CASE STUDY
WASTE HEAT RECOVERY TECHNOLOGY
AMERICAN MNCs

Company Details

An American MNC based on Kandla deals in a complex refinery which include processing of soybean oil, Palm Oil, Hydrogenation, Post treatment of product used for manufacturing of Vanaspati/ Specialty fats. Since all this setup in one plant, even after a great development in heat recovery, there are still a big potential in improvement for low grade waste heat(T<100C).

Background of the Project

The MNC operated an edible oil refinery at Kandla location. With increase in its production there was a need for expanding the operations of oil refinery. The expansion called for higher quantity of energy and steam for process requirements. With a big setup in multiple refining processes and products , it too has a big potential in availability of low grade waste heat(T<100C) that can be used to cut down their utility cost and consumption.

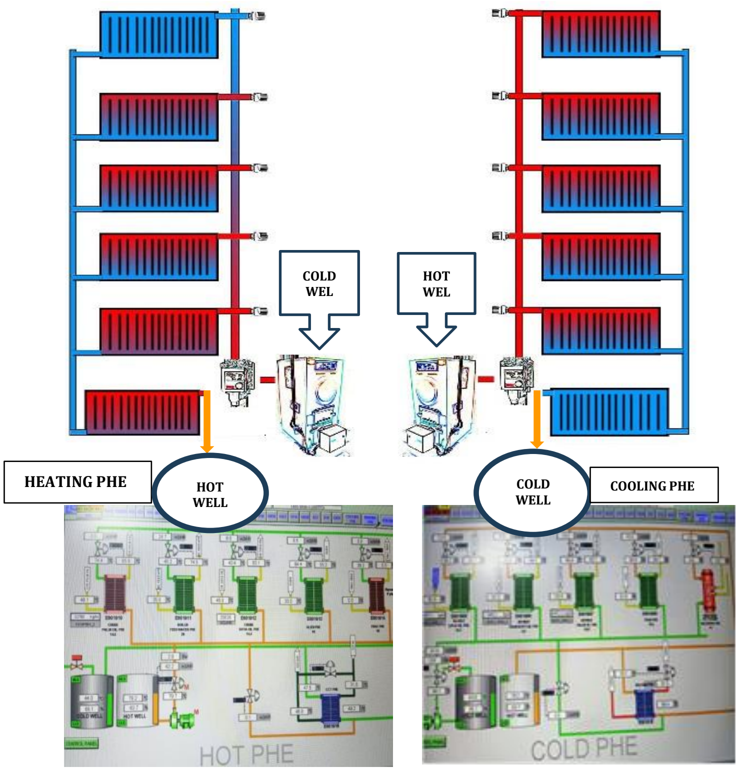
This led the plant team to go for waste heat recovery technology to cater their energy and steam requirements of the plant.

Waste heat recovery & utilization as well as utility consumption reduction

- Hotwell-Coldwell loop generation -Heat exchange between DM water and all the low-grade heat source so as to generate hot water in Hotwell, from the hot well tank this heat is given to the products/material/utility which needs to be heated.
- Aim was to have full heat recovery within sections with no or min steam required for heating and no or less cooling water is required for cooling the oil.
- Replacement of conventional vacuum system with ACL (Chilled water operated) lowering the amount of motive steam by 65% as well as the total water consumption by **60%.**
- Thermal energy savings due to complete heat recovery in the plant is approximately around 15 lakhs kcal equivalent to steam and 50 lakhs kcal equivalent to steam from ACL vacuum system.
- Replacement of diesel heater with HP steam heater resulting in savings of 16 lakhs liter of HSD fuel.
- Replacement of existing turbine with extraction cum condensing one resulting in savings of 850 KW of power generation with same boiler load.

Phase – I

HOTWELL-COLDWELL LOOP HEAT RECOVERY SYSTEM



A Hotwell-Coldwell loop generation using pinch analysis was proposed as a solution. All low-grade heat is extracted using water and collected in hot water tank, from the hot water tank this heat is given to the products/material/utility which needs to be heated. Having done this hot water will lose the heat and gets cool down and this cooled water is than will be sent to cold well tanks. To make the system continuously working, steam heater to keep the hot water temp constant (In case of any one or more section is not running) or water cooler to get constant temp cooled water (In case of any one or more sections are not running) is installed. The hot well and cold well will be filled with DM water once for all.

This industry is a cost sensitive one and therefore rationalization of production processes such as these to bring in operational efficiencies is important. Since the demonstration project was one of the first few of its kind in this industry, the replication potential among other manufacturers is fairly high.

