

ACID CONCENTRATION SYSTEM

New way in Modern Process Science & Technology



MULTI-STAGE EVAPORATION SYSTEM FOR BETTER STEAM ECONOMY

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Every Industry has definite access to resources in order to sustain above the threshold. Businesses have to find new improved ways of utilizing these resources effectively and more importantly to its fullest capabilities.

One such task of acid recovery for reusability came across, wherein spent acid - Sulfuric acid (20%w/w conc.) was to be brought to usability by increasing concentration levels.

Projects involving multi effect evaporators have shown remarkable success in effective steam consumption. On similar lines, solution was proposed to consider multi stage evaporation system for better steam economy.

Considering the highly corrosive nature of the acid, Impervious Graphite was the optimum choice for process side material of construction.

Impervious Graphite grades, GRAPHION are excellent corrosion resistance to aggressive chemicals even at elevated temperatures. Graphite shows higher heat transfer rates than glass, excellent corrosion resistance, least adhesion angle compared to alternatives reducing risk of fouling & better thermal shock absorption.

DESIGN BASICS

The client's dye manufacturing plant used 65% conc sulfuric acid for its process which was formed by diluting 98% sulfuric acid (procured externally) with spent acid of 20% conc. This made them rely on fresh batch of conc acid, further effluent treatment of used acid.

In order to make use of spent acid, the concentration need to be increased to required levels. For this, we designed a 2-stage evaporation system in which the concentration will be increased in 2 stages. Thus allowing to carry vapours from one stage to another reducing effective steam consumption.

The 1st stage evaporator increased the feed temperature to allow vapors to form and carry into 2nd stage. Second stage evaporator carried out vacuum distillation to further increase concentration. Final 65% acid (product) was cooled in cooler where heat recovery was carried out using feed as service fluid to further reduce energy dependence.

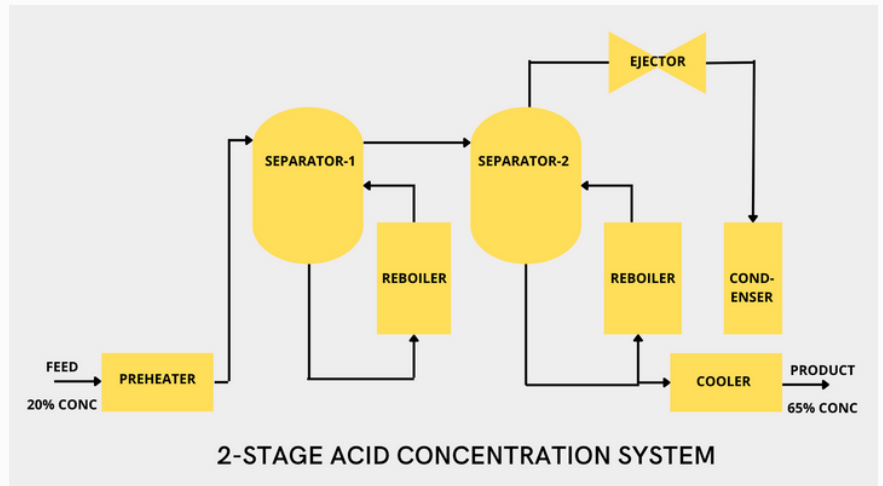
The system was designed to efficiently to reduce dependence on fresh acid (98%), minimize effluent treatment costs, and recycle spent acid helping environment at the same time.



Graphite Thermowell



PTFE Lined Shell



EQUIPMENT IN DETAIL

Sulfuric Acid is extremely corrosive and fuming acid is hazardous to health & environment. Given the nature of acids, specific alloys & materials are preferable. Super alloys provide excellent corrosion resistance but comes with a price. Therefore, Impervious Graphite exhibits excellent properties and high thermal conductivity making it preferred choice for such applications.

The system can be categorized into 4 sections:

- **Separators** - Glass-lined vessels also known as flash vessels are installed as vapour-liquid separator for each stage. Separators sizing is crucial in order to maintain Liquid column for thermosyphon action to happen.
- **Heat Exchangers** - Two Graphite Reboilers are installed across flash vessels to facilitate evaporation of water and increase product concentration. Second stage reboiler is designed to handle both side corrosive fluids with the help of seamless PTFE lining on shell side. Acidic vapors carried from 1st stage will act as heating medium for second reboiler. Primary & secondary condensers are installed at barometric heights to condense large amounts of water vapour generated from the 2nd stage. An uniquely designed both side corrosive protection polybloc type multi pass Preheater/After-cooler acted as an cooler (process side) for product to cool (liq-liq media) & transferring heat to feed thereby further reduce steam consumption.
- **Piping & Pumps** - Fluoropolymer lined pipes are excellent corrosion-resistant and durable to withstand vacuum levels. Complete process side pipes are in PTFE lining and piping fittings in PFA Molded. Hexacarb owns in-house capabilities for fluoropolymer pipes & fittings. Double Mech Seal PFA Molded Recirculation pumps were installed for forced circulation of acid. Accessories such as graphite thermowell, ptfе dip pipe etc. were supplied by Hexacarb Engineers with its in-house capabilities.
- **Storage & Circulation Tanks** - Fiber-Reinforced Plastic (FRP) circulation tanks are provided to contain final product and acidic condensate from condensers above. Separate components beyond BLP were arranged by client.

DELIVERING EFFICIENCY

Operating for 20 hrs per day, the system generated 370kg/hr of 65% w/w concentrated sulfuric acid delivering the target steam consumption boosting the operational efficiency of the plant.

The system is designed to handle 1200kg/hr of spent acid (20% conc.) This required removal of 830kg/hr clean water useful in post process applications. Removal of water from spent acid to increase its concentration required high amount of steam for boiling temperatures to be achieved. Therefore, **Steam Economy** remained the major driving factor when considering operational costs of the plant. The plant was able to achieve steam efficiency of @0.65 kg/per kg of water with the help of 2-stage system.

Zero Effluent Discharge is main feature of the system as it completely overcomes the problem of treatment of spent acid and saving millions every year.

Consumption of Fresh 98% Sulfuric Acid reduced from **3000kg/day to absolute zero** after successful commissioning of the plant.

The **Pay-Back period** of the complete system including structural and peripheral components is less than 15 months. Remarkable Cost Saving Results are the outcome of this successful system, paving new ways into modern process science & technology.



Floor-1 View



Floor-2 View

“

*Overcoming problems
& Delivering Results
are main feature of
this team...*

- MD, BPPL

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