Claims

1. A gas-liquid bubbling bed reactor, comprising a liquid distributor, a gas distributor located below the liquid distributor, a catalyst bed layer and a catalyst support plate, and an optional interception screen, wherein the top of the reactor is provided with a gas outlet, the reactor is provided with a feed inlet connected to the liquid distributor, a gas inlet connected to the gas distributor, the bottom is provided with a discharge outlet, preferably the catalyst bed is loaded with a heterogeneous catalyst, further comprising: a circulating pump, which is located between the discharge outlet and the feed inlet of the reactor; a mixer, which is located between the circulating pump and the feed inlet of the reactor, and is provided with a reactant inlet; a dissolver, which is located between the mixer and the feed inlet of the reactor, and is provided with a reaction gas inlet, and the circulating pump, the mixer, and the dissolver are successively connected by pipelines.

2. The reactor according to claim 1, wherein, the liquid distributor is located in the upper part of the reactor, the gas distributor is located in the middle or lower part of the reactor, and the interception screen is located above the catalyst bed, preferably the gas distributor is a tubular distributor.

~~3. The reactor according to claim 1 or 2, further comprising: a circulating pump, which is located between the discharge outlet and the feed inlet of the reactor; a mixer, which is located between the circulating pump and the feed inlet of the reactor, and is provided with a reactant inlet; a dissolver, which is located between the mixer and the feed inlet of the reactor, and is provided with a reaction gas inlet, and the circulating pump, the mixer, and the dissolver are successively connected by pipelines.~~

~~4~~3. The reactor according to ~~any of~~ claim~~s 1-3~~1 or 2, further comprising: a cooler located on the pipeline of the recycle stream from the discharge outlet to the feed inlet of the reactor, the cooler is preferably located on the pipeline between the discharge outlet of the reactor and the circulating pump.

~~5~~4. The reactor according to any of claims ~~1-4~~1-3, further comprising: a condenser, which is connected to the gas outlet of the reactor, preferably a gas inlet of the condenser is connected to the gas outlet of the reactor, and a liquid outlet of the condenser is connected to a liquid inlet of the reactor.

~~6~~5. A reaction system, which comprises the gas-liquid bubbling bed reactor according to any of claims ~~1-5~~1-4 and a sub-reactor, the feed inlet of the sub-reactor is connected to the discharge outlet of the gas-liquid bubbling bed reactor, preferably the sub-reactor is a fixed bed reactor,

preferably the gaseous space of the gas-liquid bubbling bed reactor is communicated with the gaseous space of the sub-reactor.

~~7~~6. The reaction system according to claim ~~6~~5, wherein the top of the sub-reactor is provided with a gas outlet, the bottom is provided with a discharge outlet, and the gas outlet is connected to the condenser, preferably the sub-reactor is not provided with a reaction gas inlet, preferably, the feed inlet of the sub-reactor is connected to a position between the discharge outlet of the bubbling bed reactor and the circulating pump through a connection pipeline, more preferably, connected to a position between the cooler of the bubbling bed reactor and the circulating pump, preferably the position of the feed inlet of the sub-reactor is not below the filling height of the catalyst bed layer of the gas-liquid bubbling bed reactor, and is not above the height of the liquid distributor of the gas-liquid bubbling bed reactor.

~~8~~7. The reaction system according to claim ~~6~~5 or ~~7~~6, further comprising: a separation unit, which is connected to the discharge outlet of the sub-reactor.

~~9~~8. The reaction system according to claim ~~8~~7, wherein the separation unit comprises: a flash device, the feed inlet of which is connected to the discharge outlet of the sub-reactor; a light-removing column, the feed inlet of which is connected to the discharge outlet of the flash device; a heavy-removing column, the feed inlet of which is connected to the discharge outlet of the light-removing column; and a batch column, the feed inlet of which is connected to the liquid outlets of the light-removing column and the heavy-removing column.

