ACTIVE VOICE

DG Set
Combined Heat and Power (CHP) Generation

A Successful Case Study of A Cold Storage

The following is a successful case study of Cold Storage unit situated at outskirts of Hyderabad. The Unit started its operations way back in 1987. The company is one of the first and commercial De-Humidification Cold Storage Unit in the state of Andhra Pradesh, exclusively designed for high value hybrid seeds, tamarind, chilies etc. The company has state-of-art pre-cooling facility for export of quick perishables like fruits, vegetables and eggs.

The unit needs both power and steam. The electrical power consumption is towards running refrigeration compressor and associated equipment like condenser pumps, chilled water pumps, cooling tower and lighting etc. The steam is used for de-humidification. In cold storage units, the temperature and RH control are most critical factors and the moisture is absorbed by silicagel as deccicant. After absorption, the silica gel needs to be regenerated, and steam is used for *Dry Air* regeneration purpose. In Dry Air dehumidification in one cycle - adsorption of moisture takes place and in other cycle - re-activation of silica gel is carried out using hot air. Hot air is generated using steam in the radiator coils.

Cold Storage Unit

Initially, the unit went for 75HP LT connection with the SEB, which is meant for lighting only. For balance power requirements, 2 x 320 KVA DG sets were installed. For steam generation, 600 kg/hr capacity HSD fired boiler was installed. The unit required around 185 kW of power and 300-350 kg/hr of steam. Initially the unit used to consume about 55-60 lit/hr Diesel in the DG sets and another 22-25 lit/hr Diesel in the boiler. The DG sets were used to operate for 12 hrs/day and the boiler was operated for about 10-12 hrs/day. With this combination, the daily energy cost used to be around Rs. 31, 416/day, and the annual bill of the order amounted to Rs. 115 Lakhs/year.

When the cost of Diesel went up exorbitantly, the unit went for a gassifier, using rice husk as fuel, by investing Rs.15 Lakhs. The gassifier was supplied by M/s Ankur Scientific Energy Systems, Baroda. The rice husk was partially oxidized, and bio-gas was generated. The other by-products of the gassifier were ash & tar. The ash had very good market value and was being used by brick manufacturers and tar was sold as a lubricant.

One problem with the gassifier was that the DG set couldn't run completely on 100% bio-gas. A minimum of 30% Diesel and 70% gas was needed. But this unit decided to use 40% Diesel and 60% bio-gas for running the DG sets. By installing this Gassifier, the Unit reduced their total energy bill to Rs. 79 Lakhs from the initial Rs. 115 Lakhs, a savings of Rs. 36 lakhs, quite a significant reduction of more than 31%.

When these people decided to go for a gassifier, the cost of rice husk used to be in the range of Rs. 700-800/ton. But over a period, when more people started using it, the cost of rice husk almost doubled and slipped into the range of Rs. 1500-1600/ ton. At this stage, they approached National Productivity Council, to help them for reduction in their energy bill further by carrying out Energy Audit.

After preliminary visits and taking some trails on DG sets, boiler and refrigeration system, the team of experts working on the project found out Vapour Absorption Refrigeration (VAR) system as the best bet to replace the existing load of 100 Tons of Refrigeration (TR), which was running on vapour compression Ammonia refrigeration system. The fact that steam was available and in case of more requirement of steam, it could be generated from bio-gas further helped in making the decision. At this stage, two alternatives were worked out. First one was to generate steam by installing Waste Heat Boiler (WHB); another alternative was to generate hot air directly from the flue gas by installing simple air heater.

There were questions about the idea of first generating steam and then produce hot air, if generating directly hot air was a possibility, thereby avoiding inefficiency. But after working out various alternatives, the team's suggestion of heat recovery from DG set's exhaust gases and generating hot air was well appreciated by the management. Since the DG sets are run continuously, it was felt that this would be an ideal case for Combined Heat & Power (CHP) generation.

