the catalyst, to be carried out on an industrially-relevant scale economically.

This object is achieved by a device according to claim 1.

In an embodiment, the disclosure relates to a device for the continuous homogeneous-catalytic reaction of a liquid with a gas and optionally a further fluid, wherein the device comprises at least one jet loop reactor having a pump-driven external liquid circuit, and wherein the device comprises at least one membrane separation stage that preferably retains the homogeneous catalyst, characterized in that the reactor is a jet loop reactor, and in that pump and membrane separation stage are arranged in the same external liquid circuit.

In a first aspect, there is provided a device for the continuous homogeneous-catalytic reaction of a liquid with a gas and optionally a further fluid, wherein the device comprises at least one reactor having a pump-driven external liquid circuit, and wherein the device comprises at least one membrane separation stage which have a molecular weight cutoff (MWCO) in the range from 150 g/mol to 1000 g/mol~~over 1 nm~~ and that preferably retains the homogeneous catalyst, whereby the reactor is a jet loop reactor, and in that pump and membrane separation stage are arranged in the same external liquid circuit, characterized in that a permeate-side free volume is provided in the membrane separation stage, which free volume is at least 0.3 dm^3 per m^2 of membrane surface.

The disclosure is based on the knowledge that a jet loop reactor and nanofiltration may be combined to form a device which permits economic carrying out of a hydroformylation on a commercial format. Fundamental to the economic efficiency of the process is simple structure of the process with as few plant components as possible and also marked retention and recirculation of the active catalyst to the reaction. A process reduced to the essential components results from the direct integration of the membrane separation into the external circuit of the jet loop reactor. This additionally permits separation of the catalyst and optionally of the free ligand under reaction conditions.

Claims

1. A device for the continuous homogeneous-catalytic reaction of a liquid with a gas and optionally a further fluid, wherein the device comprises at least one reactor having a pump-driven external liquid circuit, and wherein the device comprises at least one membrane separation stage which have a molecular weight cutoff (MWCO) in the range from 150 g/mol to 1000 g/mol~~over 1 nm~~ and that preferably retains the homogeneous catalyst,
whereby the reactor is a jet loop reactor, and in that pump and membrane separation stage are arranged in the same external liquid circuit,

characterized in that
a permeate-side free volume is provided in the membrane separation stage, which free volume is at least 0.3 dm^3 per m^2 of membrane surface.

2. The device as claimed in claim 1,
characterized in that
the pump is equipped structurally for long-term pumping of fluids which contain liquid and gaseous phases.

3. The device as claimed in claim 2,
characterized in that
the pump is a peripheral impeller pump.

4. The device as claimed in any one of the preceding claims, characterized by a permeate-side gas discharge arranged downstream of the membrane separation stage.

5. The device as claimed in any one of the preceding claims,
characterized in that
a heat exchanger for heating or cooling the feed or the permeate of the membrane separation stage is arranged in the external liquid circuit, in particular upstream of the membrane separation stage.

6. The device as claimed in any one of the preceding claims,
characterized in that