Summary

In one aspect of the present disclosure, there is provided a method for the control of pressure in a loop for the preparation of ammonia or methanol comprising the steps of:
(a) providing a fresh ammonia or methanol synthesis gas;
(b) providing a loop recirculation gas;
(c) providing a loop recirculation compressor with an anti-surge valve and/or a compressor flow regulation valve;
(d) providing an ammonia or methanol synthesis loop;
(e) adding the fresh ammonia or methanol synthesis gas into the loop recirculation gas;
(f) pressurizing the loop recirculation gas from step (e) in the loop recirculation compressor; and
(g) monitoring pressure in the ammonia or methanol synthesis loop,
wherein flow of the loop recirculation gas through the anti-surge valve and/or the recirculation compressor flow regulation valve is controlled to obtain a substantially constant pressure in the ammonia or methanol synthesis loop.

In another aspect, the present disclosure relates to a method for the control of pressure in a loop for the preparation of methanol comprising the steps of:
(a) providing a fresh methanol synthesis gas;
(b) providing a loop recirculation gas;
(c) providing a loop recirculation compressor with an anti-surge valve and/or a compressor flow regulation valve;
(d) providing a methanol synthesis loop;
(e) pressurizing the loop recirculation gas in the loop recirculation compressor;

(f) adding the fresh methanol synthesis gas into the loop recirculation gas; and
(g) monitoring pressure in the methanol synthesis loop, wherein flow of the loop recirculation gas through the anti-surge valve and/or the recirculation compressor flow regulation valve is controlled to obtain a substantially constant pressure in the methanol synthesis loop.

In yet another aspect, the present disclosure relates to a system for controlling pressure in a loop for the synthesis of ammonia or methanol, comprising:

- a make-up gas compressor configured to pressurize a make-up synthesis gas,
- a synthesis loop configured to receive a pressurized make-up synthesis gas from the make-up gas compressor, the synthesis loop comprising a synthesis reactor, a synthesis loop cooler, a loop recirculation compressor, a synthesis loop heater, and a pressure monitor;
- the synthesis reactor arranged to receive a heated loop recirculation gas from the synthesis loop heater and configured to provide an at least partially synthesized gas to the synthesis loop cooler;
- the synthesis loop cooler configured to cool the at least partially synthesized gas and separate into a product stream and a loop recirculation gas;
- the loop recirculation compressor arranged to receive the loop recirculation gas and configured to pressurize and provide a pressurized loop recirculation gas to the synthesis loop heater;

wherein the loop recirculation compressor comprises an anti-surge valve and/or a compressor flow regulation valve in communication with the pressure monitor, the anti-surge

valve and/or a compressor flow regulation valve being configured to control the flow of the loop recirculation gas through the anti-surge valve and/or a compressor flow regulation valve to obtain a substantially constant pressure in the ammonia or methanol synthesis loop.

Description

We have found that the amount of feed gas to the to the ammonia and methanol reactor can be controlled by the anti-surge control of the recirculator (loop recycle compressor). The antisurge or kickback valve is typically a fast reacting control element for protection against surge resulting in vibrations and thus damage of the compressor.

Pursuant to the above finding, the present invention provides a method for the control of pressure in a loop for the preparation of ammonia or methanol comprising the steps of

(a) providing a fresh ammonia or methanol synthesis gas;
(b) providing a loop recirculation gas;
(c) providing a loop recirculation compressor with an anti-surge valve and/or a compressor flow regulation valve;
(d) providing an ammonia or methanol synthesis loop;
(e) adding the fresh ammonia or methanol synthesis gas into the loop recirculation gas;
(f) pressurizing the loop recirculation gas from step (e) in the loop recirculation compressor; and
(g) monitoring pressure in the ammonia or methanol synthesis loop,

wherein flow of the loop recirculation gas through the anti-surge valve and/or the recirculation compressor flow

regulation valve is controlled to obtain a substantially constant pressure in the ammonia or methanol synthesis loop.

In case of slow load variation (days or weeks), the method according to the invention can be supplemented by control of the temperature in a high pressure ammonia or methanol

Claims

1. A method for the control of pressure in a loop for the preparation of ammonia or methanol comprising the steps of:
(a) providing a fresh ammonia or methanol synthesis gas;
(b) providing a loop recirculation gas;
(c) providing a loop recirculation compressor with an anti-surge valve and/or a compressor flow regulation valve;
(d) providing an ammonia or methanol synthesis loop;
(e) adding the fresh ammonia or methanol synthesis gas into the loop recirculation gas;
(f) pressurizing the loop recirculation gas from step (e) in the loop recirculation compressor; and
(g) monitoring pressure in the ammonia or methanol synthesis loop,
wherein flow of the loop recirculation gas through the anti-surge valve and/or the recirculation compressor flow regulation valve is controlled to obtain a substantially constant pressure in the ammonia or methanol synthesis loop.

