High-Specific-Surface-Area Packing for Chemical & Petrochemical Industries

(UNDERSLAB-super surface nozzle)

Mass transfer processes are essential in the **chemical and petrochemical industries** for separating, purifying, and reacting different chemical components. These processes rely on efficient **phase contact between gases and liquids or between immiscible liquid phases** to achieve optimal separation.

The most common mass transfer operations include:

- **Distillation:** Separation of liquid mixtures based on differences in volatility.
- **Absorption:** Removal of gas components by dissolving them in a liquid solvent.
- **Extraction:** Separation of compounds using a solvent that selectively dissolves one or more components.

- These processes are used in refining crude oil, gas treatment, chemical synthesis, and environmental applications like pollution control.

Role of Packing in Distillation, Absorption, and Extraction Columns

Packing plays a crucial role in improving mass transfer efficiency by **enhancing contact between phases** and **promoting effective separation**. There are two main types of packing used in industrial columns:

- **Random Packing** (e.g., Raschig rings, saddle rings):
  - Provides surface area for mass transfer.
  - Used in applications where cost and simplicity are priorities.
- **Structured Packing** (e.g., mesh packing, flat-parallel nozzles):
  - Offers higher surface area and controlled liquid distribution.
  - Reduces pressure drop and increases separation efficiency.

Packing influences **separation efficiency, energy consumption, column height, and operating costs**. Highly efficient nozzles maximize phase contact, allowing for a reduction in the structural weight of the unit, ultimately reducing energy costs.

Limitations of Conventional Packing

Traditional packing types include:

- **Random packing (e.g., Raschig rings, Pall rings, Berl saddles)**
- **Structured packing (e.g., corrugated sheets, mesh structures)**
- While effective, these packings **suffer from drawbacks**, including:
- **Limited surface area per unit volume** → reduces the mass transfer efficiency per unit of useful column volume.
- **Uneven liquid distribution** → leading to inefficient separation and increased reflux requirements.
- **High-pressure drop** → increasing energy consumption and operating costs.
- **Column size constraints** – requiring larger columns to achieve desired separation performance, leading to higher capital expenditure (CAPEX).

As industries push for **higher efficiency, lower energy consumption, and reduced environmental impact**, there is an urgent need for improved packing solutions.

Importance of Improving Packing Efficiency – Key Advantages & Benefits

The **introduction of new type of nozzles with high specific surface area** is crucial for enhancing process performance and reducing operational costs.