~~10~~9. A process for synthesizing carbonate, which uses the gas-liquid bubbling bed reactor according to any of claims ~~1-5~~1-4, and comprises the steps:

mixing alkylene oxide and a first carbon dioxide gas with a recycle stream from the reactor, and sending the resulting mixture into a liquid distributor of the reactor via the feed inlet;

sending a second carbon dioxide gas into a gas distributor of the reactor via a gas inlet;

mixing the upward-moving second carbon dioxide gas with a downward-moving stream to react in the presence of a catalyst and obtain a carbonate-containing liquid stream, preferably the catalyst is a heterogeneous catalyst.

~~11~~10. The process according to claim ~~10~~9, wherein the recycle stream flowing out of a discharge outlet of the reactor flows through a cooler and a circulating pump, then mixes in a mixer with alkylene oxide introduced from an inlet of the mixer, and then mixes in a dissolver with the first carbon dioxide introduced from an inlet of the dissolver, and then enters the liquid distributor of the reactor via a feed inlet.

~~12~~11. The process for synthesizing carbonate according to claim ~~10~~9 or ~~11~~10, wherein a gas

substance from the reactor is allowed to enter a condenser to carry out the gas-liquid separation, and the obtained liquid is returned to the gas-liquid bubbling bed reactor via a liquid inlet.

~~13~~12. A process for synthesizing carbonate, which uses the reaction system according to any of claims ~~6-9~~5-8, and comprises the steps:

the carbonate-containing liquid stream is cooled by a cooler and then divided into a first stream and a second stream;

the first stream as recycle stream is allowed to enter the feed inlet of the gas-liquid bubbling bed reactor successively through a circulating pump, a mixer, and a dissolver;

alkylene oxide is introduced into the mixer to mix with the recycle stream;

a first carbon dioxide gas is introduced into the dissolver to mix with the recycle stream;

a second carbon dioxide gas is allowed to enter a gas distributor of the gas-liquid bubbling bed reactor;

the upward-moving second carbon dioxide gas and a downward-moving liquid phase stream are mixed and reacted in the presence of a catalyst to obtain a carbonate-containing liquid stream, preferably the catalyst is a heterogeneous catalyst;

the second stream is allowed to enter the sub-reactor to continue the reaction and produce carbonate.

~~14~~13. The process for synthesizing carbonate according to claim ~~13~~12, wherein gas substances from the gas-liquid bubbling bed reactor and the sub-reactor are allowed to enter a condenser to carry out the gas-liquid separation, and the obtained liquid is returned to the gas-liquid bubbling bed reactor via a liquid inlet.

~~15~~14. The process according to claim ~~10~~9 or ~~13~~12, wherein based on the total mass of carbon dioxide introduced into the gas-liquid bubbling bed reactor, the partition ratio of the first carbon dioxide gas to the second carbon dioxide gas is (1-50):(50-99), preferably (10-50):(50-90).

~~16~~15. The method according to claim ~~10~~9 or ~~13~~12, wherein the ratio of the density of the catalyst to the density of the reactants (a mixture of alkylene oxide and carbonate) is 0.3-2, preferably 0.5-1.5, the molar ratio of carbon dioxide and alkylene oxide is 1:1-10:1, preferably 1:1-2:1; the reaction pressure is 1-10 MPa, and the reaction temperature is 80-300°C.

~~17~~16. The process according to claim ~~13~~12, wherein the process further comprises that the carbonate product obtained from the sub-reactor is allowed to enter a separation unit, and comprises the steps:

the crude carbonate product is allowed to enter a flash device for treatment to obtain a liquid

stream and a gas;

the liquid stream obtained from the flash device is allowed to enter a light-removing column for treatment to obtain a light component and a bottom liquid;

the bottom liquid obtained from the light-removing column is allowed to enter a heavy-removing column for treatment to produce a light component, an electronic-grade carbonate, a high-grade carbonate, and a mixture of carbonate and heavy component, or to produce a light component, an electronic-grade carbonate, and a mixture of carbonate and heavy component;

the light components obtained from the light-removing column and the heavy-removing column and the bottom liquid obtained from the heavy-removing column are allowed to enter a batch column to produce a light component, a high-grade carbonate, an electronic-grade carbonate, and a heavy component.