Claims

1. An aqueous solution comprising acrylic acid and the conjugate base thereof in a total amount, calculated as acrylic acid, of at least 10% by weight, based on the weight of the aqueous solution, and, based on the total amount of acrylic acid and the conjugate base thereof present in the aqueous solution, calculated as acrylic acid,

≥	50 ppm by weight	in total of propionic acid and the conjugate base thereof, calculated as propionic acid,
≥	200 ppm by weight	in total of formic acid and the conjugate base thereof, calculated as formic acid,
≥	3000 ppm by weight	in total of acetic acid and the conjugate base thereof, calculated as acetic acid,
≤	10 ppm by weight	in total of benzoic acid and the conjugate base thereof, calculated as benzoic acid,
≤	10 ppm by weight	in total of maleic anhydride, maleic acid and the conjugate bases thereof, calculated as maleic acid,
≤	10 ppm by weight	in total of phthalic anhydride, phthalic acid and the conjugate bases thereof, calculated as phthalic acid,
≤	50 ppm by weight	of acrolein,
≤	50 ppm by weight	of benzaldehyde,
≤	50 ppm by weight	of 2-furaldehyde, and

   at least 20 mol% of at least one alkali metal cation.

2. A process for preparing an aqueous target product solution comprising acrylic acid and the conjugate base thereof, which comprises the following process measures:

   - at least one C_3 precursor compound of acrylic acid is passed as a constituent of a reaction gas input mixture comprising the at least one C_3 precursor compound of acrylic acid, molecular oxygen and at least one inert diluent gas other than CO_2 and water through a partial oxidation zone and partially oxidized therein to acrylic acid by a heterogeneously catalyzed gas phase partial oxidation over catalysts present in the solid state with the molecular oxygen to obtain a product gas mixture comprising CO_2, water, the target product acrylic acid, the secondary constituents formic acid, acetic acid, propionic acid, benzoic acid, acrolein, benzaldehyde, 2-furaldehyde, phthalic anhydride and/or phthalic acid, maleic anhydride and/or maleic acid, and at least one inert diluent gas other than CO_2 and water,

   - the product gas mixture conducted out of the partial oxidation zone, optionally after its temperature has been reduced in a cooling zone by direct and/or indirect cooling, is conducted through an absorption zone I in which an absorbent I conducted in

cocurrent or in countercurrent to the product gas mixture, on the route of the product gas mixture through absorption zone I, scrubs the secondary constituents benzoic acid, phthalic acid and/or the anhydride thereof and maleic acid and/or the anhydride thereof out of the product gas mixture by absorption to form an absorbate I,

- the absorbate I is discharged from absorption zone I and the scrubbed product gas mixture conducted out of absorption zone I is conducted through a condensation zone I and, on the route of the scrubbed product gas mixture through condensation zone I, an aqueous acrylic acid solution also comprising the secondary constituents formic acid, acetic acid, propionic acid, acrolein, benzaldehyde and 2-furaldehyde in dissolved form is condensed as condensate I out of the scrubbed product gas mixture by direct and/or indirect cooling thereof, with the proviso that there remains a CO_2– and water-comprising residual gas mixture I which, aside from the at least one inert diluent gas other than CO_2 and water, and acetic acid, propionic acid, acrolein, benzaldehyde and 2-furaldehyde as secondary constituents, still comprises at least 10% of the amount of acrylic acid present in the product gas mixture,

- at least a portion of condensate I is conducted as absorbent I into the absorption zone I, and any remaining residual amount of condensate I is conducted out of condensation zone I as aqueous intermediate I,

- the residual gas mixture I conducted out of condensation zone I is passed through an absorption zone II in which an aqueous alkali metal base is conducted in cocurrent or in countercurrent to the residual gas mixture I as absorbent II and, on the route of the residual gas mixture I through the absorption zone II, scrubs out not only acrylic acid but also CO_2, and also the secondary constituents formic acid, acetic acid, propionic acid, acrolein, benzaldehyde and 2-furaldehyde, out of residual gas mixture I by absorption to form an aqueous alkali metal acrylate solution as absorbate II, leaving a residual gas mixture II which comprises, aside from the at least one inert diluent gas other than CO_2 and water and a residual amount of acrylic acid, also water,

- residual gas mixture II is conducted out of absorption zone II, and absorbate II is withdrawn from absorption zone II as aqueous intermediate II,

- if no aqueous intermediate I is conducted out of condensation zone I, the acrolein, benzaldehyde and 2-furaldehyde secondary constituents present in the aqueous intermediate II are absorbed therefrom by extraction with an organic extractant, and the remaining aqueous raffinate II is removed from the organic extract II formed as the aqueous target product solution comprising acrylic acid and the conjugate base thereof,

