Cleaner Production: Big Impact from Simple Measures A Case Study in the Desiccated Coconut Industry of Sri Lanka

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ABSTRACT

Desiccated coconut (DC) industry is one of the economically important and major export oriented food processing industries in Sri Lanka. This paper discusses various cleaner production (CP) options available in the DC industry to reduce cost of production and to mitigate negative environmental effects of the manufacturing process. Majority of the CP options discussed in this paper are simple measures that can easily be implemented. More importantly, these measures derive substantial benefits to the industry. In one of the mills, the contribution of CP measures towards the reduction of cost of production is around 18%. CP measures therefore can contribute in making the DC industry continually competitive in the global market.

1. INTRODUCTION

Sri Lanka is the world's fourth largest producer of coconut covering a total acreage of over one million. The average annual coconut crop production is around 3000 million nuts of which around 65% is directly used for domestic consumption (for cooking purpose). The rest is mainly used by two industries, namely, desiccated coconut (18%) and coconut oil [1].

Desiccated coconut (DC) is a dried white, particulated or shredded product manufactured from peeled kernel of seasoned coconut under hygienic processing conditions. It is used in the bakery and confectionery industry for fillings for nut bars, cookies, biscuits, sanding of cakes, pies, and other food products. It is estimated that to produce one metric ton of DC, 8000 nuts are required [2].

Sri Lanka is considered to be the birthplace of the DC industry and the first factory was established nearly a century ago (1880) in Colombo and continues to be one of the country's important food processing industries. DC industry in Sri Lanka consists of around 66 mills which are categorized as traditional (16 mills), modernized (49 mills) and ultra modernized (1 mill with an installed capacity of 250 000 nuts per day, which has a much greater degree of mechanization) [1]. The capacity of an average factory varies from 30 000 to 40 000 nuts per day. Industry output is around 60 000 tons of DC per year. The share of the annual DC production in traditional and modern mills is 30% and 70%, respectively.

Sri Lanka is the world's second largest DC producer after the Philippines, sharing about 25% of the global annual DC production. Sri Lanka and the Philippines account for more than 60% of the global DC production [2]. There are about 35 000 personnel involved in the coconut processing industry in Sri Lanka in various capacities, out of which nearly 10 000 are directly employed by the DC industry [1].

The DC industry at present is facing market uncertainties, both in supply and demand. The DC industry has to compete with other coconut industries for the raw material (coconut). In the demand side, the market for DC has been sluggish and forecast to increase only marginally as no new market is being identified. Both supply and demand constraints have resulted in under capacity operation in most mills and hence less profits [1].

2. OBJECTIVE

The objective of this paper is to disseminate the findings of two research projects: one is a regional research program by Industrial Service Bureau (ISB) of Sri Lanka and Asian Institute of Technology (AIT), under the Asian Regional Research Programme on Energy, Environment and Climate (ARRPEEC) funded by the Swedish International Development Co-operation Agency (Sida); and the other is a project to 'Strengthen Environmentally Sound Resource Management and to Encourage Environmental Advocacy and Stewardship through Active Community (stakeholder) Participation' conducted by ISB under the framework of Local Environmental Fund (LEF) established in Sri Lanka with the financial support of the Royal Netherlands Embassy and administered by the World Conservation Union (IUCN).

Through this paper, it is intended to provide the prospective beneficiaries (i.e., desiccated coconut industry, service providers engaged in the promotion of cleaner production, and the academia) awareness on the possibilities of introducing cleaner production with the view to enhance the competitiveness of the desiccated coconut industry while minimizing the negative environmental effects.

3. METHODOLOGY

Under the patronage of two research projects mentioned in the preceding section, ISB in collaboration with the National Cleaner Production Centre (NCPC) initiated a series of activities to promote CP in the DC industry which include CP audits, awareness and training programs for operating personnel, assistance and guidance for the implementation of CP measures and post-implementation monitoring.

This paper is prepared based on actual results of CP measures implemented in three DC mills. It includes technology and production process with a view to provide the reader with a basic understanding of various operations discussed, the CP measures implemented along with their cumulative benefits and the lessons learned.

4. TECHNOLOGY AND PRODUCTION PROCESS

The level of technology employed by the industry is not sophisticated though the maintenance of hygienic condition is of paramount importance as the product is a food item. There are a series of operations in DC manufacturing process, i.e., hatcheting, paring, pairing, sterilizing, cutting, drying, grading and packing. Figure 1 shows the process diagram of DC production [2].

