CLAIMS

1. Method for producing hydrogen from DME (dimethyl ether) by reforming, **characterized in** that the reforming is carried out at a pressure in the range from 15 bar to 70 bar, preferably in the range from 20 bar to 40 bar, and at a reformer outlet temperature in the range from 750° C to 1050° C, and a nickel- or cobalt-based catalyst material is used for the reforming process.

2. Method according to claim 1, **characterized in** that a catalyst bed with at least two layers is used, wherein at least one layer comprises or consists of an acidic catalyst material, in particular gamma alumina, and at least one further layer comprises or consists of a nickel- or cobalt-based catalyst material, or wherein two layers comprise or consist of a nickel-based catalyst material and/or that the catalyst bed comprises a catalyst filling or is provided by such a filling, and/or that a catalyst bed is used which comprises a first and a second region, wherein the first region has a first catalyst material and the second region has a second catalyst material different from the first catalyst material, and wherein the catalyst bed is embodied and arranged in a reformer used for the reforming process (4) such that the first and second regions are flowed through successively by the DME and/or by a product formed from the DME during the reforming process, preferably wherein the first catalyst material is an acidic catalyst material and the second catalyst material is a nickel- or cobalt-based catalyst material, and/or wherein the first region is arranged upstream of the second region, and/or wherein the catalyst bed is arranged in a preferably vertically arranged reformer tube of a reformer (4) used for the reforming process.

3. Method according to claim 1 or 2, **characterized in** that a CO_2 separation process is carried out after the reforming process, preferably wherein

the CO_2 separation is preferably carried out by chemical scrubbing, in particular amine scrubbing in one or two stages, and/or by physical scrubbing, in particular based on methanol and/or DME, and/or by a membrane process and/or by an adsorption process and/or with a CO_2 separation rate of at least 55%, preferably with a CO_2 separation rate in the range of 80% to 99%.

4. Method according to claim 3, **characterized in** that after the CO_2 separation, a hydrogen purification is carried out, in particular wherein a gas originating from the hydrogen purification, which preferably comprises H_2 and CH_4 and CO, is compressed and fed to the inlet side of a reformer (4) used for the reforming process, in particular together with the DME, preferably wherein the hydrogen purification is carried out by pressure swing adsorption and a tail gas from the pressure swing adsorption is compressed and fed to the inlet side of the reformer (4) together with the DME.

5. Method according to claim 3 or 4, **characterized in** that the CO_2 separation is carried out by or includes a condensation process, preferably wherein the cold required for condensing the CO_2 is provided by means of an open or closed refrigeration circuit containing DME as a refrigerant.

6. Method according to one of the preceding claims, **characterized** in that a reformer (4) embodied as a steam reformer is used, wherein the steam reforming is carried out in particular at a reformer outlet temperature in the range from 750° C to 950° C, preferably 775° C to 950° C.

7. Method according to claim 6, **characterized in** that a fired, in particular gas-fired, steam reformer with a burner is used, in particular wherein the flue gas is partially condensed, in particular wherein heat integration of the flue gas takes place and the partial condensation of the flue gas takes

place in a final stage of the heat integration, and/or wherein the condensation enthalpy is used to heat DME, combustion air, and/or water.

8. Method according to one of claims 3 to 5 and claim 7, **characterized in** that gas originating from the CO_2 separation process is fed to the burner and used as fuel for the burner.

9. Method according to claim 7 or 8, **characterized in** that part of the hydrogen produced is fed to the burner and used as fuel for the burner.

10. Method according to claim 4 and claim 9, **characterized in** that hydrogen is extracted after hydrogen purification and fed to the burner.

11. Method according to one of claims 1 to 5, **characterized** in that a reformer (4) embodied as an autothermal reformer is used, wherein the autothermal reforming is preferably carried out at a reformer outlet temperature in the range from 950° C to 1050° C, and/or that a gas-heated auxiliary reformer is used, wherein synthesis gas obtained in the reformer (4) is fed to the auxiliary reformer for its heating, preferably wherein the auxiliary reformer is connected upstream of the reformer (4) or connected in parallel to the reformer (4), and/or wherein the auxiliary reformer is embodied as a steam reformer, and/or that an adiabatic pre-reformer connected upstream of the reformer (4) is used, preferably wherein the pre-reformer comprises an acidic catalyst material or a Ni-based catalyst material with a higher Ni loading than the catalyst material of the reformer (4).

12. Method according to one of the preceding claims, **characterized in** that the synthesis gas obtained by reforming is cooled.

