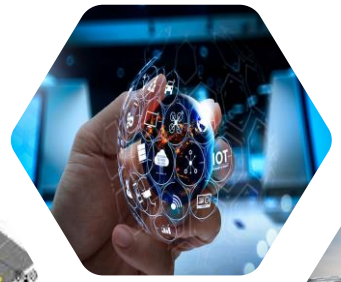
Advanced Waste Heat Recovery Solutions



Excelsource
International Private Limited
Technology :: Innovation :: EPC

Excelling Customer Satisfaction through Innovative Solutions.

Why is Advanced Waste Heat Recovery required ?

- Continual increase in demand & cost of primary sources of energy such as electricity, natural gas, Coal/Lignite/Biomass, heating oil and many more.

- **To sustain & grow against** the increased cost of production due to increased cost of electricity, steam, water and inefficient use of these resources.

- The environmental impact associated with the use of energy sources has garnered considerable public attention from activists, academia, various levels of government and private industries.

What is the Waste Heat Recovery ?

- **Waste Heat recovery is the collection of the heat created as an undesired by-product of the operation of the piece of an equipment or machinery to fulfill a desired purpose elsewhere.**

- The Heat Recovery System (WHR) is employed to recover and reuse sensible heat available in hot streams, such as Out going finished product, exhaust gases from boilers, furnaces, gas turbines, diesel generator (DG) sets, etc.

- WHRs are used in numerous applications depending on the quantum of recoverable heat available for extraction. Some of the applications include a WHR boiler, air pre-heater, charge/scrap pre-heating, economizer, etc.

Components of Heat Recovery System

Waste heat recovery system requires 3 elements:

1. An accessible source of waste heat
2. A heat recovery system
3. An application for the reclaimed energy

Sources of waste heat

(e.g.,combustion exhausts, process exhausts, hot gases from drying ovens, cooling tower water, heat stored in products leaving the process, heat in gaseous and liquid effluents leaving the process)

Recovery technology

(e.g., regenerator, recuperator, heat wheel, heat pipe, economizer, waste heat boiler, heat pumps, heat exchanger (shell & tube type, plate type), thermo-compressor, Hotwell-coldwell loop system etc)

End use of recovery heat

(e.g., preheating(boiler feed water, raw material, combustion air), electricity supply, hot water generation, steam generation, transfer to liquid or gaseous process streams etc.)

Photos of typical process plants

Photos of typical process plants

Advanced & highly cost effective Heat Recovery Solution Implemented by Excelsource