5. CLEANER PRODUCTION – A CASE STUDY

Though the industry is economically important, it has to struggle for its survival due to supply and demand constraints, process deficiencies and inefficiencies arising from technology obsolescence, escalating input costs, and more importantly the environmental challenges [1]. One of the options available for its survival and growth is to implement cost cutting measures by adopting cleaner production technologies.

Given below is a list of CP measures that have been (or are being) implemented in three desiccated mills in Sri Lanka. They are categorized as housekeeping measures and technology adoption.

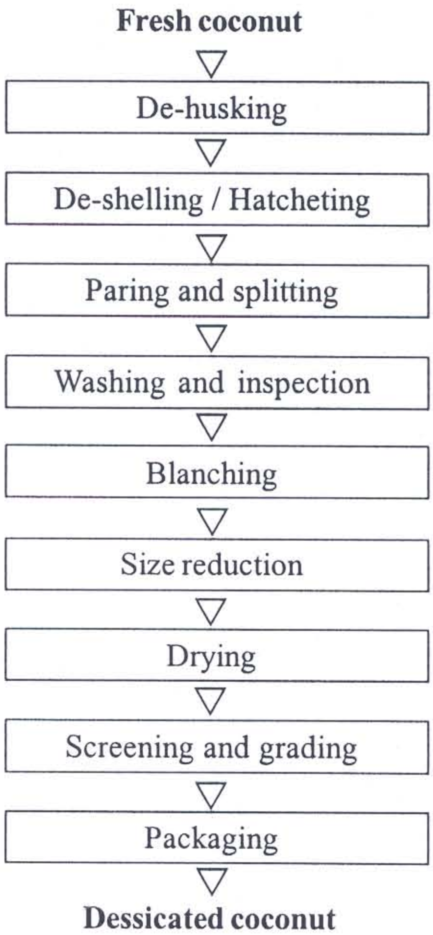

Fig. 1 Flow diagram of DC production process

Housekeeping Measures

- Reduction of nuts rejection by proper handling at the time of loading and unloading,
- Reduction of coconut meat (kernel) rejection by proper awareness of "peelers",
- Reduction of wash water by proper water management,
- Extraction of high quality coconut oil from sterilizing tank, and
- Reduction DC waste

Technology Adoption

- Oil recovery from wastewater grease tanks, and
- Combustion efficiency improvement of the steam boiler

As can be seen from the succeeding discussion, most of these measures can be treated as simple housekeeping measures that do not require sophisticated technical know-how. The 'situation before', action taken and the 'situation after', and the benefits derived from these measures are briefly described in this paper. It is important to note that certain measures have yielded varying benefits in the different mills as they differ in many aspects, such as operation and management, though they adopt basically the same technology.

In the first mill (Mill A), all seven CP measures (housekeeping measures and technology adoption) were implemented. In the second (Mill B) and the third (Mill C), only one or two measures have been fully implemented at the time of writing this paper. Implementation of other CP measures is in progress. Table 1 shows a brief comparison of the three mills.

Table 1 Comparison of three mills in Sri Lanka

	Mill A	Mill B	Mill C
Average daily capacity	50,000 nuts	150,000 nuts	40,000 nuts
Category	Modernized	Modernized	Modernized
Operating days per year (under normal nut supply situations)	200 days	240 days	200 days

5.1 Case Study: Mill A

5.1.1 First Measure: Reduction of nuts rejection by proper handling at the time of loading and unloading

Situation Before

In this mill, around 2000 nuts were rejected daily due to mishandling when loading to lorries at the collection points and when unloading at the mill premises. Loading to lorries is normally carried out by throwing de-husked nuts into the cabin of the lorry from a distance of around 3 m to 5 m from the edge of the lorry. In the process, fully dried and de-husked nuts tend to crack when they collide with other nuts in the lorry.

In many instances, 'nut loaders' do not pay adequate attention to select good nuts from collecting centers as there is neither incentive nor disincentive for quality of nuts. Spoilt and small nuts are not taken for DC manufacturing. However, damaged and smaller nuts are converted into copra which is a low value product compared to DC. DC, at Sri Lankan ruppees (SLRs) 70 per kg, is normally 3.5 times more expensive than copra which is around SLRs 20 per kg (US$ 1 = SLRs 97).

