

DESCRIPTION

FILM REACTOR FOR A GAS-LIQUID, IN PARTICULAR A SULFONATION, OR SULFATATION, REACTION

5 Field of application of the present invention

The present invention relates to a continuous falling film reactor to obtain a product through a gas-liquid, in particular a sulfonation, or sulfatation, reaction.

Preferably, the product obtained through the present reactor is a surfactant, in particular a surfactant of the anionic type.

10 In particular, the reaction, in particular the sulfonation or sulfatation reaction, occurs between a first reagent, in particular in the liquid phase, especially in the form of an organic raw material, and a second reagent, in particular in the gaseous phase, especially in the form of sulphuric anhydride, i.e., diluted sulphuric anhydride, preferably diluted with air.

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State of the art

Reactors to obtain a corresponding surfactant of the anionic type, through a continuous, rapid, and exothermic sulfonation, or sulfatation, reaction between a first reagent in the liquid phase, i.e., in the form of an organic raw material, and a
20 second reagent in the gaseous phase, i.e., in the form of sulphuric anhydride, in particular diluted with air, are known.

Said already-known sulfonation, or sulfatation, reactors comprise a reactor body, or outer shell, in particular elongated and vertical, which is adapted to house a plurality of chambers, in particular elongated and/or tubular reaction chambers, in
25 particular falling reaction chambers, between said first reagent and said second reagent, as well as means for the introduction of said first reagent, or organic raw material, and means for inputting said second reagent, or sulphuric anhydride, into the respective one of said reaction chambers.

A felt problem related to these already-known reactors is an imperfect

distribution of said second reagent, or sulphuric anhydride, inside said reaction chambers. This causes the known reactors not being able to obtain an efficient control of the process and such as to limit the occurrence of side reactions, i.e., such as to ensure a high qualitative uniformity, and with the further drawback that
5 frequent maintenance interventions are required, resulting in a shorter duration of the reactor production cycles.

In fact, in said already-known reactors, the presence of deposits of carbonaceous material inside the respective reaction chamber is excessive, and, in order to remove them, it is necessary to resort to frequent and relevant cleaning
10 interventions of the same chamber.

A further felt problem related to these already-known reactors is the non-homogeneous and even distribution of said first reagent, or organic raw material in the liquid phase, between the reaction chambers and on the inner surface of the respective reaction chamber, and this also is such as not to obtain an efficient
15 control of the process, such as to limit the occurrence of side reactions and the achievement of a high qualitative uniformity and such as to make the presence of deposits of carbonaceous material inside the respective reaction chamber excessive, thus requiring to resort to frequent and relevant cleaning interventions for the same chamber, and consequent reduced duration of the production campaigns of these
20 already-known reactors.

Furthermore, another felt problem related to these already-known reactors is the uneven distribution of the cooling liquid flow into said reactor body, or outer shell, with the result that some reaction chambers are not sufficiently and/or homogeneously cooled with respect to other chambers of the reactor. Ultimately,
25 this also causes a lesser reaction efficiency and a shorter duration of the production cycles of the reactor.

In any case, industrially, a need is strongly felt to make products, in particular surfactant products, which are of high quality.

Summary of the invention.

Therefore, the present invention aims to propose a solution that is new and alternative with respect to the solutions known so far, and in particular it is aimed to obviate one or more of the drawbacks or problems set forth above and/or to meet
5 one or more needs set forth above, and/or anyhow felt in the art, and in particular deducible from the above.

Thus, a continuous falling film reactor is provided, to obtain a product through a gas-liquid, in particular a sulfonation, or sulfatation, reaction, between a first reagent, in particular in the liquid phase, especially in the form of an organic
10 raw material, and a second reagent, in particular in the gaseous phase, especially in the form of sulphuric anhydride, i.e., of diluted sulphuric anhydride, preferably diluted with air; the reactor comprising a reactor body, or outer shell, adapted to house a plurality of chambers, in particular elongated and/or tubular chambers, for a reaction between said first reagent and said second reagent; said chambers, in
15 particular elongated and/or tubular reaction chambers having a respective inner surface, in particular for the sliding of said first reagent in the form of a thin film, or layer, means for the introduction of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, into said chambers, in particular elongated and/or tubular, reaction chambers, and means for inputting said
20 second reagent, in particular in the gaseous phase, especially in the form of sulphuric anhydride, in the respective, in particular elongated and/or tubular, reaction chamber; means, or a head, being provided for the introduction of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, in the respective, in particular elongated and/or tubular, reaction chamber;
25 characterized in that said means, or head, for the introduction of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, in the respective, in particular elongated and/or tubular, reaction chamber, comprise, or comprises, corresponding nozzle means, in particular, radially extending nozzle means, for the passage of said first reagent, or organic raw

material, in particular a fluid, preferably liquid raw material, towards the respective, in particular elongated and/or tubular, reaction chamber; and in that said nozzle means are in the form of said nozzle means calibrated so as to cause a predetermined load loss of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, feeding towards the respective, in particular elongated and/or tubular, reaction chamber, such as to ensure a controlled, in particular a constant or substantially constant, flow rate, of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, entering the respective, in particular elongated and/or tubular, reaction chamber, and so as to evenly distribute said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, on the respective inner surface thereof.

In this manner, a homogeneous and even distribution of said first reagent, in particular in the liquid phase, on the inner surface of the respective reaction chamber is ensured.

Therefore, a more efficient reaction is obtained, hence the presence of deposits of carbonaceous material inside the respective reaction chamber is reduced, and therefore the need to carry out periodical cleaning interventions for the same chamber is consequently reduced.

Ultimately, the service life of the same reactor in a condition of high efficiency is extended.

Furthermore, in this manner, a product is made, i.e., a surfactant product, in particular a surfactant of the anionic type, the quality of which is particularly high.

Brief description of the drawings

This and other innovative aspects, or respective advantageous embodiments are anyhow set forth in the attached claims, the specific technical features of which can be found, together with corresponding advantages achieved, in the following description, illustrating in detail a merely exemplary, non-limiting embodiment of

the invention, and which is made with reference to the attached drawings, in which:

- Fig. 1 illustrates a vertical section, schematic view of a preferred embodiment of reactor according to the present invention;
- Fig. 2 illustrates a schematic, cutout perspective view of the upper part of
5 the preferred embodiment of reactor according to the present invention;
- Fig. 3 illustrates a schematic side elevation view of the preferred embodiment of means for inputting said second reagent, which is used in the reactor according to the present invention;
- Fig. 4A illustrates a vertical section, schematic view of a preferred
10 embodiment of means, or head, for the introduction of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, in the respective one of said chambers, in particular elongated and/or tubular, reaction chambers, which are used in the reactor according to the present invention;
- Fig. 4B illustrates a schematic side elevation view of a preferred
15 embodiment of the outer body composing the means, or head, for the introduction of said first reagent;
- Fig. 4C illustrates a vertical section, schematic view of the preferred embodiment of the outer body composing the means, or head, for the introduction of said first reagent;
- Fig. 4D illustrates a vertical section, schematic view of a preferred
20 embodiment of the inner body composing the means, or head, for the introduction of said first reagent;
- Fig. 4E illustrates a vertical section, schematic view of a preferred embodiment of a thickness member to adjust the fitting positioning between said
25 first and second bodies composing the respective means, or head, for the introduction of said first reagent;
- Fig. 5 illustrates a perspective schematic view of a preferred embodiment of means for the distribution of said first reagent, between said chambers, in particular elongated and/or tubular, reaction chambers, which are used in the reactor

according to the present invention;

- Fig. 6 illustrates a longitudinal section, schematic view of a first preferred embodiment of means for cooling said reaction chambers, or tubes, which are used in the reactor according to the present invention;

5 - Fig. 7A illustrates a longitudinal section, schematic view of a second preferred embodiment of means for cooling said reaction chambers, or tubes, which are used in the reactor according to the present invention;

- Fig. 7B illustrates a transversal section, schematic view of the second preferred embodiment of means for cooling said reaction chambers, or tubes, which
10 are used in the reactor according to the present invention;

- Fig. 7C illustrates a vertical section, schematic view of a detail of the second which are used of means for cooling said reaction chambers, or tubes, which are used in the reactor according to the present invention;

- Fig. 7D illustrates a schematic elevation front view of a planar member that
15 is adapted to homogeneously distribute the transversal flow of the cooling fluid, or liquid, used in the second preferred embodiment of means for cooling said reaction chambers, or tubes, which are used in the reactor according to the present invention;

- Fig. 7E illustrates an enlarged schematic view of a detail of said planar
20 member of Fig. 7D, in particular illustrating respective openings for the passage of the cooling fluid or liquid.

