A world designed to last

Ripple Tray™ Technology

Proprietary separation trays serving the chemical, petrochemical, and refining industries for more than half a century

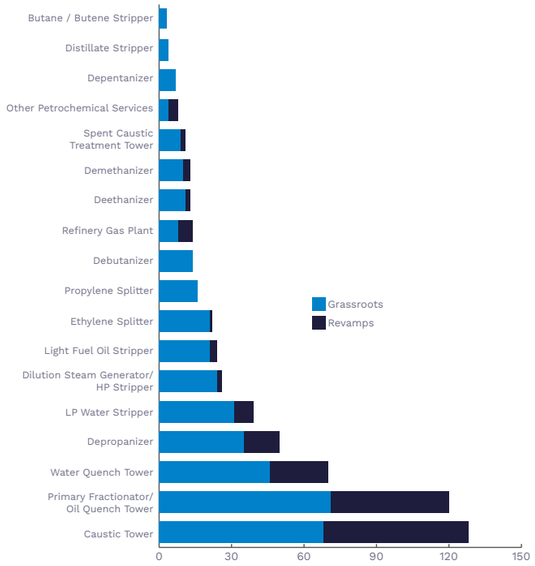


TECHNIP ENERGIES

Advanced tower performance in nearly 500 applications worldwide

Technip Energies is a leader in separation technology, providing advanced know-how in engineering services. Our patented Ripple Tray™ technology, a popular standard design feature for grassroot applications, can improve performance and reduce capital investment in new and revamped facilities.

RIPPLE TRAY EXPERIENCE



The trays have been proven for distillation, absorption, stripping, and heat transfer service in towers up to 44.2 feet (13.5 meters) in diameter.
By optimizing liquid and vapor handling, the trays enable significant capacity increases over conventional trays. In addition, the continuous agitation of the liquid on the top side of the trays, combined with continuous underside wetting/washing action, makes them ideal for fouling services. Tray designs covering a range of applications are available.

Continuous development

The Ripple Tray has been a mainstay in the separation business for many years. Driven by a growing need for high-capacity trays, and in the spirit of continuous development, we have developed several generations of these trays. Each provides advanced mechanical features that include tower attachment, improved installation, and increased capacity.

Proven performance

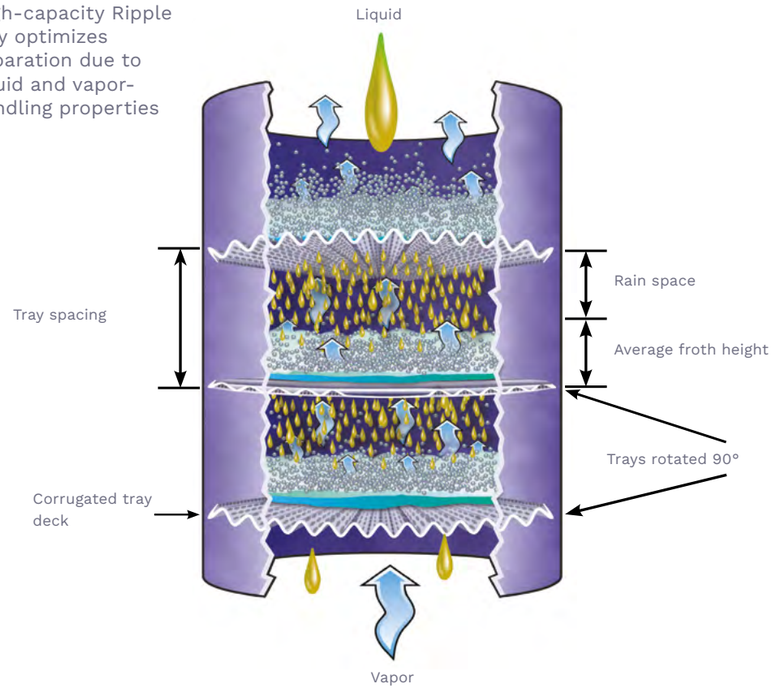
The Ripple Tray is a true counter-current contact device. Due to the nature of the frothing action and the liquid/vapor sharing of the open area, the tray easily attains efficiency equivalent to that of the Murphree point efficiency.

Stable efficiency has been demonstrated repeatedly in commercial applications over a wide range of operating conditions. The overall efficiency of conventional crossflow trays can be highly dependent on loadings due to flow path length variations and liquid back mixing on the tray decks. However, the tray is not influenced by such phenomena. In addition, the counter-current contacting of the well-distributed falling liquid droplets against the up-flowing vapor enhances tray efficiency through additional contact time. The tray achieves predictable efficiencies in similar service regardless of tower size.