Unloading at the mill premises is normally carried out on to a cemented floor. Though the rubber carpets are available to lay on top of the cemented floor to prevent damages, 'nut unloaders' mainly due to lack of awareness on loss of income, do not use them for the intended purpose.

Action Taken and the Situation After

The damage due to loading was reduced by introducing cane baskets to carry nuts to the lorry instead of directly throwing them. Photo 1 shows the loading of nuts using cane baskets. The damage due to unloading was reduced by re-laying rubber carpets on cemented floors as shown in Photo 2. These measures were supplemented with a financial incentive/disincentive system for loaders and 'nut unloaders'. Prior to introduction of these measures, they (sometimes the same party does the loading

Photo 1 Loading of nuts using cane baskets

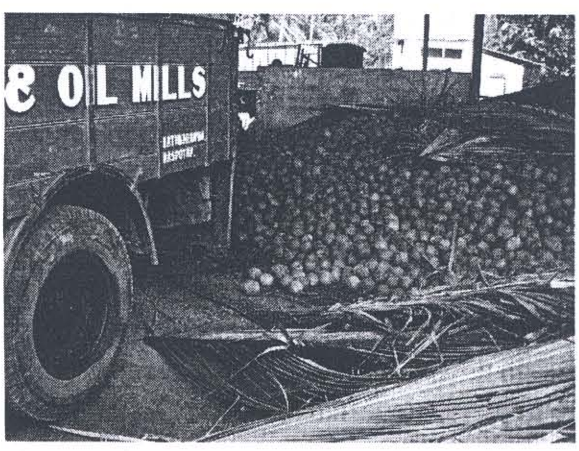

Photo 2 Unloading of nuts on rubber carpets

and unloading) were made aware of the cost of the damage to the mill and what it means to them in terms of financial incentives/disincentives. These measures have resulted in the reduction of rejected nuts from 2000 to around 800 a day, which means an additional 1200 nuts per day were made available for DC manufacturing.

Benefits Derived

An additional income of around SLRs 5,700 per day was achieved through this measure. The calculation is based on the price advantage of DC over copra (see Appendix A). This would translate to an annual income of SLRs 1.14 million (US$ 11,750) on the basis of 200 working days.

5.1.2 Second Measure: Reduction of coconut meat (kernel) rejection by proper awareness of "Peelers"

Situation Before

After the coconut shell is removed which is called 'hachetting' or 'deshelling', the outer brown skin of the kernel (testa) has to be scraped or peeled, which is called 'paring', to ensure the quality and the whiteness of DC. Photo 3 shows the peeling of kernels. This operation has to be done with utmost care so that over or under paring is prevented. Under paring will badly influence the quality of DC while over paring will waste valuable coconut meat which could otherwise be processed as DC. Though the testa or parings is a waste of DC manufacturing process, it is sold for coconut oil extraction which has a low value than DC.

In this particular mill, around 65 kg to 100 kg of parings per 1000 nuts which is far above the industry average were generated, mainly due to lack of understanding of the 'peelers' as well as the management on the quantities and cost being involved. On average, about 35 kg to 50 kg parings are produced per 1000 nuts [2].

Action Taken and the Situation After

The quantification of parings generated and assigning a value to it was the first step. After the peelers were made aware of the value involved, it was very easy to set norms with their fullest cooperation. It was mutually agreed upon to keep the parings under 50 kg for 1,000 nuts to be at par with industry average and to levy/accept a fairly heavy penalty varying from SLRs 15 to 35 per kg for extra parings generated (SLRs 15 for up to 15 kg; SLRs 25 from 16 kg to 35 kg; and SLRs 35 for above 35 kg). This means that the penalty begins with 12% of fees paid to peelers (at SLRs 125 per 1000 nuts) and they do not get any payment at all if they generate 8 kg over the norm set.

