Report on Waste Water treatment -cum-recycling plant at M/s Hind Glass Industries and Pooja Glass Works Firozabad

Clean Technology Initiative (CTI) project
a program of USAID India, Implemented by
The Louis Berger Group, Inc.

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BACKGROUND

Overview

The Louis Berger Group, Inc. (LBG) Global Environment Team (GET) is currently implementing the "Clean Technology Initiative (CTI)", a program of the USAID/India Mission. One aim of this project is to provide technical assistance in providing recommendation on technology efficiency improvement and environmental performance compliance for both foundry and glass & bangle industries.

The primary goal of the CTI program is to assist Indian industries to implement the Clean Technology Initiative as part of the global climate change program focusing on GHG emissions reduction initiatives and related energy efficiency improvements. This phase of the CTI provides a mechanism to implement at least four of the Mission's cross cutting themes of governance, urban issues, partnerships and cutting edge technologies. The project also directly supports the GOI's goal of preventing further degradation of the Taj Mahal due to air pollution.

The foundry, glass & bangle and diesel genset industries located in TTZ area in large numbers specifically in and around Agra and Firozabad are facing difficulties in adopting cost effective technological and environmental solutions for the compliance of the stringent regulatory norms and attain sustainability. Adopting environmental management systems through ISO 14001 will help glass and bangle and foundry industries to demonstrate their commitment towards improvement of environmental performance.

The glass & bangle industries are clustered in Firozabad and consume large quantity of water in the process of glass making especially in area of mould cooling, cullet washing, edge glazing etc. which is being drained out without treatment leading to land and underground water contamination. CTI team during consulting process found this as one of the most significant aspects to be immediately addressed for setting up an environmental management system as per ISO-14001 standard.

At the request of the participating units CTI is exploring to provide technical assistance to few selected units to demonstrate energy efficient system and waste water treatment cum recycling system thereby helping them to be in compliance with the environmental regulations and also reducing the consumption of water significantly, the primary source of which is the ground water. This model unit could be available to the other industries that can adopt and replicate at their respective units.

LBG-CTI retained us to provide the total design, preparation of drawings and supervision of erection, commissioning and testing of 250,000 litres per day waste water treatment cum recycling plant, cullet washing plant, neutralization unit for hydrofluoric acid waste and chrome and silver recovery units at Hind Glass Industries and Pooja Glass Works, Firozabad. The treated water will comply with the norms for reuse / discharge as per UPPCB and it will also lead to water conservation.

Objectives

The industrial units are required to comply with the norms for discharge of waste water for inland disposal. The objective of the proposed project is to assist PGWL and HGI in installation of zero discharge / waste water re-circulation and treatment plant with a capacity of 250 KLPD, waste water treatment plant for cullet washing operations, neutralization unit for hydrofluoric acid waste, chrome and silver recovery plants at their units so as to enable them to comply with regulatory norms and also to save ground water. At present PGWL and HGI consume 108 units of power every day for pumping the water. The proposed project would also lead to significant saving in the power consumption.

Anticipated Outcomes

- Installation of 250 KLPD capacity wastewater treatment and recirculation plant.
- Installation of HF neutralization plant.
- Waste water treatment plants for cullet washing & mud grinding operations
- Silver and chromium recovery plant.
- Meet environmental regulatory norms for discharge of water for inland disposal.
- Reduced consumption of raw water
- Reduced power consumption

Description of Activities:-

LBG-CTI team will provide technical assistance to the identified units in the following areas:-

1. Design and development of drainage system, sewerage lines.
2. Development of zero discharge / waste water treatment / re-circulation system for

a. Process water used for mould cooling from PGWL and HGI.
b. Waste water from washing of culets at HGI.
c. Water accumulated under furnace from HGI.
d. Waste water from mud grinding process at PGWL.

3. Design and development of silver recovery unit at PGWL.
4. Design and development neutralization unit for hydrofluoric acid waste at PGWL.
5. Design and development chrome recovery unit at HGI
6. Supply of equipment specifications along with list of possible vendors.
7. Preparation of manuals containing all design, drawings and standard operating procedures.
8. Disseminating the success story with other manufacturers.