- **Use of Pinch Technique**
- **Hotwell – Coldwell Technology**

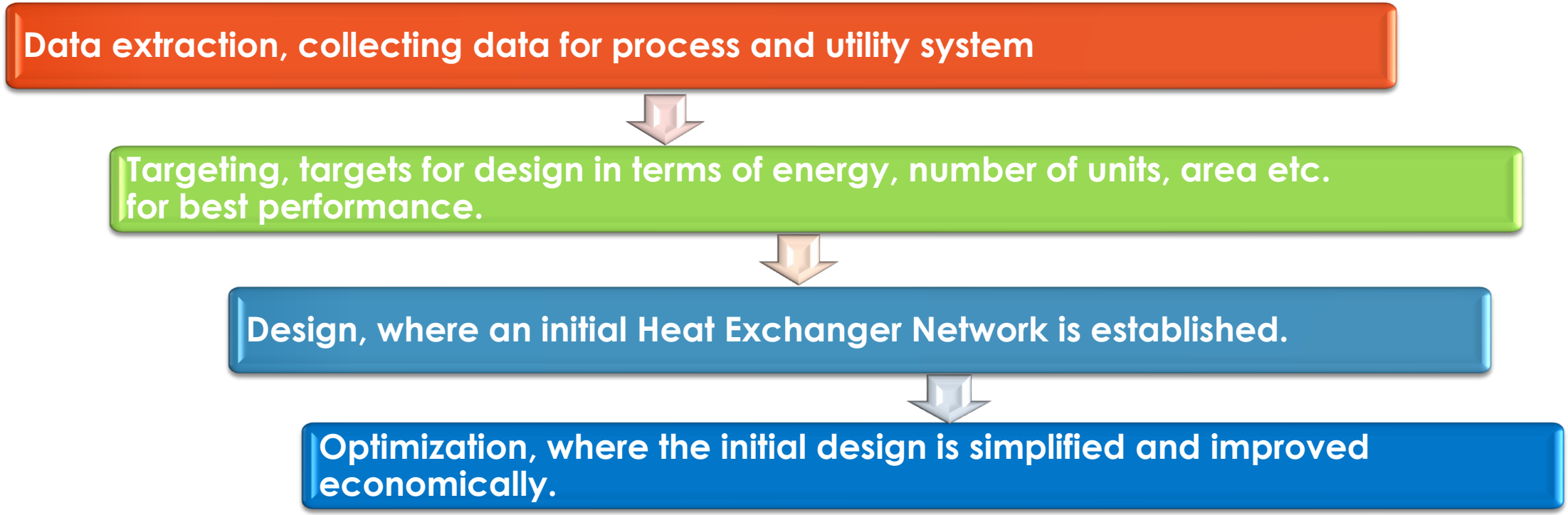
Pinch Technology

- The term **"Pinch Technology"** is a systematic methodology used for energy saving in processes and total sites, based on fundamental thermodynamics. It represents a systematic technique for analyzing chemical processes and the surrounding utility systems.

- Using Pinch Technology, it is possible to identify appropriate changes in the core process conditions that can have an impact on energy savings. A Pinch Analysis starts with the heat and mass balance for the process.

- The prime objective of pinch analysis is to achieve financial savings by better process heat integration (maximizing process-to-process heat recovery and reducing the external utility loads).

Steps of Pinch Analysis



Opportune areas for Heat Recovery

- Depending on the type of process, waste heat can be rejected at any temperature from high to low.

Low temperature waste heat sources

Systems already implementing waste heat recovery that can be further optimized to reduce heat losses which are constrained by costs and temperature limits.

High temperature systems where heat recovery is less common

Alternate waste heat sources typically not considered for waste heat recovery

In industry where the heating and cooling of the process streams are done by external utilities even though there is a possibility of heat exchange between the streams.

Heat Recovery Solutions

The first option for any heat recovery is to reuse the waste heat within the process or equipment itself as in this case the sink and source are generally close together and there are no problems in matching heat availability with demand. This can be done by pinch technology. Examples can be direct heat exchange between two process streams, economizers for boilers, etc.

The second option is to use heat in the other equipment within the process itself. It means generations of plant utilities which will help in reduction of capital expenditure. One such example is the concept of hot well and Coldwell where with extra heat we can generate hot water and then it can be used to heat the other process streams indirectly.

The third option is to generate steam , hot oil , hot water or power from waste heat that can be utilized in others units of the same industry/facility. This option arises only when waste heat is at sufficiently high temperature for reuse in the same process itself.

The fourth option is the recovery from low pressure steam or steam condensate and it can be upgraded for process use via mechanical or thermal vapor recompression. There are many applications and solution for using waste heat depending on the type of industries and utilities or materials used. It may include heating of combustion air with LP steam.

HOTWELL-COLDWELL LOOP HEAT RECOVERY SYSTEM CASE STUDY

- 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.

Case Study

- **Case Study – 1 (Edible oil refinery 1)**

- Savings equivalent to 15 lacs kcal of steam (at 3 Barg) with same amount of heat saved 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.