Detailed description of preferred embodiments of the invention

In the attached figures 1 to 7E, a preferred embodiment is illustrated of a
25 continuous falling film reactor adapted to obtain a product through a gas-liquid, in particular a sulfonation, or sulfatation, reaction, between a first reagent, in particular in the liquid phase, especially in the form of an organic raw material, for example selected between alkyl benzenes, linear or branched alkenes, low and high molecular weight alcohols, low and high molecular weight alkoxylated in particular

ethoxylated and propoxylated, esters, aromatic compounds, fatty acids, glycerides (mono-, di- and triglycerides), or other families, and a second reagent, in particular in the gaseous phase, especially in the form of sulphuric anhydride, i.e., of diluted sulphuric anhydride, preferably diluted with air.

5 As it is clear in particular from Fig. 1, the present reactor comprises a reactor body, or outer shell, 12, in particular having an elongated shape and vertically extending, which reactor has suitable means 121 for inputting said first reagent into the reactor, suitable means for inputting said second reagent 122 into the reactor, and means 123 for outletting product from the reactor, in particular for
10 outletting the surfactant product.

 As it is clear from said figures, said reactor body, or outer shell, 12 preferably has a circular outer profile and is adapted to house a plurality of chambers, in particular elongated and/or tubular reaction chambers 14, in particular for a falling continuous reaction, between said first reagent and said second reagent.

15 As it is clear from the figures, said chambers, in particular elongated and/or tubular reaction chambers 14, have a respective inner surface 140, in particular for the sliding of said first reagent in the form of a thin film, or layer, and a respective outlet, especially confluent in said outlet, in particular lower outlet, 123 of said reactor body, or outer shell, 12.

20 Furthermore, preferably said chambers, in particular elongated and/or tubular reaction chambers 14 are vertically extended and transversally ordered, or arranged, according to a quincuncial arrangement, i.e., in which respective rows 141 of chambers are spaced apart, in particular equally spaced apart from one another, and in which the respective camera 14 is perpendicularly offset with
25 respect to the adjacent chambers of the adjacent row, in particular in an equidistant manner from the same adjacent chambers.

 In particular, as it is clear from said figures, the reactor 10 comprises means 16 for the introduction of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, into the respective, in particular

elongated and/or tubular, reaction chamber 14.

Furthermore, as it is clear from the same figures, the reactor 10 comprises means 18 for inputting said second reagent, in particular in the gaseous phase, especially in the form of sulphuric anhydride, in the respective, in particular
5 elongated and/or tubular, reaction chamber 14.

Advantageously, as illustrated, that said means 18 for inputting said second reagent, in particular in the gaseous phase, especially in the form of sulphuric anhydride, are configured so as to supply to said plurality of reaction chambers, or tubes, 14 an even, or substantially even, gas flow, i.e., an even, or substantially
10 even, gas flow for the whole plurality of, i.e., for all, said reaction chambers, or tubes, 14 of the reactor.

According to another point of view, in other words, said means 18 for inputting said second reagent, in particular in the gaseous phase, especially in the form of sulphuric anhydride, are configured so as to supply to said plurality of
15 reaction chambers, or tubes, 14 a gas flow having an even advancement rate, i.e., a gas flow having an even advancement rate for the whole plurality of, i.e., for all, said chambers, or tubes.

In practice, in this manner, it is possible to obtain a more efficient reaction and thus to reduce the presence of deposits of carbonaceous material inside the
20 respective reaction chamber 14 hence to decrease the need to carry out periodical cleaning interventions for the same reaction chambers, with a consequent extension of the service life of the same reactor in a condition of high efficiency.

Furthermore, in this manner a product is obtained, i.e., a surfactant product, in particular a surfactant of the anionic type, the quality of which is particularly
25 high.

In an advantageous manner, as it is very clear from Fig. 1, said reactor body, or outer shell, 12 has a peripheral, in particular circumferential, outer wall, 120, especially, as illustrated, defined by corresponding longitudinal wall sections 120a, 120b, 120c that are connected to one another at the respective longitudinal ends.

In particular, the peripheral outer wall of said reactor body, or outer shell, 12 ends in an outlet section 120c, in particular defined by a conical wall that is located downstream, i.e., inferiorly, to said main and intermediate part 120b of the circumferential outer wall 120, and which conveys said obtained product, or
5 surfactant, towards the outlet mouth 123.

As it is clear from said figures 1 to 3, with advantage, said means 18 for inputting said second reagent, in particular in the gaseous phase, especially in the form of sulphuric anhydride, are supported by said reactor body, or outer shell, 12, i.e., by the respective peripheral outer, in particular circumferential, wall, 120,
10 thereof, especially at the respective upstream, in particular upper, end thereof.

As it is clear from said figures 1 to 3, in a particularly advantageous manner, said means 18 for inputting the second reagent, in particular in the form of a gaseous reagent, preferably in the form of sulphuric anhydride, in the same chambers, in particular elongated and/or tubular reaction chambers 14, comprise a
15 tubular, in particular cylindrical, conduit, 181, which extends according to a respective longitudinal axis L, in particular coaxial to the longitudinal axis of the main body 120a, 120b, 120c of the reactor, and which directly supplies the same second reagent in inlet into said reaction chambers 14.

As illustrated, said tubular, in particular cylindric, conduit, 181 for inputting
20 the second reagent, in particular in the form of a gaseous reagent, preferably in the form of sulphuric anhydride, in the same reaction chambers 14, has an inner, especially smooth, preferably cylindrical tubular, surface, 181xa, which extends according to said longitudinal axis L, which is parallel to the axis of the respective chambers, in particular elongated and/or tubular reaction chambers 14.

As illustrated, said tubular, in particular cylindric, conduit, 181 extends
25 between an upstream, or upper, end, 182 and a downstream, or lower, open end 183, for the inlet into said reactor body, or outer shell, 12.

As illustrated, said tubular, in particular cylindric, conduit, 181 for inputting the second reagent, in particular in the form of a gaseous reagent, preferably in the

form of sulphuric anhydride, in the same reaction chambers 14, opens at a zone, or plane, 162, at which the openings 149 for inputting the respective gas flow into the corresponding reaction chambers 14 are provided.

As it is clear from said figures 2 and 3, advantageously, said means 18 for
5 inputting the second reagent, in particular in the form of a gaseous reagent, preferably in the form of sulphuric anhydride, in the same reaction chambers, or tubes, comprise a mouth 184 for the inlet of said second reagent, in particular at an upstream, or upper, end, 182 of said tubular, in particular cylindric, conduit, 181, and in particular provided at the side wall of the same tubular, in particular
10 cylindric, conduit, 181, and an outlet mouth 183, in particular lying in a plane that is perpendicular, or transversal, to said longitudinal axis L of the same tubular conduit 181.

As illustrated, said tubular, in particular cylindric, conduit, 181 for inputting the second reagent has a closing, in particular an outermost upper closing wall, 186,
15 provided on the side of the same tubular, in particular cylindric, conduit, 181, which is opposite the side for the connection to the peripheral, in particular circumferential, outer wall 120, of the reactor body.

As it is clear from said figures, and in particular from Fig. 3, said second reagent comes especially from a respective adduction conduit 185, in particular
20 perpendicularly elongated with respect to said tubular, in particular cylindric, conduit, 181.

As illustrated, furthermore, said tubular, in particular cylindric, conduit, 181, i.e., the corresponding cylindrical inner surface thereof, has a respective diameter "D".

As it is clear from said figures 1 to 3, in an advantageous and particularly preferred manner, said means 18 for inputting said second reagent, in particular in the gaseous phase, especially in the form of sulphuric anhydride, i.e., said tubular, in particular cylindric, conduit, 181, have, or has, a longitudinal length, "l",
25 especially comprised between said inlet mouth 184, i.e., between the lower edge

thereof, and said outlet mouth 183 of said tubular conduit 181, which longitudinal length, "l" is greater than the extension of the corresponding diameter "D" of said means 18 for inputting said second reagent, i.e., of said tubular conduit 181, which in particular is greater than 2-folds the extension of said diameter "D", preferably
5 which is greater than 3-4-folds the extension of said diameter "D", and, in an even more preferred manner, being greater than 5-folds the extension of the same diameter "D".

According to an alternative form, not illustrated in the attached figures, it would also be imaginable to obtain an even, or substantially even, gas supply, i.e., a
10 gas supply with a positive advancement rate, for the whole plurality of, i.e., for all, said chambers, or tubes, through corresponding diverting members, or septa, to be positioned in said means 18 for inputting said second reagent, in particular in the gaseous phase, upstream the inlet into the same reaction chambers, or tubes 14.

