Claims

1. An apparatus (1) for carrying out mass transfer processes, comprising a column (2) having at least two inlet pipes (3, 5) for introducing a gaseous phase, where separation-active internals (9) are accommodated in the column (2) and a column section (29) extends from the at least two inlet pipes (3, 5) to the separation-active internals (9), in which section a coverage of a cross-sectional area of the column (2) is less than 25%, based on the total cross-sectional area, and where the at least two inlet pipes (3, 5) have a height offset which corresponds to not more than three times the largest inlet pipe diameter (6) and the at least two inlet pipes (3, 5) are at an angle (α) of from 60° to 150° to one another and have asymmetry with respect to one another, wherein the asymmetry is given by the at least two inlet pipes (3, 5) each having different inlet pipe diameters (6, 17).

2. The apparatus (1) according to claim 1, wherein the asymmetry is given by the at least two inlet pipes (3, 5) being distributed asymmetrically around the circumference (19) of the column (2).

3. The apparatus (1) according to claim 1 or 2, wherein the angle (α) differs by at least 10°, in particular at least 30°, from a further angle (β) between two of the at least two inlet pipes (3, 5).

4. The apparatus (1) according to any of claims 1 to 3, wherein the at least two inlet pipes (3, 5) are arranged at the same height (8) on the column (2).

5. The apparatus (1) according to any of claims 1 to 4, wherein the at least two inlet pipes (3, 5) are arranged at the bottom of the column (2) or as side inlet on the column (2).

6. The apparatus according to any of claims 1 to 5, wherein the apparatus (1) comprises precisely two inlet pipes (3, 5) for introducing a gaseous phase, where the two inlet pipes (3, 5) have a height offset which corresponds to not more than three times the largest inlet pipe diameter (6).

7. The apparatus (1) according to any of claims 1 to 6, wherein the at least two inlet pipes (3, 5) open radially into the column (2).

8. The apparatus (1) according to any of claims 1 to 7, wherein the separation-active internals (9) comprise a structured packing and/or packing elements.

9. The apparatus (1) according to any of claims 1 to 8, wherein the separation-active internals (9) comprise trays without guided flow, for example dual-flow trays, ripple trays and/or cascade trays.

10. The apparatus (1) according to any of claims 1 to 8, wherein the separation-active internals (9) comprise crossflow trays.

11. The apparatus (1) according to any of claims 1 to 10, wherein vaporizers (20, 30) are attached via the at least two inlet pipes (3, 5) to the column (2).

12. The use of the apparatus (1) for carrying out mass transfer processes according to any of claims 1 to 11 for producing isocyanates, styrene or an alkyl acrylate, in particular a butyl acrylate, or in crackers, in particular for dissociating C_3-hydrocarbons.

13. The use according to claim 12, wherein the asymmetry is given by the flow velocities through the at least two inlet pipes (3, 5) being different.

14. The use according to claim 12 or 13, wherein the apparatus (1) for carrying out mass transfer processes is used as rectification column (40) in a process for the continuous production of an alkyl acrylate (H_2C=CH-C(=O)OR, where R = n-butyl or isobutyl), where aqueous 3-hydroxypropionic acid is reacted under dehydrating and esterifying conditions in the presence of the appropriate butanol (R-OH) in a reactor comprising the rectification column (40) and butyl acrylate formed, unreacted butanol and also water used and water formed are distilled off as ternary azeotrope at the top and, after separation into a respectively liquid aqueous phase and liquid organic phase, the aqueous phase and the organic phase are each at least partly discharged and the organic phase comprising the butyl acrylate and the butanol is fractionally distilled.

15. The use according to any of claims 12 to 14, wherein a liquid phase (12) is taken off from the rectification column (40), at least partially vaporized and at least partly recirculated via the at least two inlet pipes (3, 5) to the rectification column (40).

16. The use according to claim 15, wherein the liquid phase (12) is at least partially vaporized in at least two vaporizers (20, 30).

17. The use according to any of claims 12 to 16, wherein the pressure at the top of the rectification column (40) is in the range from 0.2 bar to 5.0 bar absolute.

18. The use according to any of claims 14 to 17, wherein the fractional distillation of the organic phase comprising the butyl acrylate and the butanol is carried out by distilling off

the butanol in an additional rectification column (40) and distilling off the butyl acrylate from the resulting bottoms in a further additional rectification column (40).

19. A method for designing the apparatus (1) for mass transfer according to any of claims 1 to 11, comprising the following steps:

(a) specification of the position and orientation of the at least two inlet pipes (3, 5) on the column (2);

(b) calculation of the gas flow in the column (2) using a flow simulation;

(c) repetition of the steps (a) and (b) with different positions and orientations of the at least two inlet pipes (3, 5) and

(d) selection of the position and orientation of the at least two inlet pipes (3, 5) at the flow which displays the most uniform flow pattern.