50 Years of Structured Packing

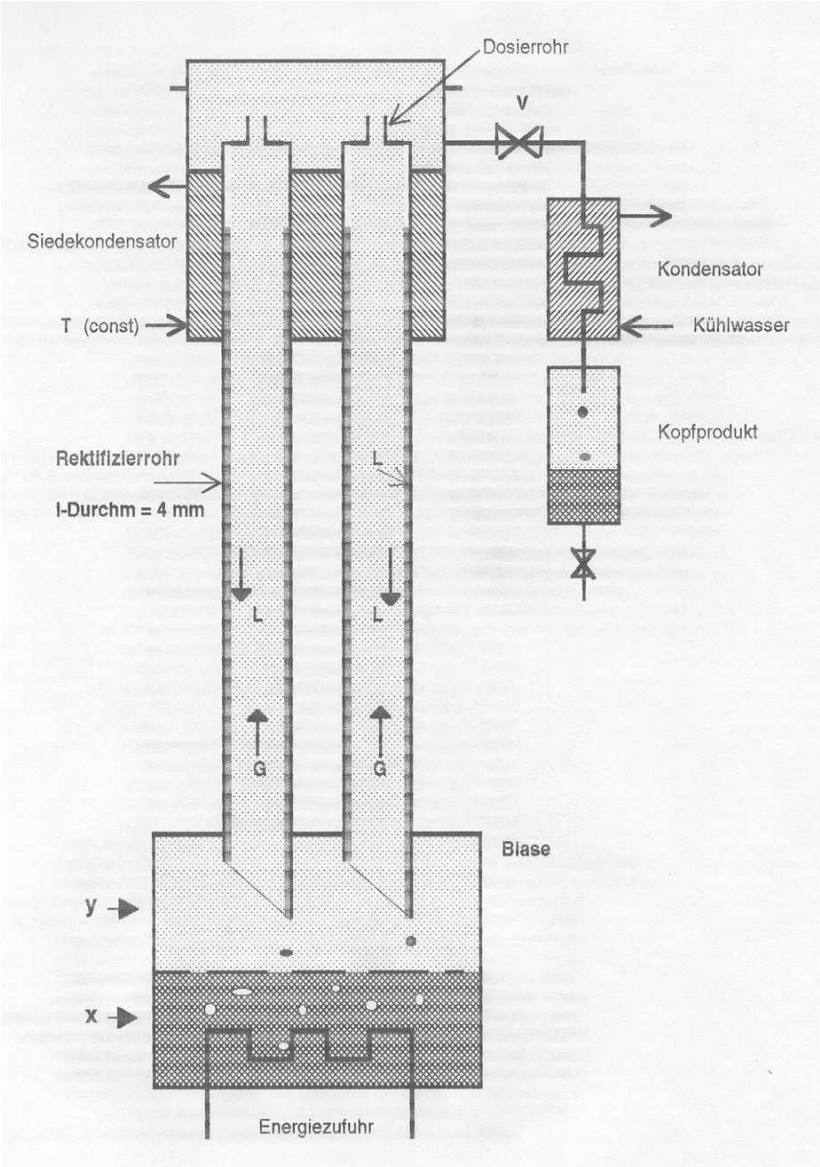
Sulzer Chemtech

Dr. Lothar Spiegel | June 2013

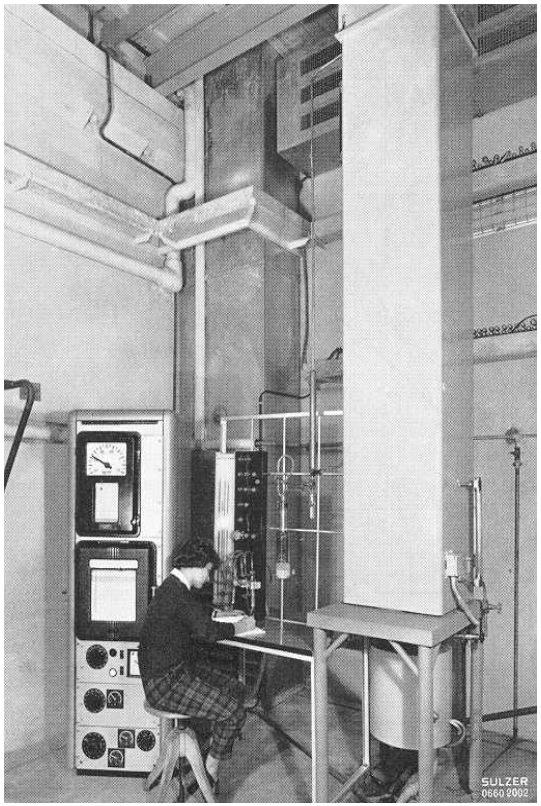
The Fifties: How everything began

- Sulzer was very active in the booming field of nuclear technology with the manufacturing of components for nuclear power plants
- There was an construction department at Sulzer for steam vessels, pressure lines, food industry
  little profitable
- Heavy water production was of high interest (use of natural Uranium)
- 1950 Sulzer acquired a license from Prof. Werner Kuhn, University of Basel, for his film column apparatus