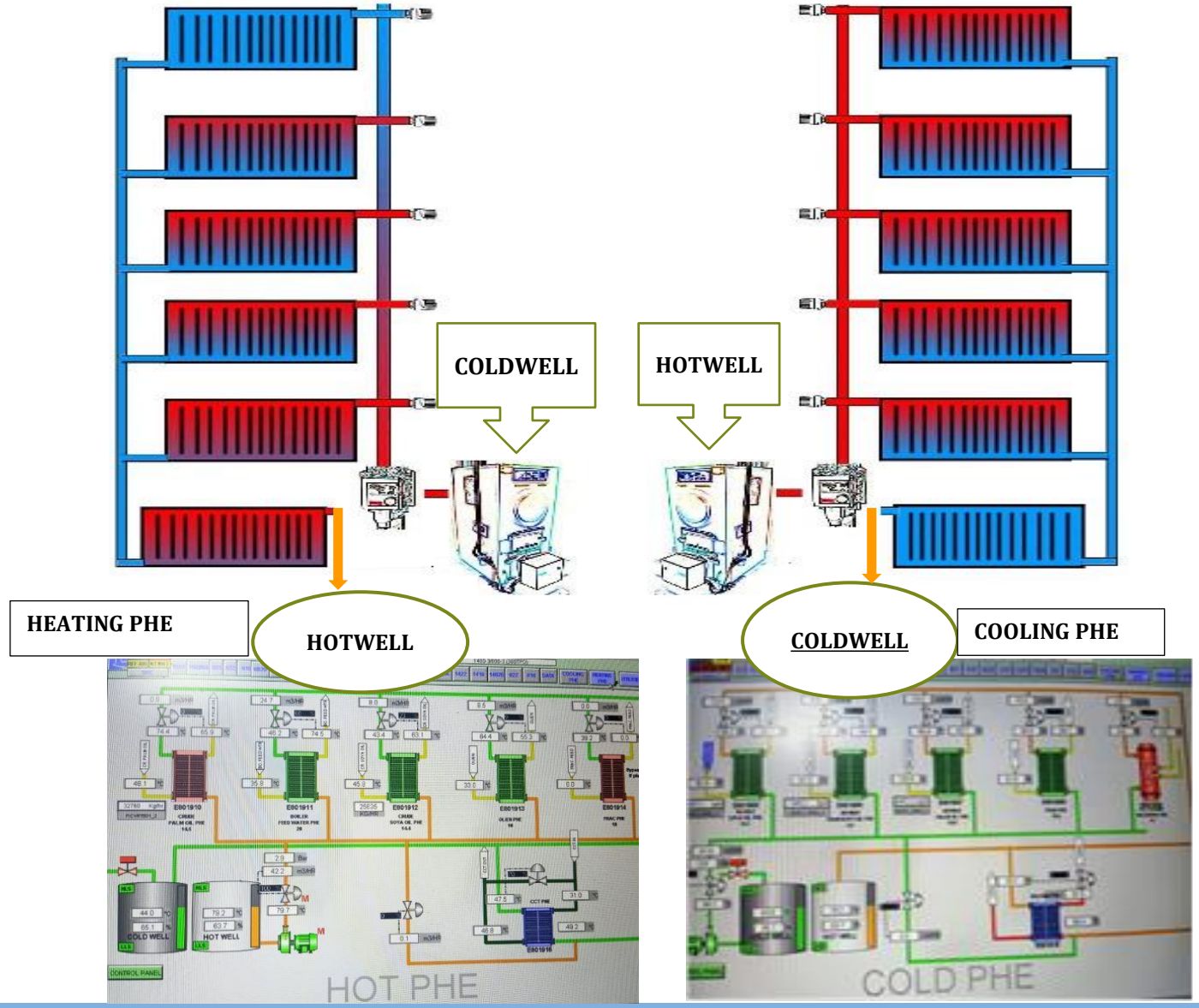
- 200 m3/hr cooling tower operation is stopped which has resulted in saving of about 50 KW power in pumping and cooling tower fan and about 48 m3/day water is saved.

- **Case Study – 2 (Edible oil refinery 2)**

- Savings equivalent to 13 lacs kcal of steam (at 3 Barg) with same amount of heat saved 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 35 KW power in pumping and cooling tower fan and about 29 m3/day water is saved.