As it is clear from the subsequent figures 4A to 4E, according to another
15 advantageous aspect, means, or head, 24 are provided for the introduction of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, in the respective, in particular elongated and/or tubular, reaction chamber 14.

As it is clear from said figures 4A to 4E, advantageously, said means, or
20 head, 24 for the introduction of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, in the respective, in particular elongated and/or tubular, reaction chamber 14, comprise corresponding nozzle means 240, in particular, radially extending nozzle means, for the passage of said first reagent, or organic raw material, in particular a fluid, preferably liquid raw
25 material, towards the respective, in particular elongated and/or tubular, reaction chamber 14.

As it is clear from said figures 4A to 4E, in a particularly advantageous manner, said nozzle means 240 are in the form of said nozzle means calibrated so as to cause a predetermined load loss of said first reagent, in particular in the liquid

phase, especially in the form of an organic raw material, feeding towards the respective reaction chamber 14, and such as to ensure a controlled, in particular a constant or substantially constant, flow rate, of said first reagent entering the respective, reaction chamber 14.

5 In this manner, a homogeneous distribution of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, on the respective inner surface 140 of the respective reaction chamber 14 is ensured.

 Therefore, a more efficient reaction is obtained, and thus the presence of deposits of carbonaceous material inside the respective reaction chamber is
10 reduced, and the need to carry out periodical cleaning interventions for the same chamber is consequently reduced.

 Ultimately, the service life of the same reactor in a condition of high efficiency is extended.

 Furthermore, in this manner, a product is made, i.e., a surfactant product, in
15 particular a surfactant of the anionic type, the quality of which is particularly high.

 As it is clear from said figures 4A to 4E, advantageously, said nozzle means 240 impart to said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, a load loss above 5000 Pa, preferably above 10000 Pa, and more preferably above 20000 Pa.

20 As it is clear from said figures 4A to 4E, with advantage, said nozzle means, for the passage of said first reagent, or organic raw material, in particular a fluid, preferably liquid raw material, towards the respective, in particular elongated and/or tubular, reaction chamber 14, comprise a single calibrated passage nozzle 240, which is obtained in said means, or head, 24 for the introduction of said first
25 reagent, in particular in the liquid phase, especially in the form of an organic raw material, in the respective, in particular elongated and/or tubular, reaction chamber 14.

 Said calibrated passage nozzle means, or single nozzle, 240, obtained in said means, or heads, 24 for the introduction of said first reagent, in particular in the

liquid phase, especially in the form of an organic raw material, in the respective, in particular elongated and/or tubular, reaction chamber 14, extend, or extends, in particular radially, between an outer face, or surface, and an inner face, or surface of the same means, or head, 24 for the introduction of said first reagent into the
5 respective reaction chamber 14.

 In a preferred, anyhow optional, manner, said calibrated passage nozzle means, or single nozzle, 240, obtained in said means, or heads, 24 for the introduction of said first reagent lie, or lies, in a corresponding plane perpendicular, or transversal, to the respective longitudinal axis of the same means, or head, 24 for
10 the introduction of said first reagent, i.e., the respective reaction chamber 14.

 With advantage, as it is clear from said figures 4A to 4E, the calibrated passage nozzle, in particular the single calibrated passage nozzle 240 has a respective diameter that ranges between 0.1 mm and 5 mm, and that preferably ranges between 1.2 mm and 1.6 mm.

15 As it is clear from said figures 4A to 4E, advantageously, the calibrated passage nozzle, in particular the single calibrated passage nozzle 240 has a length that ranges between 1 mm and 30 mm and preferably that ranges between 7 mm and 10 mm.

 As it is clear from said figures 4A to 4E, advantageously, said means, or
20 head, 24 for the introduction of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, in the respective, in particular elongated and/or tubular, reaction chamber 14, comprise an annular, in particular circumferential, cavity, 241 for the peripheral diffusion of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material,
25 which annular, in particular circumferential, cavity, 241 for the peripheral diffusion of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, is in communication with the inside of the respective reaction chamber 14, through an annular conduit 242, that is longitudinally extending and coaxial with the respective reaction chamber 14, and in particular, as illustrated,

radially converging towards and into the respective reaction chamber 14, opening at the inner surface 140 of the respective reaction chamber 14.

In an advantageous manner, as it is clear from said figures 4A to 4E, said annular conduit 242 and/or said annular, in particular circumferential, cavity, 241, for the peripheral diffusion of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, are defined between a first and a second bodies 24xa, 24xb, in particular tubular, which are coaxially coupled one inside the other, in particular in a male-female relation.

In particular, as it is clear from said figures 4A to 4E, said annular conduit 242 is defined between the outer surface 24ya of the lower part of said inner body 24xa and the inner surface 24yb of the lower part of said outer body 24xb of the head.

As illustrated in Figure 4A, said first body, or male body, 24xa is in connection and coaxial with the respective, in particular elongated and/or tubular, reaction chamber 14 and being internally hollow, in particular tubular, to convey said second reagent downstream, in particular in the form of a gaseous reagent, preferably in the form of sulphuric anhydride, into the respective, in particular elongated and/or tubular, reaction chamber 14.

Advantageously, it is provided for that said annular conduit 242 has a circumferentially even configuration, and in particular a thickness of the passage, in particular according to a radial direction, that is less than 2 mm, in particular that is less than 1 mm, and in a particularly advantageous manner that ranges between 0.1 mm and 0.5 mm.

In this manner, advantageous means are defined, which are able to circumferentially, homogeneously distribute, along the same annular conduit 242, the flow of the first reagent, in particular in the liquid phase, especially in the form of an organic raw material, feeding towards the respective reaction chamber.

In particular, it is intended that, while being preferred that the same annular conduit 242 has a general conical configuration, as illustrated, it can be also

conceived that the same annular conduit 242 is made in a cylindrical configuration.

As it is clear from said figures 4A to 4E, the present head 24 can comprise an annular member 25, with a predetermined thickness, which is adapted to be interposed between the transversal annular surface 24za' of a shoulder 24za,
5 radially projecting externally to said inner body 24xa, located at the end, upper in use, of the same inner body 24xa, and an outermost annular surface 24zb', upper in use, of said outer body 24xb.

As it is clear from said figures, said calibrated nozzle 240 is defined by a corresponding screw 243 that screws in a corresponding hole, in particular a radial
10 hole, 244 of said outer body 24xb, which screw 243 has a corresponding axial through hole 240, defining said calibrated nozzle.

As it is clear from the figures, said annular, in particular circumferential, perimetral spreading cavity, 241 is defined between corresponding annular grooves 24ka and 24kb, which are provided, i.e., obtained, at the respective outer surface
15 24ya of said inner body 24xa and the inner surface 24yb of said outer body 24xb.

As it is clear, said calibrated nozzle 240, i.e., the corresponding hole 244 for housing said screw 243 having said nozzle 240, opens at said recessed annular surface 24kb of said outer body, i.e., in use, at said annular cavity 241.

In particular as illustrated, said first body, or male body, 24xa defines said
20 opening 149 for inletting the respective flow of reagent gas, preferably in the form of sulphuric anhydride, into the respective, in particular elongated and/or tubular, reaction chamber 14.

As it is clear from said figures 4A to 4E, said nozzle means, or said calibrated passage nozzle, 240 are provided, or is provided, in said second body, or
25 female body, 24xb of the means, or head, 24 for the introduction of said first reagent.

Advantageously, as it is clear from said figures 1, 2, and 5, said means 16 for the introduction of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, into said chambers, in particular elongated

and/or tubular reaction chambers 14, comprise means 161 for the distribution of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, between said reaction chambers 14.

In a particularly advantageous manner, as it is clear from said figures 1, 2, and 5, said means 161 for the distribution of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, between said reaction chambers 14, are adapted to supply said first reagent to said inlet means, or nozzle means, 240 of the respective reaction chamber 14.

Advantageously, as it is clear from said figures 1, 2, and 5, said means 161 for the distribution of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, between said chambers, in particular elongated and/or tubular reaction chambers 14 comprise a plane, in particular horizontal, preferably having a circular outer profile, 162 for conveying said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, towards said inlet means, or nozzle means, 240 of the respective, in particular elongated and/or tubular, reaction chamber 14.

In a particularly advantageous manner, as it is clear from said figures 1, 2, and 5, means 163 are provided for the supplying of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, to said conveying plane 162 of said first reagent towards said inlet means, or nozzle means, 240 of the respective reaction chamber 14.

As it is clear from said figures 1, 2, and 5, with advantage, said means 163 for the supplying of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, to said conveying plane 162, extend peripherally outwards to said plane 162 for conveying said first reagent towards said inlet means, or nozzle means, 240 of the respective reaction chamber 14.