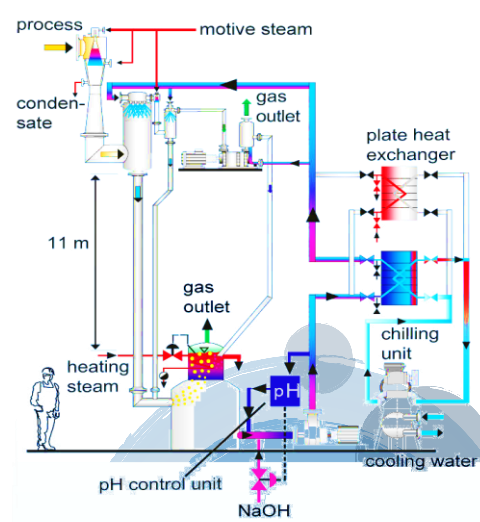
Besides it also promotes a cost-effective technology, which improves industry competitiveness and also helps in trade-off between capital and operating cost.

Savings equivalent to 13 lacs kcal of steam with same amount of heat save in cooling tower operation which will save power for pumping and cooling tower fan, also the makeup water is reduced by 1% of circulation flowrate. 115 m3/hr cooling tower operation is stopped which has resulted in saving of about 50 KW power in pumping and cooling tower fan and about 40 m3/hr water is saved.

ALKALINE CHILLED WATER VACUUM SYSTEM

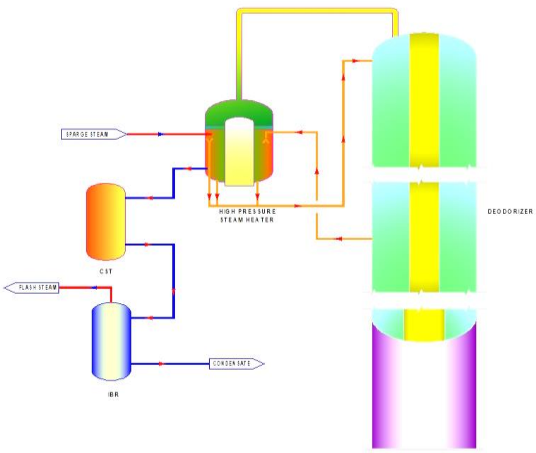
Replacement of conventional vacuum system with ACL (Chilled water operated) so as to lower the amount of motive steam as well as the total water consumption though the power consumption in the ACL system is quite high compared to conventional one. The benefits of this system are lower operating cost (usually electrical energy is cheaper than motive steam) with clean cooling tower operation as well as less water consumption.

Savings equivalent to 50 lacs kcal of steam with an extra power consumption of 263 KW.



Phase – II

HP STEAM HEATER



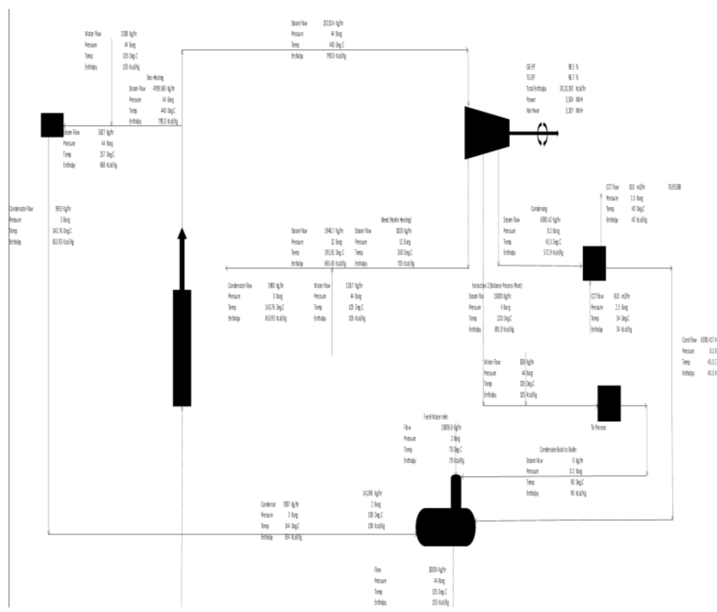
HP Steam heater was installed so as to heat the deodorizer feed oil to a temperature of complete deodorization. The complete set up consists of a steam heater along with the installations of condensate pot and flash vessel for flash steam recovery. The actual idea behind this was to utilize the surplus thermal energy(steam) available and reduce the load of Geka boiler used for the heating of oil to the final deodorization temperature. This gives us an added advantage of diesel savings.

Savings equivalent to 16 lacs liter of diesel with the installation of steam heater in this particular plant.

EXTRACTION CUM CONDENSING TURBINE

Replacement of conventional turbine system with extraction cum condensing turbine so as to generate more power for plant operations with the same boiler load. This was only possible with the surplus steam saving from alkaline chilled water vacuum system.

Savings equivalent to approx. 850 KW of total power generation from the new turbine and a total savings of 550 KW of power after the extra power utilization in ACL vacuum system.