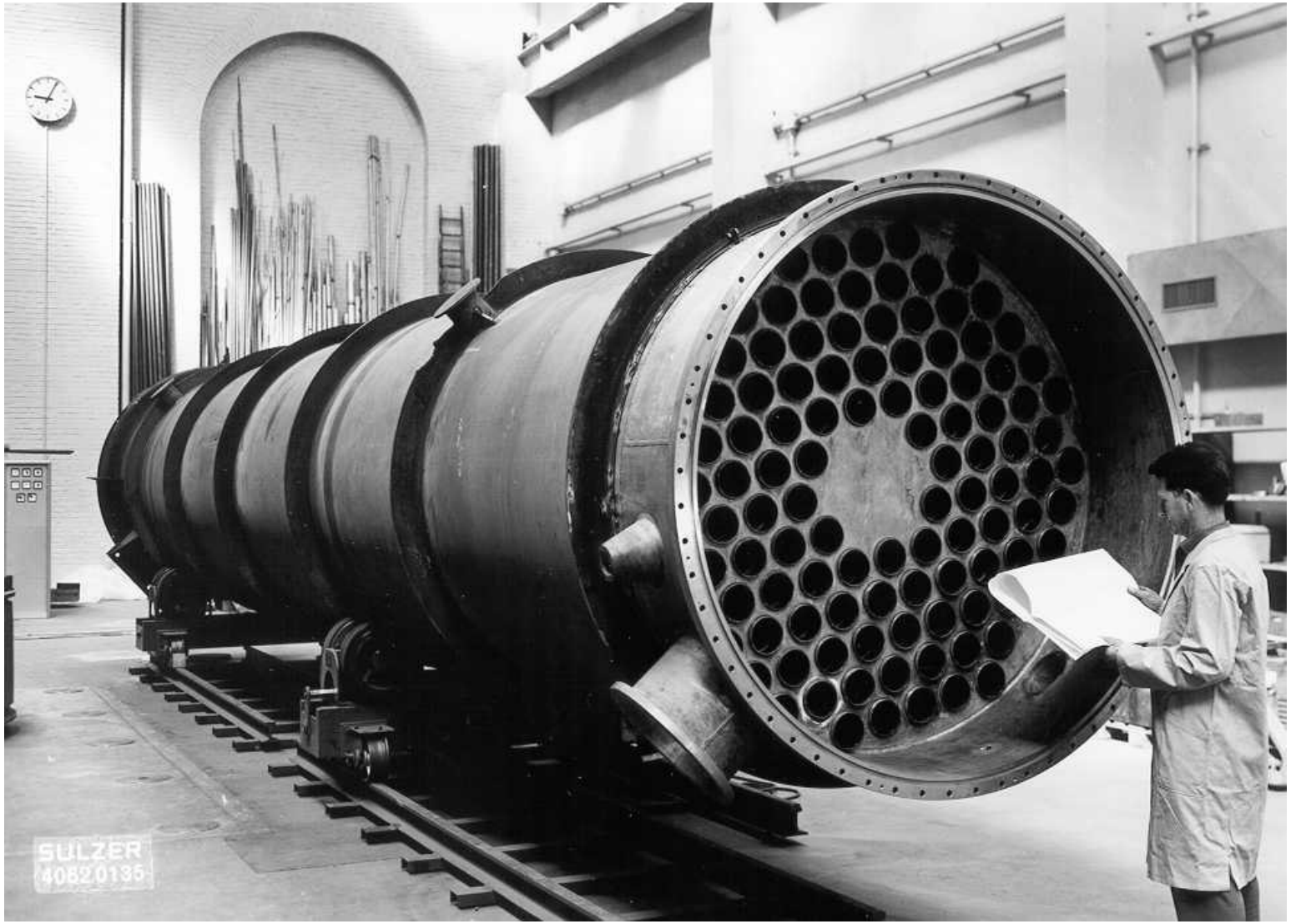
Principle of the Kuhn column



Experimental laboratory column
61 empty tubes, diameter 4mm, 2m long

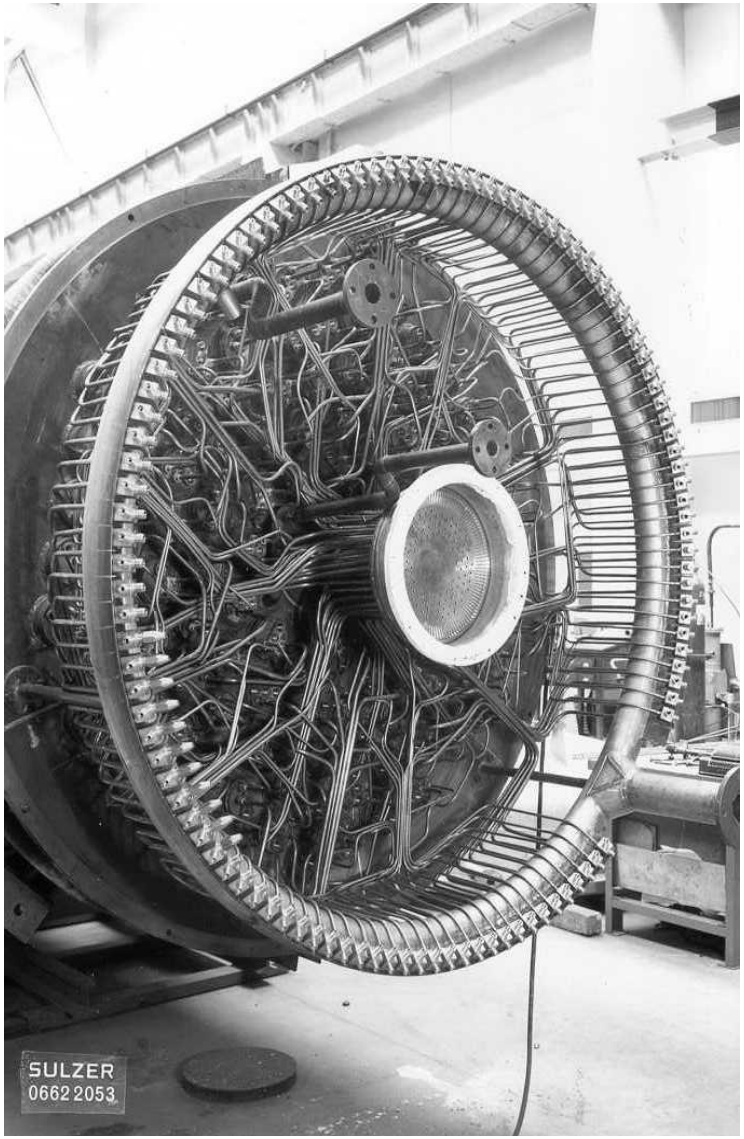


Industrial example of the Kuhn column



The end of the Kuhn columns

- High NTS per m, low pressure drop but:
- Small throughput per tube -> Parallel connection of the film tubes and …
- Larger tubes -> Decrease of the separation efficiency
- Complicated apparatus (see feed point)
- Sensitive to maldistribution -> no sharp separation
- Conclusion: Kuhn columns not suitable for CPI, therefore the further development of the Kuhn column was abandoned.



Begin of the packing aera

Dr. Max Huber, born 1925

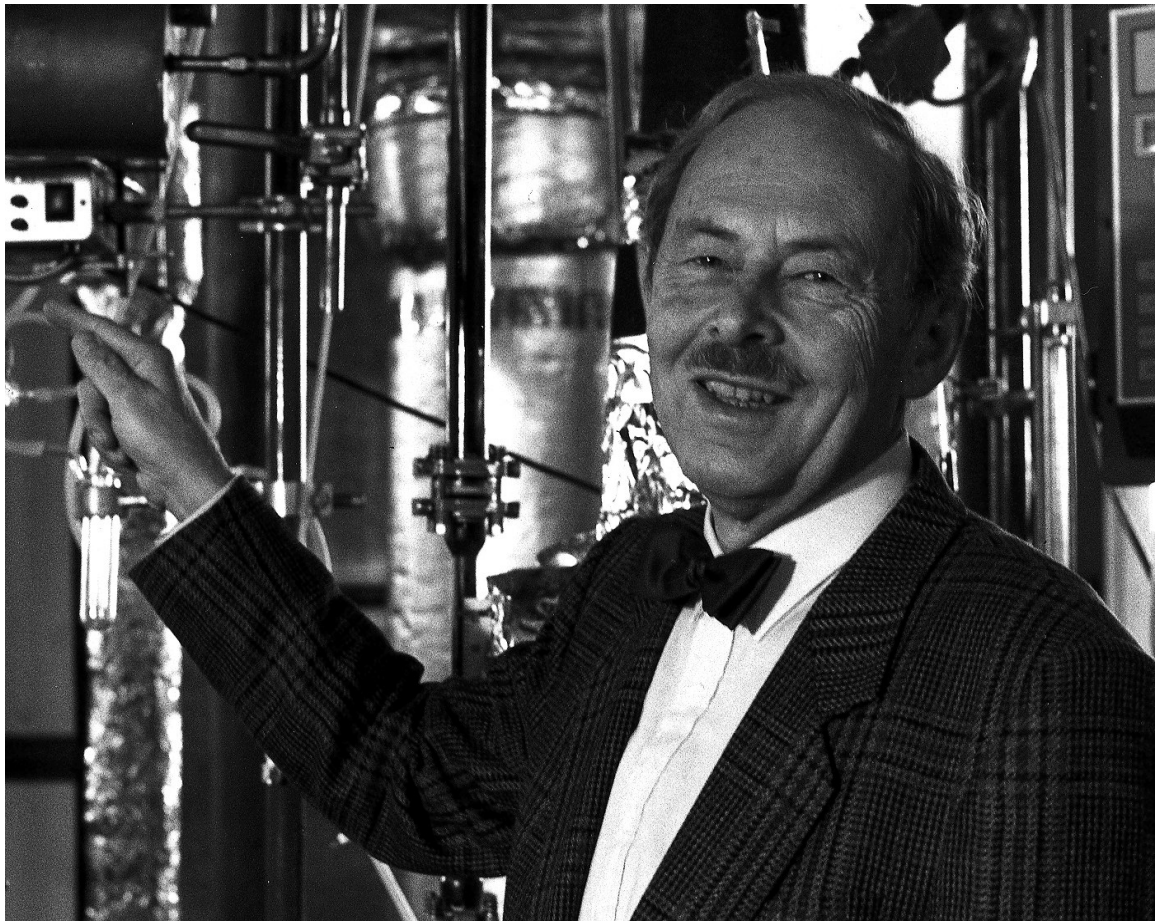
1944-48 Chemistry at ETH

1948-52 PhD with Clusius,
Separation Swing,
University of Zürich

1953-55 National Research
Council Ottawa,
Flow in pores of
activated carbon

1956-58 Separation of Uranium
isotopes with counter current
ionic migration with
Clusius

