



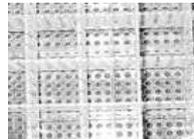
## High Performance Trays

### INTRODUCTION

Some radical new designs in column internals have been developed and introduced in the 1990's. These new internals offer dramatic gains in efficiency and capacity for mass transfer columns. These internals are characterized by optimal capacity-efficiency profiles, improved operation properties and low-costs.

Within the **AlphaTRAY™** range, HAT manufactures under exclusive license from Gesip GmbH two designs of **Highspeed™** tray for different applications. These are:

#### High Performance Types:



**HST**  
**Highspeed Sieve Trays**



**HSC**  
**Highspeed Swirl Cyclone Trays**

#### HSC Swirl Cyclone Tray

The **AlphaTRAY HSC** Highspeed Swirl Cyclone Tray (Fig. 1) is a tray with weir and downcomer. It is equipped with swirl mixing and separating elements (SME) fixed into the opening of the tray plate. The SME consists of a vertical cylinder with an annular row of holes in its lower section. The axial swirler, which is firmly attached to the inside of the cylinder has inclined vanes in the upper section and is provided with a net of ribs arranged axially along the nozzle axis at the lower section. The mass transfer zone is directly above the swirler. The cyclone separator with the concentric annular slot separates the liquid from the gas/vapor phase. Deflection rings prevent short-circuiting of the liquid after the mass transfer.