Outline of the activities of Hind Glass Industries

Industry overview

Glass industry consumes water for mould and generator, cooling operations like cullet washing to edge mud grinding. At campus of M/s. Pooja Glass Works Pvt. Ltd and M/s Hind Glass Industries, it was estimated that total consumption of water in the tune of 200,000 litres per day, which is being drained out as wastewater. The estimated total financial loss of **Rs. 450 per day** on pumping cost alone to the Industry besides wastage of national wealth.

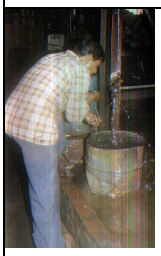
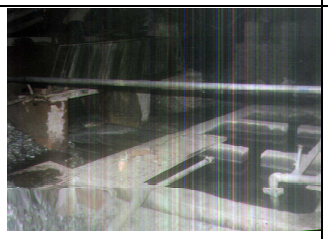
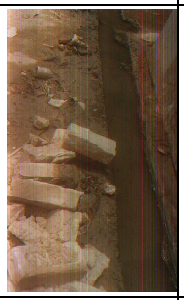
Process Description

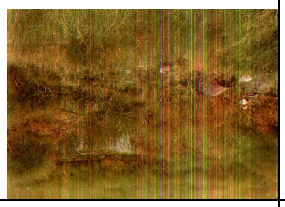
- Hind Glass has one tank furnaces of 50TPD capacity, three annealing furnaces and four edge glazing furnaces. There are several numbers of IS 6 section DG/SG machine and ¾ (GE) m/c making containers and press and blow items like, Jar, Jug, and Cup etc. All IS and 3/4 machines are attached with automatic processes system. Hind Glass Industries also has in house packing and decoration system. Power is supplied by five gas fired generating sets.
- Major Raw materials like, Quarts, Soda Ash, Calcite, Feldspar and cullet are mixed proportionally and send to natural gas fired melting furnace for melting operation. After melting batch material, converted to molten glass passes through the fore hearth and releases measured quantities of molten glass to the mould through automatic process. Items are then shaped by a press machine. The next step is edge glazing process which provides a smooth rounded edge to the item. Finally Products are subjected to the annealing process on a belt conveyor. The quality process generates rejects which are recycled back in the process. The packing department then packs and dispatches the boxes as per schedule.
- Pooja Glass have one tank furnace of 30 TPD capacity, batch materials consisting of quartz, soda ash, calcite and cullets are fed to the furnace, it is converted into molten glass. The whole process of making decorative items and glassware are carried out manually by mouth blowing process. Finally products are being sorted out in belt conveyor after passing through annealing process. The quality process generates rejects which is recycled back into the process.

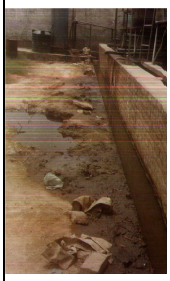
Table – I

Usage of Water at different Processes in the Industry

OBSERVATION	REMARKS (Present practice)
Glass industries use water for various cooling operation, cullet washing, electroplating and polishing the products.	
Cooling water has suspended particles and temperature higher than the ambient temperature.	Discharged as wastewater
Cullet washing has high settable mud as suspended solids and dissolved solids, which increase the B.O.D. in the waste water.	Discharged as wastewater
There are two type of metal plating shops	
Chrome plating: It uses standard process of electroplating to attain their metal plating objectives, releases chrome ions etc. as contaminant in wastewater.	Collected and Stored
Plating unit also produce D.M. water for the process thus producing Calcium chloride etc, with lot of variation in pH and TDS of water.	Discharged as wastewater
Silver Plating: It uses deposition of silver metal on the glass surface by ionic displacement method, releases the ions like silver metal, ammonia etc. in wastewater.	Discharged as wastewater
In etching shop, glass industry uses the Hydrofluoric acid, as etching material, it generates HF wastewater.	Discharged as wastewater
Besides this wastewater is generated at glass finishing shops the main component of these shop is mud and particles of grinding tool etc.	Discharged as wastewater