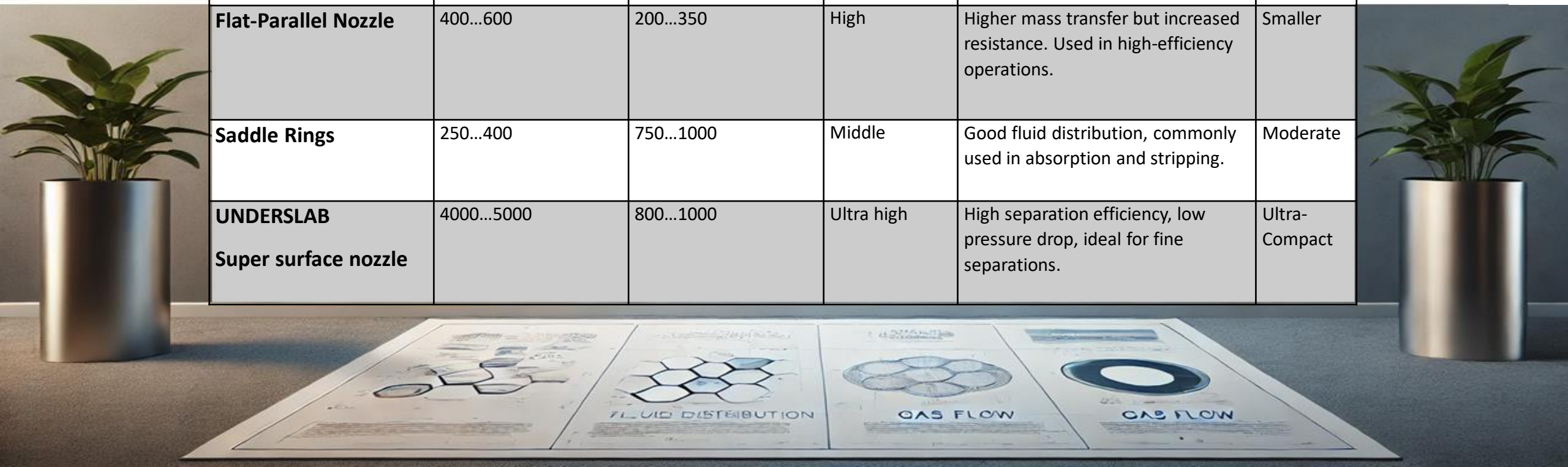
- **Higher Specific Surface Area → Improved Mass Transfer**
  - More surface area means better interaction between phases, leading to improved separation.
  - Reduces the number of theoretical stages required in a column.
- **Reduced Column Size → Lower Capital Costs (CAPEX)**
  - More efficient packing allows for shorter, more compact columns.
  - Lower structural and installation costs.
- **Lower Energy Consumption → Reduced Operating Costs (OPEX)**
  - High-efficiency packing reduces pressure drop, minimizing energy required for pumping and compression.
  - Improved separation reduces reflux ratios, lowering heating and cooling demands.
- **Better Liquid Distribution → Enhanced Process Stability**
  - Advanced nozzles (e.g., **Mesh 1300, flat-parallel packing**) improve wetting characteristics, preventing dry spots and channeling.
  - Ensures uniform mass transfer, increasing operational reliability.
- **Increased Capacity & Flexibility**
  - High-performance packing **handles higher throughputs** without flooding.
  - Can accommodate changes in process conditions without major equipment modifications.

The **introduction of new high-specific-surface-area packing (e.g., Mesh 1300, flat-parallel nozzles)** revolutionizes mass transfer operations by **enhancing efficiency, reducing costs, and enabling more compact designs**. As industries move toward **energy-efficient and high-performance separation systems**, investing in advanced packing technologies is essential for long-term competitiveness and sustainability.

