Green Industry Institute Partnership project: A case study towards win-win scenario

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INTRODUCTION

It is well known that academic researchers are facing severe problems of funding in almost all parts of the world. That creates hurdle on the path of application-oriented research. The other side of the coin is also not seems good as by the comments from many academicians themselves that most of the academic researches are just for the peer journal publications. Very few are real application oriented, particularly for small-scale industries. In this era of global competitiveness, academics must push their research work towards high quality and innovative, both basic and applied must be used. This case study of GIIPP was an initiative by Nirma University (NU), Ahmedabad and The Green Environment Services Co-operative Services Limited (GESCSL), Vatva, Ahmedabad to overcome all the hurdles of the funding and to use basic and applied by merging with the resources available from both the sides. Academicians and Universities are having potential of good literature survey, experimentations, analysis and evaluation. At the same time industries are running short of time for trials for the developments and also they have strength of funds and experiment facilities. Time is always the constraint for everyone. NU and GESCSL break all these boundaries and initiate something different than the routine research work. The objectives were very clear with a vision to provide green and eco-friendly solution to the problems of the industry and to provide industrial exposure to the students and the faculty members of the Nirma University.

TEAM

A team of coordinator and faculty members of Chemical Engineering Department was constructed to plan and carry out the various activities under GIIPP.

APPROACH

It was decided to go for the application oriented work and literature survey for the industry. It was also decided to visit the various industries once in a week. During visit a discussion to be done with the industrialist to understand their technical issues. Then visit the site physically. Observational Power is needed to identify the problem location and technical knowledge and logic must be used to formulate the problem. After formulation of the problem, collect required data. Analysis may be done during a week time with the help of literature survey and data collected. Based on the analysis and evaluation of the data and literature survey, suggestions to be made to the industry. Also, it is required to be checked that how many of the suggestions are really applicable and implemented.

ACTIVITIES PLANNED

Following activities were planned to carry out under GIIPP:

1) LITERATURE REVIEW: The topics given by the industries to the faculty members and literature support will be extended by University Team in continuous interaction with the industry representative at the end; problem statement can be jointly prepared for taking further activities.
2) RESEARCH PROJECT: Based on the problem statement jointly prepared few research projects will be identified and students from the institute can take it as their research projects at Post-graduate

(PG) level. Wherever possible it can be given to Under-graduate (UG) level students also. Depending upon the topic identified the research projects can be carried out at Nirma University or Industries.

3) PUBLICATION: It is envisaged to have frequent interaction between two groups and it is expected that both the sides will share their experience and the issues discussed and the output of any joint activity will be published in Newsletter to be circulated internally.
4) ARRANGE THE LECTURE SERIES: Based on the issues given by the industries a lecture series may be organized by calling experts (in house and outside)
5) CARRY OUT CP ASSESSMENT EXERCISE: CP exercises to be carried out for industry. That may be taken up as an assignment to the PG students.

GAINS

To faculty members:

- Development of consultancy skill
- Real industrial environment exposure
- Improvement in problem solving skill
- Insight to understand industrial problems & Development of industrial problem solving aptitude and attitude
- Be able to think able beyond curriculum
- Criss-cross artificial disciplinary boundaries
- Bench mark data as well as case studies collection and analysis improves knowledge through reading to solve industrial problems
- Management and effective utilization of time
- Job satisfaction and satisfaction of serving for industries
- Industrial relation developments
- Classroom teaching improvements by discussing real live problems
- Relate theoretical knowledge for practical application and improves ability to develop thumb rules
- Problems with students' community
- Improves report writing skills, analytical skills and presentation skills
- Publication of research papers, which can be used by industrial technologist
- Monetary gain

To the students:

- Industrial exposure, Insight to understand industrial problems & Development of industrial problem solving aptitude
- Multidisciplinary training
- Ability to work in team
- Bench mark data as well as case studies collection and analysis improves knowledge through reading to solve industrial problems
- Relate theoretical knowledge for practical application and improves ability to develop thumb rules
- Develop Creative original thinking process of "Think Global but act Local".
- Earn credits from industries as well as institute

To the institute:

- Industry- Institute interaction leads to useful technology transfer
- Development of research facilities and laboratory infrastructure
- Effective utilization of institute infrastructure facility
- Appreciable impact on the reputation of the Institute
- Ability to attract research funding and alumni support as well as high quality students
- Help department and by large Institute to carry out research/ project work with help of industries infrastructure.
- Strengthen Institute Industry relationship

To the industry:

- Received best literature survey facility and expertization from theory
- "I do not require CP" - mindset Changed
- "I have best system" – rethinking initiated
- "There is no scope for further improvement" – observational error correction attitude developed

