INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 4.295
(Volume 5, Issue 3)
Available online at: www.ijariit.com

Cleaner production assessment in optical brightening agent manufacturing industry

Tejas Patel
tejas_pinkypatel@yahoo.com
Aadishwar College of Engineering and Technology, Venus Swarnim Startup and Innovation University, Gandhinagar, Gujarat

S. M. Usman
hodcl@venusict.org
Aadishwar College of Engineering and Technology, Venus Swarnim Startup and Innovation University, Gandhinagar, Gujarat

ABSTRACT

Optical Brightening Agents (OBA) manufacturing industry is currently facing tough market competition and environmental issues, demanding productivity improvement and waste reduction by adopting Cleaner Production (CP) techniques. Majority of OBA manufacturing industries are operated based on conventional practices generating higher quantum of wastes. Adoption of adequate CP options would not only result in waste reduction but also in productivity improvement by better processes efficiencies, optimization of resource consumption, etc. During the study, probable CP options have been identified based on the causes of generation waste streams and then identified CP options were screened and evaluated based on their economic feasibilities. It was attempted to determine costs and benefits possible from eliminating/reducing the waste streams in monetary terms and also to calculate the payback period for each of the CP options. The aim of this study was to derive the CP options that may be practically implemented by the industry for reducing the waste generation and improving productivity.

Keywords— *OBA manufacturing industry, Cleaner production, Feasibility assessment, CP assessment, Prioritization, Cost estimation, Waste streams*

1. INTRODUCTION

Cleaner Production (CP) is defined as the continuous application of an integrated preventive environmental strategy applied to processes, products and services to increase overall efficiency and reduce risks to the environment which also includes human beings. Each action to reduce consumption of water, raw materials and energy, or to use renewable energy and to prevent or reduce the generation of waste as well as recycle and reuse of the waste can increase productivity and bring financial benefits to the enterprise. The key difference between Pollution Control (PC) and Cleaner Production (CP) is one of timing. Pollution control is an after-the-event, 'react and treat' approach. Cleaner Production is forward-looking, 'anticipate and prevent' philosophy.

Cleaner Production (CP) begins with the insight that even if environmental technologies has to lead to a significant reduction of emissions (at least per product) they are expensive and need further input of materials, energy and manpower. Environmental technologies, therefore, offer no economic incentives for industry. On the opposite, they generally lead to higher production costs, and they include a regulatory approach. The industry may avoid environmental technologies by investing in countries with less strict regulations. Cleaner Production, on the contrary, aims to reduce both the negative effects on the environment and the operating costs. Cleaner Production works with process integrated – preventive – methods instead of End-of-Pipe solutions. Cleaner Production is the conceptual and procedural approach to production that demands that all phases of the life cycle of a product or of a process should be addressed with the objective of prevention or minimisation of short and long-term risks to humans and to the environment.

The Optical Brightening Agents (OBA) manufacturing industry at Vatva is currently facing tough market competition and environmental issues demanding productivity improvement and waste reduction by adopting Cleaner Production (CP) techniques. It was attempted to carry out CP assessment to derive the CP options that may be practically implemented by the industry for reducing the waste generation and improving the productivity for enhancing the sustainability of the industry.

2. METHODOLOGY

The OBA industry at Vatva is manufacturing various Optical Brightening Agents using the same manufacturing process but using a different combination of raw materials as per market demand. To start with the Cleaner Production assessment, it was necessary to decide the focus area. Based on the feedback, it was realized that product BA-6 was being manufactured more often than any other products. Hence it was decided to restrict CP assessment to BA-6 product only.

At the outset of the study, probable CP options were identified first based on the causes of generation of each of the waste streams and then after identified CP options were screened/prioritized and evaluated based on their economic feasibilities. Losses and benefits (in monetary terms) possible from eliminating/reducing the waste streams were determined and payback period for each of the CP options was calculated. During CP assessment, brainstorming sessions were held with factory persons engaged in manufacturing process/operations. Practically implementable CP options were then determined based on the outcome of CP assessment. During CP assessment, brainstorming sessions were held with factory persons engaged in manufacturing process/operations as and when required.

