CLAIMS

1. A hydrogen production process comprising ammonia cracking, the process comprising

supplying a gaseous process flow comprising ammonia, preferably by vaporing liquid ammonia at a heat exchanger vaporizer or by supplying gaseous ammonia directly;

preheating the gaseous process flow at a preheater upstream an ammonia cracking reactor;

feeding the preheated gaseous process flow as a feed to a reaction zone of the ammonia cracking reactor;

catalytically cracking at least part of the ammonia comprised in the feed at the reaction zone yielding a flow of a hot process mixture comprising hydrogen and nitrogen; and

providing a heat duty for the cracking and the preheating by firing of a fuel in the presence of an oxidant at a combustion zone of the reactor;

wherein the process comprises

a recuperative transfer of heat from the hot process mixture to the process feed at the reaction zone by passing the hot process mixture received from the catalytic reaction zone through an internal recuperative heat exchanger of the cracking reactor;

optionally, wherein the fuel for the firing comprises one or more of: ammonia, hydrogen, and a mixture of hydrogen and nitrogen.

2. The process according to claim 1, wherein preheating the gaseous process feed comprises a heat transfer from the reactor effluent to the gaseous feed.

3. The process according to claim 1, further comprising preheating the oxidant prior to the firing, said preheating comprising a heat transfer of

heat from a flue gas off flow from the firing; optionally, wherein the oxidant is heated to a temperature above 1000 °C.

4. The process according to claim 2, wherein the duty for the vaporizing, for the preheating the gaseous process flow, and for preheating the oxidant flow is supplied by residual heat from firing the fuel.

5. The process according to claim 1, further comprising ammonia slip removal from the reactor effluent yielding a purified reactor effluent and an ammonia enriched off flow, wherein ammonia from the off flow is recycled back to the reactor for processing and/or for firing.

6. The process according to claim 1, further comprising purifying the reactor effluent, preferably downstream a ammonia slip removal, said purification yielding a hydrogen enriched product flow at a desired purity and an off flow comprising at least nitrogen and hydrogen, wherein off flow is recycled back to reactor for firing.

7. The process according to claim 1, comprising further cooling the comparatively cooled effluent flow prior to the ammonia slip removal at a recuperative heat recovery system comprising at least one heat exchanger that operates against boiling water.

8. A plant for performing a production process of hydrogen by cracking ammonia, preferably the process according to claim 1, the plant comprising at least

a recuperative cracking reactor comprising: a reaction zone; a combustion zone; and a recuperative heat exchanger, and

a preheater positioned upstream the reaction zone for preheating a gaseous process feed comprising ammonia, wherein

the reaction zone contains a catalyst for catalyzing a conversion of at least part of the ammonia comprised in the feed yielding a flow of a hot process mixture comprising hydrogen and nitrogen,

the combustion zone is in thermal contact with the reaction zone to provide a heat duty for the production process by firing a fuel in the presence of an oxidant,

the recuperative heat transfer zone is fluidly connected to an output of the reaction zone and wherein the recuperative heat transfer zone is configured to heat the feed at the reaction zone by a recuperative transfer of heat from the flow of the hot process mixture prior to releasing the process mixture as a reactor effluent from the reactor..

9. The plant according to claim 8, wherein the preheater is a heat exchanger configured to, in use, transfer heat from the reactor effluent to the gaseous feed for preheating the gaseous process feed and yielding a comparatively cooled effluent flow.

10. The plant according to claim 8, comprising a fired process heater comprising a combustion chamber and a convective section to recover heat from a flue gas off flow from the combustion chamber whereby the combustion zone, the reaction zone, and the recuperative heat exchanger, in fluid connection with the catalytic zone, are housed in the combustion chamber.

11. The plant according to claim 8, further comprising an oxidant preheater configured to preheat a flow of the oxidant prior to the firing using heat from a flue gas off flow from the firing; optionally, wherein the preheater, the oxidant preheater, as wells as a heat exchanger vaporizer for vaporizing liquid ammonia are connected to receive a required heat duty from residual heat from firing of the fuel.

12. The plant according to claim 8, further comprising a processing section for purifying the effluent, the processing section comprising one or more of

an ammonia slip remover, yielding a purified effluent and an ammonia enriched off flow, and

an purifier, preferably downstream the ammonia slip remover, said purifier, yielding a hydrogen enriched product flow and a nitrogen enriched off flow comprising hydrogen,

and wherein the processing system is configured to recycle one or more ammonia enriched off flow and the nitrogen enriched off flow back to the cracking reactor for further processing and/or firing; optionally, the plant further comprising a cooler configured to further reduce a temperature of the comparatively cooled effluent flow upstream the processing section, said cooler comprising at least one heat exchanger that operates against boiling water.

13. The plant according to claim 8, further comprising a pre-reformer fluidly connected between the cracking reactor and the preheater, and configured to crack a part of, preferably up to 10%, the ammonia in the preheated feed.

14. The plant according to claim 8, further comprising one or more pump and heat exchanger vaporizer for vaporizing liquid ammonia from a storage to a processing pressure, wherein a heat for the vaporizing is supplied by the heat duty from firing the fuel.

15. The plant according to claim 8, further comprising a recycle loop configured to recycle part of the formed hydrogen product back into the feed to the reactor; optionally, wherein a level of hydrogen in the feed is preferably in a range of 1-5 vol%.