

- (b) discharging, from an outlet of the reactor, reaction mixture comprising reaction product and solvent;
 - (c) conducting the entire reaction mixture discharged in step (b) to a filtration membrane, whereby the filtration membrane is permeable to the solvent and
5 provided to be impermeable to the reaction product;
 - (d) recycling solvent which permeates the filtration membrane for diluting said substrate feed in step (a); and
 - (e) conducting the retentate from said filtration membrane to a reservoir other than said reactor, said retentate comprising reaction product,
 - 10 wherein said substrate feed and said solvent are mixed in a mixing vessel to form a diluted substrate feed which is continuously discharged from said mixing vessel to said reactor, wherein step (d) comprises continuously returning solvent which permeates the filtration membrane to said mixing vessel.
- 15 More particularly, provided herein is a continuous process for carrying out a chemical reaction of a substrate in a diluted reaction mixture comprising a solvent, the process comprising the steps of:
- (a) (simultaneously) adding a substrate feed and a solvent for diluting said substrate feed to form a reaction mixture in a reactor; and causing said substrate to form a reaction
20 product in said reaction mixture;
 - (b) discharging, from an outlet of the reactor, reaction mixture comprising reaction product and solvent;

In certain embodiments, said filtration membrane has a reaction product rejection of at least 90%.

In particular embodiments, said filtration membrane has a substrate rejection of at least 95%.

- 5 In certain embodiments, said filtration membrane is selected from the group consisting of a nanofiltration membrane, a microfiltration membrane, an ultrafiltration membrane, a reverse osmosis filtration membrane, and combinations thereof.

In particular embodiments, the temperature within the filtration loop and reaction vessel may be different. More particularly, the temperature within the filtration loop feed tank and
10 the reaction vessel may be different. Most particularly, the temperature within the filtration loop feed tank may be lower than the temperature within the reaction vessel.

In another aspect of the present disclosure, there is provided a system for carrying out a chemical reaction of a substrate in a diluted reaction mixture comprising a solvent,
15 comprising:

- (i) a reactor comprising:
 - a first and second inlet; and
 - a reactor outlet;
- (ii) a mixing vessel having an inlet and connected to said reactor via said first inlet;
- 5 (iii) a first feed tank configured to contain the substrate connected to said mixing vessel;
- (iv) a second feed tank connected to said reactor via said second inlet;
- (v) a filtration loop feed tank comprising:
 - a first filtration loop feed tank inlet which is connected to said reactor via said
 - 10 reactor outlet;
 - a second filtration loop feed tank inlet; and
 - a filtration loop feed tank outlet;
 and
- (vi) a filtration membrane configured for receiving a solution from said filtration loop
- 15 feed tank outlet, said filtration membrane having a retentate side and a permeate side, whereby the filtration membrane is further configured for returning the permeate to said mixing vessel via said inlet, and for returning the retentate to said filtration loop feed tank via said second filtration loop feed tank inlet.

Further provided herein is a system for carrying out a chemical reaction of a substrate in a diluted reaction mixture comprising a solvent, comprising:

- (i) a reactor (3) comprising:
 - a first, second, and third inlet (7, 8, 9); and
 - a reactor outlet (13);
- (ii) a first feed tank (1) connected to said reactor (3) via said first inlet (7);
- 25 (iii) optionally, a second feed tank (2) connected to said reactor (3) via said second inlet (8);
- (iv) a filtration loop feed tank (4) comprising:
 - a first filtration loop feed tank inlet (10) which is connected to said reactor (3) via said reactor outlet (13);
 - 30 - a second filtration loop feed tank inlet (11); and
 - a filtration loop feed tank outlet (14);
 and
- (v) a filtration membrane (5) configured for receiving a solution from said filtration loop feed tank outlet (14), said filtration membrane having a retentate side (15) and a permeate side (16), whereby the filtration membrane is further configured for
- 35 returning the permeate to said reactor (3) via said third inlet (9), and for returning the