Scenario during inception	
Electroplating shop is to be shifted from present location.	Under construction
The tap in the electroplating shop was found leaking and due to which, lots of water is wasted.	Need check
Mixed bed unit is not in operative condition. 	Need proper care
 Most of the cooling pipelines have developed leakages and nee  d replacement. There is one tap, which is always in running condition,	Need control, to reduce the water wastage
Lubricating / cutting oil is mixed-up with wastewater near furnace in HGI.	Need proper disposal
Design of re-circulation tank for cullet washing tank is not proper. 	Proper separation of suspended solids of water needed to reduce the suspended solids, and increase the life of recycling of water in re-circulation system
Since the drains are design to carry rainwater as well as wastewater during dry weather conditions there is tendency of deposition of sludge the drain system. 	New water carrying lines are needed with proper velocity
Drains are open, which are liable for choking with waste material, quartz sand, polythene bags, and other non bio- degradable solids.	Need to be covered

Raw water treatment plant e.g. pressure sand filter, water softener does not have pressure sensing / display units thus quality operation is difficult.	Instrumentation is required.
Bottom and top of both water treatment vessels are not designed to operate in pressurized operating conditions.	Manufacturers fault need correction
Leakage in cooling water from cooling chamber in the generator no. 4. 	Need attention
Wastewater is being discharged in under capacity soak pits. Thus water is logged in the field near power house. 	Proper ecological evapo-transpiration system is to be developed
Overhead storage tank does not have any level display device, which can cause wastage of fresh water due to overflow	Proper water level indicators is to be installed
There are two finishing shops using spray paints/ polishes. Causing air pollution.	Air washer should be installed
Similar operation is being conducted at different locations e.g. silver plating,	Need consolidation
In PGI mud is used for finishing the handcrafted items. Since the quantity of water is inadequate hence velocity of water in drain does not attain self-cleaning velocity, thus drains are flooded with sludge.	Need proper separation of mud at the point of use.

	Plant operators have habit of throwing waste oil in the wastewater drain or on open land. 	Practice has to be discontinued or corrected to protect the water and the environment.
Note: In Support of observation, Photographs of the site are enclosed.		

Objectives was set for

- To regulate and reduce the consumption of water.
- To improve the efficiency of washing process.
- To recover the important minerals like Silver and Chromium from the wastewater.
- Prevention of free HF to mixed with wastewater.
- To make the industry ZERO DISCHARGE unit.

A team of surveyors visited both the units to collect required information, data for preparation of plant layout plan, road levels, working areas, pathways and existing drainage and demarcation plant. (Details are shown in drawings no. 18/07 DWG 01). Waste water sample was collected and analyzed for different parameters, which will form the basis of design of waste water treatment cum recycling plant, the results are as follows:

Color:	Colloidal solution, mud and suspended solids
T. S. S.	450 mg /l
Oil and grease	Nil

Cullet washing

Glass industry uses cullet as one of the raw material along with other chemicals for glass manufacturing. Cullets are procured from out side sources and also the rejected glass product is recycled back in the process. Cullet procured from the out side sources contain impurities such as dust, iron etc, and if these are not removed will impart color and other undesirable effects on the end product. These are first segregated and washed in cullet washer, primarily a tilled rotating drum washer filled with high pressure jets to remove the dust. Cullets are fed into the washer by means of conveyors.

Need for remedial measures

Cullet washing is best suitable solution for above mention problem. Since impurities are both organic as well as inorganic, the waste water after washing has high BOD and TSS. The waste water after washing is discharged to the adjacent land through the drain without any treatment, which was leading to the contamination of land and underground water.

Wastewater treatment cum recycling plant for Cullet washing

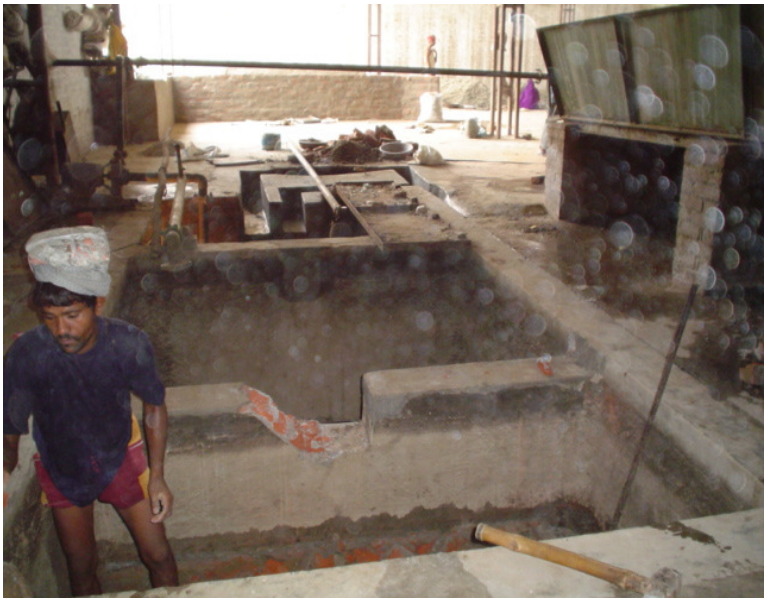
The wastewater from the cullet washing is discharged in a settling tank, which can only remove the larger particles and particles less than 1mm does not have adequate settling time and escapes with the wastewater. The wastewater after the cullet washing is discharged daily.