1958 Start at Sulzer



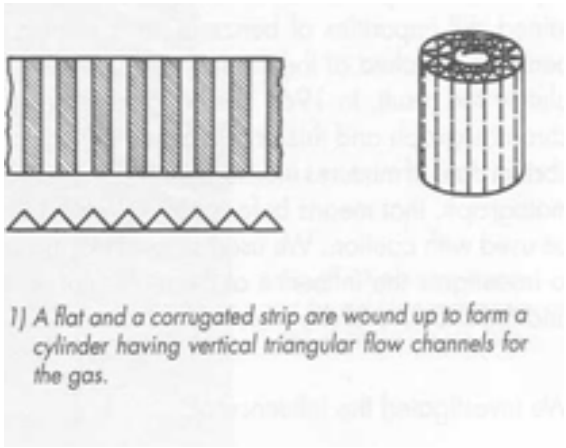
Development of packing 1

New approach:

Develop packing for any diameter, NTSM 5-10, low pressure drop per theoretical plate

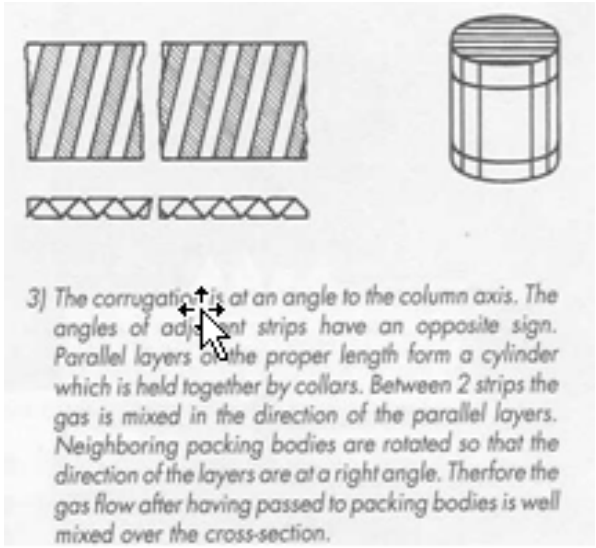
Idea:

- Packing to consist of self wetting wire gauze (based on experience with Dixon rings)
- Regular structure (analog to Kuhn column)



1) A flat and a corrugated strip are wound up to form a cylinder having vertical triangular flow channels for the gas.

From vertical to inclined channels

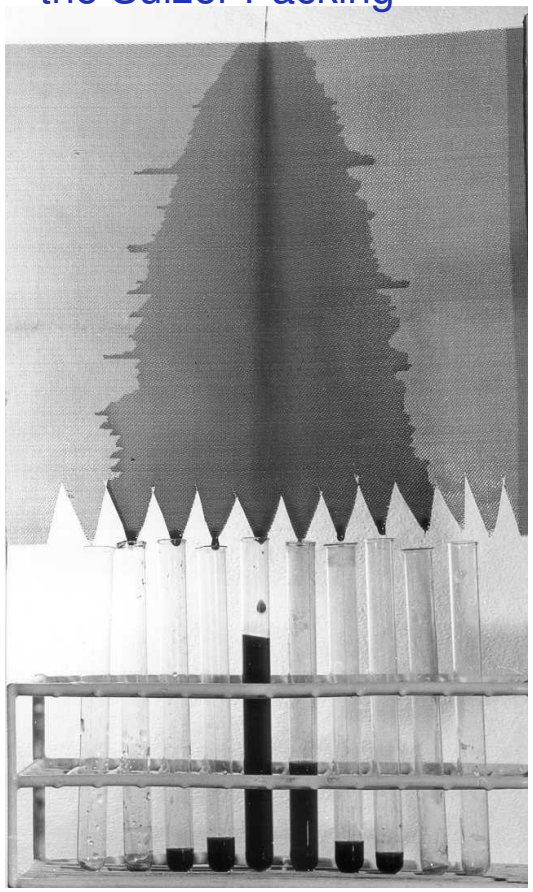


3) The corrugation is at an angle to the column axis. The angles of adjacent strips have an opposite sign. Parallel layers of the proper length form a cylinder which is held together by collars. Between 2 strips the gas is mixed in the direction of the parallel layers. Neighboring packing bodies are rotated so that the direction of the layers are at a right angle. Therfore the gas flow after having passed to packing bodies is well mixed over the cross-section.