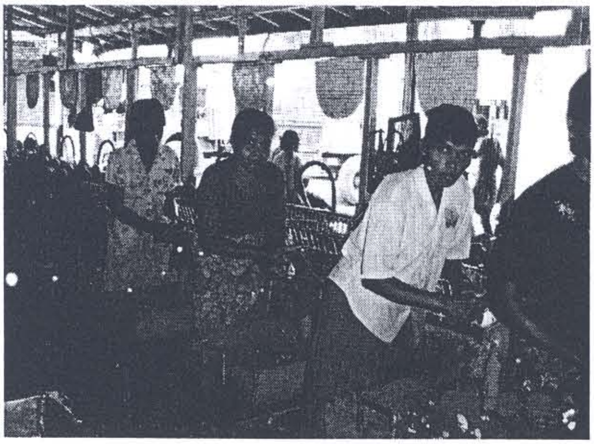

Photo 3 Peeling of kernels

These measures resulted in the reduction of parings from a level of around 65 kg to 100 kg to around 35 kg to 50 kg per 1000 nuts, which means a reduction of around 48%.

It should be noted that though there is no direct incentive given to good performers, the management has decided to reward the peelers who perform below the norm with increased annual bonuses.

Benefits Derived

An additional income of around SLRs 46,000 per day was achieved through this measure. The calculation is based on the price advantage of DC over copra. Moisture content of DC is around 2.5 to 3% [2]. Therefore DC yield from parings is about 46%. Moisture content of copra is below 6% [3]. Therefore copra yield from parings is about 48%. This would translate to an annual income of SLRs 9 million (US $ 94,500) on the basis of 200 working days.

This CP measure gave the highest financial benefit to this mill as peeling operation was far above the industry average. Contribution of this measure towards the reduction of cost of production is around 10%. The production cost is shown in Appendix B.

5.1.3 Third Measure: Reduction of wash water by proper water management

Situation Before

In this mill, around 40 m^3 of water was used daily for washing of kernel after peeling the testa, for washing the floor for general cleanliness, and for maintaining hygienic conditions. Water is normally pumped from a well within the mill premises and supplemented with water transported from bousers at the cost of SLRs 1,600 per load to meet the shortfall. Around 4 loads per day worth SLRs 6,400 were used.

It was observed that all pipelines and hoses used for washing were of one inch diameter. Most of the hoses were left open with running water even after floor washing as there was no easy way of closing them. Kernel wash tanks were either overflowing most of the time or emptied and refilled frequently though the water was good enough for further cleaning.

Action Taken and the Situation After

As in the 'situation before', quantification of water used was the first activity of the process. Thereafter, the operators were made aware of the value involved and hence their fullest cooperation was ensured to implement the following measures:

- One inch diameter pipelines used for floor washing were replaced with ½ inch pipelines.
- Water injection nozzles with stoppers were introduced.
- Operators were educated to prevent overflow of water from kernel wash tanks and to refill only when it is necessary.

These measures resulted in the reduction of water usage from 40 m^3 to around 16 m^3 a day, which means a reduction of around 60%. It was possible to manage with 2 bouser loads of water instead of 4 as used before.

The substantial saving of wash water will drastically reduce the pollution load of the treatment system. Photos 4 and 5 show the kernel wash tanks and water nozzles, respectively.

Benefits Derived

A saving of around SLRs 3,200 per day was achieved through this measure. This would translate to an annual income of SLRs 0.64 million (US $ 6,600) on the basis of 200 working days.

Photo 4 Kernel wash tanks

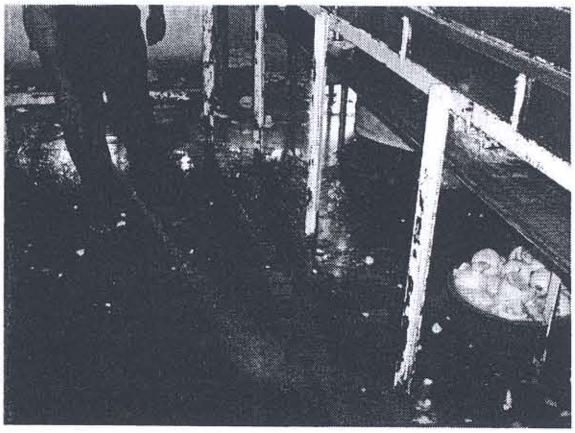

Photo 5 Water nozzles

The enormous saving of cost of coconut wastewater treatment (operation and the capital layout in case of a new treatment plant) which could be expected has not been considered for this calculation as the treatment techniques for coconut wastewater are not yet established in Sri Lanka although certain R&D works on treatment techniques are being carried out by the Industrial Services Bureau (ISB). The calculation considered 60 m^3 of coconut wastewater which consisted of 40 m^3 of wash water and 20 m^3 of coconut water (sap) and pasteurizing water. Hence the reduction of wastewater load is 40%.