In this manner, a homogeneous and even distribution of said first reagent to all the reaction chambers is ensured, which allows to get an efficient reaction for all the reaction chambers of the reactor.

In this manner, the reactor makes a product, i.e., a surfactant product, in particular a surfactant of the anionic type, the quality of which is particularly high.

Advantageously, as it is clear from said figures 2 and 5, said means 163 for the peripheral supplying of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, to said conveying plane 162
5 comprise a peripheral channel 163', in particular external to said conveying plane 162, and inside which said first reagent spreads and from which it peripherally opens to said conveying plane 162 of said first reagent towards said inlet means, or nozzle means, 240 of the respective reaction chamber 14.

10 Advantageously, as it is clear from said figures 2 and 5, said peripheral supplying channel 163', in particular external to said conveying plane 162, and preferably circular, comprises a bottom surface 163a, in particular horizontal, especially extending with a circular profile.

As it is clear from said figures 2 and 5, said peripheral supplying channel
15 163', in particular external to said conveying plane 162, and preferably circular, comprises a respective side surface 163b, in particular circular, preferably perpendicular to said conveying plane 162 of said first reagent and opening, or overflowing, thereinto, and especially extending vertically, or perpendicularly, to said bottom surface 163a, on the radially inner side thereof.

20 With advantage, as it is clear from said figures 2 and 5, said peripheral supplying channel 163', in particular external to said conveying plane 162, and preferably circular, comprises a respective side surface 163c, in particular circular, especially extending vertically, or perpendicularly, to said bottom surface 163a, on the radially outer side thereof, i.e., on the side that is radially opposite the one of
25 said side surface 163b opening on said conveying plane 162.

Noticeably, as it is clear from said figures 2 and 5, said plane 162 for conveying said first reagent is arranged at a height level that is above the bottom surface 163a of said peripheral channel 163'.

However, according to a different embodiment, not illustrated in the

attached figures, it can be also conceived that said plane for conveying said first reagent is arranged at a height level below the bottom surface of said peripheral channel, which in this case could be defined, on the inner side thereof, by a corresponding plate suitably perforated and through which said first reagent reaches
5 the same conveying plane.

As it is clear from said figures, the heads 24 have the respective upper end projecting perpendicularly from said sliding and distribution plane 162, in particular in such an extent as to arrange superiorly, or substantially at this, the corresponding nozzle means, or single nozzle, 240.

10 As it is clear from said figures 1, 2, and 5, means 121 are provided for the inlet of said first reagent into said means 161 for the distribution of said first reagent between said chambers, in particular elongated and/or tubular reaction chambers 14, i.e., for the inlet into said peripheral channel 163' for the supplying of said first reagent.

15 Advantageously, as it is clear from said figures 1, 2, and 5, said means 121 for the inlet of said first reagent into said means 161 for the distribution of said first reagent between said chambers, in particular elongated and/or tubular reaction chambers 14, i.e., for the inlet into said peripheral supplying channel 163', directly open into said peripheral supplying channel 163'.

20 In an advantageous manner, as it is clear from said figures 1, 2, and 5, said means 121 for the inlet of said first reagent into said means 161 for the distribution of said first reagent between said chambers, in particular elongated and/or tubular reaction chambers 14, i.e., for the inlet into said peripheral supplying channel 163', comprise a plurality of openings 121 for the inlet of said first reagent, in particular
25 in the liquid phase, especially in the form of an organic raw material, which opening apertures 121 are angularly distributed, peripherally to said peripheral supplying channel 163'; in particular, a plurality of angularly spaced apart inlet openings 121 is provided, in particular equally spaced apart from one another.

With advantage, as it is clear from said figures 2 and 5, said plane 162 for

conveying said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, towards said inlet means, or nozzle means, 240 of the respective reaction chamber 14, has a plurality of holes 14' for the passage of said chambers, in particular elongated and/or tubular reaction chambers 14, i.e., for
5 corresponding heads 24, located in the upstream zone in these reaction chambers 14.

Advantageously, as it is clear from the figures 6 and 7A to 7E, means 22 are provided for cooling said chambers, in particular elongated and/or tubular reaction chambers 14, which cooling means 22 use a cooling fluid, or liquid, in particular
10 water.

Advantageously, as it is clear from said figures 6 and 7A to 7E, said means 22 for cooling said chambers, in particular elongated and/or tubular reaction chambers 14 comprise, or are defined by, said reactor body, or outer shell, 12 housing said reaction chambers 14, means 221 for inputting a cooling fluid, or
15 liquid, into the same body, or outer shell, of the reactor, 12, and means 222 for outletting the same cooling fluid, or liquid.

In particular, as illustrated in figure 1, a plurality of mouths 221 are provided for inputting a cooling fluid, or liquid, and a plurality of mouths 222 for outletting the same cooling fluid, or liquid.

20 As it is clear from Fig. 1, in an advantageous manner, said means 221 for inputting a cooling fluid, or liquid, into the same body, or outer shell, of the reactor, 12, comprise one or more mouths 221 for inputting a cooling fluid, or liquid, and/or said means 222 for outletting the same cooling fluid, or liquid, comprise one or more mouths 222 for outletting the same cooling fluid, or liquid.

25 In particular, as it is clear from said figures 6 and 7A to 7E, the respective means, or respective mouth, 222 for outletting the same cooling fluid, or liquid, are positioned, or is positioned, at a height that is different from the respective means 221, or respective mouth, for inputting a fluid, or liquid.

Advantageously, as it is clear from said figures 6 and 7A to 7E, said means

22 for cooling said reaction chambers, or tubes, 14 comprise, inside said reactor body, or outer shell, 12 for housing said reaction, in particular tubular, chambers 14, means 225 for conveying, or diverting, the flow of said cooling fluid, or liquid, in particular in the form of water, onto, or along, the outer surface of said chambers, in particular elongated and/or tubular reaction chambers 14.

In this manner, it is possible to distribute as desired said flow of said cooling fluid, or liquid, into said reactor body, or outer shell, 12 and to homogeneously cool said chambers, in particular elongated and/or tubular reaction chambers 14.

As it is clear from said figures 6 and 7A to 7E, in a particularly advantageous manner, said means 225 for conveying, or diverting, the flow of said cooling fluid, or liquid, in particular in the form of water, onto, or along, the outer surface of said chambers, in particular elongated and/or tubular reaction chambers 14, comprise respective septum means 226, 227 which are adapted to convey, or divert, said flow of said cooling fluid, or liquid according to a respective predetermined or forced path.

Advantageously, as it is clear from said figures 6 and 7A to 7E, said septum means 226, 227, which are adapted to convey, or divert, said flow of said cooling fluid, or liquid according to a respective predetermined path, transversally extend with respect to the extension longitudinal axis of the reactor, i.e., of said reactor body, or outer shell, 12, and/or of said chambers, in particular elongated and/or tubular reaction chambers 14.

With advantage, as it is clear from said figures, said septum means 226, 227, which are adapted to convey, or divert, said flow of said cooling fluid, or liquid according to a respective predetermined path, comprise a plurality of transversal septa 226, 227 longitudinally mutually spaced apart along said reactor body, or outer shell, 12, or along said, in particular elongated and/or tubular, reaction chambers 14.

As it is clear from said figures 6 and 7A to 7E, with advantage, the septa of the respective plurality of longitudinally spaced apart septa, 226, 227, which are

adapted to convey, or divert, said flow of said cooling fluid, or liquid according to a respective predetermined path, are longitudinally equally spaced from one another.

With advantage, as it is clear from said figure 6, in accordance with a first preferred embodiment of said means 22 for cooling said reaction chambers, or
5 tubes, 14, said septum means, or respective plurality of longitudinally spaced apart septa, 226, which are adapted to convey, or divert, said flow of said cooling fluid, or liquid according to a respective predetermined path, are adapted to make said flow of said cooling fluid, or liquid, take a longitudinal, or predominantly longitudinal, path, in particular from bottom to top of, at least partially along, or
10 adjacent to, the respective plurality of chambers, in particular tubular reaction chambers 14.

Advantageously, as it is clear from said figure 6, in accordance with the first preferred embodiment of means 22 for cooling said reaction chambers, or tubes, 14, said flow of said cooling fluid, or liquid according to a respective longitudinal, or
15 predominantly longitudinal, path, has lengths of longitudinal flow, along, or adjacent to, the respective plurality of chambers, in particular tubular reaction chambers 14, and in particular for the passage through said septum means, or respective septum, 226, and radial expansion lengths between corresponding or adjacent septum means, or septa, 226.