CTI provided Hind Glass Industries, the design and drawings for the waste water treatment plant for cullet washing. The implementation of the same was carried out by HGI. (Drawing Nos. 1 and 2)

The opening of first baffle wall so that all incoming water moves down ward and horizontal velocity is reduced to minimum.

1. To increase the settling surface and reducing the Reynolds number, tube type media was suggested. Thus increasing the settling area to 14 times.
2. Closing the short circuiting area and making full baffle wear to achieve laminar flow.
3. The third chamber to be used as reservoir for pump.
4. Two parallel grit chambers to be constructed based on velocity, which will eliminate larger (2-3mm) grit (glass) from going to the settling tank.

Cullet washing wastewater treatment and recycling unit



Results

Results of the treated water samples collected from the final outlet after installation of waste water treatment plant for cullet washing operation are shown in Table II:

Table- II

Results of treated water after waste water treatment plant of cullet washing unit

S. No.	Parameter	1st day	2nd day	3rd day	4th day
1	TSS	20mgl	30mgl	32mgl	32mgl
2	COD	120mgl	200mgl	232mgl	250mgl
3	COLOUR	Light dirty			To
4	pH	8.2	8.1	7.5	7.2

It is clear from the above results that effluent water does not have any visible particles thus target of recycling of water is achieved. However COD of water has increased pH has gone down to a limit which hampers the cleaning of glass as slime formation was observed in the final reservoir. Hampering somewhat cleaning of glass as water become sticky.

It was suggested to use TSP (tri sodium phosphate) to enhance cleaning properly and flocks created (due to reaction with Ca and Mg) improve settling quality of water. The high pH of salt improves cullet washing. Previously the waste water was discharged after one washing now it is recycled and discharged after 7-8 days, saving significant amount of fresh water and also power saving was obtained due to reduction in pump's operating hours (details shown in Table IV).

Operational procedure for settling tank

Cleaning of grit chamber

1. Grit chamber is supposed to be cleaned every 3 hrs of operation or as soon as they are filled with grit.
2. Damper in line towards grit chamber 1 is to be opened during beginning days.
3. As soon as grit is filled in chamber to the level of flout separately level. Chamber in the line should be placed and damper for line 2 should be opened so that water start following chamber II.
4. Now clean chamber 1 and it should be ready for the next cycle.
5. Dust and other light particles settle in chamber 1 of settling tank, it has capacity to accumulate about $1m^3$ of volume; it should be cleaned after two weeks of operation.
6. To clean it first opens the valve of drain, and than pump the water from chamber 1 & 2. When water is removed use sludge pump to remove the sludge.
7. Refill the water with fresh makeup water and operate it for next cycle.

Table III shows the details of present status of objectives achieved:

Table- III

Present status of Objectives achieved

Process	Stage	Present status of treatment plant	Result	Recovery Per day	Remark
Cullet washing	Unit is operative	Already operating	As per the expectation , needs only 1500 litres per day per unit	The waste water has to discharged after 7-8 days instead daily Raw water consumption reduced by 23KL and power by 20 kWh	• Only BOD was observed in the water, which will be treated in recycle plant in Phase II • Design & drawing of waste water treatment plant (WTP) submitted • (drawing Nos. 1 & 2)
Edge Finishing (mud grinding)	In operation	Yet to be erected	After treatment water will be recycled which will lead to raw water and power conservation	Raw water consumption will be reduced by 11 KL and power by 8.8 kWh	Design & drawing submitted (drawing Nos. 3,4,5 & 6)