CLAIMS

1. A continuous process for carrying out a chemical reaction of a substrate in a diluted reaction mixture comprising a solvent, the process comprising the steps of:
 - 5 (a) simultaneously adding a substrate feed and a solvent for diluting said substrate feed to form a reaction mixture in a reactor; and causing said substrate to form a reaction product in said reaction mixture;
 - (b) discharging, from an outlet of the reactor, reaction mixture comprising reaction product and solvent;
 - 10 (c) conducting the entire reaction mixture discharged in step (b) to a filtration membrane, whereby the filtration membrane is permeable to the solvent and provided to be impermeable to the reaction product;
 - (d) recycling solvent which permeates the filtration membrane for diluting said substrate feed in step (a); and
 - 15 (e) conducting the retentate from said filtration membrane to a reservoir other than said reactor, said retentate comprising reaction product,wherein said substrate feed and said solvent are mixed in a mixing vessel to form a diluted substrate feed which is continuously discharged from said mixing vessel to said reactor, wherein step (d) comprises continuously returning solvent which
20 permeates the filtration membrane to said mixing vessel.
2. The process according to claim 1, wherein said reaction is selected from the group consisting of a cyclization reaction, a polymerization reaction, an enzymatic reaction showing substrate inhibition, an enzymatic reaction showing product inhibition, a
25 reaction showing precipitation of the substrate or of a co-reactant, and combinations thereof.
3. The process according to claim 1 or 2, wherein said substrate feed and said solvent enter said reactor as separate streams which are mixed inside said reactor, and
30 wherein step (d) comprises continuously returning solvent which permeates the filtration membrane to said reactor.
4. The process according to any one of claims 1 to 3, wherein the volume of solvent
35 added in step (a) is at least 5 times the volume of substrate feed added in step (a).

5. The process according to any one of claims 1 to 4, wherein step (a) further includes mixing said substrate feed and solvent with one or more additional components selected from a catalyst and a co-reactant which is to be reacted with said substrate.
- 5 6. The process according to claim 5, wherein said substrate feed is continuously discharged from a substrate feed tank and said one or more additional components are continuously discharged from one or more feed tanks other than said substrate feed tank.
- 10 7. The process according to claim 5 or 6, wherein the rejection of said filtration membrane is below 10% for one or more components selected from said co-reactant, said catalyst, and one or more side products.
8. The process according to any one of claims 1 to 7, wherein
 - 15 - step (c) comprises conducting the reaction mixture discharged in step (b) to a filtration loop feed tank; discharging reaction mixture from an outlet of said filtration loop feed tank; and conducting the reaction mixture to said filtration membrane; and
 - step (e) comprises returning the retentate from said filtration membrane to said
- 20 filtration loop feed tank.
9. The process according to any one of claims 1 to 8, wherein at least 95% of the solvent added in step (a) is solvent from the permeate side of the filtration membrane.
- 25 10. The process according to any one of claims 1 to 9, wherein said filtration membrane has a reaction product rejection of at least 90%.
11. The process according any one of claims 1 to 10, wherein said filtration membrane has a substrate rejection of at least 95%.
- 30 12. The process according to any one of claims 1 to 11, wherein said filtration membrane is selected from the group consisting of a nanofiltration membrane, a microfiltration membrane, an ultrafiltration membrane, a reverse osmosis filtration membrane, and combinations thereof.

13. A system for carrying out a chemical reaction of a substrate in a diluted reaction mixture comprising a solvent, comprising:
- (i) a reactor comprising:
 - a first and second inlet; and
 - 5 - a reactor outlet;
 - (ii) a mixing vessel having an inlet and connected to said reactor via said first inlet;
 - (iii) a first feed tank configured to contain the substrate connected to said mixing vessel;
 - (iv) a second feed tank connected to said reactor via said second inlet;
 - 10 (v) a filtration loop feed tank comprising:
 - a first filtration loop feed tank inlet which is connected to said reactor via said reactor outlet;
 - a second filtration loop feed tank inlet; and
 - a filtration loop feed tank outlet;
 - 15 and

- (vi) a filtration membrane configured for receiving a solution from said filtration loop feed tank outlet, said filtration membrane having a retentate side and a permeate side, whereby the filtration membrane is further configured for returning the permeate to said mixing vessel via said inlet, and for returning the retentate to said filtration loop feed tank via said second filtration loop feed tank inlet.
- 5
14. The system according to claim 13, wherein the reactor is provided with a mixing means.
- 10
15. The system according to claim 13 or 14, further comprising means for adjusting the rate at which reaction mixture is discharged from the filtration loop feed tank and the substrate addition rate, in function of the membrane flux.