Fuyang Chemical General Works

Background

The Fuyang Chemical General Works, located in Fuyang City in Anhui Province of China, was selected as a demonstration for the China-Canada Cooperation Project in Cleaner Production (CP). This project was initiated in October 1996 and is funded by the Canadian International Development Agency. It is being implemented by the Canadian Executing Agency consisting of PricewaterhouseCoopers, SNC-Lavalin and ESSA Technologies. At the beginning of the demonstration, in 1996, the plant employed 1300 people to produce 200,000 tonnes annually of ammonium bicarbonate and urea fertilizers with a gross value of $250 million Renminbi (RMB). As is typical of fertilizer plants, the facility also generated large amounts of air and water pollution, especially ammonia and sulphur.

What was done

Canadian engineers and process specialists worked closely with the State Economy and Trade Commission (SETC), the Chinese Project Office and Fuyang plant personnel to identify practical no, low, and medium cost ways to improve productivity and profitability and to reduce pollutants. They applied the following principles of CP:

- minimize water consumption
- use raw materials and energy efficiently
- recover, reuse or recycle losses of raw materials and/or finished products from the process
- improve procedures (called "good housekeeping")
- handle raw materials, intermediate products, and finished goods carefully and safely

CP Methodology

- Clean Production (CP) begins with an audit. The basic step in the CP audit is the preparation of Process Flow Diagrams (PFDs).
- 28 PFDs were developed at the Fuyang plant. Each describes a specific unit process, including all major pieces of process equipment (pressure vessels, reactors, scrubbers, coolers, pumps, etc.), and process streams.
- Environmental emissions (liquid effluents, air emissions and wastes) from every item of process equipment were systematically assessed.
- A list of all environmental emissions was prepared, indicating the sources (i.e. equipment number), the nature (stream number), the point of discharge, the general composition and frequency (e.g. continuous emission, intermittent emission, blow downs, periodic maintenance, etc.).
- CP measures were identified to reduce ammonia; some measures were also identified in other areas of operation.
- Ten no and low-cost ammonia solutions and three medium cost measures were implemented. About 10 other CP recommendations may be implemented in the near future.

What happened

In the first full year of implementing no and low-cost CP measures, production increased three percent, with savings of 15 million RMB. The plant used less raw material and generated less pollution.

Cleaner production elements continue to be implemented. Management and staff have put in place a continuous improvement (CI) process. Medium cost solutions for reducing emissions of ammonia and sulphur were implemented in 1999, when equipment costing 1.6 Million RMB (for three CP solutions) was commissioned. The Plant also initiated measures to recover waste oil. These measures paid for themselves in less than one year.

Why it worked

Management was fully committed to the program; it challenged and empowered employees to find solutions, and offered them bonuses as rewards. Employees quickly rose to the challenge and embraced the principles of CP. Improving workforce skills through training, recognizing the importance of women in the workforce, and partnerships with government agencies and others all played a role in the success.

Senior managers are aware of the need to motivate workers to improve performance. They see women as an important human resource, and have adopted gender equity as a mechanism to help female workers improve themselves and their work.

The successful demonstration also proved the importance of providing other enabling conditions. The project developed policies that support CP and relevant industrial guidelines, and put in place computers and supporting information systems. The latter provides access via the website to international CP information, and the ongoing capacity to analyse monitoring data from the plant.

Cleaner Production measures to reduce ammonia

ID#	Description	CP Measures	Objective	Cost Category
1	Air emissions from mother liquor tanks	Collect air emissions; direct to wet scrubber	• Reduce air emissions • Improve occupational health • Recover ammonia	Low
2	Air emission from bagging operation	Ventilation, air collection and scrubbing of air at wet scrubber	• Reduce air emissions • Improve occupational health • Recover ammonia	Low
3	Scrubbing liquor from ammonia scrubber	Recovery and recycling at new CP equipment	• Prevent discharge to sewer and to atmosphere • Recover ammonia	(see item 6)
4	Bleed from integrative tower	Recovery and recycling at new CP equipment	• Prevent discharge to sewer and atmosphere • Recover ammonia	(see item 6)
5	Tail gas from CO/ CO_2 trace removal	Recycling at other process unit	• Reduce air emission of NH_3 • Recover ammonia	(see item 6)
6	Bleed from isobaric absorber	New CP equipment for the concentration, recovery and reuse of ammonia from items 3, 4, 6 and 9	• Prevent discharge to sewer • Reduce losses of ammonia to atmosphere via cooling tower • Recover ammonia • Reduce raw material • Generate revenue	Medium
7	Supernatant from sulphur wastes at gas de-sulphurisation area	New equipment for recovering sulphur, extracting and recycling diluted ammonia	• Convert sulphur wastes into saleable products • Reduce losses of ammonia to the air • Prevent discharge of ammonia to the sewer	Medium
8	Ammonia condensate from the collection of contaminated air in bagging area	Manual collection of condensate before it reaches sewers, return to recovery	• Prevent discharge to the sewer • Recover and reuse ammonia	Zero
9	Excess dilute ammonia solution from CO/CO_2 trace removal	Recovery and reuse at new CP equipment	• Reduce discharge to servers and to air • Recover ammonia	(see item 6)
10	Recovery and reuse of spent lube oil	Collect waste lube oils in the plant and implement new equipment for purifying waste oils	• reduce discharge of waste oils to sewers • reduce purchasing of fresh oil	Medium

Benefits of Cleaner Production

No and low cost ammonia measures (initiated late 1997)

Reduction in losses of ammonia	1,400 tonnes/year
Recovery of hydrogen in equivalent NH_3	1,400 tonnes/year
Net revenues generated	1.8 million RMB*/year

Medium cost measures (initiated late 1999)

Ammonia Recovery Unit	
Ammonia recovered	4,400 tonnes/year
Reduction in water consumption	8,400 tonnes/year
Money saved (net)	3.1 million RMB*/year
Sulphur Recovery Unit	
Ammonia recovery	270 tonnes/year
Sulphur recovered	550 tonnes/year
Reduction in water consumption	29,000 tonnes/year
Money saved (net)	0.34 million RMB*/year
Oil Recovery Unit	
Oil recovered	120 tonnes/year
Money saved	0.20 million RMB*/year
Cost of "medium cost" measures	approximately 1.666 million RMB* for three CP solutions
Time to recover cost:	less than 1 year

* RMB = Renminbi = 0.18 Canadian dollars

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