5.1.4 Fourth Measure: Extraction of high quality coconut oil from sterilizing tank

Situation Before

Washed kernel before being shredded into small pieces for drying is sterilized for disinfection using hot water. The water temperature of the sterilized tank is maintained at 100^{0}C through a steam coil. In this process, a certain amount of oil in coconut kernel is dissolved in the boiling water and floats as a thin layer on top of the water tank. At the end of the day, sterilized tank is emptied and cleaned and hence the oil layer also finds its way to the drain.

Action Taken and the Situation After

Collecting and heating the oil layer resulted in generating around 3.5 kg of very high quality coconut oil. Photo 6 shows the oil layer of the sterilizing tank.

The pollution load of the coconut wastewater treatment will be reduced with the removal of oil.

Benefits Derived

An additional income of around SLRs 250 per day was achieved through this measure. The calculation is based on the coconut oil price of SLRs 75 per kg. This would translate to an annual income of SLRs 50,000 (US $ 515) on the basis of 200 working days.

The saving of cost of coconut wastewater treatment which could be expected has not been considered in this calculation.

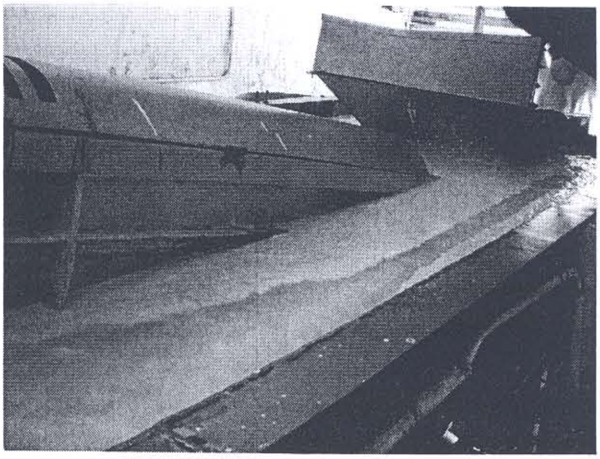

Photo 6 Oil layer of sterilizing tank

5.1.5 Fifth Measure: Reduction of DC waste

Situation Before

In this mill, around 25 kg of DC worth around SLRs 1,750 has been wasted daily due to flyover from dryers and sifters and spillage from conveyers and carelessness of operators in screening, grading, weighing and packing. Photo 7 shows the flyover of DC from dryer.

Action Taken and the Situation After

Flyover from dryers and sifters and spillage from conveyers were reduced by fixing door leaks and effecting simple repairs. In addition, the operators were educated on proper handling of products.

These measures have resulted in the reduction of waste from 25 kg to around 2 to 3 kg a day.

Benefits Derived

An additional income of around SLRs 1,540 per day is achieved through this measure. The alternative use of waste DC and the cost incurred for repairs were not considered for calculation. This would translate to an annual income of SLRs 0.31 million (US$ 3,175) on the basis of 200 working days.