# High Performance Trays

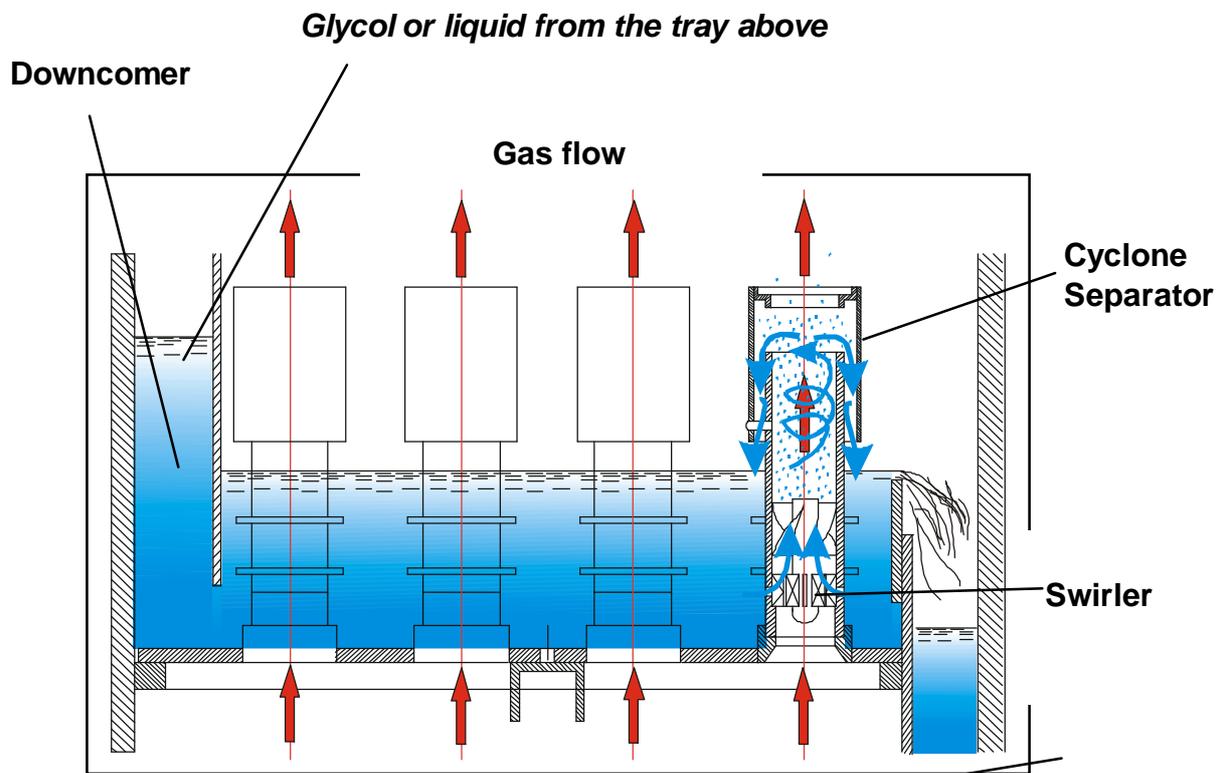


Fig 1: HighspeedTray with contact and separating elements

The liquid enters each SME through an annular row of holes in the lower, grid zone of the vertical blades and is dispersed into small droplets. The liquid droplets move in an axial direction together with the gas within the SME and flow upwards until the two phases reach the inclined blades of the axial swirler. Here the liquid-gas flow is subject to a rotary motion causing the drops to be flung to the inside wall of the element. This creates a rotating liquid film, which moves upward due to the frictional drag forces of the gas flow. The final separation of the liquid drops and the liquid film from the gas flow takes place in the separation zone. The separated liquid exits the SME via a deflection cap, which prevents it from being re-entrained. It is discharged downwards back onto the tray.

The high flow velocities in the SME guarantee an intensive atomization of the liquid and both an initial high intensity level mass transfer and the subsequent effective cyclonic phase separation in the swirled flow.

The most important performance features of the columns with this HSC tray are

- Realization of highly compact, multifunctional mass transfer columns, especially for the high-pressure dehydration and separation of gases.



## High Performance Trays

- A miniaturization of the columns leads to considerable equipment savings with special advantages for offshore facilities (reduction by typically one-half of the column mass compared with traditional structured packing construction).
- This tray can be utilized for the refitting and modernization of existing columns as well as in combination with other mass transfer equipment.
- Realization of 1.5 to 2 theoretical trays for each metre of column height, while maintaining a tray spacing of 400 to 500 mm.
- High level of flexibility allowing separation of gas-liquid mixtures with higher solid content
- Indifference to deviations from the horizontal (unevenness) during column operation, a factor especially important for offshore facilities.
- Maximum liquid load of up to  $100 \text{ m}^3 / \text{m}^2 \text{ h}$ , the result of the foam suppressing characteristic of the SME elements (no foaming, clear (vapour-free) liquid in the downcomer)
- This tray can also be utilized as a high performance mist eliminator.

The preferred application fields are the natural gas, oil and petrochemical industries for onshore but especially of off-shore plants, gas processing at high pressure e.g. dehydration in glycol columns, gas sweetening, absorption and desorption processes, the rectification of hydrocarbon or other mixtures and in environmental technologies for gas scrubbing.