- if aqueous intermediate I is conducted out of condensation zone I, the acrolein, benzaldehyde and 2-furaldehyde secondary constituents present in the aqueous intermediate II are absorbed therefrom by extraction with an organic extractant, and the remaining aqueous raffinate II is removed from the organic extract II formed, and the acrolein, benzaldehyde and 2-furaldehyde secondary constituents present in the aqueous intermediate I are absorbed therefrom by extraction with an organic extractant, and the remaining aqueous raffinate I is removed from the organic extract I formed, and the aqueous raffinate II and the aqueous raffinate I are combined to give the aqueous target product solution comprising the acrylic acid and the conjugate base thereof, from which CO_2 is optionally outgassed,

or

- the aqueous intermediate II and the aqueous intermediate I are combined to give an aqueous intermediate III, and the acrolein, benzaldehyde and 2-furaldehyde secondary constituents present in the aqueous intermediate III, from which CO_2 is optionally outgassed beforehand, are absorbed therefrom by extraction with an organic extractant, and the remaining aqueous raffinate III is removed from the organic extract III formed as the aqueous target product solution comprising acrylic acid and the conjugate base thereof.

3. The process according to claim 2, wherein the aqueous raffinate removed from the particular organic extract comprises organic extractant in dissolved form, and the organic extractant present in dissolved form is removed from the aqueous raffinate by extraction, adsorption and/or rectification.

4. The process according to claim 2 or 3, which is followed by a process for free-radical polymerization which is effected from the aqueous target product solution, optionally after organic extractant still present therein has been removed beforehand.

5. The process according to claim 2 or 3, which is followed by a process for free-radical polymerization in which acrylic acid and the conjugate base thereof present in the aqueous target product solution, optionally after organic extractant present therein has been removed therefrom, and optionally at least monoethylenically unsaturated compounds other than acrylic acid and the conjugate base thereof, are polymerized into polymer.

6. The aqueous solution according to claim 1 which is obtainable by a process according to claim 2 or 3.

7. The use of aqueous solutions according to claim 1 or 6 for preparation of polymers obtained by free-radical initiation.

8. A process for free-radical polymerization, which is effected from an aqueous solution according to claim 1 or 6.

Claims

1. An aqueous solution comprising acrylic acid and the conjugate base thereof in a total amount, calculated as acrylic acid, of at least 10 % by weight, based on the weight of the aqueous solution, and, based on the total amount of acrylic acid and the conjugate base thereof present in the aqueous solution, calculated as acrylic acid,

≥ 50 ppm by weight	in total of propionic acid and the conjugate base thereof, calculated as propionic acid,
≥ 200 ppm by weight	in total of formic acid and the conjugate base thereof, calculated as formic acid,
≥ 3000 ppm by weight	in total of acetic acid and the conjugate base thereof, calculated as acetic acid,
≤ 10 ppm by weight	in total of benzoic acid and the conjugate base thereof, calculated as benzoic acid,
≤ 10 ppm by weight	in total of maleic anhydride, maleic acid and the conjugate bases thereof, calculated as maleic acid,
≤ 10 ppm by weight	in total of phthalic anhydride, phthalic acid and the conjugate bases thereof, calculated as phthalic acid,
≤ 50 ppm by weight	of acrolein,
≤ 50 ppm by weight	of benzaldehyde,
≤ 50 ppm by weight	of 2-furaldehyde, and

at least 20 mol % of at least one alkali metal cation.

2. A process for preparing an aqueous target product solution comprising acrylic acid and the conjugate base thereof, which comprises the following process measures:

- at least one C_3 precursor compound of acrylic acid is passed as a constituent of a

reaction gas input mixture comprising the at least one C_3 precursor compound of acrylic acid, molecular oxygen and at least one inert diluent gas other than CO_2 and water through a partial oxidation zone and partially oxidized therein to acrylic acid by a heterogeneously catalyzed gas phase partial oxidation over catalysts present in the solid state with the molecular oxygen to obtain a product gas mixture comprising CO_2, water, the target product acrylic acid, the secondary constituents formic acid, acetic acid, propionic acid, benzoic acid, acrolein, benzaldehyde, 2-furaldehyde, phthalic anhydride and/or phthalic acid, maleic anhydride and/or maleic acid, and at least one inert diluent gas other than CO_2 and water,