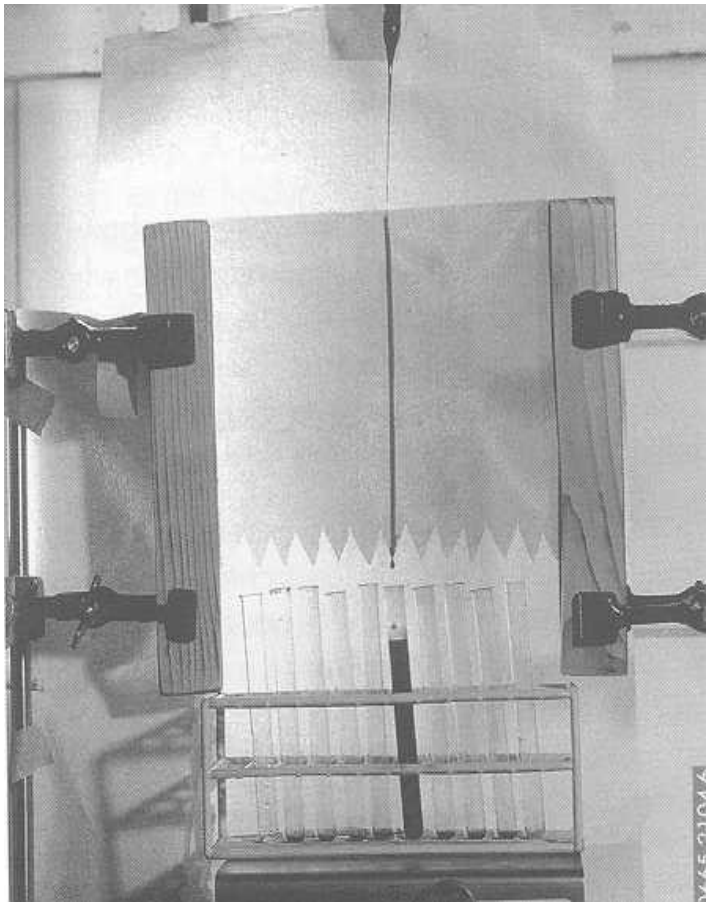
Development of packing 2

- Different tests with wire gauze

Special wire gauze for the Sulzer Packing



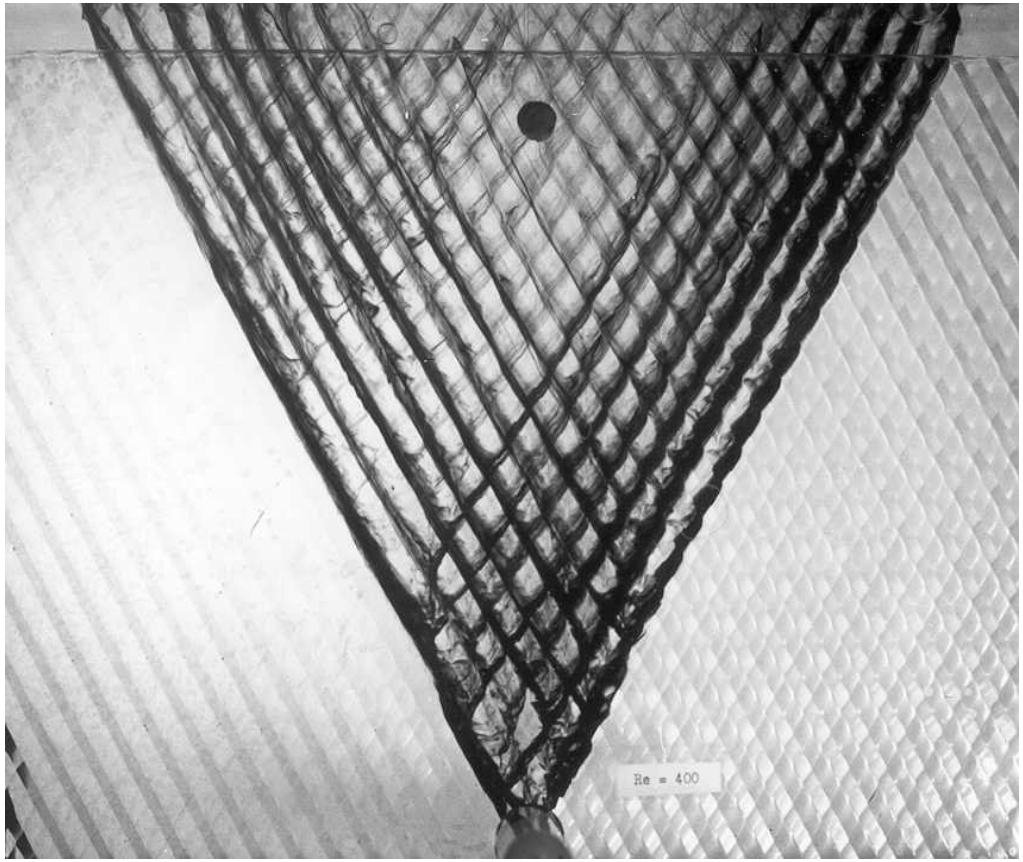
Normal wire gauze as used for Dixon rings

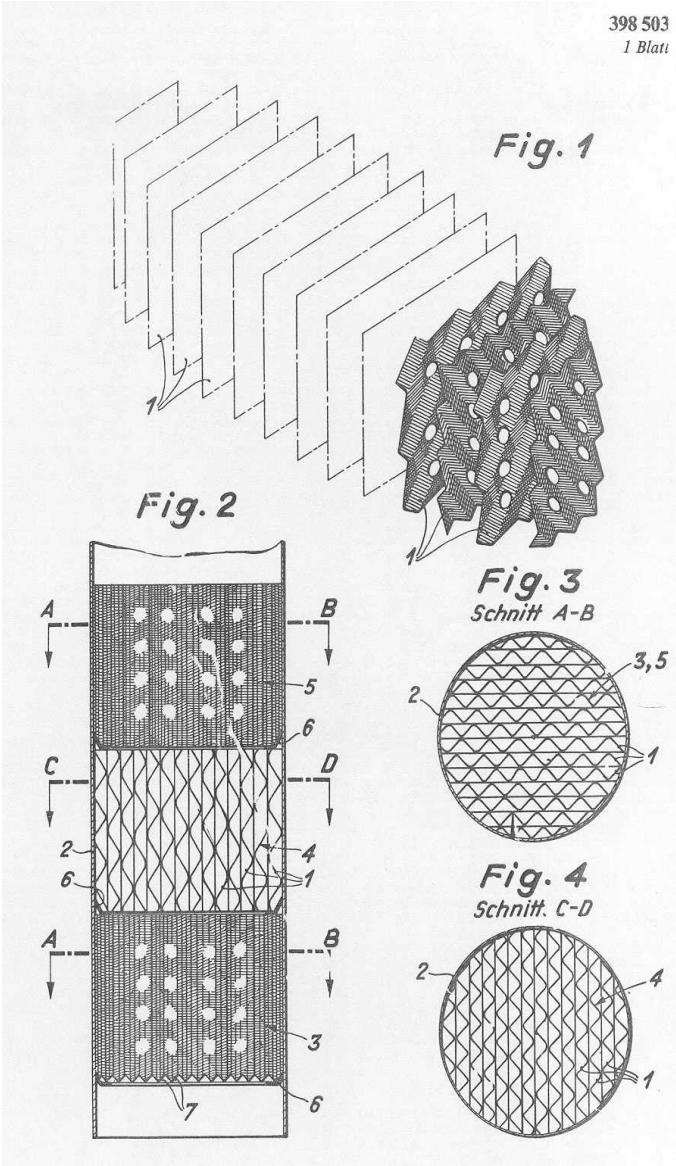


Development of packing 3

Patent 1962

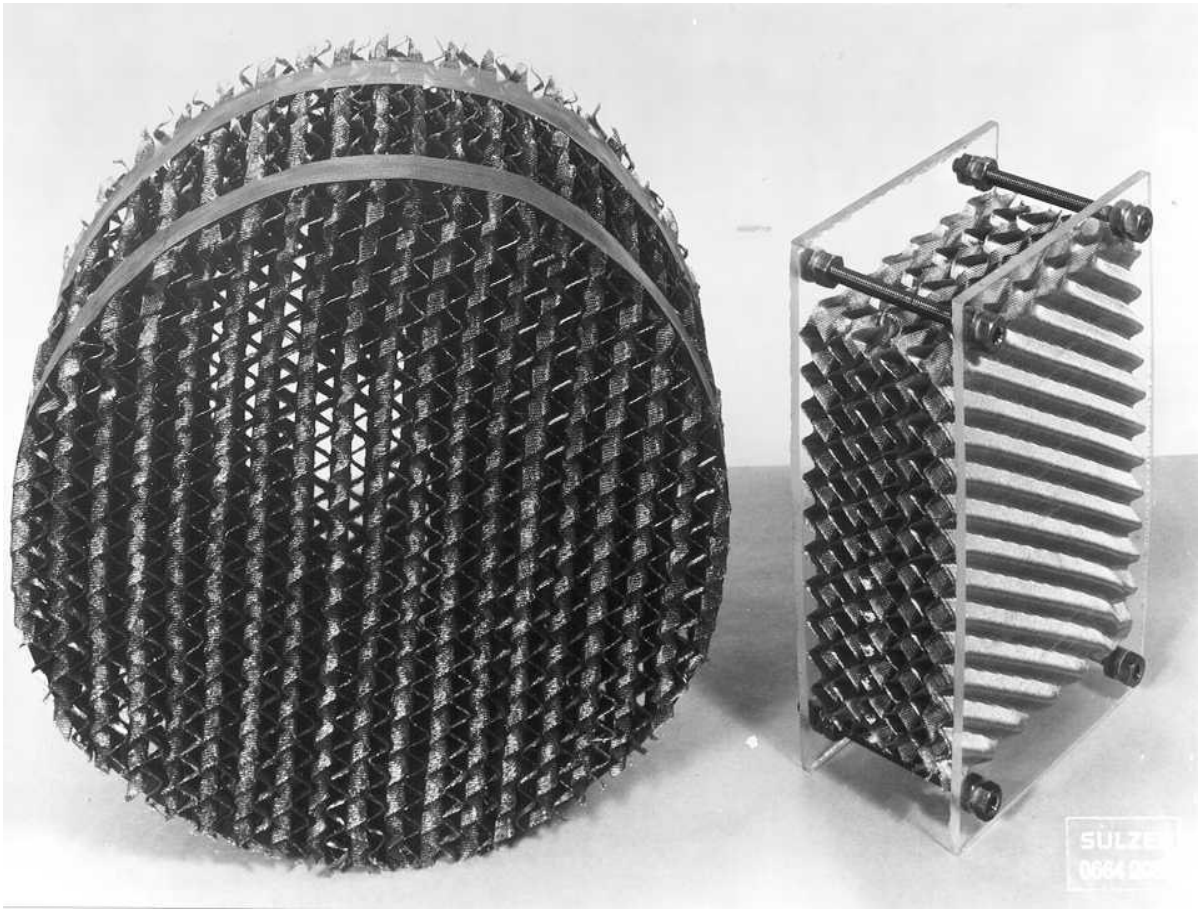
Distribution tests with water in the flow channel (Zogg, 1972) demonstrate strong lateral mixing