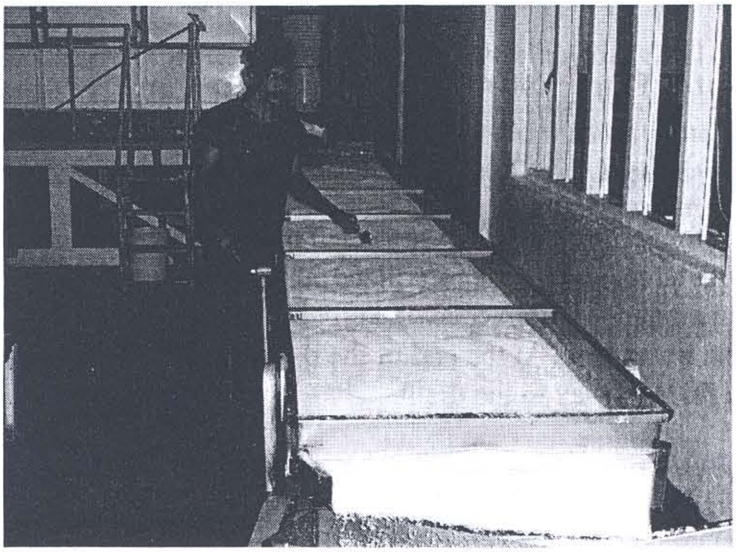

Photo 7 Flyover of DC from dryer

5.1.6 Sixth Measure: Oil recovery from wastewater grease tanks

Situation Before

The wastewater contains about 0.05% of oil. Oil and grease content of fresh coconut water is around 2000 mg/L while oil and grease content of wastewater is around 400 to 600 mg/L [2]. As in many other DC mills in Sri Lanka, oil separation in this mill was done in four rectangular (2 m x 2 m x 2 m) concrete tanks using gravity separation prior to the treatment or disposal of wastewater. This low-grade oil is sold to tile manufacturing industry for lubricating purposes. Oil is made by heating the sludge consisting of oil and waste kernel pieces removed from separation tanks.

The daily removal of oil was around 1 barrel (equivalent to 210 liters or 200 kg) and was sold at a price of around SLRs 8,000 per barrel.

Action Taken and the Situation After

Six new separation tanks (with a total capacity of approximately 50 m^3) made of concrete were added at a cost of around SLRs 150,000. As a result, the daily removal of oil was increased from 1 to 4 barrels. Photo 8 shows the six new oil extraction tanks.

The phenomenal increase in the amount of oil recovered from wastewater will drastically reduce the pollution load of the treatment system.

Benefits Derived

An additional income of around SLRs 24,000 per day was achieved through this measure. This would translate to an annual income of SLRs 4.8 million (US $ 49,500) on the basis of 200 working days.

The enormous saving of cost of coconut wastewater treatment (operation and the capital layout in case of a new treatment plant) which could be expected has not been considered in the calculation.

5.1.7 Seventh Measure: Combustion efficiency improvement of the steam boiler

Situation Before

The steam boiler was operating at the combustion efficiency of around 79% at the fuel oil consumption rate of 112 L/h. Photo 9 shows the steam boiler.

Action Taken and the Situation After

This is the only technical measure out of the seven measures adopted. The boiler efficiency was measured using a portable microprocessor controlled flue gas analyzer and the burner was properly tuned to achieve around 84% combustion efficiency.

This measure has resulted in the improvement of combustion efficiency by 5% and hence reduction of fuel consumption by 7.5 L/h.

Benefits Derived

A saving of around SLRs 1,650 per day is achieved through this measure. The calculation was based on the fuel oil price of SLRs 26 per liter. This would translate to an annual income of SLRs 0.33 million (US$ 3,400) on the basis of 200 working days.

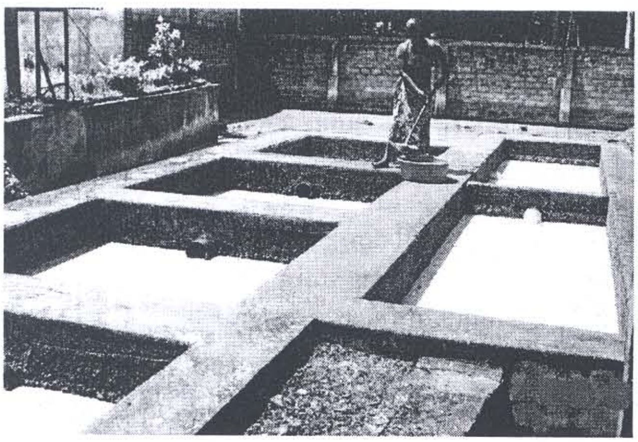

Photo 8 Six new oil extraction tanks

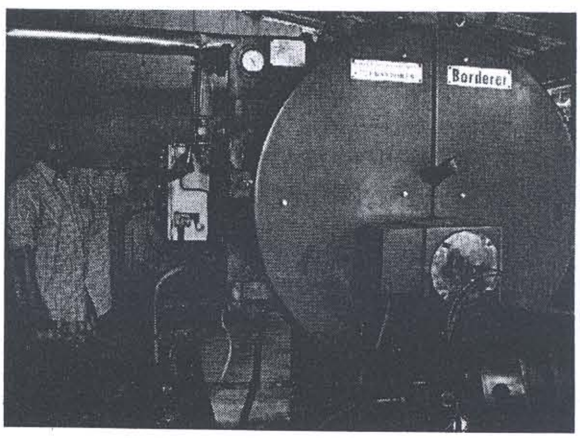

Photo 9 Steam boiler

GHG mitigation owing to the better combustion efficiency of the fuel is an indirect benefit derived at the macro level (national and global). The gaseous emissions of the Sri Lankan DC industry due to the combustion of fuel oil (in modernized factories) and firewood (in conventional factories) has been estimated as: CO_2 = 72 500 tons/year; CO = 7000 tons/year; SO_2 = 250 tons/year; and NO_2 = 30 tons/year [1].

