THE FUTURE OF TANK DESIGN

An update on tank design: Why design makes all the difference

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Thankfully, the old days of riveted tanks are gone, and the adage that "a tank is a tank" has become a thing of the past. Older tanks are being replaced by stronger, more durable and technologically advanced tanks of concrete, welded and bolted designs utilizing state-of-the-art materials and concepts. New technology, high strength materials, and automated fabrication tools have enabled tank and silo manufacturers to design and engineer storage vessels to meet the exact needs and size parameters of a facility, suit the specific properties of a product, design a product to last for decades and erect quickly. The best-built tanks today may expect a lifespan exceeding 30 years, and will experience less maintenance requirements than ever before. Engineers develop a structural design for tanks based on the product to be stored and the parameters of the location. Utilizing tools of geometry, and considering hoop and buckling stresses, vector analysis is used to determine horizontal and vertical loads and reactions. No national standards exist for dry bulk tank design, and therefore it is up to the skill and experience of individual designers and manufacturers to choose wisely from a wide variety of design concepts to achieve a safe and economical product.

Until recently, the materials of tank construction have not changed much over the years. With the wider availability and acceptance of higher strength steels and alloys, computer analysis, and automated fabrication machinery, improvements in the design and construction of storage tanks have been realized. The materials of tank construction usually depend on the volume of material to be stored. Field-welded steel and concrete tanks often are used to store an exceptionally large volume of product. Carbon and stainless steel as well as aluminum bolted and shop welded tanks are used for both dry and liquid storage and accommodate a wide range of volume and materials.

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tanks that utilize a form-flanged-panel design. When assembled, the built-in "rib" provides stiffness and strength at each multiple level of height, in both the horizontal and vertical directions. To achieve similar rigidity, flat panel tanks (such as welded or lap joint design) must include extra material to achieve stiffness. Today's shop welded and bolted tank designs allow for components to be installed at the factory before coatings are applied, and prior to field erection. Pre-engineered openings reduce erection time and eliminate the need for painting in the field. Field-welded tanks typically are cut in the field after erection to accommodate piping and factory equipment connections.

Bolted tanks with a flanged-panel design take advantage of gravity and a compression seal. The weight of the tank panels and product loads will compress the gaskets to form and maintain a leak-tight seal. Bolted tanks with lap joint design must rely on the tension and tightness of the bolts to maintain a seal in the weaker slip-joint design.

The importance of design

It is hard to underestimate the importance of proper design when it comes to tanks. Proper design ensures the greatest flow of product, ease of use and durability. The first step in determining proper tank or silo design is to understand the characteristics of the product to be stored, and the parameters required of the storage vessel.

Product characteristics

All materials have their own characteristics – whether dry foods, plastics, chemicals, wood products, wastewater, petrochemicals, wastewater, or potable water. What is the volume of storage needed? Is the product to be stored free-flowing or non-free flowing? What is the product's abrasiveness? What is the moisture content? Does the product require high-pressure storage, or low to atmospheric storage? What are the temperature ranges of the product? What are the chemical ranges? Is the product alkaline, neutral, or acidic?

The most important product characteristic that affects tank design is flow requirement. Flow requirement is determined through flow testing, which gauges the flowability of the product when subjected to a variety of conditions. The results will determine the proper degree for the hopper and hopper outlet, what