IDEAL APPLICATIONS

- Quench water towers
- Primary fractionators
- Quench oil towers
- Gasoline fractionators
- Water strippers
- Caustic towers
- Demethanizers
- De-ethanizers
- Absorbers
- Stabilizers
- Slurry strippers
- Fouling services

High-capacity Ripple tray optimizes separation due to liquid and vapor-handling properties



Ripple tray characteristics

High capacity

Compared to conventional sieve or valve trays, Ripple Trays can easily increase column capacity by 40% or more. Additional capacity can be realized at a variety of conditions, whereas a large portion of the conventional tray geometry must be dedicated to the downcomer and receiving-pan area.

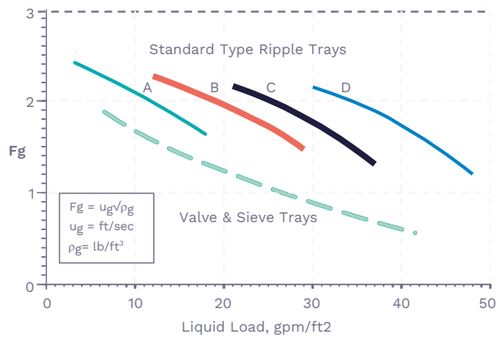
The Ripple Tray is not restricted by a particular geometry like other high-capacity trays. For example, other trays have distinct downcomer areas that limit liquid handling capabilities. The Ripple Tray, however, has unique self-adjusting characteristics that accommodate various combinations of high liquid and vapor loads. The operating range of a tray is large relative to its high-capacity features.

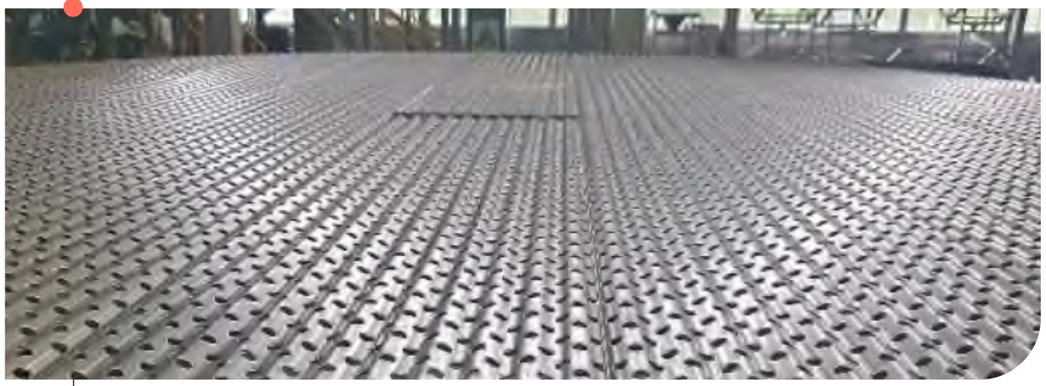
Turndown to 60% of design is typical and can be increased by adjusting the tray spacing and other mechanical features. Large turndown is possible because the tray-deck corrugations enable stable uniform vapor distribution at low loadings.

Anti-fouling capabilities

The Ripple Tray has superior ability to combat fouling without the associated problem of vapor/liquid maldistribution. The combination of turbulence on the tray deck with continuous washing of the bottom surface eliminates stagnation on the trays. This action prevents solids from collecting and polymers from forming.

RIPPLE TRAY CAPACITY ADVANTAGES





Fabrication

The Ripple Tray is made of perforated metal panels formed into sinusoidal corrugations. These corrugations provide a large surface area for vapor and liquid traffic, while the integral reinforcement furnishes inherent rigidity. Additionally, the corrugations prevent sagging and buckling of the decks that frequently plague ordinary trays. Because there are no downcomers, the down-flowing liquid and up-flowing vapor share the open area of the tray deck. The entire cross-sectional area of the tower is used for vapor/liquid contacting, enabling high tray capacity.

The trays are rotated 90 degrees alternately to facilitate liquid mixing from tray to tray. At low loadings, this rotation promotes liquid redistribution and corrects any random maldistribution that may occur.

The tray can be fabricated from carbon steel, stainless steel, copper, aluminum, titanium, and other metals.