Frosting Shop	In operation	Neutralized and disposed	Compliance with the environmental regulations	___	Design & drawing of neutralizing tank submitted (drawing No. 7)
Silver finishing shop	This operation has been stopped.	Not required	___	___	Design & drawing of silver recovery plant submitted
Plating shop	Unit is operative	Yet to be installed	Chromic acid will be recovered	Raw water consumption will reduce by 0.48 KL	Design, drawing and specifications of equipments submitted
Cooling of moulds	Wastewater will be treated in the Phase II	ETP under erection	Due to recycling of treated water, it will lead to raw water and power conservation	Consumption of raw water will be reduced by 45 KL and power by 36 kWh	Design & drawing of ETP submitted
ETP		Under erection	Compliance with environmental regulations	Zero discharge, over all consumption of raw water will be reduced by 130 KL and power by 104 kWh	Design & drawing of ETP submitted
Tap water	Modified		Saving of water	Water consumption reduced by 14 KL and power by 11.2 kWh	Already rectified

Table-IV

Details of estimated savings after implementation of the units

Details of process which was undertaken	Estimated present water consumption	Estimated water consumption after treatment	Net. Saving of fresh water	Estimated saving in kWh or product	Financial gain
Cullet washing shop	25,000 litres per day per unit	2000 litres per day/ per unit	23,000 litres per day/ unit	20 kWh/ unit	77.00 per day/ unit
Edge finishing shop	12,000 litres per day / unit	1000 litres per day / unit	11,000 litres per day/ unit	8.8 kWh	37.00 per unit
Frosting shop	200 litres	200 litres	Nil		
Silver finishing shop	200 litres	200 litres	Nil	Silver recovery	To be estimated
Plating shop	500 litres	20 litres	480 litres	Recovery of Chromic Acid	To be estimated
Cooling of moulds	50,000 litres per day	5000 litres	45,000 litres	36 kWh	151
Tap water	15,000 litres.	1000 litres	14000litres.	11.2 kWh	47.00
Total	150,000 litres per day	At max 20,000 litres	130,000 Litres	104 kWh	Rs. 436.00 Per day or **1,52,880.00** per year

Conclusion

All the design and drawings for all waste water treatment plants for cullet washing and mud grinding operations, neutralization tank for Hydrofluoric acid waste, recovery plants for silver and chromic acid, ETP and layout were prepared and submitted.

Waste water treatment plant for cullet washing process has been successfully erected and commissioned, and is in operation for the last one and half years. Due to recycling of the treated water the duration of replacing water has increased from 1 to 7-8 days which leads to significant reduction in consumption of raw water i.e. around 23 KL / day and power by 20 kWh / day.

Pooja Glass has already stopped the silver coating operation and the hydrofluoric acid waste from the etching plant is being neutralized before its disposal. The Effluent treatment plant (ETP) is under erection, after it's commissioning the raw water consumption will be reduced by 118 KL /day and there will be power saving of 95 kWh /day. The rest of the systems will be taken into consideration in phases.
The issues addressed related to the environment

- Depletion of Natural resources i.e. water
- Saving of energy
- Better working conditions for artisans
- Quality improvement of cullet washing
- Disposal of waste water generated
- Conservation of water & land resources
- Arresting of ground water contamination
- Compliance with the environmental regulations

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List of drawing enclosed are as follows

- Road map of Zero discharge Glass Industries.
- Schematic diagram of wastewater recycling of cullet washer
- Schematic diagram of wastewater recycling and recovery of chromic acid .
- Plan & cross-section of Sedimentation Tank Drawing No. 1.
- Layout Plan of Sedimentation Tank for cullet washing tank Drawing No. 2.
- Plan of sedimentation tank of mud grinding Drawing No. 3.
- Sections of sedimentation tank of mud grinding, Grit settler Drawing No. 4
- Sections of sedimentation tank of mud grinding, Grit settler Drawing No. 5
- Plan and sections of mud drying beds Drawing No. 6.
- Neutralization Tank of HF Drawing No. 7.
- Plan and sectional view of Trickling filter for ETP.
- Top & cross-section view of Sedimentation Tank of ETP.
- cross-section view of aeration and equalization Tank of ETP.
- Top & Sectional view of Sedimentation Tank for cullet washing.
- Layout of ETP Drawing No. 8