3. QUANTIFICATION AND COST ESTIMATION OF WASTE STREAMS:

The detailed study revealed that a total of 12 waste streams is arising from various sources that can be grouped into three areas, viz. process, housekeeping and utilities. Each of the identified waste streams was quantified based on actual volumetric measurement or mass balance where volumetric measurement is not possible. Thereafter, the annual cost of each of the waste streams was estimated based on the current market rates. The outcome of this exercise is depicted below:

Table 1: Quantification and cost estimation of waste streams

S no.	Waste Streams	Material Loss In Kg/Batch	Total cost in Rs./Annum
A. Process			
1.	Vapour losses during 3rd Condensation Reaction.	513	46,170
2.	Vapor losses during Clarification operation.	20	18,000
3.	Vapor losses during Isolation.	74	66,600
4.	Mother liquor from Filter Press.	7025	31,16,625
5.	Energy losses due to variation in process parameter.		24,750
B. Housekeeping			
6.	Losses of ice due to melting.	40	18,000
7.	Losses of ice during the transfer from crusher to the reactor.	60	27,000
8.	Loss of material (wet cake) due to adherence to PP plates and cloth	20	7,42,500
9.	Spillage of wet cake while transferring it to trolley from the filter press area.	30	10,12,500
10.	Loss of wet cake while emptying the trolley for preparation of the slurry.	26	8,77,500
C. Boiler			
11.	Discharge of condensate.	1500	7,42,500
12.	Steam losses (5% of total steam).	175	1,26,000
Total (A+B+C)			**70,98,675 (Say, Rs. 71 Lacs)**

(Basis: One batch of OBA of 750 kg, 3 batches per day, 300 days of working in a year.)

4. IDENTIFICATION AND PRIORITIZATION OF CP OPTIONS

All the waste generating activities were studied and the causes for generation of each of the waste streams were identified in consultation with concerned factory staff. The identified causes of waste streams generation were then used for the purpose of generating CP options. Brainstorming sessions were conducted along with the technical staff and shop floor level workers of the relevant department to arrive at the CP options to each individual cause. After identification, CP options were divided into the following two categories; viz. (1) Directly implementable [options that are very easy to implement without any technical difficulty], and, (2) Needs further analysis [options that are technically or economically difficult to implement or needs to be assessed further to check its viability].

5. FEASIBILITY ASSESSMENT OF DIRECTLY IMPLEMENTABLE CP OPTIONS

Feasibility of the simple CP Options that are very easy to implement without any technical difficulty was assessed. Directly implementable CP options are:

(a) Providing lids/covers to the manholes at the top of the Reactors for preventing vapour losses during 3rd condensation and isolation.
(b) Installation of a water meter for charging the exact quantity of water into the Reactors in order to reduce the generation quantity of Mother Liquor.
(c) Provision of online pH meter onto the Reactors.
(d) Ice to be purchased in slots as per the requirement.
(e) To cover the ice with gunny bags
(f) To equip Ice Storage Area with thermocol sheet insulation.
(g) Use of HDPE plastic containers in place of bags for ice handling.
(h) Air pressure jet to be used to remove the cake.
(i) Combined air and water pressure jet to be used to remove the cake from the filter press
(j) To provide air on both sides of the filter press.
(k) Wet cake to be directly filled in trolleys and taken to the solution preparation area prior to spray drying.
(l) Low height parapet bund wall to be provided around filter presses for restricting inflow/outflow of wastewater/material.

(m) The trolleys/drums used in the handling of wet cake to be lined with plastic sheets.
(n) Provision of condensate collection well.
(o) Reuse of the condensate water.
(p) Steam leakages to be rectified.
(q) Replacement of damaged insulation of steam lines.

Investment required for the above measures and annual savings due to the same were worked out, which showed that the payback periods for the above measures range between 18 days to 4 months.

6. FEASIBILITY ASSESSMENT OF THE CP OPTIONS THAT NEED FURTHER ANALYSIS

Feasibility of the CP Options that need further analysis [options that are technically or economically difficult to implement or needs to be assessed further to check its viability] was assessed, the outcome of which is depicted in the table below:

Table 1: Feasibility assessment of the CP

S no.	CP Option	Technical feasibility	Economic feasibility	Environmental feasibility
1	A chilling system to be provided	Chilling Plant is a well-proven technology and it will be designed based on the cooling temperature required and mass of the reactor. So the technical feasibility is very high.	Investment - 10,000,00 Savings - 15,32,850 Pay back - 9 months	It will reduce the quantity of effluent as well as reduce the lifecycle reduction in generation of solid sludge.
2	Provide a jacketed vessel for chilled water re-circulation.	It is accomplished by providing one tank of chilled water and the copper coil inside the reactor for circulation of chilled water.	Investment – 40000 Savings – 168300 Payback - 4 months	It will reduce the quantity of effluent generation and thus reduce the load on ETP.
3	Reorientation of crusher with bucket Elevator	As the space for crusher with bucket elevator is not available on a floor it is not possible to reorient crusher with a bucket elevator. So this option is technically not feasible.	Investment – 45000 Savings – 27000 Payback – 1.6 year	It will reduce the volume of fresh water going to ETP due to melting
4	Some coagulating agent can be added to the slurry for getting better nature of the cake.	It is feasible but it will require research because of its effect on product and its quality and nature of the product and nature of coagulant agent.	Investment – 1,26,000 Savings – 3,00,000 Payback – @ 5 months	It will reduce the organic load of effluent.
5	A trough with a screw conveyor to be placed below the filter press that can directly transfer the wet cake without manual handling.	Technical feasibility of putting screw conveyor below the filter press will depend on the floor space available on the shop floor.	Investment – 365000 Savings – 445500 Payback – 10 months	It will reduce the organic load on effluent and thus there will be life cycle reduction in organic loading
6	A trough with a screw conveyor to be placed below the filter press that can directly transfer the wet cake without manual handling to the slurry preparation area	Technical feasibility of putting screw conveyor below the filter press will depend on the floor space available on the shop floor.	Investment – 365000 Savings – 386100 Payback – 11 months	It will reduce the organic load on effluent and thus there will be life cycle reduction in organic loading