20 As it is clear from said figure 6, in an advantageous manner, said septum means, or respective transversal septum, 226, which are adapted to convey, or divert, said flow of said cooling fluid, or liquid according to a respective predetermined longitudinal, or predominantly longitudinal, path, are adapted, or is adapted, to define a gap, in particular an annular gap, 226b, for the longitudinal
25 passage of said flow of said cooling fluid, or liquid, in the neighbourhood of the respective, in particular elongated and/or tubular, reaction chamber 14.

In an advantageous manner, as it is clear from said figure 6, in accordance with the first preferred embodiment of said means 22 for cooling said reaction chambers, or tubes, 14, said septum means, or respective transversal septum, 226,

which are adapted to convey, or divert, said flow of said cooling fluid, or liquid according to a respective predetermined path, comprise at least one corresponding hole, defined by a corresponding, preferably circular, edge, 226a, for the passing through of the respective reaction chamber 14, in particular which respective hole
5 226a has a corresponding diameter that is greater than the diameter of the respective reaction chamber 14 by such an extent as to define said annular gap 226b for the passage, in particular longitudinal, of said flow of said cooling fluid, or liquid.

Advantageously, as it is clear from said figure 6, in accordance with the first
10 preferred embodiment of said means 22 for cooling said reaction chambers, or tubes, 14, said septum means, or respective transversal septum, 226, which are adapted to convey, or divert, said flow of said cooling fluid, or liquid according to a respective predetermined path, comprise, or are composed of a corresponding transversal panel, or wall 226 having one or more holes 226a for the passing
15 through of the corresponding ones of said, in particular elongated and/or tubular, reaction chambers 14.

As it is clear from said figure 6, in a particularly advantageous manner, in accordance with the first preferred embodiment of said means 22 for cooling said reaction chambers, or tubes, 14, said septum means, or respective plurality of
20 longitudinally spaced apart septa, 226, i.e., the respective panel 226, which are adapted, or which is adapted, to convey, or divert, said flow of said cooling fluid, or liquid according to a respective predetermined path, have, or has, a respective peripheral, or circumferential, outer edge 226c for the engagement against the peripheral, in particular circumferential, inner surface, 220', of said reactor body, or
25 outer shell, 12.

Advantageously, as it is clear from said figures 7A to 7E, in accordance with a second preferred embodiment, said means 22 for cooling said reaction chambers, or tubes, 14, said septum means, or respective plurality of longitudinally spaced apart septa, 227, which are adapted to convey, or divert, said flow of said

cooling fluid, or liquid according to a respective predetermined path, are adapted to make said flow of said cooling fluid, or liquid, take a zigzagging path, in particular from bottom to top, with said flow of said cooling fluid, or liquid moving transversally to said chambers, in particular elongated and/or tubular reaction
5 chambers 14, between corresponding or adjacent septum means, or septa, 227, and especially in contact with the portions of said reaction chambers 14 extending between the same septum means, or septa, 227.

In a particularly advantageous manner, as it is clear in particular from figures 7A to 7E, in accordance with the second preferred embodiment, said means
10 22 for cooling said reaction chambers, or tubes, 14, said septum means, or respective plurality of longitudinally spaced apart septa, 227, which are adapted to convey, or divert, said flow of said cooling fluid, or liquid according to a respective predetermined path, comprise corresponding means 228 for the passage, in particular in the longitudinal direction, of said flow of said cooling fluid, or liquid,
15 through said septum means, or respective septum, 227.

Especially, said means 228 for the passage, in particular in the longitudinal direction, of said flow of said cooling fluid, or liquid, through said septum means, or respective septum, 227, being provided at, or in the proximity of, a respective transversal end 227a, 227b of the septum means, or respective septum, 227, which
20 are adapted to convey, or divert, said flow of said cooling fluid, or liquid according to a respective predetermined path.

As it is clear in particular from figures 7A to 7E, with advantage, in accordance with the second preferred embodiment of said means 22 for cooling said reaction chambers, or tubes, 14, said means 228 for the passage, in particular in
25 the longitudinal direction, of said flow of said cooling fluid, or liquid, through said septum means, or respective septum, 227, of said septum means, or respective septa, 227, which are adjacent to one another, are provided at transversal ends 227a, 227b that are mutually opposite.

Advantageously, as it is clear from said figures 7A to 7E, in accordance

with the second preferred embodiment of said means 22 for cooling said reaction chambers, or tubes, 14, said septum means, or respective septum, 227, which are adapted to convey, or divert, said flow of said cooling fluid, or liquid according to a respective predetermined path, at a respective transversal end 227a, 227b, are open,
5 i.e., have a corresponding edge, in particular a linear edge, 227c which is spaced apart from the corresponding inner surface of said reactor body, or outer shell, 12, so as to define a corresponding, in particular longitudinal, passage opening, for said flow of said cooling fluid, or liquid.

Advantageously, as it is clear from said figures 7A to 7E, in accordance
10 with the second preferred embodiment of said means 22 for cooling said reaction chambers, or tubes, 14, said septum means, or respective septum, 227, which are adapted to convey, or divert, said flow of said cooling fluid, or liquid according to a respective predetermined path, have, or has, a respective peripheral, or circumferential, outer edge 227d for the engagement against the peripheral, in
15 particular circumferential, inner surface, 220', of said reactor body, or outer shell, 12.

As it is clear from said figures 7A to 7E, in an advantageous manner, said septum means, or respective transversal septum, 227, which are adapted to convey, or divert, said flow of said cooling fluid, or liquid according to a respective
20 predetermined path, comprise, or are composed of a corresponding transversal panel, or wall 227 peripherally defined by a corresponding edge 227c, 227d, in particular having a circumferential length for the engagement to and sealing against said inner surface of said reactor body, or outer shell, 12 and a length, especially a rectilinear length, which is spaced apart from the same inner surface of said reactor
25 body, or outer shell, 12 to define said opening for the passage of said flow of said cooling fluid, or liquid.

As illustrated, said panel, or transversal wall, 227 further has a plurality of holes 227e for the passing through of the corresponding ones of said, in particular elongated and/or tubular, reaction chambers 14.

With advantage, as it is clear from said figures 7A to 7E, in accordance with the second preferred embodiment, at the gap provided between adjacent transversal septa 227, 227, means 229 are provided, which are adapted to evenly distribute said transversal flow of said cooling fluid, or liquid.

5 Advantageously, as it is clear from said figures 7A to 7E, in accordance with the second preferred embodiment, said means 22 for cooling said reaction chambers, or tubes, 14, said means 229 which are adapted to evenly distribute said transversal flow of said cooling fluid, or liquid, are at a respective transversal end of said gap that is provided between adjacent transversal septa 227, 227, and/or at
10 the respective opening 228, upstream, for the passage of said flow of said cooling fluid, or liquid, through said septum means, or respective septum, 227.

As it is clear from said figures da 7A a 7E, in a particularly advantageous manner, in accordance with the second preferred embodiment, said means 229 which are adapted to evenly distribute said transversal flow of said cooling fluid, or
15 liquid, longitudinally extend, in particular between the corresponding adjacent transversal septa 227, 227 defining the transversal flow space of said cooling fluid, or liquid, especially engaging one of or both the corresponding opposite surfaces of said adjacent transversal septa 227, 227.

Furthermore, as it is clear from the figures, in accordance with the second
20 preferred embodiment, said means 229 which are adapted to evenly distribute said transversal flow of said cooling fluid, or liquid, transversally extend until engaging the inner surface of the reactor body, or outer shell, 12.

Advantageously, as it is clear from said figures 7A to 7E, in accordance with the second preferred embodiment, said means 229 which are adapted to evenly
25 distribute said transversal flow of said cooling fluid, or liquid, comprise a corresponding planar member 229 having corresponding means for the opening or the passage of said flow of said cooling fluid, or liquid.

In an advantageous manner, said means 229 which are adapted to evenly distribute said transversal flow of said cooling fluid, or liquid, are defined by, or are

in the form of, a porous member, a network member, a perforated plate, suitable flow conveyors, or other.

In particular, as it is clear from said figures 7D and 7E, when for said means 229 that are adapted to evenly distribute said transversal flow of said cooling fluid, or liquid a perforated plate is used, corresponding holes 229f are provided in the
5 same plate, for example in an empty/full percentage of about 58%.

As it is clear from said figures 7A to 7E, with advantage, in accordance with the second preferred embodiment, said means 22 for cooling said reaction chambers, or tubes, 14, said septum means, or respective septum, 227, which are
10 adapted to convey, or divert, said flow of said cooling fluid, or liquid according to a respective predetermined transversal, or zigzagging, path, comprise a plurality of through holes 227e for the passing through by the respective plurality of chambers, in particular elongated and/or tubular reaction chambers 14, and which through
15 holes 227e have, or has, a respective peripheral, or circumferential, inner edge 227e for the engagement, in particular a sealed engagement, against the peripheral, in particular circumferential, outer surface of the corresponding one of said reaction chambers 14.