- "I have enough expertization in my company" – resource utilization ability developed

ACTIVITIES CARRIED OUT:

PERFORMANCE IMPROVEMENT OF VENTURI SCRUBBER:

Problem Statement: When the gases coming out of the combustion chamber of the boiler are, dry (i.e. having temperature more than 130 Deg. C) and the temperature of the gases entering to the bag filter is above 70 deg. C, there is no problem in maintaining the conditions as per the GPCB norms. In addition, at that condition they did not observe the clogging of the pores of the bag filter. However, when the temperature of the gases entering to the bag filter is below 70 deg. C, SPM contents are goes high and not matching with the GPCB norms. So now, the problem is how to make them possible to match with GPCB norms and how the clogging of the pores of the bags in the bag filter can be prevented.

Observations/Recommendations/ Remedies (Refer Fig. 1):

1. Gases coming out of the combustion chamber are entering to the venturi scrubber from the bottom and liquid is sprayed from the top of the venturi scrubber. i.e. the venturi scrubber is operating in counter current manner. But based on the literature survey, the arrangement should be co-current.
2. Gases coming out of the combustion chamber are entering to the venturi scrubber from the bottom just above the surface of the caustic solution.
3. No liquid – gas separator zone is provided separately. The wet gases are coming out of the venturi scrubber, without passing through demister pad, are directly entering to the bag filter using blower action. But demister pad is required for better performance of the venturi scrubber.

(B) UTILIZATION OF SOLID LANDFILL SITE:

Gujarat Industrial Waste Management Company Ltd. (GIWMCL) has developed total three sites for the disposal of the solid (Non-hazardous) waste. Later on it merged in to the GESCSL to look after the proper treatment of the solid waste generated at the premises of member units, proper storage and conveyance to the Treatment, Stabilization and Disposal Facility (TSDF). Landfill site No. I & II have been filled up and final treatment of covering of the landfill site was also finished. Presently, landfill site No. III is in use where daily 600 – 700 MT of the solid wastes are received from the unit members of VIA. Problem stated is to calculate the life cycle of landfill site No. III.

Table 1. Summary of Utilization of the landfill sites at GESCSL:

Land fill site No	Approx. Area of Land (m^2)	Size of Battery L*W*H Mt^3	Total Volume Available (m^3)	Total Qty. of solid waste disposed off in MT	Apprx. Bulk density of dumped material in Ton/ m^3
TSDF-1	32,881	100 *70*10.5	73,500	74287	1.0100
TSDF-2	32,881	114*170* 10.6	1,30,000	1,70,004	1.3077
TSDF-3	36,000	211*270 * 14.86	4,10,000	5,75,000	1.4024

Table 2. Data available for TSDF – III:

Land fill site No	TSDF-3
Commencement date of landfill site	19/3/2003
Approx. Area of Land (m^2)	36,000
Size of Battery	211 mt. (L) 270 mt.(W) 14.865 mt.(H)
Total Volume Available (m^3)	4,10,000
Total Quantity of solid waste disposed off in Metric Ton	5,75,000
Approximate Bulk density of dumped material to be achieved in Ton/ m^3	1.4024
Total Quantity of solid waste in Ton disposed off till 30/11/2005	2,69,000

Recommendations:

Data were collected from the actual site and calculations were done based on two different densities (1.4024 T/$m^3$and 1.2 T/m^3). The data collection and calculation part is shown in the tables 1 and 2 as above and table 3 as below.

Table 3. Tentative life calculation for TSDF – III:

Land fill site No	**TSDF-3 (Density = 1.4024 T/m^3)**	**TSDF-3 (Density = 1.2 T/m^3)**
Total Quantity of solid waste can be disposed off in Metric Ton (X)	**5,75,000**	**4,92,857.143**
Total quantity disposed off between 19/3/2003 to 30/11/2005 in Metric ton (Y)	**2,69,000**	**2,69,000**
Air Space available in Ton (X) – (Y) = (Z)	3,06,000	223857.143
Daily intake of solid waste in Ton (A)	600	600
Approximate working Day of landfill site per annum (B)	26 days * 8 months = 208	26 days * 8 months = 208
Annual Intake of solid waste in MT at landfill site TSDF-3 as per practical data (C)	208 * 600 = 1,24,800	208 * 600 = 1,24,800
Total Life of the Land fill site = X / C	575000 / 1,24,800 = 4.61 years = 4.61 * 208 days = 958.88 working days	492857.143 / 1,24,800 = 3.95 years = 3.95 * 208 days = 821.6 working days
Remaining Life of the Land fill site = X / C	3,06,000/ 1,24,800 = 2.45 years = 2.45 * 208 days = **509.6 working days**	223857.143/ 1,24,800 = 1.79 years = 1.79 * 208 days = **372.32 working days**

The calculation for utilization of solid landfill site done by the GIIPP team and it was compared with the calculation done by the private environmental consultant. The results of the comparison show the difference of around 30,000 tons of solid waste. As per GIIPP team calculation around 30,000 tons of more solid waste can be accommodated in landfill site. Thus, the calculations done by the GIIPP team helped Green in indirect savings.