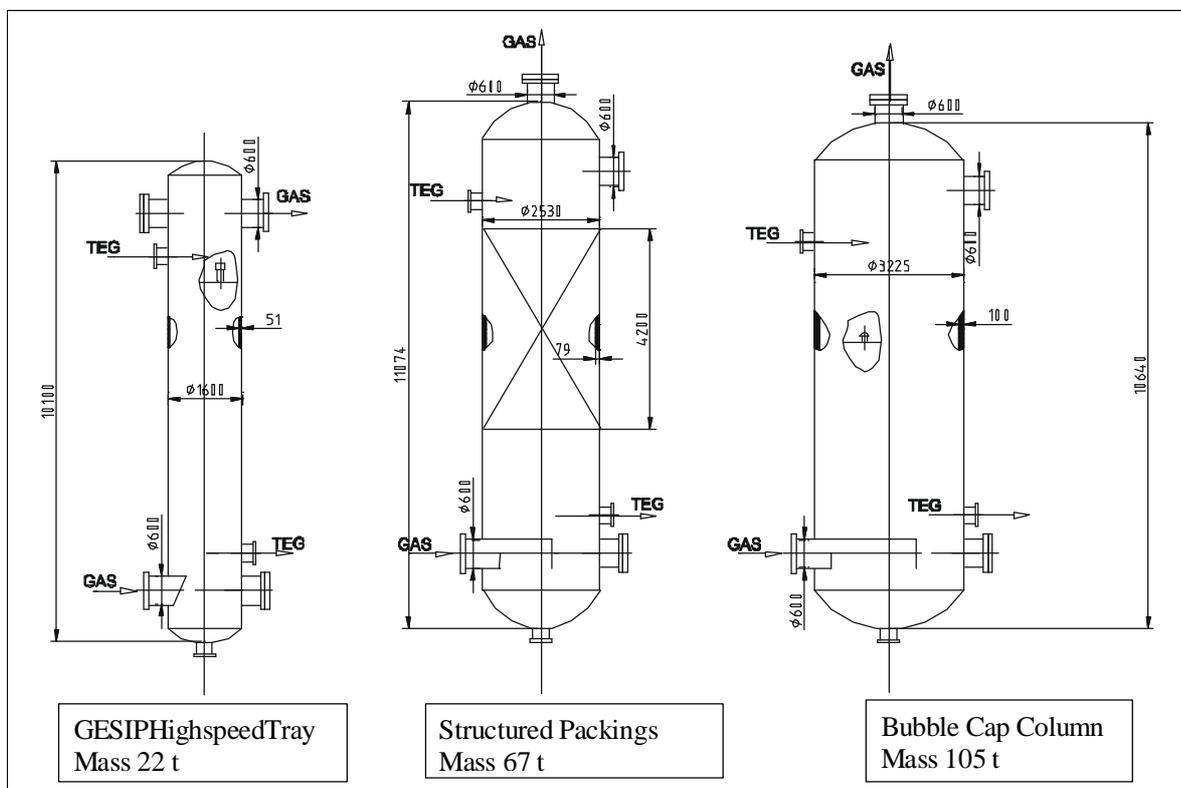


Fig. 2: Comparison of column sizes and weights for the dehydration of natural gas (10 MM Nm<sup>3</sup>/d, at 30°C and 60 bar)



## High Performance Trays

### HST Highspeed Sieve Tray

The HST Sieve Tray is a dual-flow sieve tray without downcomer and with a special froth stabilizer (Fig. 3). This new tray design improves the flow characteristics and increases the mass transfer significantly. The highly efficient froth stabilizer is located directly on the tray plate. The stabilizer has a special construction consisting of two different right-angled cellular systems which guarantees a well-organized flow regime of the liquid phase (solvent) as well as of the gaseous phase (or gas to be cleaned). The layout of this stabilizer on the sieve tray also provides optimal conditions for the development of a stable froth layer (Fig. 4).

The stability of this froth layer is an essential prerequisite for high efficiency of the entire column and it allows an increase in the superficial gas velocity up to 3 m/s (Fig. 5). The upper parts of the stabilizer sheets are perforated to improve the mass transfer and thus increase the separation efficiency. The lower part is without perforations. The height of the mobile froth on the tray is between 100 to 300 mm, so that a tray spacing of 250 to 300 mm and F-factors of 1.8-2.5 and liquid loads from 0.1 to 50 m<sup>3</sup>/m<sup>2</sup>.h are possible in columns with large diameters. These columns operate very stably and efficiently with low liquid loads. This new type of construction doubles the performance of sieve tray columns compared with traditional construction.

