Claims

1. A feeding device for preparing a feed stream (a) for a solution polymerization, comprising a feed vessel (1), the feed vessel (1) comprising:
   - a top zone (2) and a bottom zone (3);
   - a feed outlet (4) for withdrawing the feed stream (a), wherein the feed outlet (4) is positioned at the bottom zone (3);
   - a waste outlet (5) for withdrawing a waste vapour stream (b), wherein the waste outlet (5) is positioned at the top zone (2);
   - a first heat exchanger (6) positioned below the top zone (2);
   - an absorber (7) positioned below the first heat exchanger (6);
   - a first inlet (8) for introducing a fresh liquid stream (c) into or on top of the absorber (~~3~~7), wherein the first inlet (8) is positioned at the absorber (7);
   - a second inlet (9) for introducing a recycle liquid stream (d), wherein the second inlet (9) is positioned below the first inlet (8); and
   - a third inlet (10) for introducing a recycle vapour stream (e), wherein the third inlet (10) is positioned below the second inlet (9) and above the feed outlet (4).
2. The feeding device according to one of the preceding claims, further comprising:
   - a storage vessel for storing the feed stream (a) positioned downstream of the feed outlet (4).
3. The feeding device according to one of the preceding claims, wherein the second inlet (9) further comprises a sprayer device configured to spray the at least one recycle liquid stream (d) into the feed vessel (1).
4. The feeding device according to one of the preceding claims, wherein the feed vessel (1) further comprises a first distributor (11) positioned above the second inlet (9) and a second distributor (12) positioned below the second inlet (9).
5. The feeding device according to one of the preceding claims 1 or 2, wherein the second inlet (9) is positioned at the absorber (7).

6. The feeding device according to one of the preceding claims, wherein the third inlet (10) is located in the bottom zone (3) and wherein the third inlet (10) further comprises a dosing pipe (13) extending into the bottom zone (3).

7. The feeding device according to one of the preceding claims, wherein the feed vessel (1) further comprises a third distributor (14) located above the third inlet (10).

8. A solution polymerization reactor assembly comprising a feeding device according to any of the preceding claims.

9. A process for preparing a feed stream (a) for a solution polymerization in a feed vessel (1), the feed stream (a) comprising at least one solvent, at least one reactant and optionally hydrogen, the process comprising the steps of:

   (i) providing at least one fresh liquid stream (c) comprising the at least one solvent and optionally the at least one reactant;

   (ii) providing at least one recycle liquid stream (d) comprising the at least one solvent and the at least one reactant;

   (iii) providing at least one ~~vapour~~ recycle vapour stream (e) comprising the at least one reactant;

   (iv) contacting the at least one recycle vapour stream (e) with the at least one recycle liquid stream (d) yielding a contacted recycle liquid stream (d1) and a contacted recycle vapour stream (e1);

   (v) contacting the contacted recycle vapour stream (e1) with the at least one fresh liquid stream (c) yielding a contacted fresh liquid stream (c1) and a waste vapour stream (b);

   (vi) combining the contacted fresh liquid stream (c1) with the contacted recycle liquid stream (d1) yielding the feed stream (a);

   (vii) withdrawing the waste vapour stream (b) by a waste outlet (5) positioned at a top zone (2) of the feed vessel (1);

   (viii) withdrawing the feed stream (a) by a feed outlet (4) positioned at a bottom zone (3) of the feed vessel (1), wherein

in step (i) the at least one fresh liquid stream (c) is provided by a first inlet (8) into or on top of an absorber (~~3~~7), wherein the first inlet (8) is positioned at the absorber (7),

in step (ii) the at least one recycle liquid stream (d) is provided by a second inlet (9), wherein the second inlet (9) is positioned below the first inlet (8),

in step (iii) the at least one ~~vapour~~ recycle vapour stream (e) is provided by a third inlet (10), wherein the third inlet (10) is positioned below the second inlet (9) and above the feed outlet (4).

10. The process according to claim 9, wherein step (vi) is carried out within step (v) so that the contacted fresh liquid stream (c1) is also contacted with the recycle vapour stream (e).

11. The process according to one of claims 9 or 10, further comprising the step of:

(ix) distributing the recycle liquid stream (d) before step (iv).

12. The process according to one of claims 9 to 11, further comprising the step of:

(x) distributing the recycle vapour stream (e) before step (iv).

13. The process according to any of the preceding claims 9 to 12, further comprising the step of

(xi) intermediately storing the feed stream (a) in a storage vessel after step (vii).

14. The process according to any of the preceding claims 9 to 13, further comprising the step of

(xii) at least partially condensing the ~~vapour~~ waste vapour stream (b) using a first heat exchanger (6) yielding a condensed ~~vapour~~ waste vapour stream (b1) and reintroducing the condensed ~~vapour~~ waste vapour stream (b1) in step (v).

15. The process according to any of the preceding claims 9 to 14, further comprising the step of

(xiii) at least partially cooling the fresh liquid stream (c) using a second heat exchanger before step (i).