Hotwell – Coldwell Technology



Case Study

- **Case Study – 3 (Sulphuric Acid Plant)**
- Conventional Sulphuric acid plants require water for their cooling systems.
- Cooling is required to reject surplus heat not recovered as steam.
- In the direct cooling system, the heat from the absorption and drying towers was emitted to the air.
- With the application of heat recovery system, the heat is instead transferred to a closed loop cooling water circuit containing demineralized water. This water is heated and the hot water is used to heat the boiler feed water, leaching process or any other process streams which requires heating.
- Reducing the water consumption lowers the cost of sourcing reliable supplies of clean water as well as the cost associated with treating effluent streams.
- It also helps improve the sustainability of the acid plant operation by reducing the impact on surrounding communities.
- In this acid cooling system, the hot Sulphuric acid from the absorption towers was cooled off in a plate type heat exchanger by DM water and the heat was transferred to a heat integration loop via a compact heat exchanger and it was released to a process heat for further process streams heating.

Case Study

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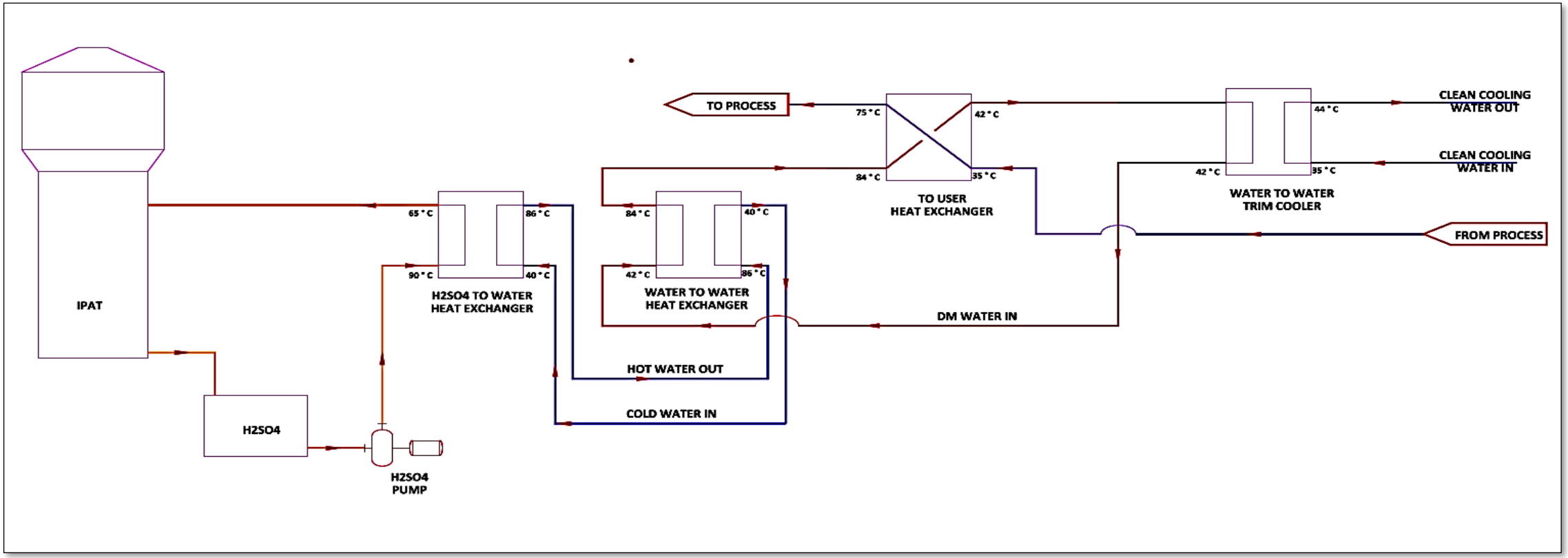


- Savings equivalent to 50 lacs kcal of thermal energy with in cooling tower operation which will save power for pumping and cooling tower fan, also the makeup water is reduced by 1% of circulation flowrate.