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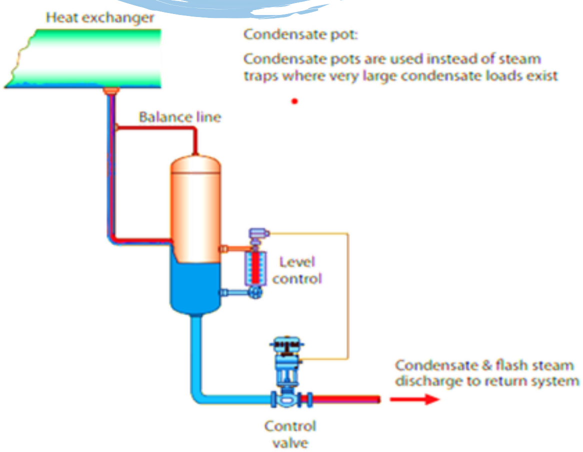
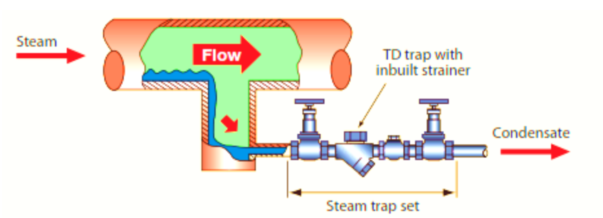
Condensate pot vs Steam trap system



VS



Considering the literature, during a steam trap audit, it is not unusual to find more than 10% of the steam trap population failed open. Hence a pot is a much better solution to ensure that 100% of its surface is effectively condensing steam and transferring heat.

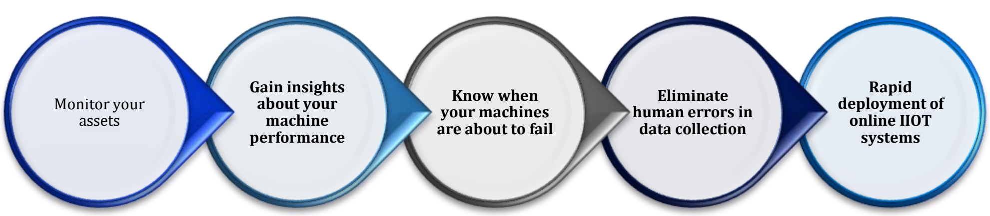
Through good engineering practices and management of the steam and condensate system, ample savings can be realized through lower energy costs, emissions and effluent cost. This has a positive impact on process efficiency by improving control and enhanced output.

A steam trap is a compact, relatively inexpensive solution for condensate removal. The need for accurate condensate removal; a pot is a much better solution due to its ability to accept instrumentation, controls, and condensate pumps. The degree of heat transfer control; a pot can be used to vary the amount of condensate level and, thereby, flood a portion of tubes in the related exchanger, reducing the amount of heat transfer area and the amount of heat transferred.

An example justifying it can be of stall. Stall occurs when the steam pressure in the heat exchanger drops below the back pressure acting on the steam trap. This prevents the flow of condensate. The need to ensure that all condensate is effectively removed from the heating system in order to ensure that 100% of its surface is effectively condensing steam and transferring heat; here, a pot is almost mandatory in order to monitor the real condensate level and ensure rapid removal. In short, a pot gives you a lot of process flexibility while a steam trap is restricted by its narrow scope of design and capacity.

Few other developments and technology for enhanced heat recovery system.

INDUSTRIAL IOT
How it Works



Factors being monitored for different assets

BOILERS, CHILLERS, COOLING TOWERS, PUMPS, TURBINE, AIR COMPRESSORS, HEAT EXCHANGERS ETC.

- Flow
- Pressure
- Temperature
- Current
- Vibration

For instance, in a pump, new multivariable transmitters measure pump operating characteristics (vibration, temperature, power and speed) and compare existing conditions to equipment limits. Process pressure measurements can be combined with guided-wave radar level transmitters and leak detection sensors ensure integrity of the sealing and lubrication system. Then the analytics app is preconfigured to combine all the data so it can provide summaries and specific, actionable information. This can reduce the downtime and helps in predictive maintenance of the particular equipment.

Well-designed chillers work to deliver the right temperatures, humidity levels, and ventilation for the space, while also prioritizing low operating cost and energy efficiency as well as ensuring low sound levels and minimal environmental impact. With IIOT condition monitoring of chillers can help to track key performance indices on a continuous basis. The history data of these performance indices can help to identify whether the chiller is operating at its best efficiency.

Thus, IIOT can be implemented in major equipments to increase the efficiency and reduce operational downtime

Results & Benefit of the Project

- The cost of power from turbine was found to be much cheaper than that available to the company from the grid at current rates.
- Savings in terms of thermal energy were 12 tones per hour for this particularly edible oil refinery plant.
- Savings in terms of HSD were assumed at 16 lacs liter with approx. cost 12 crores.
- The net surplus power from the waste heat recovery project - 550 KW

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