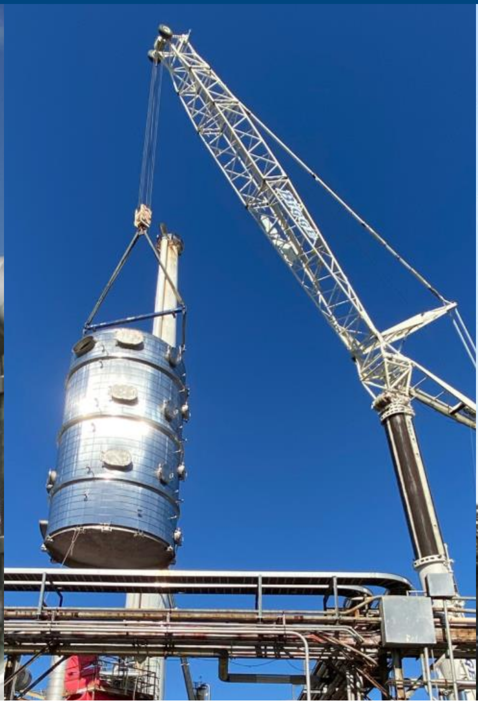
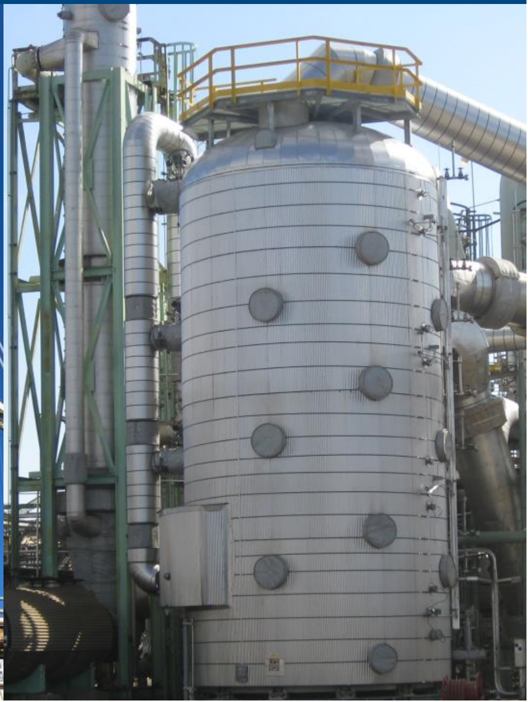
NORAM

SULFURIC ACID
Products and Services

STAINLESS STEEL CONVERTERS

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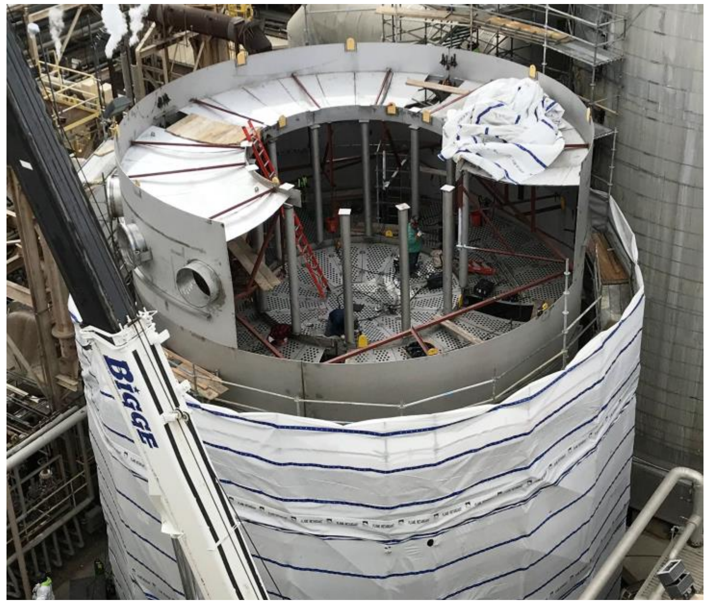
The converter in a sulfuric acid plant holds the catalyst required for the conversion of SO_2 to SO_3. Typically the gas passes through the pellet-shaped catalyst mass from top to bottom, leaving through a perforated catalyst support plate. Also typically, the converter holds several catalyst beds in series, each separated from the preceding bed by a division plate. For maximum conversion efficiency, the gas passing through the catalyst beds has to be cooled between beds, which is usually accomplished through external heat exchangers. Key performance parameters for converters are uniform gas distribution in the shallow catalyst beds and low overall pressure drop.

