

SULFURIC ACID CONCENTRATION

Introduction

Sulfuric acid is a common but very important chemical, finding its application directly and indirectly in manufacture of fertilizers, dyes, intermediates and many others. Commercial Sulfuric acid is typically available as 98% w/w concentration.

Several applications of Sulfuric acid involve the use of medium or high concentrations acid, which ends up as relatively dilute acid by picking up water from the reaction. This dilute acid has to be either treated as effluent or disposed. Alternatively, the dilute acid may be concentrated to bring it to the desired concentration level and recycled in the process.

This takes care of effluent problem and also, reduces requirement of fresh make-up acid.

The concentration of Sulfuric acid involves evaporating the associated water preferentially by boiling.

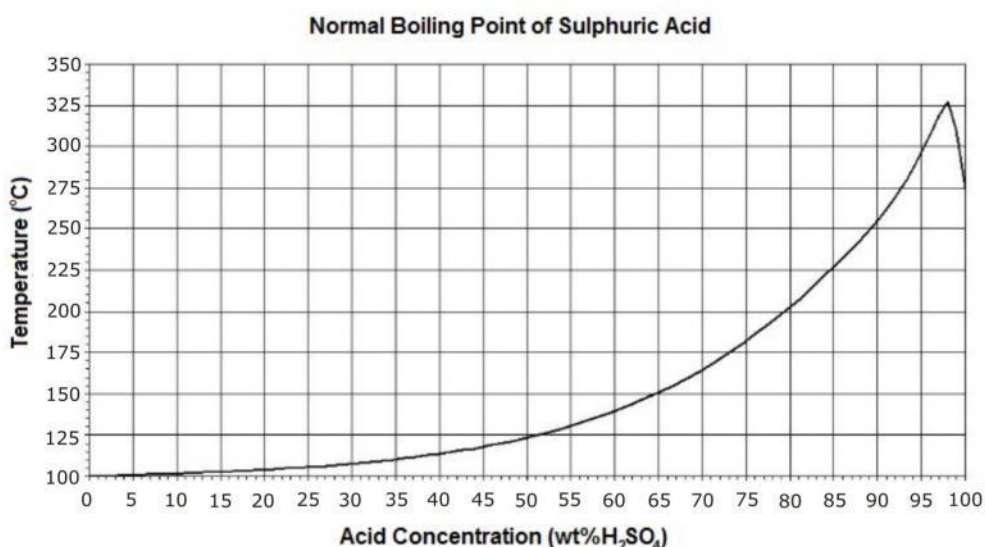


Engineering challenges and considerations

Sulfuric acid is highly toxic and corrosive and reacts readily with metals, depending on its strength and operating parameters. Thus, very few Material of Construction are compatible to handle, process and store Sulfuric acid. Thus, special design and special knowledge is required to set up and operate plants handling Sulfuric acid.

Sulfuric acid is a relatively heavy liquid. The atmospheric boiling points of different strengths of Sulfuric acid are as shown in the graph below.

It can be seen that the atmospheric boiling points of Sulfuric acid upto concentrations of appr. 68 % are manageable for the compatible material of construction. Also, the partial pressure of Sulfuric acid is very low and hence, there is negligible carry-over.



The boiling points of Sulfuric acid at higher concentrations than appr. 68 % are relatively high, as compared to the allowable limits for the compatible material of construction. Also, if steam is being used as heating medium, much higher pressures of steam is required. The partial pressure of Sulfuric acid also increases in this concentration range. It then requires boiling under suitable vacuum so as to lower the temperature. However, cooling medium temperatures are also to be taken into consideration when operating under vacuum.

Sulfuric acid may be concentrated practically upto 96% strength, as it forms azeotrope around 98% at atmospheric pressure.

Sulfuric acid concentration by Ablaze

Ablaze has a long and successful record of design and supply of several Engineered systems for mineral acids. Being manufacturer of Borosilicate Glass equipment, PTFE components and PTFE lined components, Ablaze is well qualified to handle such systems as these are the major Material of Construction used in such systems. Ablaze also has in-house capabilities for Instrumentation and Automation, which is necessary for reliable and safe operation.

Custom made designs are offered for Sulfuric concentration systems, depending on the initial and final concentrations of acid, heating medium and cooling medium available etc.