2. The method of claim 1, wherein the compressor flow regulation valve is arranged in parallel with the anti-surge valve.

3. The method of claim 1 or 2, wherein flow of the fresh ammonia or methanol synthesis gas is controlled by an anti-surge valve of a compressor for the fresh synthesis gas.

4. The method of any one of claims 1 to 3, comprising the further step of controlling temperature in a high-pressure

loop separator arranged in the loop for the preparation of ammonia or methanol.

5. The method of any one of claims 1 to 4, wherein hydrogen in the fresh ammonia or methanol synthesis gas is provided by means of electrolysis of water.

6. The method of claim 5, wherein the electrolysis of water is performed in a solid oxide electrolysis cell.

7. The method of any one of claims 1 to 4, wherein the fresh methanol synthesis gas is provided by co-electrolysis of water and carbon dioxide.

8. The method of any one of claims 1 to 6, wherein nitrogen in the fresh ammonia synthesis gas is provided by means of air separation.

9. The method of any one of claims 1 to 4, wherein the fresh ammonia synthesis gas is prepared of water and air in a solid oxide electrolysis cell.

10. The method of any one of claims 1 to 9, wherein flow of the loop recirculation gas is additionally controlled by a loop pressure controller downstream or upstream the recirculation compressor.

11. The method of any one of claims 1 to 10, wherein the module of the fresh ammonia synthesis gas is controlled by a ratio controller of hydrogen and nitrogen flow in ammonia synthesis gas by controlling the nitrogen flow rate relative to the hydrogen flow rate.

12. The method of claim 11, wherein the ratio controller is compensated by a real-time analyzer.

13. A method for the control of pressure in a loop for the preparation of methanol comprising the steps of:
(a) providing a fresh methanol synthesis gas;
(b) providing a loop recirculation gas;
(c) providing a loop recirculation compressor with an anti-surge valve and/or a compressor flow regulation valve;
(d) providing a methanol synthesis loop;
(e) pressurizing the loop recirculation gas in the loop re-circulation compressor;
(f) adding the fresh methanol synthesis gas into the loop recirculation gas; and
(g) monitoring pressure in the methanol synthesis loop, wherein flow of the loop recirculation gas through the anti-surge valve and/or the recirculation compressor flow regulation valve is controlled to obtain a substantially constant pressure in the methanol synthesis loop.

14. A system for controlling pressure in a loop for the synthesis of ammonia or methanol, comprising:

- a make-up gas compressor configured to pressurize a make-up synthesis gas,
- a synthesis loop configured to receive a pressurized make-up synthesis gas from the make-up gas compressor, the synthesis loop comprising a synthesis reactor, a synthesis loop cooler, a loop recirculation compressor, a synthesis loop heater, and a pressure monitor;
- the synthesis reactor arranged to receive a heated loop recirculation gas from the synthesis loop heater and

configured to provide an at least partially synthesized gas to the synthesis loop cooler;

- the synthesis loop cooler configured to cool the at least partially synthesized gas and separate into a product stream and a loop recirculation gas;

- the loop recirculation compressor arranged to receive the loop recirculation gas and configured to pressurize and provide a pressurized loop recirculation gas to the synthesis loop heater;

wherein the loop recirculation compressor comprises an anti-surge valve and/or a compressor flow regulation valve in communication with the pressure monitor, the anti-surge valve and/or a compressor flow regulation valve being configured to control the flow of the loop recirculation gas through the anti-surge valve and/or a compressor flow regulation valve to obtain a substantially constant pressure in the ammonia or methanol synthesis loop.

15. The system according to claim 14, wherein the compressor flow regulation valve is arranged in parallel with the anti-surge valve.

16. The system according to claim 14, further comprising a second anti-surge valve configured to control the flow of ammonia or methanol make-up synthesis gas provided by the make-up gas compressor to the synthesis loop.

17. The system according to claim 14, further comprising a high pressure loop separator arranged in the loop for the preparation of ammonia or methanol, for controlling temperature.

18. The system according to claim 14, further comprising a loop pressure controller downstream or upstream of the re-circulation compressor for additionally controlling the loop recirculation gas.