions in the use of primer paint

The amount of paint used on automobiles has been reduced by improving the methods of painting interior panels and by using more systematic spraying methods. Reductions in the amount of paint used also leads to lower costs and reductions in the creation of solid waste. A 15% reduction in paint usage has reduced the amount of Volatile Organic Compounds (VOC) emission by 15%.

②Installment of the Minibell spray

The Minibell spray was installed in a new plant to reduce the amount of paint consumption and VOC discharge by improving the efficiency of movement during the painting process. Unlike conventional spray guns, the Minibell spray is basically automated, and its installation allows a reduction in labor and improvements in quality.

In the conventional painting process, only 30 to 40% of the paint was effectively sprayed onto the cars, and the remainder, between 60 and 65% was discarded into the sludge pool as paint sludge (solid waste) because this process was manually operated by laborers. These figures have now been improved through the use of the Minibell spray, and an efficiency rate has risen between 65 and 70%. This not only reduces the amount of paint being wasted to the level of 30 to 35%, but also reduces the amount of solid waste. In addition to this, this facility does not require man-power, thus helping to streamline the factory.

4) Source emission measures

③Reduction of sludge generated from painting processes

Previous painting processes usually created sludge containing a massive amount of phosphate. Company E trained its workers on how to use phosphates used in pretreatments appropriately and successfully improved its facilities.

In the conventional car body painting processes, the pretreatment of metal, which also prevented rusting, was done by applying a chemical conversion coating of phosphates by spraying manganese phosphate and zinc phosphate solution on the surface of the iron base prior to painting. However, trivalent iron ions are dissolved and oxidized to become iron phosphate, then precipitated to become sludge. Experience shows that the amount of sludge depends on the amount of phosphates sprayed.

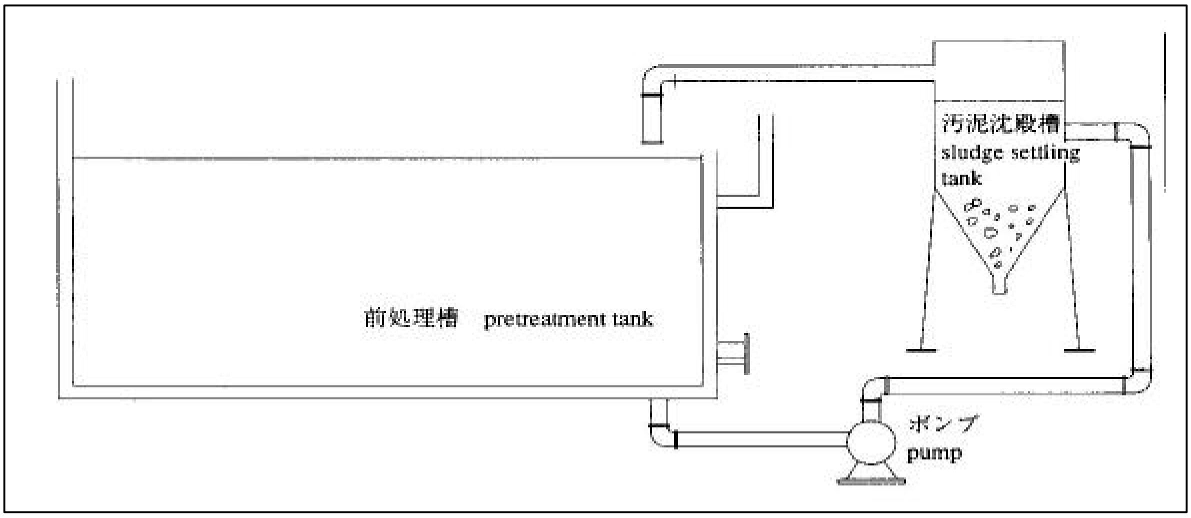
A review of the painting processes revealed that the amount of sludge could be reduced by redesigning the spraying method. Two kinds of process improvements were made to reduce the amount of sludge as follows.

One involved preventing the excessive use of pretreatment chemicals which could increase the amount of sludge by properly managing the equipment for phosphates used in the pretreatment process. Workers were trained to judge the proper amount of pretreatment chemicals in case of equipment trouble, and as a result the amount of sludge decreased. The decreased use of phosphate also reduced costs.

On the other hand, although the sludge that accumulated in the pretreatment tanks was removed weekly, the gradual accumulation of sludge increased the amount of work. When the tank was full of sludge, the phosphate content in the tank decreased and the paint quality was adversely affected.

A sludge settling tank was therefore added and a pump for removing sludge was installed to improve the facility. As a result, sludge could be removed while the facility was still operating. The improvement also prevented the pretreatment chemicals from overflowing from the pretreatment tank, minimized the COD load on the waste water treatment facility, and improved the quality of film during the pretreatment process.