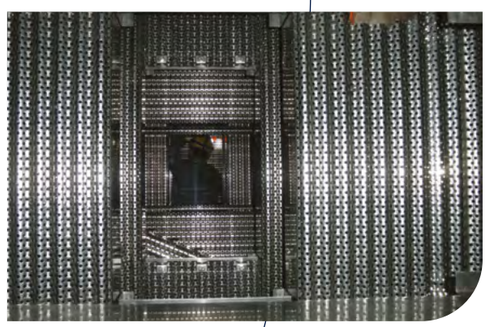
Installation

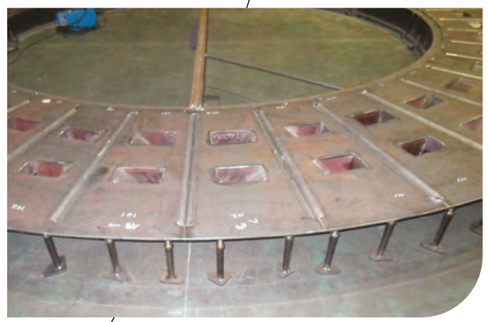
Ripple Trays are manufactured in sections to allow easy passage through a tower manhole. The trays are supported by a continuous 360-degree support ring, and rigidity and strength are ensured by integral support channels. Manways are provided in the trays for installation and maintenance. Large-diameter towers may use conventional structural members, but sizes are minimized by the inherent tray strength. Trays are clamped at their periphery to the support ring. The current generation tray requires less time for installation than previous models.

Vapor Flute™

The capacity of a tower with Ripple Trays can be maximized with the addition of Technip Energies's Vapor Flute™, a proprietary internal device that improves the vapor velocity profile into the tower trayed section. The flute enables better contact, less entrainment, and greater efficiency for trays and structured packing.







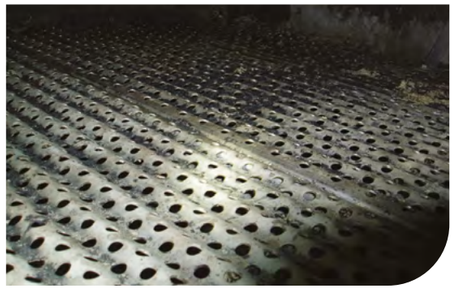
Technical services

In addition to Ripple Tray equipment supply, we provide a range of technical services for any distillation problem:

- **Process simulation design and optimization** – Through decades of process engineering and design experience, Technip Energies has perfected the techniques of process simulation. Our dedicated quench simulation platform for olefins plants has exceptional flexibility, and a similar program is available for caustic tower analysis. We use reliable accurate modeling techniques for troubleshooting and enhancing tower performance.
- **Computational fluid dynamic and finite element analysis** – Technip Energies analyzes vapor and liquid towzer maldistribution using computational fluid dynamics techniques. This is coupled with finite element analysis techniques to solve problems associated with nozzle stress and internal performance issues. These techniques are used routinely in the design of our Vapor Flute™ distribution device.
- **Field advisory services** – We offer an extensive scope of services. Qualified personnel provide installation inspections and commissioning, start-up, and performance test assistance, supporting equipment performance and mechanical warranties. Our highly experienced field staff provides practical advice for working and technical problems



Case studies



Typical rectification section Ripple Tray during turnaround inspection.



Bottom of a Ripple tray in Caustic tower during turnaround inspection.

Rectification section fouling improvement

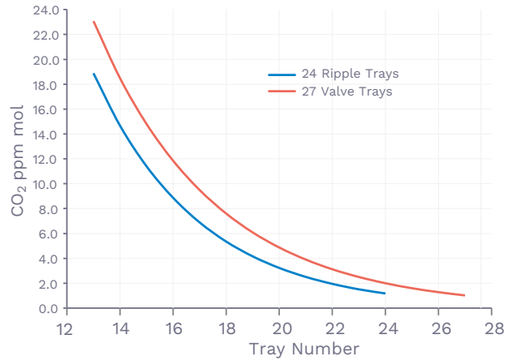
After nine months of operation, Ethylene Plant A experienced continual problems with primary fractionator rectification section fouling. The plant could be maintained in operation for up to 2½ years with the use of additives, but instead, our client decided to replace 20 existing conventional valve trays with an equal number of Ripple Trays. Since installation, there has been no evidence of fouling limiting operation and no need for additive injections.

Higher acid gas removal efficiency

At Ethylene Plant B, the caustic tower was originally furnished with 24 valve trays. For the revamp condition, an evaluation concluded that hydrogen sulfide (H_2S) removal could be achieved within the 24 valve trays, but carbon dioxide (CO_2) removal required 27 valve trays. However, use of 24 high-capacity Ripple Trays achieved both the CO_2 and H_2S removal specifications. The graph compares acid gas removal performance of the valve trays and Ripple Trays. After five years of service, this Ripple Tray caustic tower has consistently met the ethylene product CO_2 specification.



Ripple tray Caustic tower in Chine.



Improved CO_2 Removal Efficiency with Ripple Trays

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