Process

The process basically involves boiling of Sulfuric acid to preferentially evaporate water. The process scheme and operating parameters are selected based on several factors:

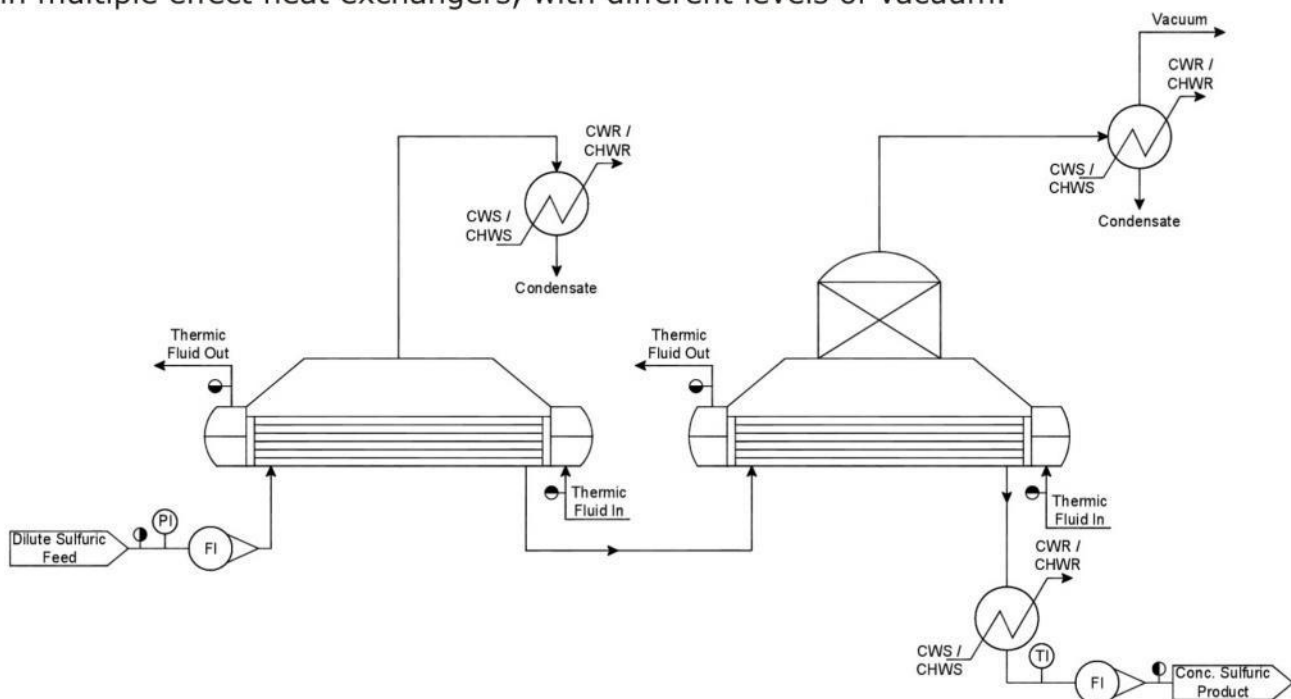
- Plant capacity
- Feed composition/ impurities if any
- Initial concentration
- Final concentration
- Heating medium
- Cooling medium

A typical and generic Flow scheme is shown for concentration of Sulfuric acid. The actual process scheme is decided based on the above factors.

Feed Dilute Acid is fed to the Evaporator/ Boiler where operating pressure is maintained as per the product strength required and the heating medium being used. The heating medium shall be typically Saturated Steam or Thermic fluid. The preferentially evaporated water is condensed in a condenser and the condensate collected. Vacuum system may be connected to the condenser depending again on the product strength required. At higher concentrations of acid, proper demister needs to be provided to avoid carry over of Acid mist.

Generally, the concentration of Sulfuric acid upto appr 68% may be accomplished under atmospheric pressure in Horizontal kettle type heat exchangers. Multiple stages and Vacuum operation may be considered depending on heating medium and the plant capacity.

For concentrations above appr 68%, vacuum operation is mandatory. The process is then carried out in multiple effect heat exchangers, with different levels of vacuum.



Typical flow scheme for Sulfuric acid concentration

Typical utilities required for Sulfuric acid concentration system:

The process scheme and thus, utilities requirement shall depend on various factors as indicated in the Process description section above.

The typical utilities required for Sulfuric acid concentration system can be:

- Steam (dry and saturated, pressure depending on the final concentration required and operating pressure selected)
- Thermic fluid (180-190 deg C supply temperature)
- Cooling water (28-32 deg C supply temperature)
- Vacuum (level depending on the final concentration required and operating pressure selected)

Salient features for Ablaze Sulfuric acid concentration system

• **Energy efficiency**

The concentration of Sulfuric acid is highly energy intensive process. Cross heat exchange and recovering heat from evaporated water are also considered under special circumstances of high capacity and higher strengths of acid.

• **Instrumentation**

The boiling point and specific gravity of Sulfuric acid vary considerably with the product strength and are inter-related. Thus, proper instrumentation is considered in the design to monitor and control various operating parameters. This ensures proper product quality and optimum operating parameters.

• **Safety**

Sulfuric acid being toxic and corrosive, proper safety measures have to be considered during design, construction and operation of sulfuric acid concentration units.

• **Alternative/ options of MoC**

Suitable and compatible Material of Construction needs to be considered for such units, depending on the concentration of acid and operating parameters like temperature and pressure. Ablaze manufactures most of the compatible material components/ equipment in-house for such units.



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