In accordance with a third implementation form, not illustrated in the attached figures, it can be conceived to combine the septum means, or respective
20 plurality of longitudinally spaced apart septa, 226, of the first embodiment, which are adapted to convey, or divert, said flow of cooling fluid, or liquid, according to a longitudinal, or predominantly longitudinal, path, in particular from bottom to top of, at least partially along, or adjacent to, the respective plurality of chambers, in particular tubular reaction chambers 14, with said septum means, or respective
25 plurality of spaced apart septa, 227, which are adapted to convey, or divert, transversally, or in a zigzagging manner, said flow of said cooling fluid, or liquid, defining a respective and desired path for the cooling flow.

Advantageously, said chambers, in particular elongated and/or tubular reaction chambers 14, are made of a corrosion-resistant material, for example in an

alloy 28 or similar material.

In this manner, the service life of the reactor is considerably increased.

In practice, as it is clear, the technical features illustrated above allow, singularly or in a respective combination, to achieve one or more of the following
5 advantageous results:

- a better distribution of said second reagent, or sulphuric anhydride, inside the respective reaction chamber can be obtained, which allows to obtain a more efficient reaction;

- the need for maintenance is decreased;

- 10 - a longer life of the reactor is obtained;

- the presence of deposits of carbonaceous material inside the respective reaction chamber is reduced;

- the need to carry out periodical cleaning interventions for the same chamber is reduced;

- 15 - the service life of the same reactor in a condition of high efficiency is extended;

- a homogeneous and even distribution of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, on the inner surface of the respective, in particular elongated and/or tubular, reaction chamber is
20 ensured;

- it becomes possible to distribute in a desired manner said flow of said cooling fluid, or liquid, into said reactor body, or outer shell, and to homogeneously cool said chambers, in particular elongated and/or tubular, reaction chambers;

- a product is made, i.e., a surfactant product, in particular a surfactant of the
25 anionic type, the quality of which is particularly high.

The present invention is susceptible of evident industrial application. The person skilled in the art can also devise a number of modifications and/or variations to be made to the same invention, while still remaining within the scope of the inventive concept, as widely explained. Furthermore, the person skilled in the art

will be able to devise further preferred implementations of the invention, which comprise one or more of the characteristics illustrated herein above of the preferred implementation set forth above, in particular as set forth in the attached claims. Furthermore, it must also be understood that all the details of the invention can be

5 replaced by technically equivalent elements.

CLAIMS

1. A continuous falling film reactor (10) to obtain a product through a gas-liquid, in particular a sulfonation, or sulfatation, reaction, between a first reagent, in particular in the liquid phase, especially in the form of an organic raw material, and
5 a second reagent, in particular in the gaseous phase, especially in the form of sulphuric anhydride, i.e., of diluted sulphuric anhydride, preferably diluted with air; the reactor comprising a reactor body, or outer shell (12), adapted to house a plurality of chambers, in particular elongated and/or tubular chambers, (14) for a reaction between said first reagent and said second reagent; said chambers, in
10 particular elongated and/or tubular reaction chambers (14) having a respective inner surface (140), in particular for the sliding of said first reagent in the form of a thin film, or layer, introduction means (16) of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, into said chambers, in particular elongated and/or tubular reaction chambers (14), and introduction
15 means (18) of said second reagent, in particular in the gaseous phase, especially in the form of sulphuric anhydride, in the respective, in particular elongated and/or tubular, reaction chamber (14); means, or head (24) being provided for the introduction of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, in the respective, in particular elongated and/or
20 tubular, reaction chamber (14); characterized in that said means, or head, (24) for the inlet of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, in the respective, in particular elongated and/or tubular, reaction chamber (14), comprise, or comprises, corresponding nozzle means (240), in particular, radially extending nozzle means, for the passage of said first reagent,
25 or organic raw material, in particular a fluid, preferably liquid raw material, towards the respective, in particular elongated and/or tubular, reaction chamber (14); and in that said nozzle means (240) are in the form of said nozzle means calibrated so as to cause a predetermined load loss of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, feeding

towards the respective, in particular elongated and/or tubular, reaction chamber (14), and such as to ensure a controlled, in particular a constant or substantially constant, flow rate, of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, entering the respective, in particular
5 elongated and/or tubular, reaction chamber (14), and so as to evenly distribute said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, on the respective inner surface (140) thereof.

2. The reactor according to claim 1, characterized in that said nozzle means (240) impart to said first reagent, in particular in the liquid phase, especially in the
10 form of an organic raw material, a load loss above 5000 Pa, preferably above 10000 Pa, and more preferably above 20000 Pa.

3. The reactor according to any of the preceding claims 1 and 2, characterized in that said nozzle means comprise a single calibrated passage nozzle (240) obtained in said means, or head, (24) for the inlet of said first reagent, in particular
15 in the liquid phase, especially in the form of an organic raw material, in the respective, in particular elongated and/or tubular, reaction chamber (14).

4. The reactor according to any of the preceding claims, characterized in that the calibrated passage nozzle, in particular the single calibrated passage nozzle (240) has a respective diameter that ranges between 0.1 mm and 5 mm, and
20 preferably that ranges between 1.2 mm and 1.6 mm.

5. The reactor according to any of the preceding claims, characterized in that the calibrated passage nozzle, in particular the single calibrated passage nozzle (240) has a length that ranges between 1 mm and 30 mm and preferably that ranges between 7 mm and 10 mm.

25 6. The reactor according to any of the preceding claims or according to the pre-characterizing part of claim 1, characterized in that said means, or head, (24) for the inlet of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, in the respective, in particular elongated and/or tubular, reaction chamber (14), comprise an annular, in particular circumferential,

cavity, (241) for the peripheral diffusion of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, which annular, in particular circumferential, cavity (241) for the peripheral diffusion of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, is in communication with the inside of the respective, in particular elongated and/or tubular, reaction chamber (14) through an annular conduit (242) that is longitudinally extending and coaxial with the respective reaction chamber (14), in particular radially converging towards and into the respective reaction chamber (14), and opening at the inner surface (140) of the respective reaction chamber (14).

7. The reactor according to claim 6, characterized in that said annular conduit (242) and/or said annular, in particular circumferential, cavity, (241), for the peripheral diffusion of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, are defined between a first and a second bodies (24xa, 24xb) coaxially coupled one inside the other; said first body, or male body, (24xa) being in connection with and coaxial to the respective, in particular elongated and/or tubular, reaction chamber (14) and being internally hollow, in particular being tubular, to convey said second reagent, in particular in the form of a gaseous reagent, preferably in the form of sulphuric anhydride, downstream into the respective, in particular elongated and/or tubular, reaction chamber (14).

8. The reactor according to claim 7, characterized in that said annular conduit (242) has a circumferentially even configuration, and in particular a thickness of the passage, in particular according to a radial direction, that is less than 2 mm, in particular that is less than 1 mm, and a particularly advantageous manner that ranges between 0.1 mm and 0,5 mm.

9. The reactor according to any of the preceding claims 7 and 8, characterized in that said nozzle means, or said calibrated passage nozzle, (240) being provided, or provided for, in said second body, or female body, (24xb) of the means, or head, (24) for the inlet of said first reagent, in particular in the liquid phase, especially in

the form of an organic raw material, in the respective, in particular elongated and/or tubular, reaction chamber (14).

10. The reactor according to any of the preceding claims or according to the pre-characterizing part of claim 1, characterized in that said means (16) for the
5 introduction of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, into said chambers, in particular elongated and/or tubular, reaction chambers (14), comprise means (161) for the distribution of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, between said reaction chambers (14).

10 11. The reactor according to claim 10, characterized in that said means (161) for the distribution of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, between said reaction chambers (14), are adapted to supply said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, to said inlet means, or nozzle means, (240) of
15 the respective, in particular elongated and/or tubular, reaction chamber (14).

12. The reactor according to any of the preceding claims 10 and 11, characterized in that said means (161) for the distribution of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, between said chambers, in particular elongated and/or tubular, reaction chambers
20 (14) comprise a plane, in particular horizontal, preferably having a circular outer profile, (162) for conveying said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, towards said inlet means, or nozzle means, (240) of the respective, in particular elongated and/or tubular, reaction chamber (14).