Figure 3-1 Reduction of Sludge Generated from Pretreatment Process of Painting



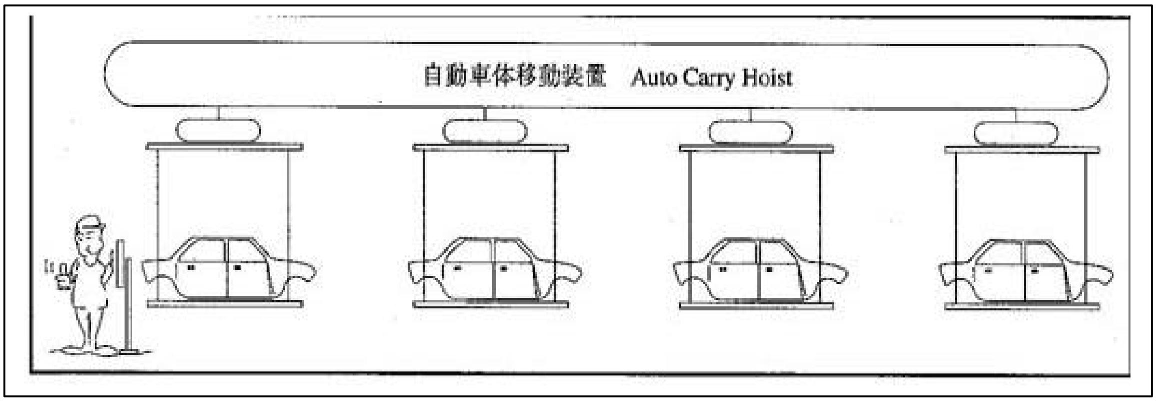
④Improvement in the quality of waste water after Electrodeposition (ED) painting

Paint carry-over after the electrodeposition (ED) paint process is the principle cause of COD load and lead content of waste water treatment facilities. Therefore, facilities were improved to reduce the inflow of paint carry-over.

After the application of ED paint, car bodies pass through several washing baths to rinse off that excess paint. However, the conventional carrying hoists of car bodies were manually operated, which made it difficult to control the waste water quality due to the irregular timing of rinses. An automatic hoist called an "ED Auto Carrier" was then installed to ensure a constant pass time for each washing bath. In addition, the rinse time and drying time between each washing bath were prolonged to prevent rinsed-off paint from coming off into the wash water. A mechanism to immediately collect and return water for washing into the ED paint baths was also installed.

These improvements on the facility minimized ED paint carry-over and reduce the COD load and the lead content of waste water flowing into the waste water treatment facility.

Figure 3-2 Newly-Installed Auto Carry Hoist



⑤Recycling used solvents to reduce loads on waste water facilities

To reduce the load on waste water treatment plants using solvents in various kinds of processes, used thinner was recycled and, as a result, manufacturing costs were significantly reduced.

In the conventional process, lacquer thinner was used as a cleansing agent to wash the paint from the spray suits, spray guns, pressure tanks, mixing tanks and as a rinsing agent of paint containers, and the used thinner was discharged from the spray booth water directly to waste water treatment plant and was neutralized there.

In the improved process, the used thinner is collected through the pipe from the cleansing bath into drums and then sent to the recycling area.　Approximately 200 liters of used thinner are collected every day and the amount of thinner which can be recycled is 122 liters in a single process, which takes 5 to 6 minutes.

This project reduced the percentage of used thinner in the waste water treatment plant to 23%, and could minimize COD and VOC (Volatile Organic Compounds) in the treated waste water.

⑥ Efficient waste water treatment by proper management of waste water from the sludge bath

This project involves the thorough management of both the quality and quantity of the waste water discharged from the processes of the sludge bath in order to realize a more effective operation of the waste water treatment plant.

In the conventional waste water treatment process, the discharge of the waste water from the sludge bath depended on the judgement of the person in charge of the production line, and was carried out as occasion arises.　This caused a number of problems, such as the ineffective operation of the waste water treatment plant and overflows from the equalization tank.

The improved process uses a Wastewater Dump Request System.　The details that must be entered on this request form include the amount of waste water, the date and time that the dump will be started, the type of pollutants that are conceivably contained within the waste water, and the reason for dumping the waste water. According to the form, the Environment Section then carries out checks on the schedule, the capacity of the equalization tank and the characteristics of the waste water before finally instructing the person in charge of the waste water treatment plant.

As a result, the reduction in load on the waste water treatment plants improved the efficiency of waste water treatment and eliminated overflows from the equalization tank.

5) Examples of other improvements

⑦Scrap assortment and complete disposal

This scheme was started for the purpose of selling scrap to external contractors. Scrap was sorted by an assembling process and the total amount of scrap was monitored monthly.

In the conventional process, all scrap from the assembly line was dumped into a large dumpster without sorting, then was processed by a contractor.