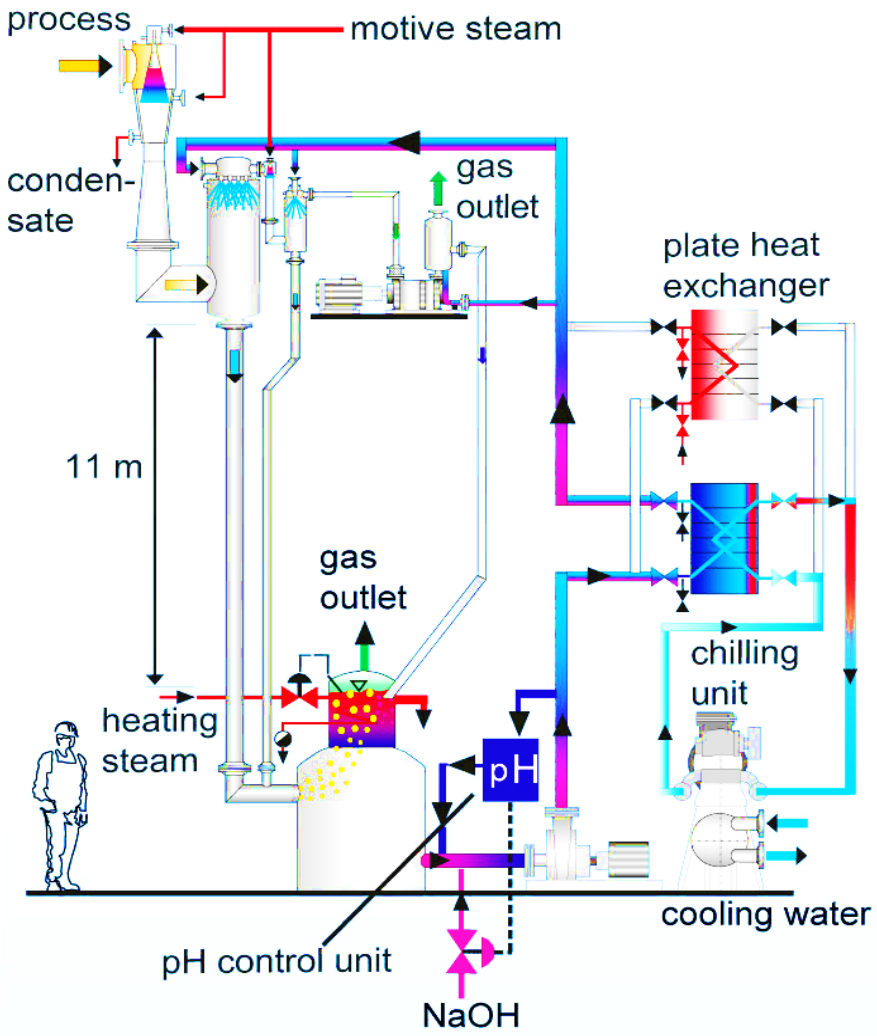
- 550 m3/hr cooling tower operation is stopped which has resulted in saving of about 80 KW power in pumping and cooling tower fan and about 132 m3/day water is saved.

Innovative Component – Chilled Water Vacuum system

- Vacuum systems are an integral part of any plant with major influence on the production quality in edible oil, biodiesel and also oleo- chemical industry. Such kind of systems can easily handle large mass flows in combination with a low absolute process pressure.

- Vacuum system in plant is used to provide the vacuum condition for various steps that includes hydrogenation, fractionation, bleaching, deodorization and deacidification. Vacuum systems are also suitable for various process steps such as drying, distillation, fractionating as well as transesterification during production of biodiesel, fatty acids, soaps and glycerin.

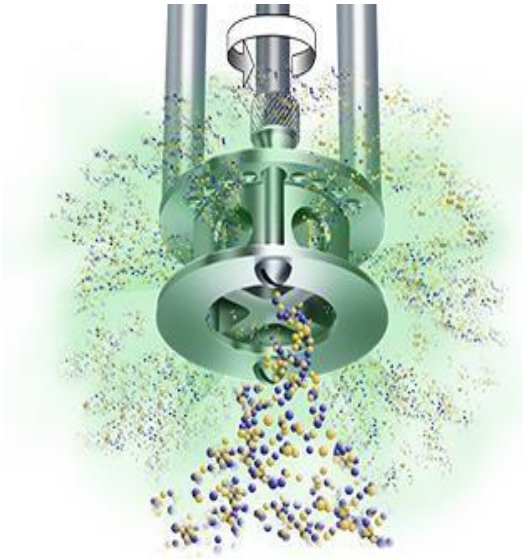
- There are many options available for vacuum system however to meet future requirements such as sustainable and environment–friendly operation along with meeting the environmental compliances, alkaline closed loop vacuum systems are widely preferred.