As can be seen from the table above, the payback period for CP options varies from 4 months to 1.6 years. The assessment also showed that the option of Reorientation of crusher with Bucket Elevator is not technically feasible due to space constraints.

7. CONCLUSION

CP assessment revealed that the payback periods for CP options in OBA manufacturing industry varies from 18 days to 1.6 years and that major economic and environmental benefits could be gained by adopting CP measures for sustainability of the OBA manufacturing industry.

8. REFERENCES

[1] A book on Government Strategies and Policies for Cleaner Production by United Nations Environment Programme, First Edition 1994.
[2] Lennart Nilsson et. al, “Cleaner Production Technologies and Tools for Resource Efficient Production” - Book 2 in a series on Environmental Management.
[3] Yusup, M.Z. et. al, A Review on Optimistic Impact of Cleaner Production on Manufacturing Sustainability, Journal of Advanced Manufacturing Technology, 2013.
[4] Ramjeawon, T., “A Case Study of Cleaner Production Opportunities in Small and Medium Enterprises on the Island of Mauritius”, Electronic Green Journal, 1(20), ISSN: 1076-7975, 01-04-2004]
[5] Cleaner Production: A growing movement in Brazilian Companies [Authors: Oduvaldo Vendrametto, Nivaldo Palmeri, Geraldo Cardoso O. Neto, Osvaldo D’Angelo Perretti, Journal: Associação Brasileira de Engenharia de Produção – ABEPRO, Universidade Federal de Santa Catarina – UFSC, ISSN: 1676 - 1901 / Vol. X/ Num.I/ 2010]
[6] Application of Cleaner Production for Environmental Management in Mezcauchos SAS [Authors: Jeniffer Gracia et al., Journal: CHEMICAL ENGINEERING TRANSACTIONS - VOL. 67, 2018, ISBN 978-88-95608-64-8; ISSN 2283-9216]

[7] A Cleaner Production Exercise of A Leather Manufacturing Company: A Zimbabwean Experience [Authors: Varaidzo Dandira et al., Journal: INTERNATIONAL JOURNAL OF SCIENTIFIC & TECHNOLOGY RESEARCH VOLUME 1, ISSUE 11, DECEMBER 2012, ISSN 2277-8616]

[8] Cleaner production assessment in cement plant using vertical shaft technology [Authors: Ms Chinkal R. Patel et al., Journal: Journal of Petroleum and Gas Exploration Research (ISSN 2276-6510) Vol. 3(2) pp. 26-30, April 2013]

[9] A Case Study of Cleaner Production Opportunities in Small and Medium Enterprises on the Island of Mauritius [Author: Ramjeawon T., Journal: Electronic Green Journal, 1(20), Publication Date 2004-04-01, ISSN: 1076-7975]

[10] Applying Cleaner Production and Optimising Heat Process Operations in Dairy Processing Plants – A Review [Author: P.Muredzi, Journal: European Scientific Journal February 2015 /SPECIAL/ edition vol.3 ISSN: 1857 – 7881 (Print) e - ISSN 1857- 7431]

[11] Assessment and Implementation of Cleaner Production Practices in Petroleum Lubricants Industry Value Chain in Zimbabwe [Author: Ignatio Madanhire, et al., Journal: International Journal of Science and Research (IJSR), India Online ISSN: 2319-7064]

[12] Cleaner Production Implementation at Chicken Slaughtering Plant [Author: M.I.M Hafiz et. al., Journal: International Journal of Applied Environmental Sciences, ISSN 0973-6077 Volume 11, Number 2 (2016), pp. 515-523]

[13] Evaluation of Cleaner Production Options in the Zimbabwean Metal Fabrication Sector [Author: Joseph Mavengere et. Al., Journal: International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 1, Issue 3, November 2012 ISSN 2319 – 4847]

[14] Reducing the environmental impact in the metal finishing industry by employing cleaner and safer production strategies [Author: G. Raymond et. Al., Sustainable Development and Planning IV, Vol. 2, ISSN 1743-3541]