In the improved process, the scrap generated by different sections on the assembly line was sorted and transported to a disposal area where the scrap was delivered to the contractor. This eradicates the time the contractor would have to spend to sort the scrap, and also provides a certain amount of revenue by selling the scrap.

From an environmental point of view, this has established a better management system of waste products.

⑧Energy saving by installing power meters

Power meters were installed on all major processes to determine exactly how much energy was being consumed by each process in order to reduce energy consumption.

In the conventional system, the energy consumption of the whole factory including offices was monitored by only one power meter, therefore it was impossible to perform monitoring and analysis for the purpose of reducing the energy consumption of each area.

The improved system adopted a power metering system which allowed the energy consumption of each area to be monitored with individual meters. The easier analysis for reducing consumption provided an emergency measures in case of abnormal situations. A reduction in electric-power consumption also reduces electric-power production, which in turn leads to reduction of the burden on the environment in relation to electric-power production.

⑨Improved working environment by installing a ventilation system

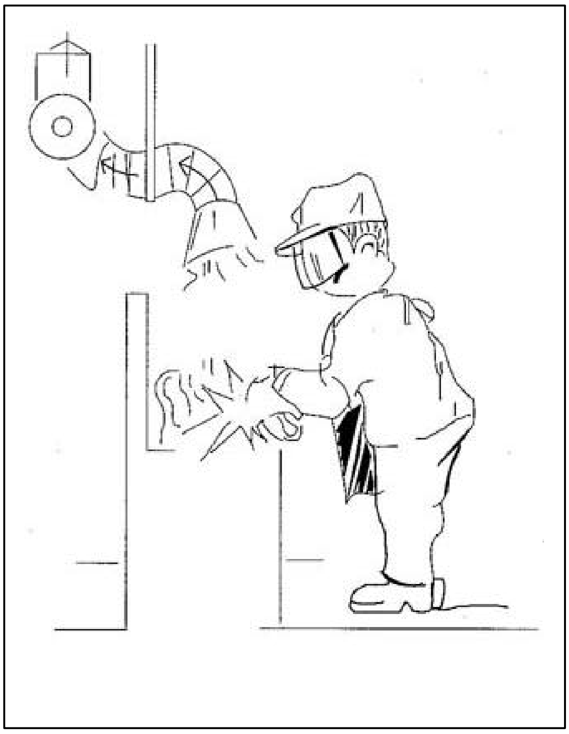
This project involved installing ventilators in the welding area to prevent polluted fumes emitted from the welding area from flowing into other areas for the purpose of improving the working environment of the parts assembly plant.

In the previous process, emissions from metal welding with inert gases or lead soldering during the welding process flowed into the assembly line area and greatly affected the working conditions of the assembly line area. Therefore, ventilators were installed in the welding area.

⑩Improved ventilation on the welding line

Figure 3-3 Ventilators Installed in the Welding Area

This project involved reduction and standardization of the ventilation cycle on the welding line from previous every eleven minutes to every two or three minutes. An additional 27 ventilation outlets to the roof could raise the exhaust capacity by about 12,000 m^3/minute and reduce the amount of heated air in the workplace and dust from the welding line.



⑪Reduction in water consumption

This project was planned and implemented to reduce water consumption due to insufficient supplies and high cost of water in the area where the new plant was located.

In the conventional process, the assembly plant consumed an average of 14,003 cubic meters of water monthly, or 5 cubic meters per unit, between January and June 1995.

The improved system called for the installation of water-saving devices, notice for water saving in washrooms and toilets, the maintenance of a monitoring system, daily inspections carried out in accordance with a check-list, and better maintenance of equipment. In addition to this, team members were instructed to read water meters correctly. Visual controllers were attached to water meters to enable the water consumption limit to be clearly seen, and automatic stop switches were installed in all tanks to prevent overflow.

These improvements resulted in an average water consumption rate of 12,002 cubic meters per month between July and December 1995, or an average of four cubic meters per unit, which led to reduction in the consumption to an average of 11,728 cubic meters per month, or 3.82 cubic meters per unit throughout the year 1996.

⑫Replacing CFCs

The conventional process used the CFC-12 refrigerant, an ozone depleting substance, in all car coolers, but the refrigerant was changed to HFC-134a in all models during 1994.

6) Issues for the future

Company E intends to address the following issues in the future:

① Informing employees: Inform employees about environmental problems, not only regional but global environment issues, by providing information, training courses or seminars.
② Periodical measuring and improvements in the precision of measuring instruments: Clarify the measuring procedures and improve the precision of measuring instruments in order to obtain precise, good results at all times.
③ Recycling treated waste water: Promote the use of recycled waste water in other processes than manufacturing processes.
④ Risk management: Establish effective risk management procedures to minimize accidents involving people and the environment.
⑤ Environmental management: Inaugurate an effective environmental management system to obtain ISO 14001 certificate.