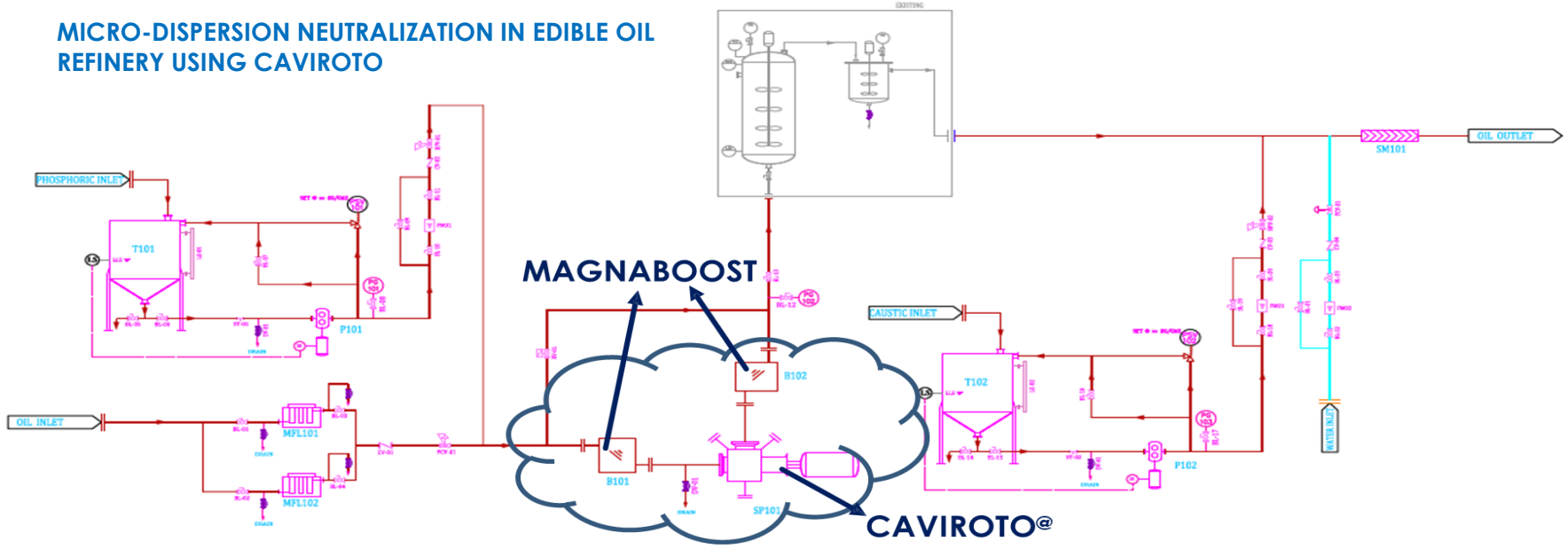
Innovative Component – CaviRoto

- **CAVIROTO@** is a multistage high intensifier (intensification multi times higher than a mechanically stirred mixer), designed to scale down the particle size through enhanced microstreaming effects, vigorous shearing and turbulence and controlled cavitation mechanism. It works through the rotation of a rotor inside a stator, which creates a suction effect. It is based on the principle of a high centrifugal force produced because of its large rpm of rotor mounted in the main spindle. The specially designed minimal tolerance of the rotor and stator makes it very high in intensifying the micro.

- **CAVIROTO@** are typically comprised of a multi blade rotor turning at high speeds within a stationary stator As the blades rotate, materials are continuously drawn into one end of the mixing head and expelled at high velocity through the openings of the stator. The resulting intense shearing and turbulence promotes fast mixing, breaks down solid agglomerates and reduces the size of suspended droplets It can achieve tip speed of up to 95 m/s.



