Sulphuric Acid Concentration

In the early seventies, Aker Solutions engineers set out to improve the sulphuric acid concentration process by building upon their knowledge and experience with Nitric Acid Concentration.

Using modern, reliable materials such as glass lined steel, PTFE, Tantalum and Zirconium the engineers at Aker Solutions developed the patented vacuum evaporation process that still forms the heart of our technology today. This process is characterized by the extensive use of gravity flow to transfer hot acid between the various process steps and by the use of natural circulation thermosyphon loops for the acid evaporators. These natural circulation evaporators allow high heat transfer rates, large turndown, minimize fouling and avoid the use of pumps in hot acid service which improves both safety and reliability. Multiple stages are used for large capacities or for large increases in concentration.

In 1975, after extensive pilot plant work, the first modern Aker Solutions Sulphuric Acid Concentration plant was designed and built for the Air Products DNT facility in Texas where it continues to operate today. Since that time, the design and technology have continued to improve and more than 40 spent acid plants have been delivered to satisfied clients around the globe. Completed plants range in capacity from 25 to 2200 MTPD and concentrate sulphuric acid from a starting concentration as low as 7 wt% to product concentrations between 83 to 96 wt% sulphuric acid.

Although the Aker Solutions Evaporator System forms the heart of every process, it is very important to incorporate into each plant the appropriate pre-treatment of the spent acid to remove (and recover) impurities and to minimize effluent. Aker Solutions has developed several additional process options that can be used to provide a custom made process for each spent acid. Examples are hydrolysis or striping processes to remove organics, Fractionation columns to concentrate and recover valuable by-products and NO_x absorption systems to clean vent gases prior to discharge.

Aker Solutions carries out extensive safety reviews and operates a testing facility to ensure that optimum conditions are selected for each spent acid. This approach has resulted in safe and reliable plants with availabilities well above 95%.

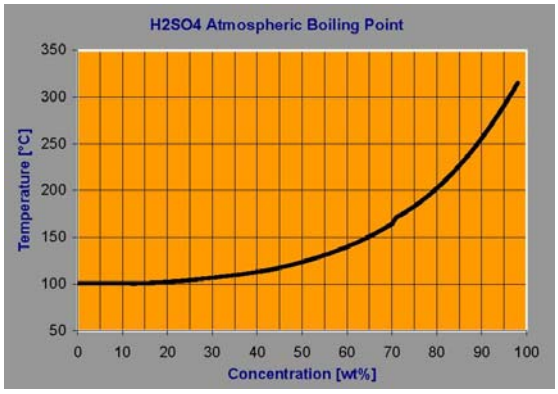
For more information please contact us to discuss your Sulphuric Acid Concentration requirements.

Aker Chemetics, A division of Aker Solutions Canada Inc.
Suite 200 – 2930 Virtual Way, Vancouver, British Columbia, Canada V5M 0A5
Tel +1 604 734 1200 Fax +1 604 734 0340 www.akersolutions.com/chemetics

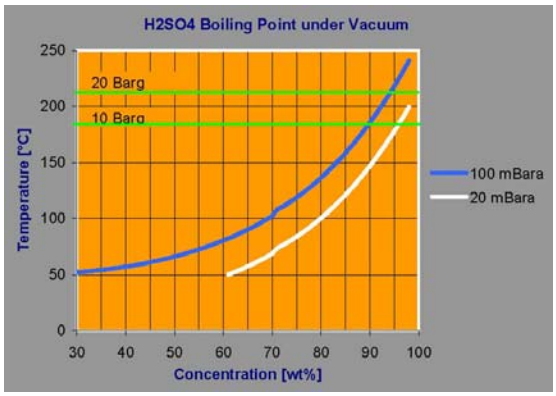
For more information please contact us at spent.acid@akersolutions.com

Sulphuric Acid Concentration background

The concentration of Sulphuric acid provides a number of technical challenges/choices that must be carefully managed in order to create an economic and reliable process.

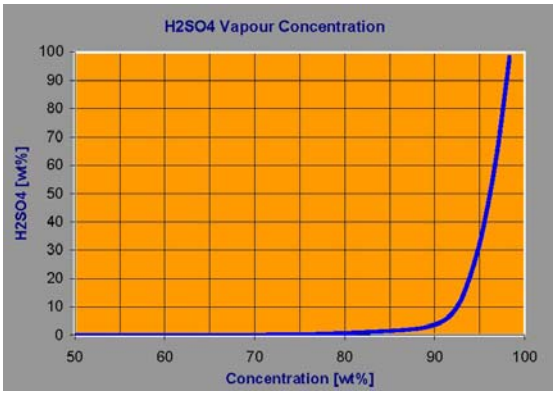


Sulphuric acid can be concentrated by boiling the solutions as water evaporates preferentially. The graph on the left shows the atmospheric boiling point of sulphuric acid at various concentrations: It is clear that high temperatures are required to obtain concentrated acid. When the required temperature exceeds the temperature of the available heat source (normally steam) and/or the temperature limits (approx. 200°C) of the available materials of construction, it is necessary to carry out the concentration under vacuum. The vacuum levels used in practice are further constraint by the desire to condense the water that has been removed from the acid using normal cooling water. The result is a practical lower operating limit of approx 100 mbara.



As can be seen on the right, using 10 barg steam it is possible to concentrate up to ~85 wt% at an operating pressure of 100 Bara. If 20 barg steam is used, the maximum possible concentration at 100 mbara pressure increases to ~90 wt%. For even higher concentrations it is necessary to operate at a lower pressure and the use of chilled water to condense the overhead vapours is required.

At high concentrations a further complicating factor comes into play. As the acid concentration increases, the vapours removed from the boiling liquid consist not only of water vapour, but also contain an increasing amount of sulphuric acid vapour (as shown in the graph below) until the azeotrope is reached at 98.3 wt% H_2SO_4:



Based on this graph it can be concluded that acid concentrations up to approx 89 wt% are possible with acceptable acid losses to the overhead vapour and no special precautions have to be taken to prevent corrosion of the overheads condensing system or recover the acid lost from the system.

At higher concentrations additional process equipment is required to remove and recover the sulphuric acid from the overhead vapour. Generally a packed column is used to contact the vapours with a dilute sulphuric acid liquid stream causing the acid vapours to be selectively removed after which the water vapour can be condensed in the overheads condensing system.

Due to the presence of the azeotrope at ~98 wt% H_2SO_4 concentration it is not practical to concentrate to a product concentration that exceeds 97 wt% H_2SO_4. If a higher concentration is required, it is possible to fortify the acid further using either SO_3 gas or Oleum.

Aker Chemetics, A division of Aker Solutions Canada Inc.
Suite 200 – 2930 Virtual Way, Vancouver, British Columbia, Canada V5M 0A5
Tel +1 604 734 1200 Fax +1 604 734 0340 www.akersolutions.com/chemetics

For more information please contact us at spent.acid@akersolutions.com