

We Claim:

1. A process (500A, 500B, 600) for one pot synthesis of dimethyl ether, the process (500A, 500B, 600) comprising:

5 separating carbon dioxide from a first stream (512, 612) comprising syngas to produce a second stream (522, 622), wherein the second stream (522, 622) is lean in carbon dioxide content;

reacting the second stream (522, 622) in the presence of a catalyst to produce a third stream (532, 632) comprising dimethyl ether, methanol, water, carbon monoxide, carbon dioxide, and hydrogen;

10 cooling the third stream (532, 632) to a temperature in a range from 10° C to 40° C to produce a fourth stream (542, 642);

washing and conducting a phase separation of the fourth stream (542, 642) to produce a product stream (572, 562, 654) comprising at least 10% by volume of dimethyl ether.

2. The process (500A, 500B, 600) according to claim 1, comprising separating the carbon
15 dioxide as a carbon dioxide stream (524, 624) from the first stream (512, 612) through a water wash followed by carbon dioxide stripping.

3. The process (500A, 500B, 600) according to claim 1, comprising reacting the second stream (522, 622) at an enhanced temperature in a range from 200 °C to 300 °C and pressure in a range from 20 bar to 30 bar in the presence of two or more catalysts.
- 5 4. The process (500A, 500B, 600) according to claim 1, wherein the step of cooling does not comprise chilling or refrigerating.
5. The process (500A, 500B, 600) according to claim 1, wherein the step of washing comprises using a hydrocarbon solvent scrubber producing a sixth stream (556, 656) comprising
10 carbon monoxide, carbon dioxide, and hydrogen.
6. The process (500A, 500B, 600) according to claim 5, comprising recycling at least a part of the sixth stream (556, 656) as a recycling stream (558, 658) to combine with the first stream (512, 612) for enhancing conversion of the syngas to dimethyl ether.
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7. The process (500A, 500B, 600) according to claim 6, wherein more than 60% of the sixth stream (556, 656) is recycled to combine with the first stream (512, 612).
8. The process (500A, 500B) according to claim 1, comprising removing methanol and water
20 from a fifth stream (554) through condensation, phase separation, distillation, or combinations thereof.

9. The process (500A, 500B, 600) according to claim 1, wherein the content of carbon dioxide in the second stream (522, 622) is less than 1 % of the total contents of the second stream (522, 622).
- 5 10. The process (500A, 500B) according to claim 1, comprising washing the fourth stream (542) before conducting the phase separation.