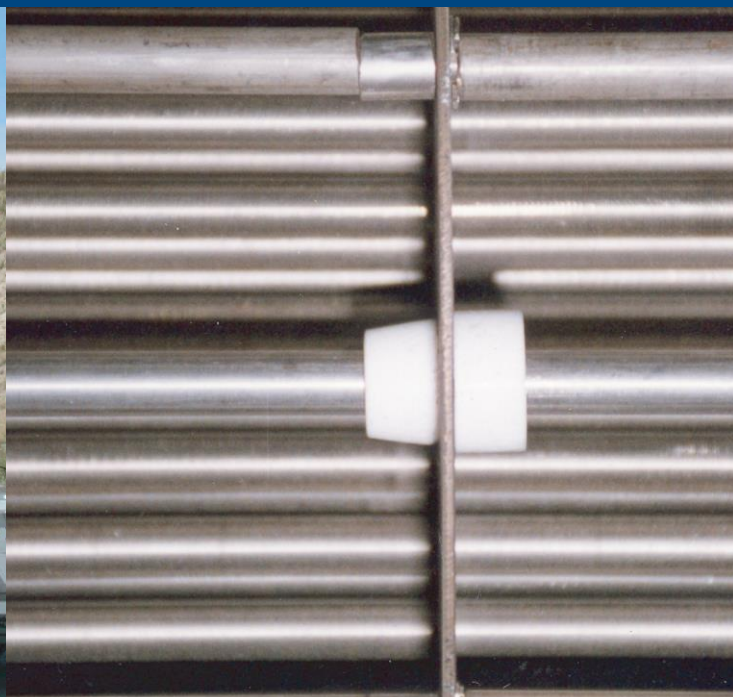


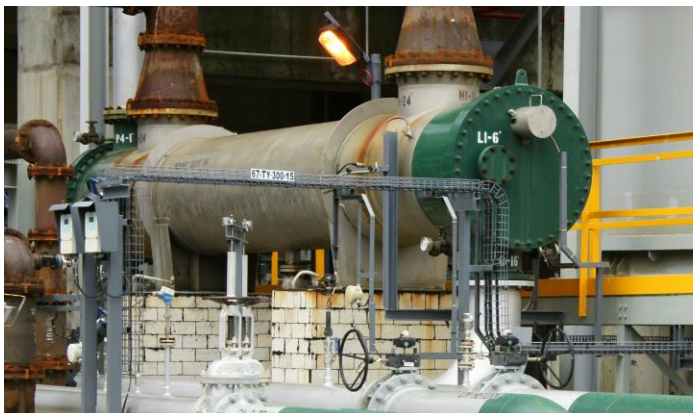
NORAM
SULFURIC ACID
Products and Services

ANODICALLY PROTECTED ACID COOLERS



The **NORAM Anodically Protected Acid Coolers** incorporate a number of important innovations which have resulted in longer service life in difficult applications. The technological improvements of the NORAM Acid Coolers have been developed under the leadership of the co-inventor of the original anodically protected acid cooler, relying on his experience gained from the design and operation of acid coolers worldwide over the past 35 years. Investigations of acid cooler failures have shown that failures were typically encountered in hot service conditions and in situations where acid concentration excursions had occurred. Failures were more prevalent in larger acid coolers. The NORAM patented Acid Cooler incorporates design improvements developed specifically to prevent such failures. These design improvements extend acid cooler life under adverse conditions and reduce maintenance requirements.

NORAM designs each cooler using normal plant operating duties and potential upset conditions with the help of its proprietary Acid Plant Flowsheeting Program. NORAM is able to specify the process duties for any acid cooler in any acid plant service. NORAM has developed a proprietary heat exchanger rating program that is used to achieve balanced designs that are thermally efficient and economical. The program is also used to model different operating scenarios if operating conditions fluctuate substantially.



The mechanical design of the coolers is performed in accordance with TEMA standards. All NORAM Coolers are custom designed specifically for the application required. For retrofits, each unit can be designed to match existing piping for direct replacement onto existing supports. The coolers are shell and tube, single segmental exchangers with multiple passes on the acid (shell) side and up to four passes on the water (tube) side.

The tubing, shell, tubesheets, baffles and tie-rods are constructed of stainless steel. Water channels can be constructed either from stainless or carbon steel



NORAM Acid Coolers are protected from hot sulfuric acid corrosion by an advanced anodic protection system. Large diameter cathodes, located in the dome spaces of the cooler, are used. These cathodes are bare, and are not covered by a Teflon™ sheath. This results in a more uniform current flow. Special seals are used to seal the cathode. Corrosion in acid coolers can occur in areas where there is inadequate electrical current flow and in areas where there is excessive electrical current flow. The low voltage drop of the NORAM cathode results in uniform distribution of electrical current to generate a very stable passivation layer on all surfaces of the stainless steel in contact with acid. Power to the NORAM cathode is fed through the ends of the cathodes. NORAM uses a proprietary software program to model the electrical potential field within each cooler to optimize the number and placement of cathodes as well as the power feed location. The stable passivation layer generated by the NORAM anodic protection system extends operational life by virtually eliminating corrosion from coolers subjected to the severest of duties

Superior Cathode Design

The cathode used in NORAM Acid Coolers has a much higher cross section than cathodes offered by others. Through modeling of the potential field in acid coolers, it has been established that significant voltage losses occur in the small diameter cathodes now used in the industry. This voltage loss in the cathodes requires that a higher voltage be applied to the end connection point to achieve an adequate supply voltage to the far end of the cathode. The higher voltage at the power feed end can accelerate the corrosion of adjacent areas of the cooler. The large diameter of the NORAM cathode dramatically increases the current carrying capability of the cathode resulting in a much more uniform voltage along the cathode length. The more uniform voltage along the cathode length moderates current distribution throughout the cooler, minimizing the possibility of generating localized high corrosion regions. The result is a broader cooler operating range.



Other benefits of the large-diameter bare NORAM cathode are increased life expectancy and reduced maintenance. The cathode is designed to last the life of the cooler. Each bare cathode is easily inspected and is accessible from one of the ends of the cooler. Removal of the cathode for maintenance, however, is typically not required. This is in contrast to Teflon™ sheathed cathodes used in conventional designs which require regular maintenance. The holes in the sheath can become blocked due to sulfate formation. The sulfate must be removed on a regular basis to maintain adequate current flow into the acid. Additionally, the sulfate can build up between the sheath and cathode and cause the cathode to cease when removal for maintenance is attempted. Use of bare cathodes in the NORAM Acid Coolers completely eliminates this maintenance problem.

Compatibility with Existing Power Supply Systems

NORAM Acid Coolers can be operated with a NORAM power supply and control system as well as with all other systems currently used in the industry. Existing power supplies can be connected directly to the NORAM Cooler without additional equipment

Rigorous Quality Control

Strict quality control and quality assurance procedures are enforced during the fabrication of each cooler to ensure that the mechanical design is executed to the highest quality standards and to guard against failure. All NORAM Acid Coolers are ASME code certified vessels. Individual finished cooler tubes are 100% eddy current tested and pneumatically pressure tested under water prior to fabrication. Completed coolers are pressure tested under ASME code and, in addition, the tube side is helium tested to check for porosity. The NORAM Acid Coolers are fabricated in Vancouver by Axton Incorporated, a fabrication shop fully owned by NORAM. Axton is qualified under ASME Section VIII, Division 1, ISO 9001-2000 and a SLQ license (China).



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NORAM TROUGH ACID DISTRIBUTORS FOR ACID TOWERS
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NORAM SX® ACID DISTRIBUTORS
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