(C) APPLICATION OF CPCT TOOLS FOR VATVA INDUSTRIES:

Aiming at organizational gains, Institute gains, faculty and students' gain and environmental gains, the major activities done by M.Tech. Students and Faculty Members during GIIPP were with the CPCT tools for G.I.D.C. Industries, Vatva. For the same, one member unit was identified and the whole activity is divided in following parts:

C1. Good House Keeping Exercise
C2. Equipment Modifications (Stirrer Design)
C3. Technology Change (NH3 absorption refrigeration cycle)
C4. Process Modification (Heat recovery in Spray Dryer)
C5. Reuse and Recycle (Membrane Technology)

After carrying out all activities, an interactive session was arranged at green premises with the industrialists for their suggestions and comments based on the work done by the students and the faculty members.

C1. GOOD HOUSE KEEPING

GHK refers to a number of practical measures based on common sense that enterprise can under take to improve their productivity, to obtain cost savings and to reduce the environmental impact of their operations. Following are the Prerequisites for Success*:*

- Management commitment and involvement
- Training regarding GHK
- Participation from industrialists' personnel
- Simple action

The major focused areas for observation are mentioned below:

- Material handling & Storage
- Energy Conservation
- Water & Wastewater Management
- Workplace safety & Protection etc
- Poor maintenance

Following are the results of GHK exercise:

- Students applied the mind maps and recorded 45 observations for the areas mentioned above.
- The plant personnel in an interactive meet accepted 90% of observations.
- Implementation plan was prepared in presence of managing director with responsibility and deadlines by the plant personnel.
- 70% of the observations were implemented within two months.

- Over and above the economic gains, the organization gained much on safety aspects.

C2: EQUIPMENT MODIFICATIONS (STIRRER DESIGN):

Existing Practice: Unit is manufacturing dyes and uses number of reactor vessels, each loaded up with an agitator system like:

a. Pitched blade type (stainless steel-rubber lined, glass lined)
b. Paddle type (wooden, stainless steel-rubber lined)
b. Impeller type (stainless steel-rubber lined, glass lined)
c. Anchor type (stainless steel-rubber lined)
d. Flat stirrer (stainless steel-rubber lined)

Proposed Modifications: After thorough literature survey and discussion with the faculty members and experts following suggestions were recommended for implementation

a. Provision of vertical pitched blades at the sides of existing agitators
b. Provision of a impeller at the bottom of the agitator shaft
c. Introducing injectors in the vessel

Learning / outcomes: During Interactive meets with the industrialists, following are the learning outcomes for the students

a. Invaluable industrial experience
b. Acquaintance to the industrial working atmosphere
c. Application of theoretical knowledge to the real life situation

C3: REUSE AND RECYCLE (MEMBRANE TECHNOLOGY):

Existing Practice: The member unit is generating wastewater of around 80000 litres with the following characteristics:
Characteristics of wastewater:
as chlorides 3000-5000 mg/l,
as TDS 9500 mg/l, as pH 7.5-8.0,
as COD 1500-1800 mg/l.
Disposal point-CETP, Vatva

Proposed Modifications: The suggestion for the Proposed Modification is to apply RO technology for recycle and reuse. Wastewater can be treated and recycle back for reuse. For partly treating of the wastewater through membrane will reduce to discharge quantity to CETP by 30% and the payback period calculated for the same was 11 months.

Learning / outcomes: During Interactive session with Industrialists following points was discussed:

- Membrane cost should be reconsider by taking help of membrane suppliers.
- Backwash cost considered was at the lower side, needs to be reconsider.

Students' learning:

- First step towards professional carrier.
- Applications of fundamentals to practical situations & Importance of thumb rule
- One should also consider economic aspects of suggestions.

C4: TECHNOLOGY CHANGE (NH_3 ABSORPTION REFRIGERATION SYSTEM):

Existing Practice: The member unit is utilizing steam of 2 TPH while the boiler has a capacity of producing 4 TPH. At the same time, the total ice consumption is 40 tones per day. The objective defined was to carry out feasibility studies for installing a refrigeration unit to produce 40 TPD ice and utilizing full capacity of boiler.