Development of packing 4

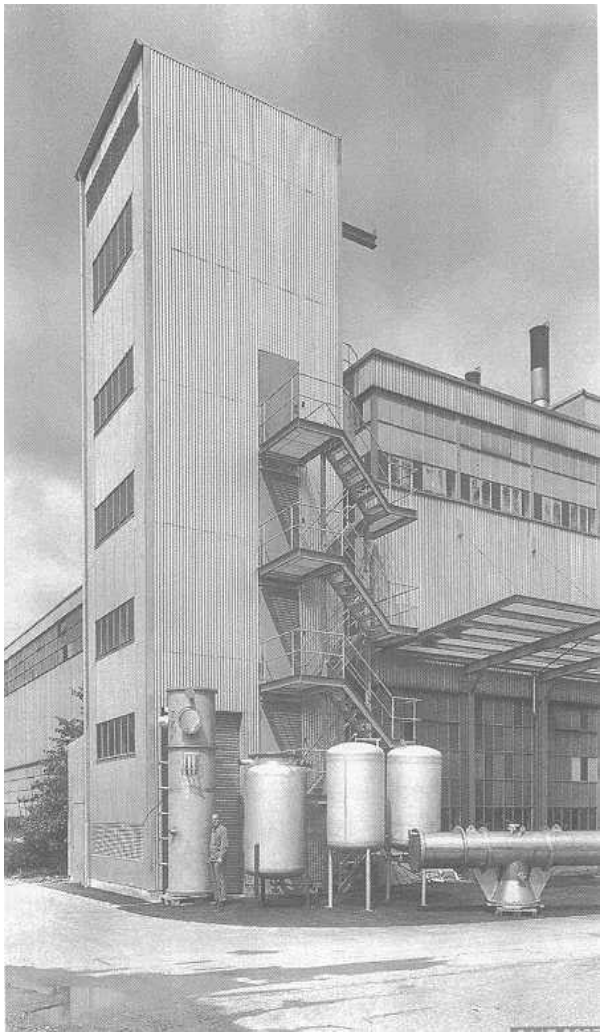
- Tests with different geometries in the 50mm laboratory column (packing height 1m) give very good results
- Decision for the types BX and CY



Pilot columns

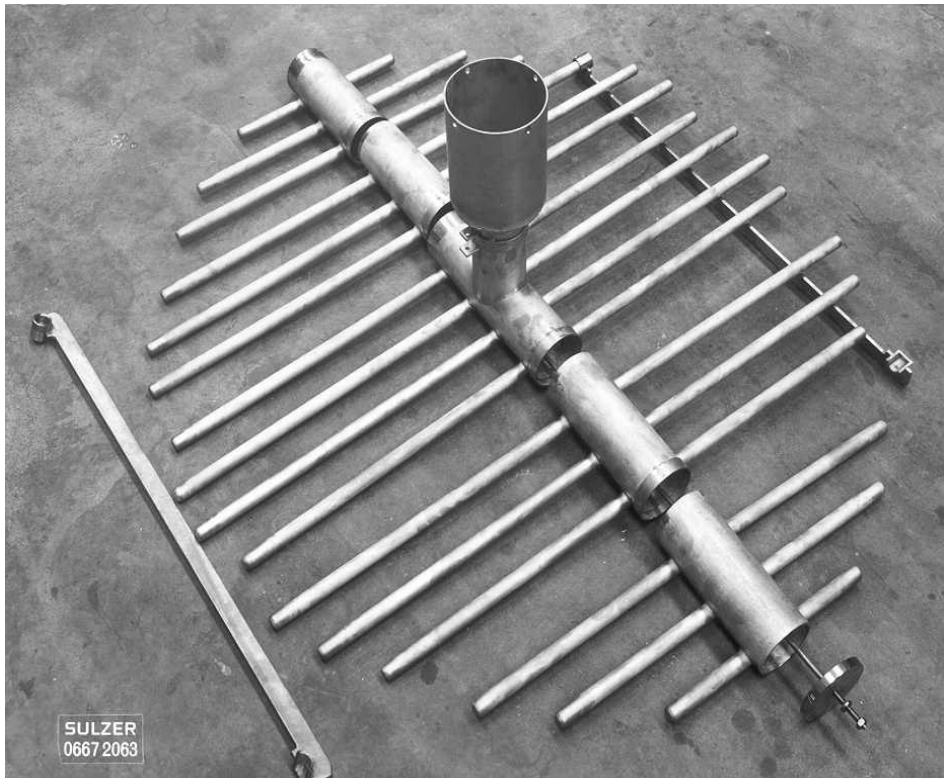
P500 (1963), first tests with larger diameters

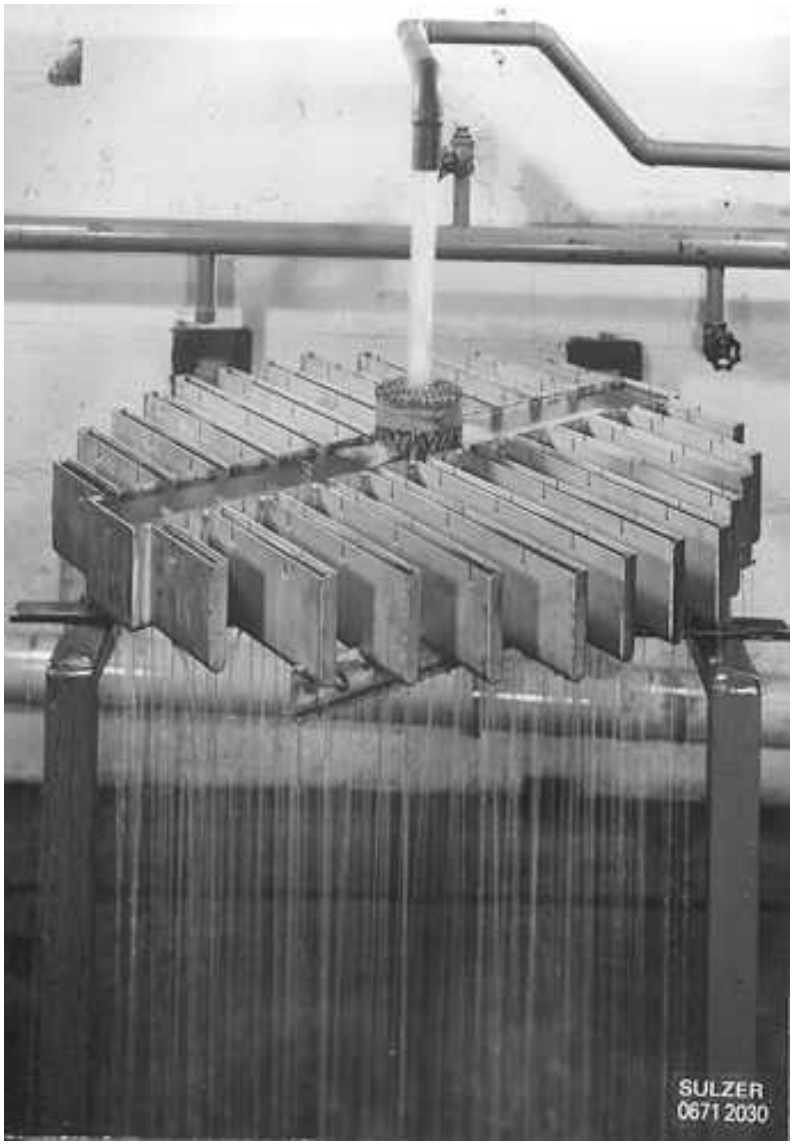
Tower for the P1000 (1966), evidence for HETP to be independent of diameter