The exhaust temperature of the DG sets used to be in the range of 390-400 °C. After detailed measurement of Flue Gas flow, the potential heat available assessed to be around 1,00,000 kcal/h, which was more than sufficient to generate 1500 CFM hot air at 120 °C. This perfectly matched the plant requirements. After giving this idea, the unit implemented the Waste Heat Recovery (WHR) system for their DG sets, in a record time of one month.

Interesting part is, based on the heat duty; the team working on the project had given them a rough estimate of heat transfer area required and the line diagram of the modification. The unit fabricated the shell & tube heat exchanger on their own inside the factory itself at a cost of only Rs. 3.5 lakhs (year 2000 cost) & present cost of Rs. 6 lakhs. One single heat exchanger, with blower could cater to both the DG sets, with by-pass arrangement. When the heat exchanger design was given to them, even the experts were not confident of their design. But after seeing the working model, which was giving hot air at 140-150 °C, at the exit of the waste heat recovery system, the team gained confidence about their designing abilities.

By implementation of the WHR, the existing steam boiler was completely stopped and has become a stand-by boiler. By this the annual bill of the plant has further reduced to Rs. 46 Lakhs from the initial Rs. 115 Lakhs. In another words, additional savings of Rs. 33 Lakhs was achieved by stopping the boiler alone. This amounts to reduction of another 42%. The following table presents the cost comparison of three different combinations, i.e. Case-1) DG set & Boiler, Case-2) DG set with Gassifier & Boiler and Case -3) DG set with Gassifier & WHR system.

Parameter	Unit	Case - I Only DG set	Case-II DG set with Gassifier	Case-III DG set with Gassifier & WHR
DG set Rating	KVA	2 x 320	2 x 320	2 x 320
Normal operation		1x320	1x320	1x320
Avg. Power Generation	kw	180	180	180
Diesel Consumption in DG	Lit/hr	55	22	22
Rice husk consumption in Gassifier	kg/hr	0	200	200
DG set Flue Gas Exit Temp.	°C	400	400	400
Steam requirement	kg/hr	300	300	0
Diesel consumption in the Boiler	Lit/hr	22	22	0
Total Energy Cost	Rs./day	31416	21552	12576
Annual Energy Bill	Rs. Lakhs	115	79	46
Annual Monetary Savings	Rs. Lakhs	–	36	69
Investment towards Gassifier	Rs. Lakhs	–	15	15
Investment towards Waste Heat Recovery	Rs. Lakhs	–	–	0.6
Total Investment	Rs. Lakhs	–	15	21
Simple Pay Back Period	Months	–	5	4

After implementation of the scheme, one problem faced by the unit was the soot deposition and fouling of the heat transfer surfaces. Since the unit was using 60% bio-gas, the problem of soot deposition aggravated with the introduction of additional equipment in the flue gas path. So, the unit decided to operate the DG sets alternately so that they get sufficient time to clean the heat transfer surfaces and for any maintenance requirements.

This is a successful case study of a small cold storage unit, which was experimented, by installing a gassifier and also the waste heat recovery system, thereby reducing their energy bill from the initial Rs.115 Lakhs to Rs. 46 Lakhs, a savings of Rs. 69 Lakhs equivalent to 60% over a period. The simple payback period was hardly less than 4 months, which is really unbelievable.

This savings are based on only 12hrs/day of operation. Imagine the savings, if the plant operates for 24 hrs and all the 3 shifts. This technology can be replicated not only in the similar cold storage units but also for other units, who needs combined heat & power (CHP) simultaneously and urge to reduce their energy bills. The significant other benefits are substantial reduction of CO_2, the main green house gas.

The estimated GHG emission reduction amounts to around 600 ton/year. So the team thought of converting it to a CDM project, however the CER numbers were not favourable in comparison to the transaction costs. Nevertheless if more people implement similar measure then it will be a good case for bundled CDM project. For all those who are intrested in this technology, the team has a video film to support their idea and not to mention, when it comes to believing, seeing does help.

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