5.2 Case Study: Mill B

5.2.1 Third Measure: Reduction of wash water by proper water management

Situation Before

In this mill, around 103 m^3 of water has been used daily for washing of kernel after peeling the testa and for washing the floor for general cleanliness and for maintaining hygienic conditions. Water is pumped from a well within the mill premises.

Action Taken and the Situation After

In addition to the measures adopted in Mill A, a complete 'water audit' was carried out in this mill before identifying CP options.

These measures have resulted in the reduction of water usage from 103 m^3 to around 60 m^3 a day, which means a reduction of around 42%.

Benefits Derived

A saving of around SLRs 860 per day is achieved through this measure. The cost of pumping water from well is estimated at SLRs 20 per m^3. This would translate to an annual income of SLRs 0.2 million (US $ 2,130) on the basis of 240 working days.

5.2.2 Sixth Measure: Oil recovery from wastewater grease tanks

Situation Before

Oil separation in this mill was done in two rectangular (2 m x 2 m x 2 m each) concrete tanks using gravity separation.

The daily removal of oil was around 0.5 barrel and was sold at a price of around SLRs 8,000 per barrel.

Action Taken and the Situation After

Two old tanks were replaced with fourteen new separation tanks (with total capacity of approximately 190 m^3) made of concrete at a cost of around SLRs 800,000. As a result, the daily removal of oil was increased from 0.5 to 2 barrels.

It should be noted that relatively low recovery of oil in this mill compared to Mill A is due to the removal of even small pieces of kernel before the wastewater stream is sent through oil separation tanks. This is a prerequisite for the trails now carried out for the treatment of wastewater.

Benefits Derived

An additional income of around SLRs 12,000 per day is achieved through this measure. This would translate to an annual income of SLRs 2.88 million (US $ 29,690) on the basis of 240 working days.

5.3 Mill C: Case Study

5.3.1 First Measure: Reduction of nuts rejection by proper handling at the time of loading and unloading

Situation Before

In this mill, around 1,500 nuts were rejected daily due to mishandling.

Action Taken and the Situation After

Similar measures as in the case of Mill A were introduced. These measures have resulted in the reduction of rejected nuts from 1500 to around 980 a day, which means an additional 520 nuts per day were made available for DC manufacturing.

Benefits Derived

An additional income of around SLRs 2,470 per day is achieved through this measure. This would translate to an annual income of SLRs 0.5 million (US $ 5,090) on the basis of 200 working days.

6. BENEFITS GAINED FROM THE IMPLEMENTATION OF CP MEASURES

A comparison of the annual benefit gained in each case study mill is shown in Table 2 to provide a sense of importance and urgency of implementation of the CP measures introduced.

A benefit of around SLRs 16 million would mean that this is more than adequate to meet the entire annual salary bill (around SLRs 6 million per year) and the energy cost (around SLRs 5.8 million

Table 2 Comparison of annual benefits gained in three mills from using CP measures

	CP Measure	Annual Benefit					
		Mill A		Mill B		Mill C	
		Million SLRs	US$	Million SLRs	US$	Million SLRs	US$
1	Reduction of nuts rejection by proper handling at the time of loading and unloading	1.14	11,750			0.5	5,090
2	Reduction of coconut meat (kernel) rejection by proper awareness of "peelers"	9.16	94,500				
3	Reduction of wash water by proper water management	0.64	6,600	0.2	2,130		
4	Extraction of high quality coconut oil from sterilizing tank	0.05	515				
5	Reduction DC waste	0.308	3,175				
6	Oil recovery from wastewater grease tanks	4.8	49,500	2.88	29,690		
7	Combustion efficiency improvement of the steam boiler	0.33	3,400				
Total		16.428	169,440	3.08	31,820	0.5	5,090

per year, 6.8%) of Mill A. In other words, the contribution of CP measures towards the reduction of cost of production is around 18%. The total cost of production is around SLRs 92 million per year.