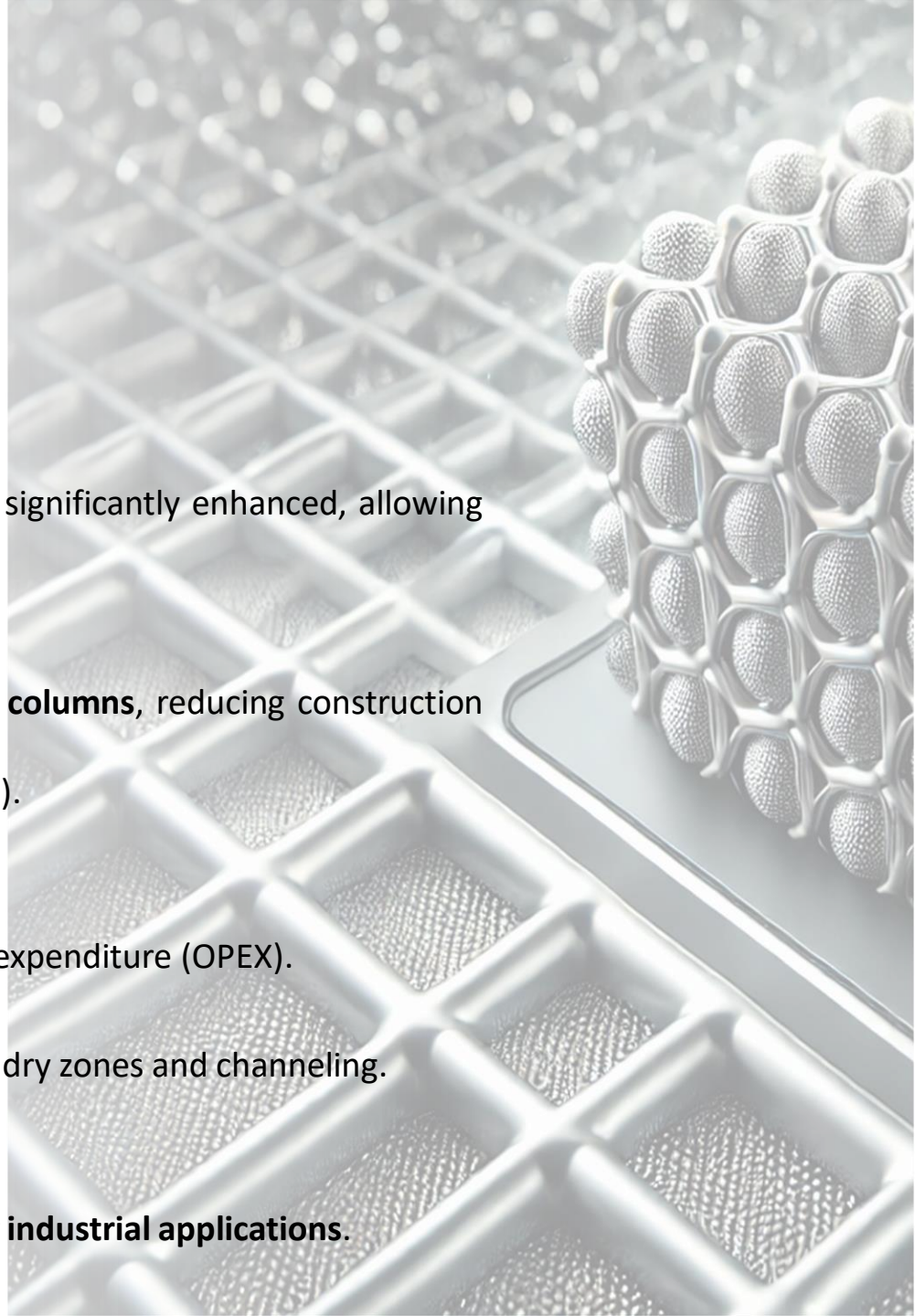
Definition of Key Parameters

The introduction of a **new nozzle with a specific surface area of 3000–5000 m²/m³** represents a significant advancement in mass transfer technology for **chemical and petrochemical industries**. This ultra-high specific surface area offers substantial benefits in **distillation, absorption, and extraction** processes by **enhancing separation efficiency, reducing equipment size, and lowering energy consumption**.

Packing Type	Specific Surface Area (m^2/m^3)	Density of the nozzle, kg/m^3	Mass Transfer Efficiency	Performance Characteristics	Column Size Impact
Mesh (Metal)	500…1700	300…700	Very high	High separation efficiency, low pressure drop, ideal for fine separations.	Compact
Raschig Rings	100…200	750…1000	Low	Low efficiency, high pressure drop, mainly used in older installations.	Large
Flat-Parallel Nozzle	400…600	200…350	High	Higher mass transfer but increased resistance. Used in high-efficiency operations.	Smaller
Saddle Rings	250…400	750…1000	Middle	Good fluid distribution, commonly used in absorption and stripping.	Moderate
UNDERSLAB **Super surface nozzle**	4000…5000	800…1000	Ultra high	High separation efficiency, low pressure drop, ideal for fine separations.	Ultra-Compact



Key Advantages of the New Nozzle



Maximized Mass Transfer Efficiency

- With **3000–5000 m^2/m^3** surface area, vapor-liquid or liquid-liquid interactions are significantly enhanced, allowing for **faster and more complete separations**.
- Ideal for **fine separations and high-purity chemical production**.

Drastic Reduction in Column Size

- High-efficiency packing allows for shorter **distillation, absorption, and extraction columns**, reducing construction costs.
- Lower weight and material requirements reduce overall capital expenditure (CAPEX).

Lower Energy Consumption & Pressure Drop

- **Minimized pressure drop** reduces the energy required for fluid circulation.
- Improved separation efficiency allows for lower **reflux ratios**, reducing operational expenditure (OPEX).

Improved Liquid Distribution & Wetting Characteristics

- Advanced **capillary action and microstructuring** enhance liquid spread, eliminating dry zones and channeling.
- Leads to more **uniform performance under varying flow conditions**.