25 13. The reactor according to claim 12, characterized in that means (163) are provided for the supplying of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, to said conveying plane (162) of said first reagent towards said inlet means, or nozzle means, (240) of the respective, in particular elongated and/or tubular, reaction chamber (14).

14. The reactor according to claim 13, characterized in that said means (163) for the supplying of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, to said conveying plane (162), extend peripherally outwards to said conveying plane (162) of said first reagent towards said inlet
5 means, or nozzle means, (240) of the respective, in particular elongated and/or tubular, reaction chamber (14).

15. The reactor according to any of the preceding claims 13 and 14, characterized in that said means (163) for the peripheral supplying of said first reagent, in particular in the liquid phase, especially in the form of an organic raw
10 material, to said conveying plane (162) comprise a peripheral channel (163'), in particular external to said conveying plane (162), and inside which said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, spreads and from which it peripherally opens to said conveying plane (162) of said first reagent towards said inlet means, or nozzle means, (240) of the
15 respective, in particular elongated and/or tubular, reaction chamber (14).

16. The reactor according to claim 15, characterized in that said peripheral supplying channel (163'), in particular external to said conveying plane (162), and preferably circular, comprises a bottom surface (163a), in particular horizontal, especially extending with a circular profile.

20 17. The reactor according to any of the preceding claims 15 and 16, characterized in that said peripheral supplying channel (163'), in particular external to said conveying plane (162), and preferably circular, comprises a respective side surface (163b), in particular circular, preferably perpendicular to said conveying plane (162) of said first reagent and opening therinto, and especially extending
25 vertically, or perpendicularly, to said bottom surface (163a), on the radially inner side thereof.

18. The reactor according to any of the preceding claims 15 to 17, characterized in that said peripheral supplying channel (163'), in particular external to said conveying plane (162), and preferably circular, comprises a respective side surface

(163c), in particular circular, especially extending vertically, or perpendicularly, to said bottom surface (163a), on the radially outer side thereof, i.e., on the side that is radially opposite the one of said side surface (163b) opening on said conveying plane (162).

5 19. The reactor according to any of the preceding claims 16 to 18, characterized in that said plane (162) for conveying said first reagent is arranged at a height level that is higher or lower than the bottom surface (163a) of said peripheral channel (163').

20. The reactor according to any of the preceding claims 10 to 29, characterized
10 in that means (121) are provided for the inlet of said first reagent into said means (161) for the distribution of said first reagent between said, in particular elongated and/or tubular, reaction chambers (14), i.e., for the inlet into said peripheral channel (163') for the supplying of said first reagent.

21. The reactor according to claim 20, characterized in that said means (121) for
15 the inlet of said first reagent in said means (161) for the distribution of said first reagent between said, in particular elongated and/or tubular, reaction chambers (14), i.e., for the inlet into said peripheral supplying channel (163'), directly open into said peripheral supplying channel (163'); and/or in that said means (121) for
20 the inlet of said first reagent into said means (161) for the distribution of said first reagent between said, in particular elongated and/or tubular, reaction chambers (14), i.e., for the inlet into said peripheral supplying channel (163'), comprise a plurality of opening apertures of said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, which opening apertures are angularly distributed, peripherally to said peripheral supplying channel (163'); in
25 particular a plurality of inlet openings aperture (121, 121, 121) that are angularly spaced apart, in particular equally spaced apart from one another being provided; and/or in that said plane (162) for conveying said first reagent, in particular in the liquid phase, especially in the form of an organic raw material, towards said inlet means, or nozzle means, (240) of the respective, in particular elongated and/or

tubular, reaction chamber (14), has a plurality of holes (14') for the passage of said, in particular elongated and/or tubular, reaction chambers (14), i.e., for corresponding heads upstream therein.

22. The reactor according to any of the preceding claims or according to the
5 pre-characterizing part of claim 1, characterized in that said means (18) for inputting said second reagent, in particular in the gaseous phase, especially in the form of sulphuric anhydride, are configured so as to supply an even, or substantially even, gas flow to said reaction chambers, or tubes, (14).

23. The reactor according to any of the preceding claims or according to the
10 pre-characterizing part of claim 1, characterized in that said means (18) for inputting said second reagent, in particular in the gaseous phase, especially in the form of sulphuric anhydride, are supported by said reactor body, or outer shell, (12), i.e., by the respective peripheral outer, in particular circumferential, wall (120), thereof, especially at the respective upstream, in particular upper, end
15 thereof.

24. The reactor according to any of the preceding claims 22 and 23, characterized in that said means (18) for inputting the second reagent, in particular in the form of a gaseous reagent, preferably in the form of sulphuric anhydride, into the same plurality of reaction chambers, in particular elongated and/or tubular, (14),
20 comprise a tubular, in particular cylindrical, conduit (181), which extends according to a respective longitudinal axis (L) and which directly supplies the same second reagent in inlet into said reaction chambers (14), which tubular, in particular cylindrical, conduit (181) has an inner, especially smooth, preferably cylindrical tubular, surface (181xa) which extends according to a respective longitudinal axis
25 parallel to the axis of said reaction chambers (14), i.e., coincident with the axis of said peripheral, in particular circumferential, outer wall (120).

25. The reactor according to any of the preceding claims 22 to 24, characterized in that said means (18) for inputting the second reagent, in particular in the form of a gaseous reagent, preferably in the form of sulphuric anhydride, in the same

reaction chambers, or tubes, comprise a mouth (184) for the inlet of said second reagent, in particular at an upstream, or upper, end (182) of said tubular, in particular cylindrical, conduit (181), in particular provided at the side wall of the same tubular conduit (181), and an outlet mouth (183), in particular lying in a plane
5 perpendicular to said longitudinal axis (L) of the same tubular conduit (181).

26. The reactor according to any of the preceding claims 22 to 25, characterized in that said means (18) for inputting said second reagent, in particular in the gaseous phase, especially in the form of sulphuric anhydride, i.e., said tubular, in particular cylindric, conduit (181), have, or has, a longitudinal length (l), especially
10 comprised between said inlet mouth (184) and said outlet mouth (183) of said tubular conduit (181), which longitudinal length, (l) is greater than the extension of the corresponding diameter (D) of said means (18) for inputting said second reagent, i.e. of said tubular conduit (181), which in particular is greater than 2-folds the extension of said diameter (D), preferably which is greater than 3-4-folds the
15 extension of said diameter (D), and, in an even more preferred manner, being greater than 5-folds the extension of the same diameter (D).

27. The reactor according to any of the preceding claims or according to the pre-characterizing part of claim 1, characterized in that means (22) for cooling said, in particular elongated and/or tubular, reaction chambers (14) are provided, which
20 employ a cooling fluid, or liquid, in particular water.

28. The reactor according to claim 27, characterized in that said means (22) for cooling said, in particular elongated and/or tubular, reaction chambers (14) comprise, or are defined by, said reactor body, or outer shell, (12) housing said reaction chambers (14) and (221) for inputting a cooling fluid, or liquid, into the
25 same body, or outer shell, of the reactor (12) and means (222) for outletting the same cooling fluid, or liquid.

29. The reactor according to any of the preceding claims 27 and 28, characterized in that said means (22), for cooling said reaction chambers, or tubes, (14) comprise, inside said reactor body, or outer shell, (12) for housing said

reaction, in particular tubular, chambers (14), means (225) for conveying, or diverting, the flow of said cooling fluid, or liquid, in particular in the form of water, onto, or along, the outer surface of said, in particular elongated and/or tubular, reaction chambers (14).

5 30. The reactor according to claim 29, characterized in that said means (225) for conveying, or diverting, the flow of said cooling fluid, or liquid, in particular in the form of water, onto, or along, the outer surface of said, in particular elongated and/or tubular, reaction chambers (14), comprise respective septum means (226, 227), which are adapted to convey, or divert, said flow of said cooling fluid, or
10 liquid, according to a respective predetermined path.

31. The reactor according to claim 30, characterized in that said septum means (226, 227), which are adapted to convey, or divert, said flow of said cooling fluid, or liquid, according to a respective predetermined path, transversally extend with respect to the extension longitudinal axis of the reactor, i.e., of said reactor body, or
15 outer shell, (12), and/or of said, in particular elongated and/or tubular, reaction chambers (14).

32. The reactor according to any of the preceding claims 30 and 31, characterized in that said septum means (226, 227), which are adapted to convey, or divert, said flow of said cooling fluid, or liquid, according to a respective
20 predetermined path, comprise a plurality of transversal septa (226, 227) longitudinally mutually spaced apart along said reactor body, or outer shell, (12), or along said, in particular elongated and/or tubular, reaction chambers (14).