Proposed Approach:
Based on the utilization of spare capacity of boiler, the ice production was calculated and the unit cost was also calculated. It was envisaged that the payback period comes out to be 27-32 months.

Interactive session with Industrialists:

- Owner of the industry appreciated the efforts put by the students and faculty members.

- Unit is planning to work out the implementation of the proposed scheme based on their cash flow availability.

Students' learning:

- Interaction with the professional
- Feasibility studies of the new scheme
- Innovativeness in thinking and generation of ideas using available resources.

C5: PROCESS MODIFICATION (HEAT RECOVERY IN SPRAY DRYER)

Problem statement:

Green member units has total 35 spray dryers installed for drying dyes. But the units are not clear about the efficiency of spray dryer. One lucrative way of improving energy efficiency is by installing heat pipe. For the identified unit, a feasibility study of installation of heat pipe was to be carried out.

Proposed Approach:

The heat pipe installation cost was calculated and pay back period for found out. The option looks attractive.

Interactive session with Industrialists:

- Chocking due to particulate matter deposition and higher power consumption on account of higher-pressure drop should be taken care off before proceeding further.
- One industry was agreed for experimental work and even Shri. Umesh Patel of Apollo Dyes was ready to give a small lab scale equipment to Nirma University

Students' learning:

- Developing problem solving approach
- Multidisciplinary approach development
- Industry – Institute Partnership base formation for industrial problem solving as in-house project for institute students.

E. FUTURE VISION:

The activities under GIIPP were carried out with the future vision of attracting more companies to take advantage of collaboration with the institute. Also many lessons were learnt which can be helpful to organize such collaborative programme in future. It is also felt that the effectiveness of such joint efforts can be improved by involving more number of faculty members and disciplines. The activities carried out under GIIPP were broadly based on CPCT tools. In future area of work can be expanded and some projects may be identified to convert it to consultancy work or research work.

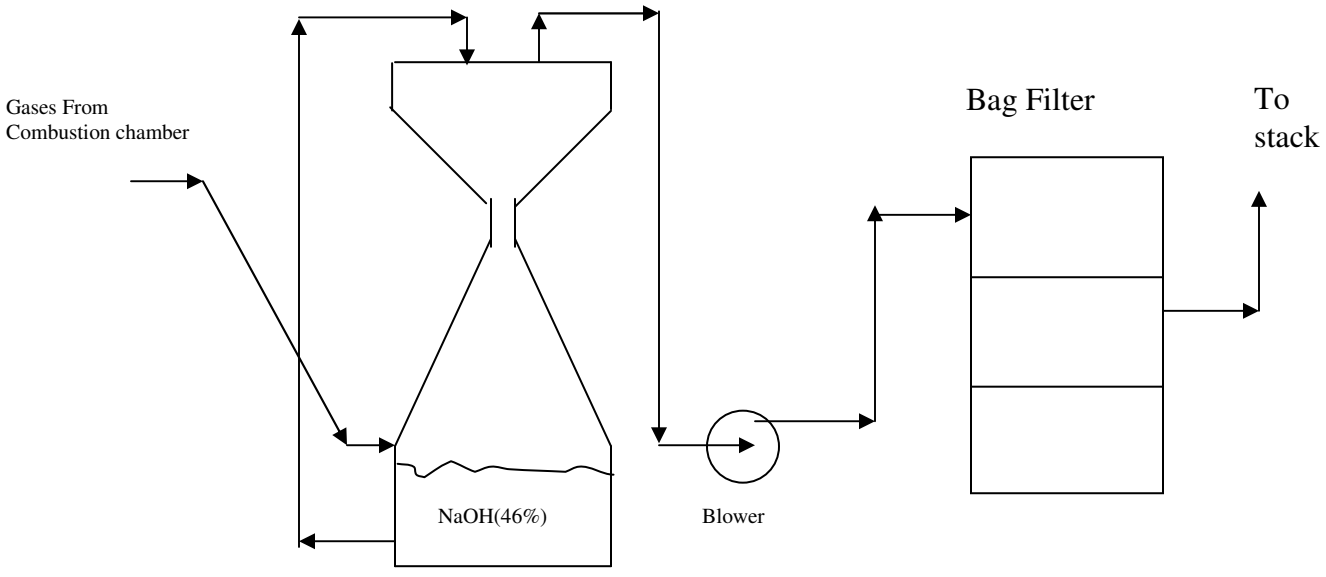

Fig. 1. Existing schematic of Venturi scrubber and Bag filter connections with combustion chamber.