13. Method according to one of the preceding claims, **characterized in** that the synthesis gas obtained by reforming is subjected to a water gas

shift reaction, preferably after cooling, and/or no combustion of a purge stream takes place.

14. Method according to one of claims 3, 4, 5 or 8 and claim 13, **characterized in** that the CO_2 separation is carried out after the water gas shift reaction.

15. Method according to one of the preceding claims, **characterized in** that the DME is supplied in liquid form and is vaporized before entering the reformer (4), preferably wherein a thermal energy storage device is used to provide the energy required for vaporization during a start-up phase, and/or wherein the vaporized DME, in particular mixed with water vapor, is superheated before entering the reformer (4).

16. Method according to claims 12 and 15, **characterized in** that, in particular after a start-up phase, the liquid DME is used to cool the synthesis gas, preferably by passing the synthesis gas obtained by reforming and the liquid DME through a common heat exchanger in which the synthesis gas is cooled and the liquid DME is vaporized.

17. Plant for producing hydrogen from DME (dimethyl ether) in a method according to one of the preceding claims, with a reformer (4), **characterized** in that the reformer (4) is embodied to carry out reforming of DME at a pressure in the range from 15 bar to 70 bar, preferably in the range from 20 bar to 40 bar, and at a reformer outlet temperature in the range from 750° C to 1050° C, preferably in the range from 750° C to 950° C, and the reformer (4) comprises a nickel- or cobalt-based catalyst material, and that a DME evaporation device (1) is provided upstream of the reformer (4), preferably wherein a thermal energy storage device is provided, via which the DME vaporization device (1) can be fed.

18. Plant according to claim 17, **characterized in** that the reformer (4) comprises a catalyst bed with at least two layers, wherein at least one layer comprises or consists of an acidic catalyst material, in particular gamma alumina, and at least one further layer comprises or consists of a nickel- and/or cobalt-based catalyst material, or wherein two layers comprise or consist of a nickel-based catalyst material, and/or that the catalyst bed comprises or is embodied as a catalyst filling, and/or that the reformer (4) has a catalyst bed comprising a first and a second region, wherein the first region has a first catalyst material and the second region has a second catalyst material different from the first catalyst material, and wherein the catalyst bed is embodied and arranged in a reformer (4) used for the reforming process such that, during operation, the first and second regions are flowed through successively by the DME and/or by a product formed from the DME during the reforming process, preferably wherein the first catalyst material is an acidic catalyst material and the second catalyst material is a nickel- or cobalt-based catalyst material, and/or wherein the first region is arranged upstream of the second region, and/or wherein the reformer (4) has a preferably vertically arranged reformer tube in which the catalyst bed is arranged.

19. Plant according to one of claims 17 or 18, **characterized in** that a CO_2 separation device (7) is provided downstream of the reformer (4) in order to separate carbon dioxide (CO_2) from the synthesis gas obtained by reforming, preferably wherein the CO_2 separation device (7) is embodied for separating CO_2 by chemical scrubbing, in particular amine scrubbing in one or two stages, and/or by physical scrubbing, in particular based on methanol and/or DME, and/or by a membrane process and/or by an adsorption process, and/or that the CO_2 separation device (7) is embodied to provide a CO_2 separation rate of at least 55%, preferably a CO_2 separation rate in the range from 80% to 99%, in particular, wherein the CO_2 separation device

(7) is embodied for CO_2 separation by a condensation process, preferably wherein the CO_2 separation device (7) is embodied to provide the cooling required for condensation of the CO_2 by means of an open or closed refrigeration circuit containing DME as a refrigerant.

20. Plant according to one of claims 17 to 19, **characterized in** that a hydrogen purification device (8) is provided downstream of the reformer (4), preferably wherein the hydrogen purification device (8) comprises at least one pressure swing adsorption reactor and/or wherein a connecting line connecting the hydrogen purification device (8) and the reformer (4), via which a gas originating from the hydrogen purification device (8), preferably comprising H_2 and CH_4 and CO, in particular a tail gas from the pressure swing adsorption, can be fed to the reformer (4) on its inlet side, in particular together with the DME, and a compressor for compressing the gas originating from the hydrogen purification device (8) is provided.

21. Plant according to claim 20, **characterized in** that the reformer (4) is embodied as a fired steam reformer and has a burner and at least one connecting line is provided between the hydrogen purification device and the burner, via which a gas originating from the hydrogen purification device (8) can be fed to the burner.