Packing fabrication 1965

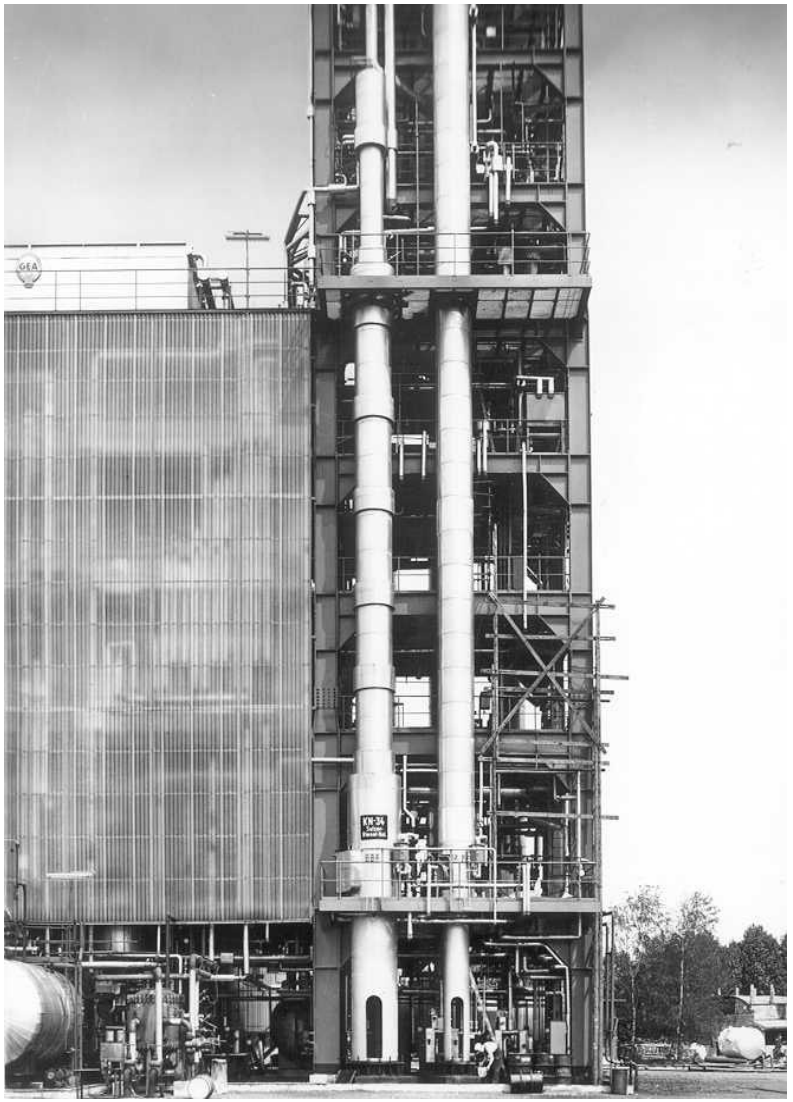
Special distributors





First success with the Sulzer packing

- 1964 Presentation of the Sulzer gauze packing at the Achema
- 1964: First order of BX, Batch, 300mm/9m, fragrances
- 1965: Order of BX, 900 mm, Xylenol separation
- 1967: License contract with Koch for US market, later with Sumitomo, Japan
- 1971 FRI tests in P1000

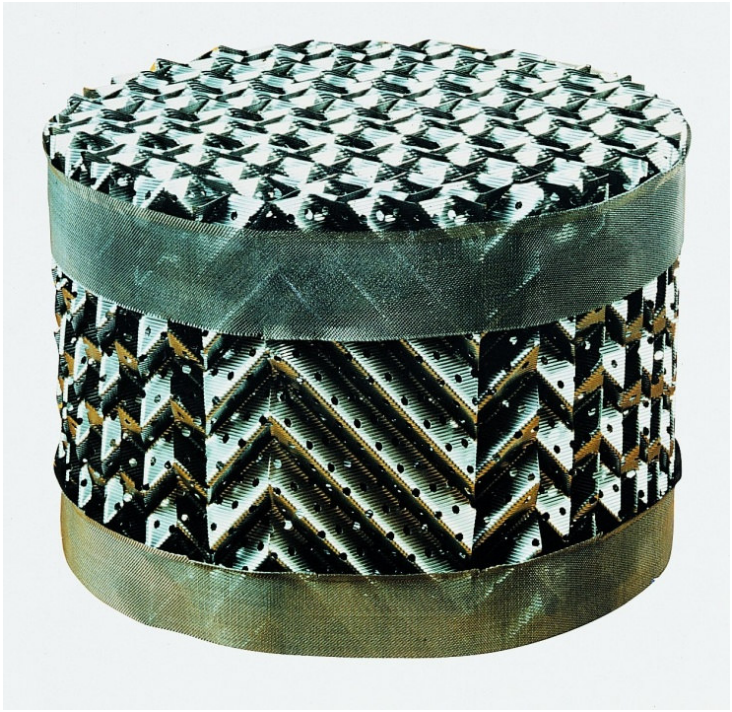


International D&A Symposium 1969 in Brighton

100th column 1970

The Seventies: The rise of the Mellapak

- 1974 First tests with Mellapak
- 1975 „Holes and grooves“
- 1976 Presentation at the ACHEMA
- 1977 First tall oil column
- 1978 First styrene column



Dr. Werner Meier, born 1938
1966 Start at Sulzer as head of the packing laboratory, later head of the separation column department

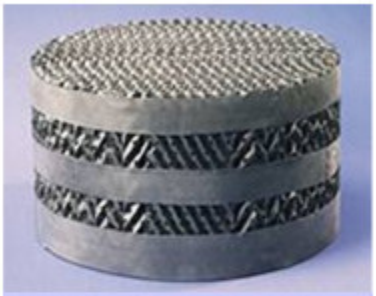
1. Talloil column 1977

More materials, more geometries

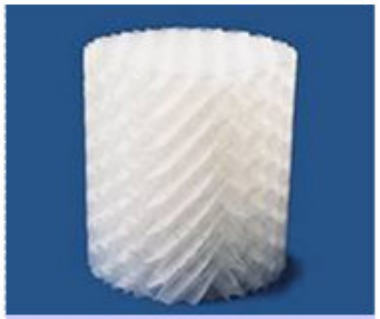
Mellapak

Mellapak®
metals and alloys

Gauze Packings



BX gauze packing
CY gauze packing in
metals and alloys



Mellapak®
in plastic

BX gauze packing
in plastic

For corrosive media:
Mellacarbon

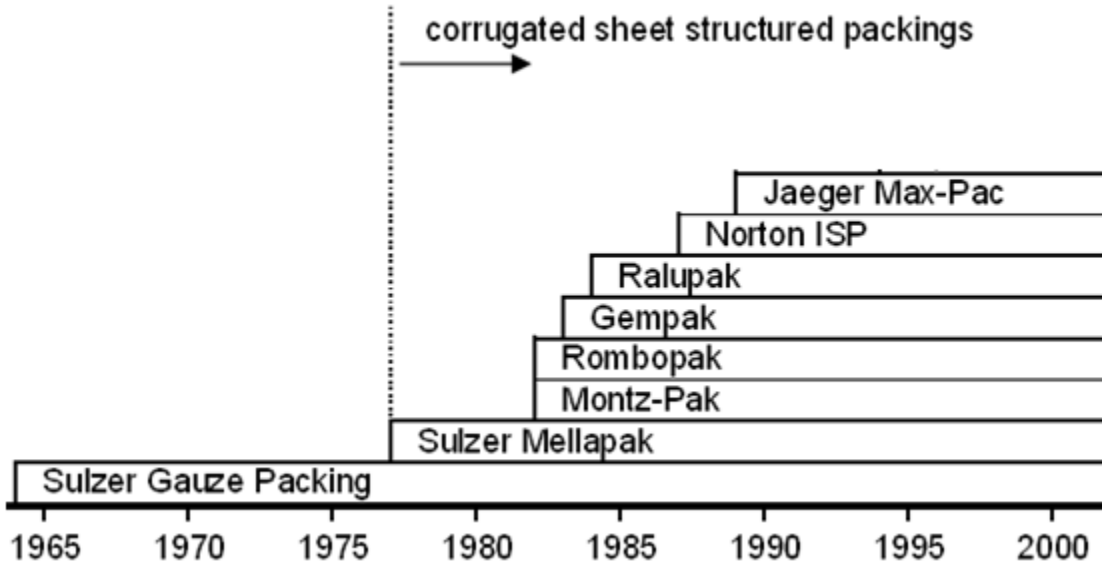
Removed from portfolio:

Kerapak

Melladur

The Eighties: First competition

1st generation packing



The Eighties: New applications

- Refinery columns (vacuum towers)
- Air separation
- Moving columns
- Failure with high pressure distillation
- Success with high pressure absorption
  Natural gas drying with glycol up to 100 bar

SIM1000 air/water column

Larger and larger diameters

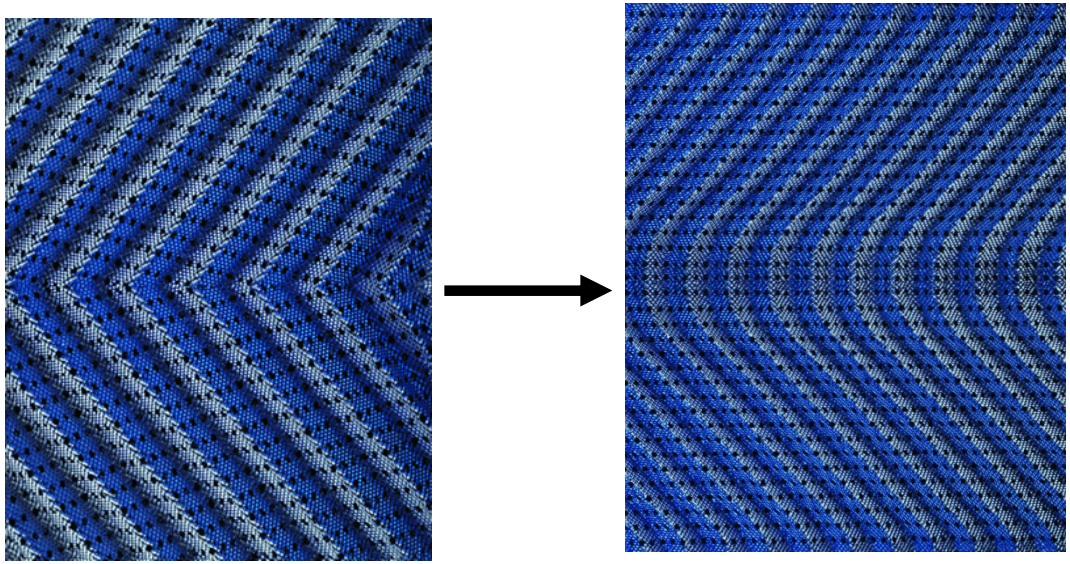
Styrene column, Dow Chemical Benelux, diameter 9.5 m, 1984

…require distributor tests

The Nineties: High performance packing

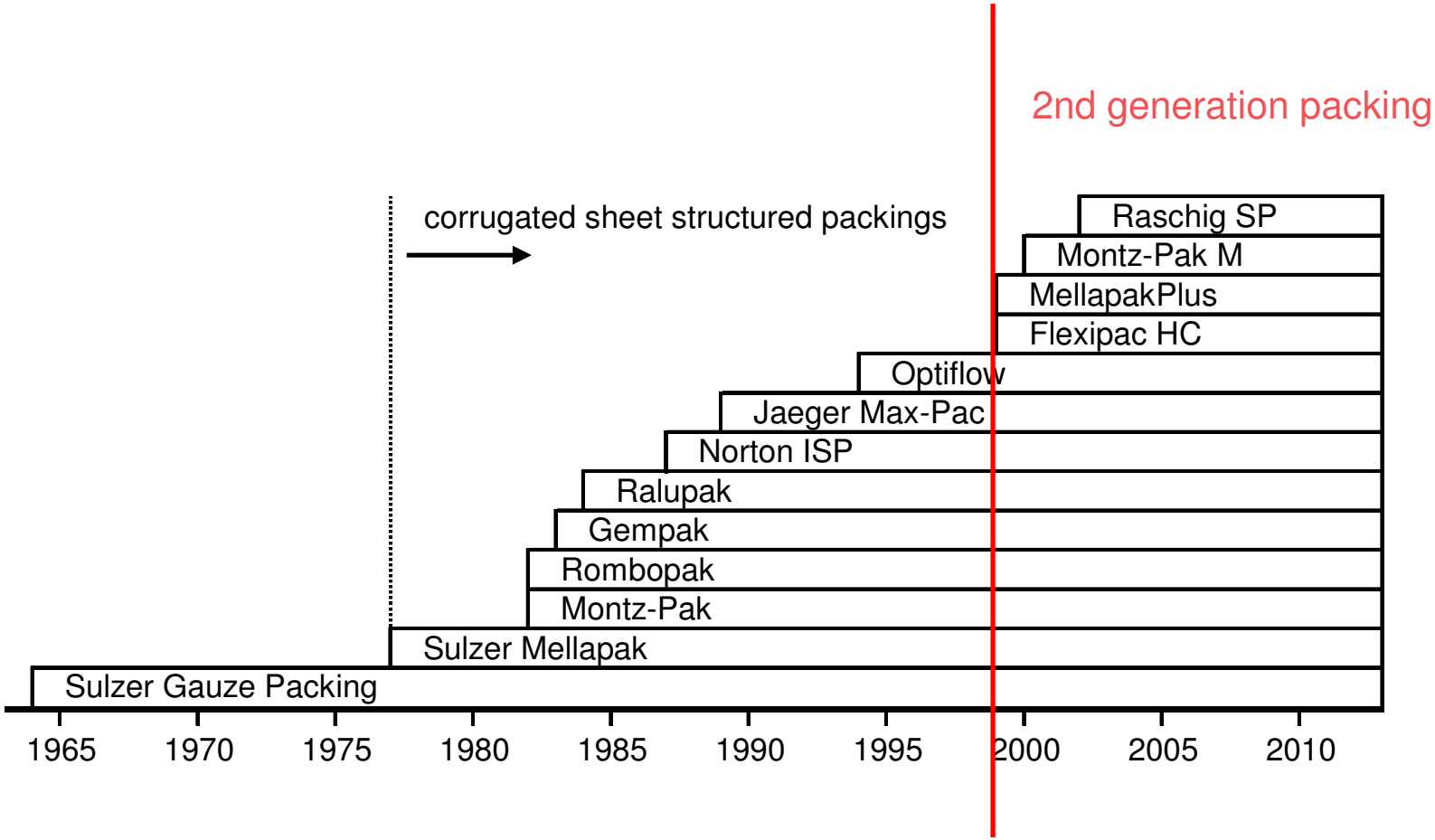
- Further boom years for styrene, air separation and refinery columns
- 1992 Optiflow

- 1999 MellapakPlus
  30% more capacity at same HETP as Mellapak



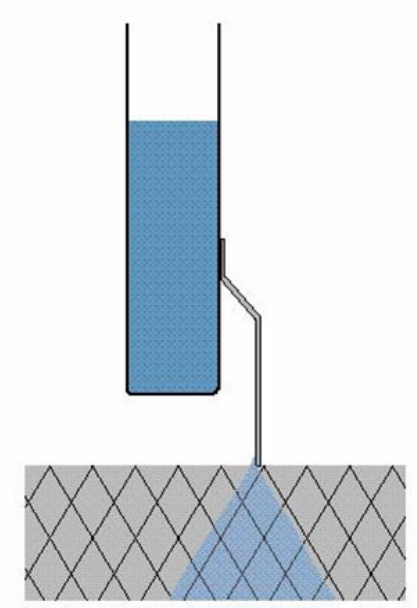
Market introduction of high performance packing from 1999