33. The reactor according to any of the preceding claims 30 to 32, characterized in that the septa of the respective plurality of longitudinally spaced apart septa, (226, 227), which are adapted to convey, or divert, said flow of said cooling fluid, or liquid, according to a respective predetermined path, are longitudinally equally
25 spaced from one another.

34. The reactor according to any of the preceding claims 30 to 33, characterized in that said septum means, or respective plurality of longitudinally spaced apart

septa, (226), which are adapted to convey, or divert, said flow of said cooling fluid, or liquid, according to a respective predetermined path, are adapted to make said flow of said cooling fluid, or liquid, take a longitudinal, or predominantly longitudinal, path, in particular from bottom to top of, at least partially along, or adjacent to, the respective plurality of reaction chambers, in particular tubular reaction chambers (14).

35. The reactor according to claim 34, characterized in that said flow of said cooling fluid, or liquid, according to a respective longitudinal, or predominantly longitudinal, path, has lengths of longitudinal flow along, or adjacent to, the respective plurality of reaction chambers, in particular tubular reaction chambers (14), and in particular for the passage through said septum means, or respective septum, (226), and radial expansion lengths between corresponding or adjacent septum means, or septa (226).

36. The reactor according to any of the preceding claims 34 and 35, characterized in that said septum means, or respective transversal septum, (226), which are adapted to convey, or divert, said flow of said cooling fluid, or liquid, according to a respective predetermined longitudinal, or predominantly longitudinal, path, are adapted, or is adapted, to define a gap, in particular an annular gap, (226b), for the longitudinal passage of said flow of said cooling fluid, or liquid, in the neighbourhood of the respective, in particular elongated and/or tubular, reaction chamber (14).

37. The reactor according to any of the preceding claims 34 to 36, characterized in that said septum means, or respective transversal septum, (226), which are adapted to convey, or divert, said flow of said cooling fluid, or liquid, according to a respective predetermined path, comprise at least one corresponding hole, which hole being defined by a corresponding, preferably circular, edge (226a), for the passing through of the respective reaction chamber (14), in particular which respective hole (226a) has a corresponding diameter that is greater than the diameter of the respective reaction chamber (14) by such an extent as to define said

annular gap for the passage, in particular the longitudinal passage, of said flow of said cooling fluid, or liquid.

38. The reactor according to any of the preceding claims 34 to 37, characterized in that said septum means, or respective transversal septum, (226), which are
5 adapted to convey, or divert, said flow of said cooling fluid, or liquid, according to a respective predetermined path, comprise, or are composed of, a corresponding transversal panel, or wall, (226) having one or more holes (226a) for the passing through of the corresponding ones of said, in particular elongated and/or tubular, reaction chambers (14).

10 39. The reactor according to any of the preceding claims 34 to 38, characterized in that said septum means, or respective plurality of longitudinally spaced apart septa, (226), i.e., the respective panel (226), which are adapted, or which is adapted, to convey, or divert, said flow of said cooling fluid, or liquid, according to a respective predetermined path, have, or has, a respective peripheral, or
15 circumferential, outer edge (226c) for the engagement against the peripheral, in particular circumferential, inner surface (220'), of said reactor body, or outer shell, (12).

40. The reactor according to any of the preceding claims 30 to 39, characterized in that said septum means, or respective plurality of longitudinally spaced apart
20 septa, (227), which are adapted to convey, or divert, said flow of said cooling fluid, or liquid, according to a respective predetermined path, are adapted to make said flow of said cooling fluid, or liquid, take a zigzagging path, in particular from bottom to top, with said flow of said cooling fluid, or liquid, moving transversally to said, in particular elongated and/or tubular, reaction chambers (14), between
25 corresponding or adjacent septum means, septa, (227), and especially in contact with the portions of said reaction chambers (14) extending between the same septum means, or septa, (227).

41. The reactor according to claim 40, characterized in that said septum means, or respective plurality of longitudinally spaced apart septa, (227), which are

adapted to convey, or divert, said flow of said cooling fluid, or liquid, according to a respective predetermined path, comprise corresponding means (228) for the passage, in particular in the longitudinal direction, of said flow of said cooling fluid, or liquid, through said septum means, or respective septum, (227); especially
5 said means (228) for the passage, in particular in the longitudinal direction, of said flow of said cooling fluid, or liquid, through said septum means, or respective septum, (227), being provided at, or in the proximity of, a respective transversal end (227a, 227b) of the septum means, or respective septum, (227), which are adapted to convey, or divert, said flow of said cooling fluid, or liquid, according to
10 a respective predetermined path; and/or in that said means (228) for the passage, in particular in the longitudinal direction, of said flow of said cooling fluid, or liquid, through said septum means, or respective septum, (227), of said septum means, or respective septa, (227) which are adjacent to one another, are provided at mutually opposite transversal ends (227a, 227b); and/or in that said septum means, or
15 respective septum, (227), which are adapted to convey, or divert, said flow of said cooling fluid, or liquid, according to a respective predetermined path, at a respective transversal end (227a, 227b), are open, i.e., have a corresponding edge, in particular a linear edge, (227c) which is spaced apart from the inner surface of said reactor body, or outer shell, (12), so as to define a corresponding, in particular
20 longitudinal, passage opening for said flow of said cooling fluid, or liquid; and/or in that said septum means, or respective septum, (227), which are adapted to convey, or divert, said flow of said cooling fluid, or liquid, according to a respective predetermined path, have, or has, a respective peripheral, or circumferential, outer edge (227d) for the engagement against the peripheral, in
25 particular circumferential, inner surface, (220'), of said reactor body, or outer shell, (12); and/or in that said septum means, or respective transversal septum, (227), which are adapted to convey, or divert, said flow of said cooling fluid, or liquid, according to a respective predetermined path, comprise, or are composed of, a corresponding transversal panel, or wall, (227) peripherally defined by a

corresponding edge (227c, 227d), in particular having a circumferential length for the engagement to and sealing against said inner surface of said reactor body, or outer shell, (12) and a length, especially a rectilinear length, which is spaced apart from the same inner surface of said reactor body, or outer shell, (12) to define said opening for the passage of said flow of said cooling fluid, or liquid, said panel, or transversal wall, (227) having a plurality of holes (227e) for the passing through of the corresponding ones of said, in particular elongated and/or tubular, reaction chambers (14).

42. The reactor according to any of the preceding claims 40 and 41, characterized in that, at the gap provided between adjacent transversal septa (227, 227), means (229) are provided, which are adapted to evenly distribute said transversal flow of said cooling fluid, or liquid.

43. The reactor according to claim 42, characterized in that said means (229), which are adapted to evenly distribute said transversal flow of said cooling fluid, or liquid, are at a respective transversal end of said gap that is provided between adjacent transversal septa (227, 227), and/or at the respective opening (228), upstream, for the passage of said flow of said cooling fluid, or liquid, through said septum means, or respective septum, (227).

44. The reactor according to any of the preceding claims 42 and 43, characterized in that said means (229), which are adapted to evenly distribute said transversal flow of said cooling fluid, or liquid, longitudinally extend, in particular between the corresponding adjacent transversal septa (227, 227) defining the transversal flow space of said cooling fluid, or liquid, especially engaging one of or both the corresponding opposite surfaces of said adjacent transversal septa (227, 227).

45. The reactor according to any of the preceding claims 42 to 44, characterized in that said means (229), which are adapted to evenly distribute said transversal flow of said cooling fluid, or liquid, comprise a corresponding planar member (229)

having corresponding means for the opening or the passage of said flow of said cooling fluid, or liquid.

46. The reactor according to any of the preceding claims 42 to 45, characterized in that said means (229), which are adapted to evenly distribute said transversal
5 flow of said cooling fluid, or liquid, are defined by, or are in the form of, a porous member, a network member, a perforated plate, suitable flow conveyors, or other.

47. The reactor according to any of the preceding claims 40 to 46, characterized in that said septum means, or respective septum, (227), which are adapted to convey, or divert, said flow of said cooling fluid, or liquid, according to a
10 respective predetermined transversal, or zigzagging, path comprise a plurality of through holes (227e) for the passing through by the respective plurality of reaction chambers, in particular elongated and/or tubular, reaction chambers (14), and which through holes (227e) have, or has, a respective peripheral, or circumferential, inner edge, (227e) for the engagement against the peripheral, in particular
15 circumferential, outer surface of the corresponding one of said reaction chambers (14).

48. The reactor according to any of the preceding claims or according to the pre-characterizing part of claim 1, characterized in that said, in particular elongated and/or tubular, reaction chambers (14), are made of a corrosion-resistant material,
20 for example, of alloy 28 or similar material.

49. A reactor, characterized in that it is obtained according to any of the preceding claims and/or as described and illustrated with reference to the attached drawings.