Increased Throughput & Capacity

- Can **handle higher flow rates without flooding**, making it suitable for **high-capacity industrial applications**.
- Ensures flexibility in process optimization.

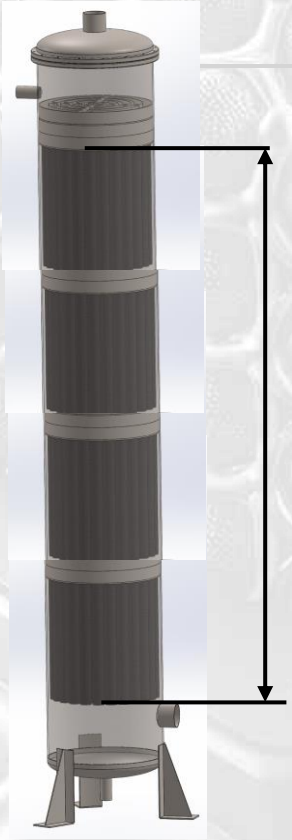
Comparison of column dimensions when using various types of packing to ensure a given specific surface area of the packing

This new super surface nozzle is ideal for:

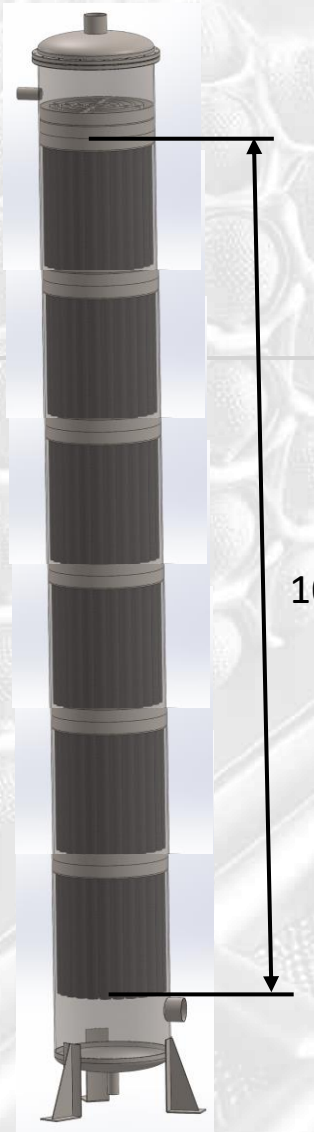
- ☑ **High-purity distillation** (pharmaceuticals, petrochemicals, fine chemicals).
- ☑ **Gas absorption & stripping** (CO_2 removal, acid gas treatment).
- ☑ **Solvent extraction processes** (refining, biofuels, specialty chemicals).
- ☑ **Cryogenic separations** (LNG processing, air separation).

UNDERSLAB

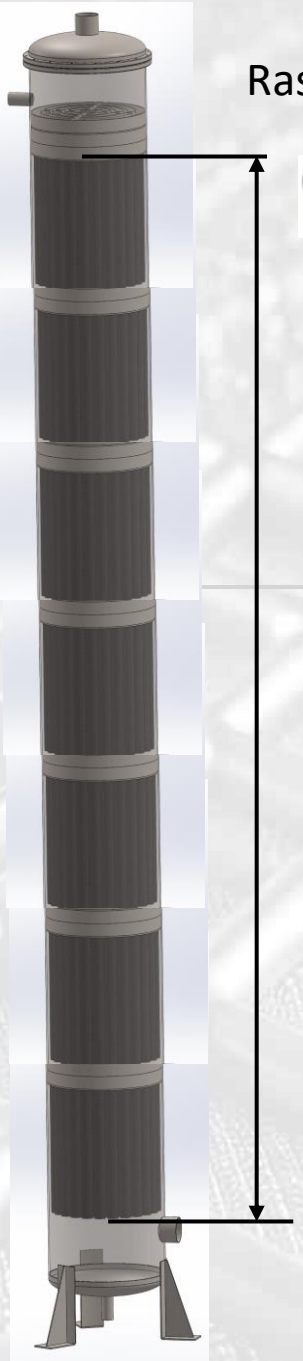
Mesh nozzle



Saddle rings



Raschig rings




Thank you for your attention!