- the product gas mixture conducted out of the partial oxidation zone, optionally after its temperature has been reduced in a cooling zone by direct and/or indirect cooling, is conducted through an absorption zone I in which an absorbent I conducted in cocurrent or in countercurrent to the product gas mixture, on the route of the product gas mixture through absorption zone I, scrubs the secondary constituents benzoic acid, phthalic acid and/or the anhydride thereof and maleic acid and/or the anhydride thereof out of the product gas mixture by absorption to form an absorbate I,
- the absorbate I is discharged from absorption zone I and the scrubbed product gas mixture conducted out of absorption zone I is conducted through a condensation zone I and an aqueous acrylic acid solution also comprising the secondary constituents formic acid, acetic acid, propionic acid, acrolein, benzaldehyde and 2-furaldehyde in dissolved form is condensed as condensate I out of the scrubbed product gas mixture by direct and/or indirect cooling thereof, with the proviso that there remains a CO_2- and water-comprising residual gas mixture I which, aside from the at least one inert diluent gas other than CO_2 and water, and acetic

acid, propionic acid, acrolein, benzaldehyde and 2-furaldehyde, still as secondary constituents comprises at least 10 % of the amount of acrylic acid present in the product gas mixture,

- at least a portion of condensate I is conducted as absorbent I into the absorption zone I, and any remaining residual amount of condensate I is conducted out of condensation zone I as aqueous intermediate I,
- the residual gas mixture I conducted out of condensation zone I is passed through an absorption zone II in which an aqueous alkali base is conducted in cocurrent or in countercurrent to the residual gas mixture I as absorbent II and, on the route of the residual gas mixture I through the absorption zone II, scrubs out not only acrylic acid but also CO_2, and also the secondary constituents formic acid, acetic acid, propionic acid, acrolein, benzaldehyde and 2-furaldehyde as absorbate II, out of residual gas mixture I by absorption to form an aqueous alkali metal acrylate solution, leaving a residual gas mixture II which comprises, aside from the at least one inert diluent gas other than CO_2 and water and a residual amount of acrylic acid, also water,
- residual gas mixture II is conducted out of absorption zone II, and absorbate II is withdrawn from absorption zone II as aqueous intermediate II,
- if no aqueous intermediate I is conducted out of condensation zone I, the acrolein, benzaldehyde and 2-furaldehyde secondary constituents present in the aqueous intermediate II are absorbed therefrom by extraction with an organic extractant, and the remaining aqueous raffinate II is removed from the organic extract II formed as the aqueous target product solution comprising acrylic acid and the conjugate base thereof,
- if aqueous intermediate I is conducted out of condensation zone I, the acrolein, benzaldehyde and 2-furaldehyde secondary constituents present in the aqueous

intermediate II are absorbed therefrom by extraction with an organic extractant, and the remaining aqueous raffinate II is removed from the organic extract II formed, and the acrolein, benzaldehyde and 2-furaldehyde secondary constituents present in the aqueous intermediate I are absorbed therefrom by extraction with an organic extractant, and the remaining aqueous raffinate I is removed from the organic extract I formed, and the aqueous raffinate II and the aqueous raffinate I are combined to give the aqueous target product solution comprising acrylic acid and the conjugate base thereof, from which CO_2 is optionally outgassed,

or

- the aqueous intermediate II and the aqueous intermediate I are combined to give an aqueous intermediate III, and the acrolein, benzaldehyde and 2-furaldehyde secondary constituents present in the aqueous intermediate III, from which CO_2 is optionally outgassed beforehand, are absorbed therefrom by extraction with an organic extractant, and the remaining aqueous raffinate III is removed from the organic extract III formed as the aqueous target product solution comprising acrylic acid and the conjugate base thereof.

3. The process according to claim 2, wherein the each aqueous raffinate removed from the each organic extract comprises organic extractant in dissolved form, and the organic extractant present in dissolved form is removed from the aqueous raffinate by extraction, adsorption and/or rectification.

4. The process according to claim 2 or 3, which is followed by a process for free-radical polymerization which is effected from the aqueous target product solution, after each organic extractant still present therein has been removed beforehand.

5. The process according to claim 2 or 3, which is followed by a process for free-radical polymerization in which acrylic acid and the conjugate base thereof present in the aqueous target product solution, after each organic extractant still present therein has been removed therefrom, and optionally at least monoethylenically unsaturated compounds other than acrylic acid and the conjugate base thereof, are polymerized into polymer.

6. The use of aqueous solutions according to claim 1 for preparation of polymers obtained by free-radical initiation.

7. A process for free-radical polymerization, which is effected from an aqueous solution according to claim 1.