7. LESSONS LEARNED

A closer look at the CP measures described in this paper would provide a greater learning opportunity for those interested in implementing such measures for productivity gains at industry level and for those interested in promoting the concept of CP for national competitiveness and environmental protection. The lessons learned are:

- Measurement and monitoring would lead to the exploration of new CP possibilities and options.
- A closer and critical look at certain processes and operations will reveal hosts of new opportunities of CP.
- Proper awareness on financial losses or gains would encourage owners and operators in adopting CP measures.
- Introduction of economic instruments would entice operators in rational thinking on CP possibilities.
- Proper operation and maintenance would lead to a significant reduction of raw materials and finished products.
- Housekeeping measures and Japanese productivity improvements measures such as '5S' and 'KAIZEN' would go a long way in achieving CP.
- Simple technical measures could make a big impact in CP.
- Commitment of the top management is essential for the successful implementation of CP measures.
- Participatory approach with the involvement of all parties concerned (owners, top management, middle management, and especially the operating personnel) in identifying CP measures and in formulating implemention strategies would ensure the sustainability of such measures. When the operating personnel feel an ownership for such measures, they cooperate very well rather than resisting such moves. Furthermore, certain desirable-organizational-attitudinal changes such as togetherness, belongingness, etc. which are under normal circumstances difficult to inculcate have emerged through this process in unimaginable proportions especially when traditional 'autocratic rule' is still prevalent in certain mills.
- Certain categories of employees such as supervisors and middle managers who are gradually becoming redundant under the present organizational development of participatory management, teamwork, etc. have re-emerged as 'CP champions'. As they could easily grasp and embrace the concept of CP due to their comparative advantage in terms of technical know-how and hands-on experience at the floor level over other categories such as top management and operating level personnel, they have now found themselves in re-defined and important positions in their organizations.
- CP efforts need to be initiated and guided by credible service providers or external expertise in the capacity of a counselor until the self momentum is created and sustained. ISB played this role.
- Successful implementation of CP measures would lay the foundation and pave the way for the easy implementation of other productivity enhancement measures such as ISO 14000 environment management systems. Mill A is preparing itself for ISO 14000 certification under the guidance of ISB.

8. CONCLUSION

Majority of the CP options discussed in this paper are simple, understandable and can be implemented easily. More importantly, they can derive substantial benefits to the industry. As the DC industry is one of the nationally important indigenous industries of Sri Lanka, CP measures would undoubtedly help to reduce the cost of production and generation of pollutants, thereby making the DC industry continually competitive in the global market.

9. ACKNOWLEDGEMENTS

The authors are grateful to the project on 'Small and Medium Scale Industries (SMI) in Asia: Energy, Environment and Climate Interrelations' under the framework of Asian Regional Research Programme in Energy, Environment and Climate (ARRPEEC) Phase-III, funded by the Swedish International Development Co-operation Agency (Sida); and the project to 'Strengthen Environmentally Sound Resource Management and to Encourage Environmental Advocacy and Stewardship through Active Community (stakeholder) Participation' under the framework of Local Environmental Fund (LEF) established in Sri Lanka with the financial support of the Royal Netherlands Embassy and administered by the World Conservation Union (IUCN), without whose support this paper could not have been written. The authors are also grateful to the owners and operating personnel of DC mills who made available their facilities without any hesitation to carry out CP audits and subsequent implementation and monitoring of CP measures.

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11. APPENDICES

11.1 Appendix A

Calculation of additional income of SLRs. 5,700 per day achieved through implementation of First Measure

5 nuts are required to make 1 kg of copra. 8 nuts are required to make 1 kg of DC. 1,200 nuts would make 240 kg of copra worth SLRs 4,800 at SLRs 20 per kg. 1,200 nuts would make 150 kg of DC worth SLRs 10,500 at SLRs 70 per kg. Therefore the net gain is SLRs 5,700 per day if the marginal cost increase for DC processing is ignored.

11.2 Appendix B

Production cost of DC process

Raw material (coconut)	–	around SLRs 80 million per year – 87%.
Energy	–	around SLRs 5.8 million per year – 6.3%.
Salary	–	around SLRs 6 million per year – 5.8%.
Water and others	–	around SLRs 0.5 million per year – 0.9%.
Total cost of production	–	around SLRs 92 million per year