Claims

1. A method of continuously separating a component from a liquid mixture using a membrane unit which comprises at least one membrane stage and is fed with the liquid mixture as feed, wherein a membrane stage comprises at least a conveying device, at least two series-connected membrane modules, and a feed vessel upstream of the conveying device,

wherein the method comprises the following steps in which:

the liquid mixture from the feed vessel is guided by means of the conveying device as feed to the first of the at least two membrane modules, which depletes the component to be separated off, based in each case on the liquid mixture guided to the first membrane module, in a resulting permeate stream from the first membrane module and enriches it in a resulting retentate stream from the first membrane module,

the retentate stream from the first membrane module is guided to the second membrane module, which depletes the component to be separated off, based in each case on the retentate stream from the first membrane module, in a resulting permeate stream from the second membrane module and enriches it in a resulting retentate stream from the second membrane module,

wherein

the at least two membrane modules are joined to one another on the permeate side by such means that at least two permeate streams are each guided to a common pipeline, which gives rise to an overall permeate stream in the common pipeline, and

wherein the at least two membrane modules are connected to the common pipeline on the permeate side in opposite directions such that a portion of the overall permeate stream, a recycled permeate, is recycled at least partly to the feed vessel and/or beyond the feed vessel but upstream of the conveying device, while the remainder of the overall permeate stream, a removed permeate, is at least partly guided out of the membrane stage, with the recycled permeate having a higher concentration of the component to be separated off than the removed permeate.

2. The method according to Claim 1, wherein the concentration of the component to be separated off in the recycled permeate is greater than in the common pipeline between the connections of the first and last membrane modules, and wherein the concentration of the

component to be separated off in the common pipeline is greater than in the permeate removed.

3. The method according to Claim 1 or 2, wherein there are no controlling actuators in the common pipeline between the connections of the first and last membrane modules to the pipeline.

4. The method according to any of the preceding claims, wherein the recycling of the recycled permeate to the feed vessel and/or beyond the feed vessel but upstream of the conveying device is not carried out by means of a conveying device but by hydraulic means.

5. The method according to any of the preceding claims, wherein the mass flow rate of one stream of the three streams selected from the feed to the membrane unit, the permeate removed, and the retentate from the membrane unit is defined by a preceding or downstream process step, and one further stream of the three streams is controlled toward a target value.

6. The method according to any of the preceding claims, wherein the mass flow rate of the permeate recycled can fluctuate and is established depending on the mass flow rate of the removed permeate.

7. The method according to any of the preceding claims, wherein both the mass flow rate of the removed permeate and the permeate pressure are established in each case by means of an adjustable flow resistor.

8. The method according to any of the preceding claims, wherein the mass flow rate of the removed permeate, depending directly or indirectly on a fill level of the feed vessel, is subject to preferably continuous closed-loop control, a feature of which is that – based on a target value fixed beforehand for the fill level of the feed vessel – the mass flow rate of the removed permeate increases with rising fill level of the feed vessel and the mass flow rate of the removed permeate decreases with falling fill level of the feed vessel.

9. The method according to any of the preceding claims, wherein the pressure on the retentate side (retentate pressure) is controlled by means of the conveying device with which the feed is fed to one or more membrane modules, and optionally a further actuator, for example a supply pressure regulator, or by means of a combination of a manometer and an adjustable flow resistor, especially a valve on the retentate side.

10. The method according to any of the preceding claims, wherein the mass flow rate on the retentate side (retentate mass flow rate) is controlled by means of a closed-loop mass flow control system on the retentate side, comprising at least a mass flow meter and an adjustable flow resistor, preferably a valve, or by means of a combination of mass flow meter and the conveying device.

11. The method according to any of the preceding claims, wherein the component is a homogeneous catalyst which is separated from a reaction mixture.

12. The method according to any of the preceding claims, wherein the conveying device is a pump.

13. A method of continuously separating a homogeneous catalyst from a liquid reaction mixture using a membrane unit which comprises at least one membrane stage and is fed with the liquid reaction mixture containing the homogeneous catalyst and coming from a reaction zone as feed, wherein a membrane stage comprises at least a conveying device, at least two series-connected membrane modules, and a feed vessel upstream of the conveying device,

wherein the method comprises the following steps in which:

the liquid reaction mixture from the feed vessel is guided by means of the conveying device as feed to the first of the at least two membrane modules, which depletes the homogeneous catalyst, based in each case on the liquid reaction mixture guided to the first membrane module, in a resulting permeate stream from the first membrane module and enriches it in a resulting retentate stream from the first membrane module,

the retentate stream from the first membrane module is guided to the second membrane module, which depletes the homogeneous catalyst, based in each case on the retentate stream from the first membrane module, in a resulting permeate stream from the second membrane module and enriches it in a resulting retentate stream from the second membrane module,

wherein

the at least two membrane modules are joined sequentially to one another on the permeate side in such a way that at least two permeate streams form an overall permeate stream in which complete mixing of the individual permeate streams does not take place, and

a portion of the overall permeate stream, a recycled permeate, is recycled to the feed vessel and/or beyond the feed vessel but upstream of the conveying device, and the remainder of the overall permeate stream, a removed permeate, is removed from the membrane stage, with the recycled permeate having a higher concentration of the homogeneous catalyst than the removed permeate.

14. The method according to Claim 13, wherein the reaction mixture is taken from the reaction zone in which a homogeneously catalysed reaction is being conducted.

15. The method according to Claim 14, wherein the homogeneously catalysed reaction is selected from the group of the following reactions: oxidations, epoxidations, hydroformylations, hydroaminations, hydroaminomethylations, hydrocyanations, hydrocarboxylations, hydrocarbonylations, hydrocarboxyalkylations, alkoxycarbonylations, aminations, ammoxidation, oximations, hydrosilylations, ethoxylations, propoxylations, carbonylations, telomerizations, metatheses, Suzuki couplings and hydrogenations.