Converter Design Concepts

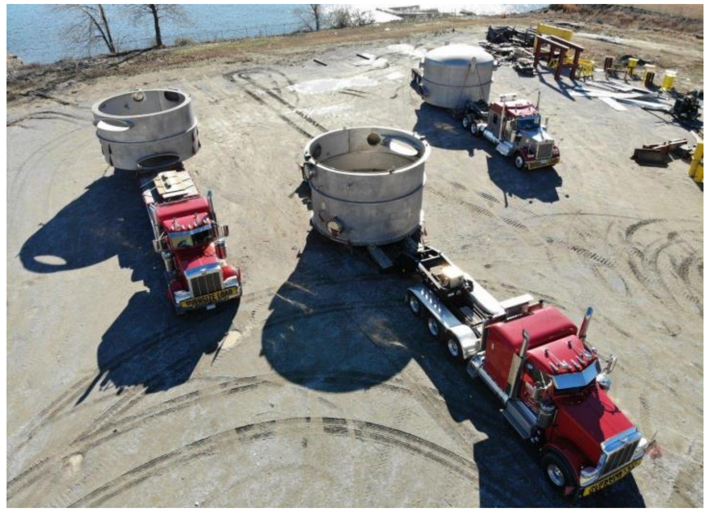
Traditional converter designs have used carbon steel shells, often with brick lining around the hot first bed, and cast iron posts and support grids to hold the catalyst mass.

Carbon steel converters may experience operating problems, including gas bypassing between catalyst beds, gas maldistribution in the catalyst mass, poor reliability of bed supports, creep deformation of mechanical components, and leaking nozzles. Corrosion from high temperature oxidation causes scale formation resulting in catalyst fouling. If maintenance is required, an extended shut-down period is often necessary because the thermal inertia of this type of converter is large, resulting in long heat-up and cool-down times.



The shortcomings of carbon steel converters led to the introduction, in the 1980s, of an all-welded stainless steel converter which has become the industry standard. NORAM has acquired the converter technology from the leader of the team that implemented this innovation, who has continued to further advance and patent this technology. Of particular significance has been the development of catenary plates to support the catalyst mass and to separate catalyst beds. These catenary plates are flexible, membrane-like plates which minimize mechanical stresses on the converter shell. This design concept is inherently superior to the flat bed design offered by others.

Stainless steel converters using flat bed support plates and divider plates welded to the shell, which basically copy the old carbon steel design, have experienced failures as a result of the differential rate of thermal expansion of the plate and the shell during heat-up.



Low Corrosion Rates

The NORAM converters are constructed entirely from stainless steel. The use of a stainless steel shell eliminates the need for brick lining while complying with ASME and European design codes. Corrosion is significantly reduced. Elimination of brick lining and the lower heat capacity of the stainless steel shell result in shorter heat-up and cool-down times. The all-welded design prevents gas bypassing between beds, improving overall conversion efficiency. The stainless steel construction and catalyst support system offer a long service life. The design also permits greater flexibility in bed and ducting arrangement.

Superior Catalyst Bed Support System

The NORAM converter employs a catenary-shaped curved plate design for catalyst bed support. The catalyst bed is supported by an assembly of fully welded, pie-shaped curved plates, bridging the shell and the center support system. This center support system can be a core tube or a ring and post arrangement. The weight of the catalyst bed is taken up entirely in tension within the curved plates. This mechanically efficient design eliminates the requirement for bed plate support beams that must be used in flat plate bed support systems. The primary benefit of the curved plate design is that plate and shell stresses induced by plate expansion and contraction are minimized. NORAM has carried out extensive mechanical design work using finite stress analysis on the nozzle connection to the converter shell and on the plate to shell connection. The weight of a NORAM converter is typically lower than that of a flat bed converter by about 25 percent, resulting in corresponding savings.

Uniform Gas Flow Distribution

NORAM has done extensive flow, pressure and temperature modeling for converters and the associated inlet and outlet ducts using Computational Fluid Dynamics (CFD) techniques. Gas flow patterns through the entire converter have been numerically simulated which allows NORAM to design converters with uniform gas distribution.

Shop Fabrication

NORAM has developed design and manufacturing procedures which allow shop fabrication of converters in sections, shipment to site, and field assembly. This approach enhances quality and minimizes field erection time.

High Overall SO_2 Conversion Efficiency

The use of all-welded stainless steel construction for the converter shell and the catalyst support and division plates prevents gas bypassing between beds. Gas leakage typically occurs in cast iron support and division plates. Elimination of this leakage source improves overall SO_2 conversion efficiency.

Design criteria have been developed to ensure optimum layout of catalyst beds and nozzles leading to very high SO_2 conversion efficiencies.

The NORAM Converter can be offered as a core entry or wall entry design. Core entry of gas above a catalyst bed results in uniform radial flow across the bed. The uniform gas flow pattern minimizes bed induced pressure loss and maximizes SO_2 conversion efficiency.

Rapid Heat-Up and Cool-Down

Traditional converter designs used a carbon steel shell with brick lining around the first catalyst bed. The brick lining is required due to the temperature limitations on the strength of the carbon steel shell. The use of brick lining in converters significantly increases the heat-up time required because rapid heating will cause cracking of the brick lining. The NORAM Converter is constructed entirely of welded stainless steel, allowing for rapid heat-up and cool-down to minimize the time for start-up and shut-down operations.

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- NORAM STAINLESS STEEL CATALYTIC CONVERTERS
- NORAM RF™ RADIAL FLOW GAS-TO-GAS HEAT EXCHANGERS
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