MICRO-DISPERSION NEUTRALIZATION IN EDIBLE OIL REFINERY USING CAVIROTO



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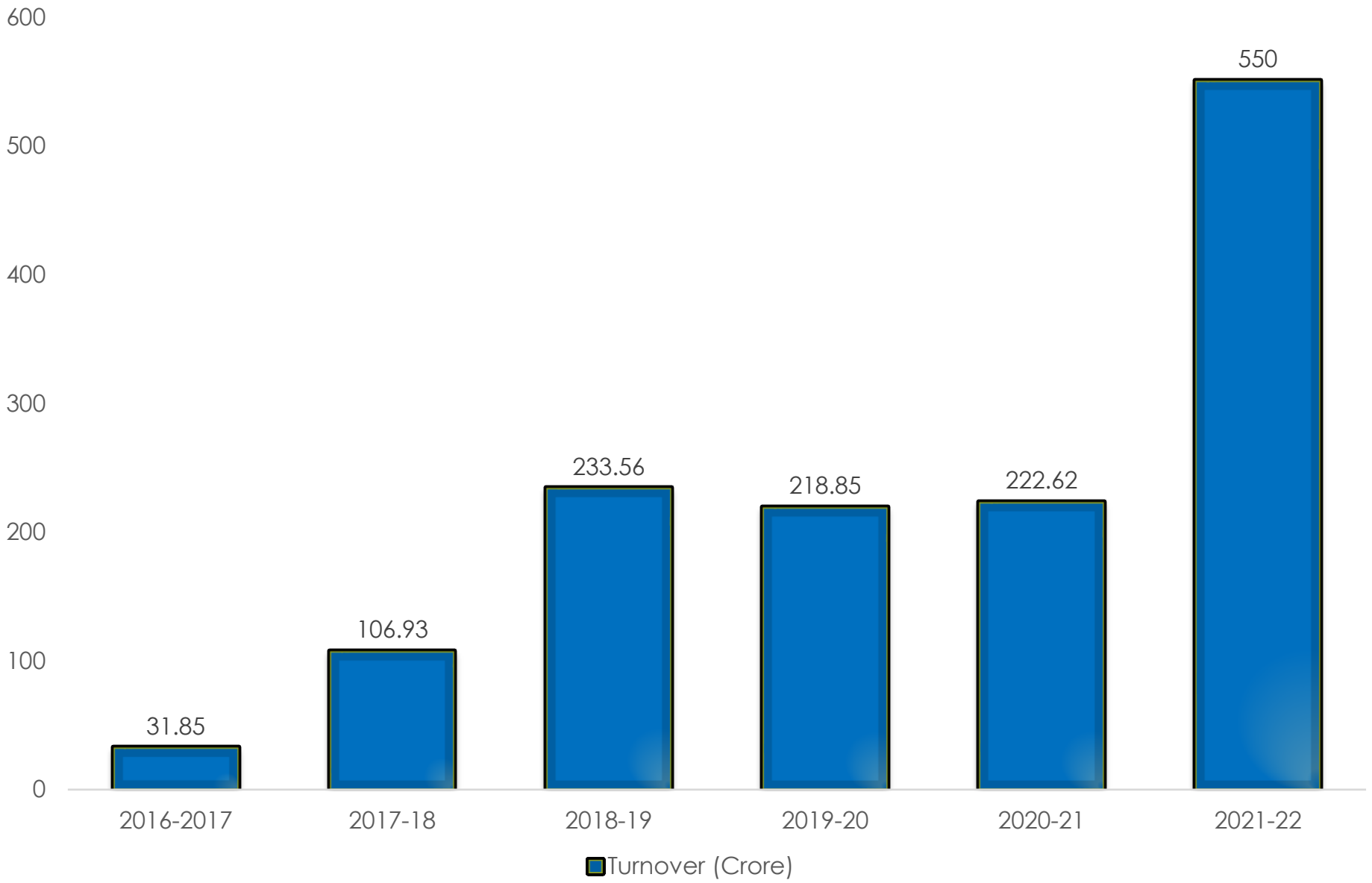
Turnover History



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