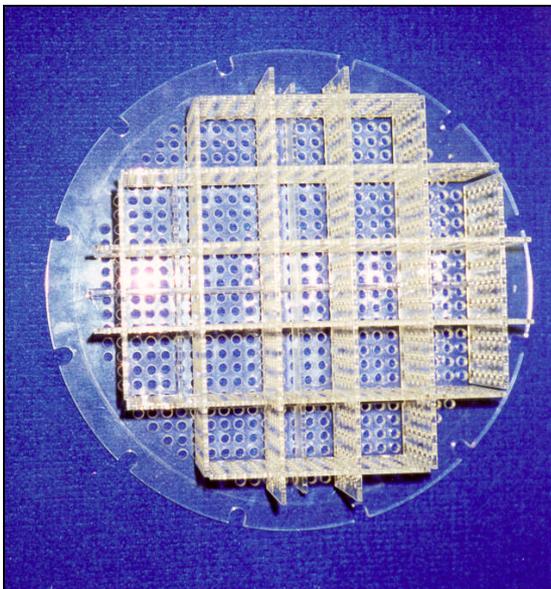


Fig. 3 : Sieve Tray with Froth Stabilizer



Fig.4: View of the Tray During Operation



# High Performance Trays

Dependence of the froth height on the liquid load at different gas velocities

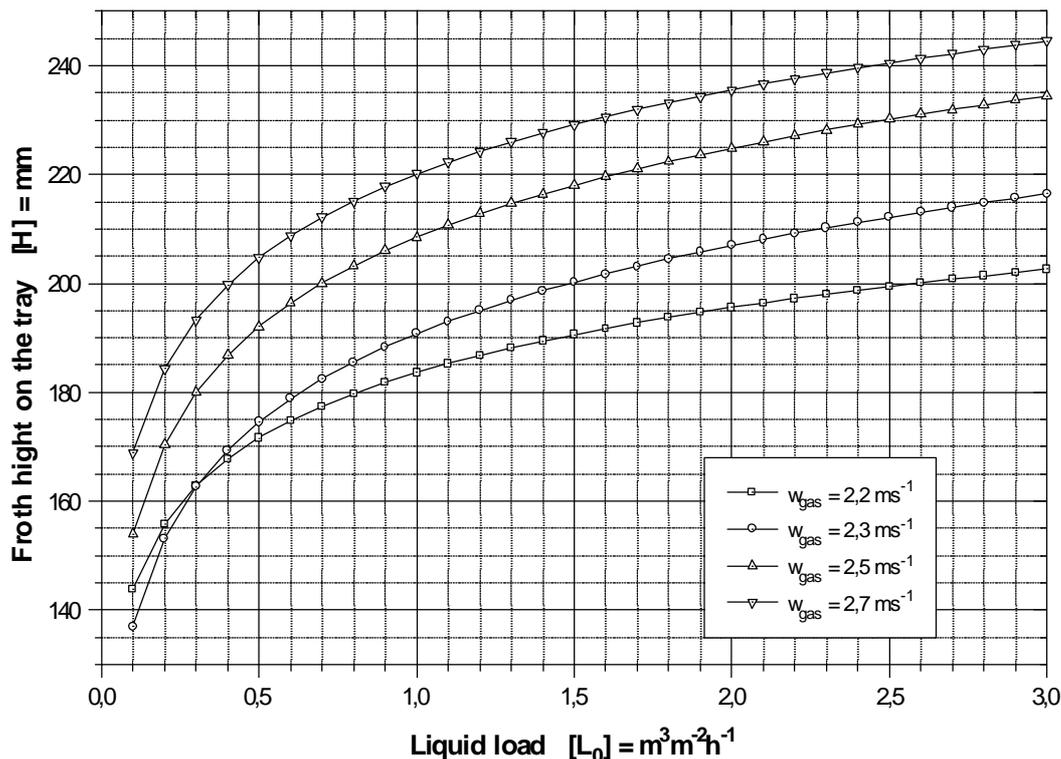


Fig.5: Froth Height on the Sieve Tray with Stabilizer as a Function of the Gas Velocity and the Liquid Load

At the same time, it also improves operating characteristics and the degree of effectiveness (significantly increased separation efficiency). The mass-transfer tray efficiency increases up to 40 % in comparison with conventional sieve trays, the surface area of the froth layer is about 500 m<sup>2</sup>/m<sup>3</sup>. Fig. 5 shows how the height of the froth layer on the HST sieve tray (with stabilizer) varies according to the gas velocity and the liquid load.

The new sieve tray with froth stabilizer allows trouble free operation even in the case of out-of-levelness of the plates. This tray can be applied in industrial absorbers and gas washers for very high throughputs, e.g. natural gas treatment, petrochemicals, chemical industry, oil refining and gas cleaning and as wet scrubbers for gas washing to remove atmospheric impurities and pollutants as well as dusts. It can be applied for washing of gases with very high content of solids as slurries or other systems. The pressure drop is very low and about 10% higher than on a conventional sieve trays (due to the higher froth layer).