Sulzer Chemtech

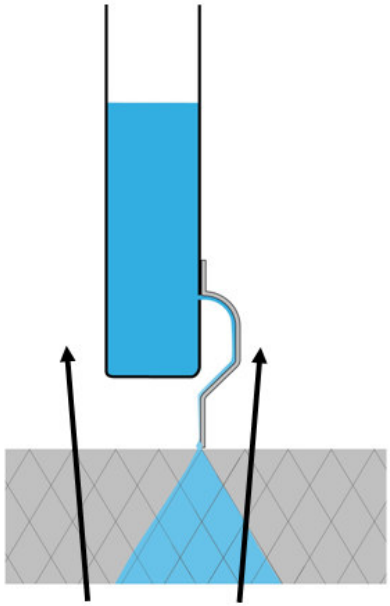


Advanced distributors

Original design
(F_V < 3.3 $Pa^{0.5}$, liq. load < 25 m^3/m^2h)



Advanced design
(F_V < 4.5 $Pa^{0.5}$, liq. load < 50 m^3/m^2h)

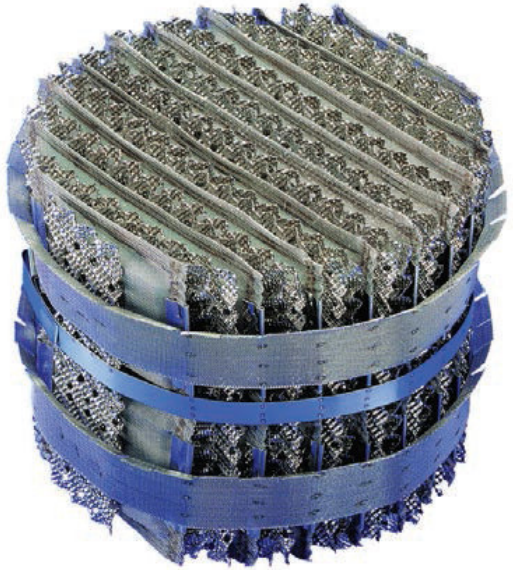


Baffle plate design improved (better fluid dynamics)

Katapak, Mellagrid

- 1990 Katapak
  Simultaneous reaction and separation of components within the packing increases yield much beyond chemical equilibrium

  But no breakthrough yet (limited number of applications?)

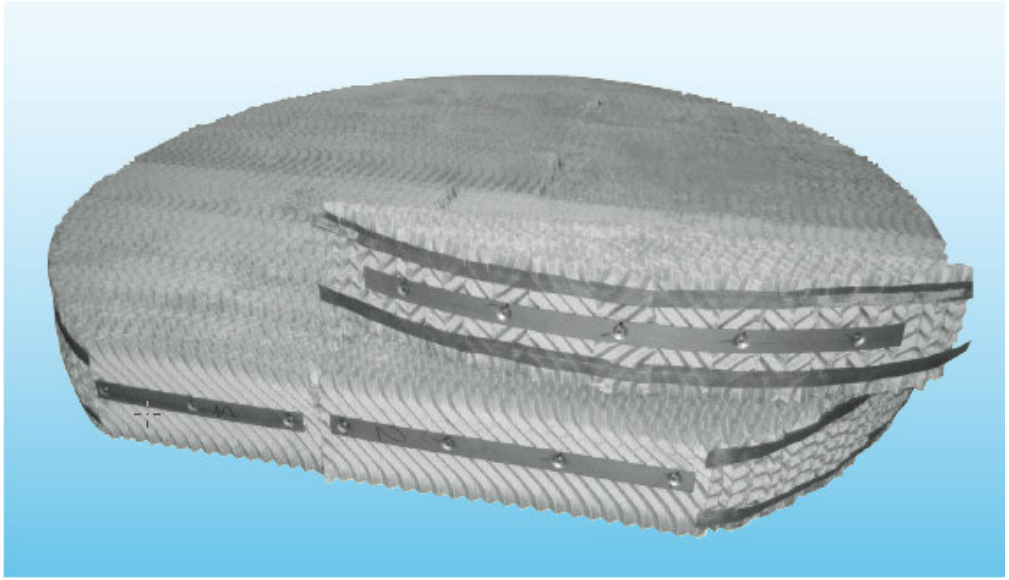


- 1996 Mellagrid

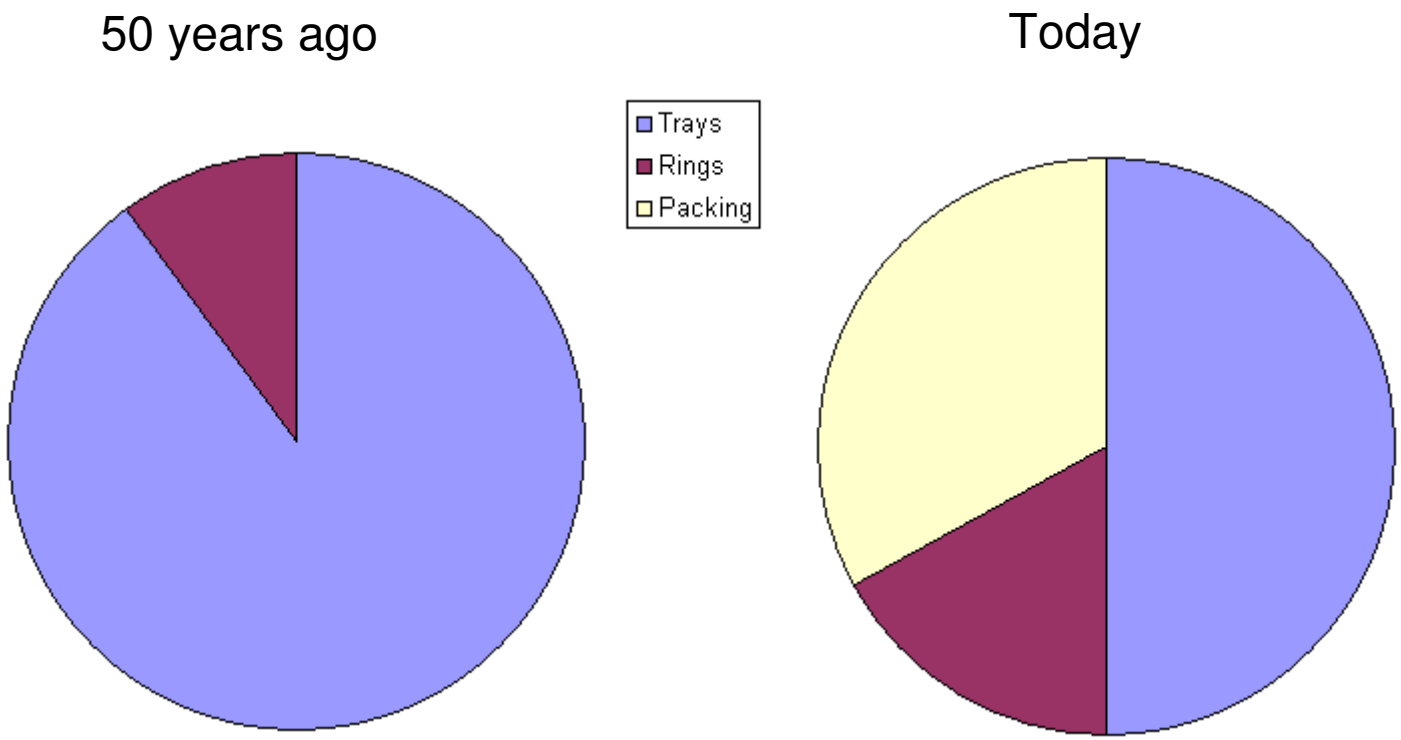
From 2000

- 2003 BXPlus from metal gauze
  20% less pressure drop than the BX packing
- 2009 Acquisition of Kühni
  Concentration of the process technology group in Allschwil
  Abandoned manufacturing of Rombopak
- 2011 MellapakCC® for CO2 Absorbers in CCS
- 2011 AYPlus™DC

For aqueous systems and low liquid loads (< 1$m^3/(m^2h)$



Outlook



Packing will keep their significance as an important separation technology for the next future.