CLAIMS

1. A method of separating hydrogen gas from an effluent gas of an ammonia cracking reactor operating at an elevated pressure, in a pressure swing adsorption (PSA) system comprising at least two PSA units in parallel,

said method comprising:

cooling the effluent gas by heat exchange to produce cooled effluent gas; and

feeding the cooled effluent gas at the elevated pressure to the PSA system to produce a hydrogen product gas and a PSA tail gas;

wherein each PSA unit comprises a feed end, a product end downstream from the feed end and an adsorbent bed located therebetween, the adsorbent bed comprising an upstream layer of non-zeolitic adsorbent that is selectively adsorbent for at least ammonia and a downstream layer of zeolitic adsorbent that is selectively adsorbent for nitrogen.

2. A method according to Claim 1, wherein the non-zeolitic adsorbent has a capacity for ammonia of at least 0.01 mmol/g at 0.005 bar and 40°C.

3. A method according to Claim 1 or Claim 2, wherein the non-zeolitic adsorbent desorbs at least 10% of adsorbed ammonia after 100 s using a nitrogen purge at 1.4 bar and 40°C.

4. A method according to any of the preceding claims, wherein the non-zeolitic adsorbent desorbs at least 30% of adsorbed ammonia after 600 s using a nitrogen purge at 1.4 bar.

5. A method according to any of the preceding claims, wherein the non-zeolitic adsorbent selectively co-adsorbs water and/or nitrogen.

6. A method according to Claim 5, wherein the non-zeolitic adsorbent has a capacity for nitrogen of at least 0.18 mmol/g at 5 bar and 40°C.

7. A method according to any of the preceding claims, wherein the non-zeolitic adsorbent has a surface acidity in the range from about pH 6.3 to about pH 9.8.

8. A method according to any of the preceding claims, wherein the non-zeolitic adsorbent is an activated carbon.

9. A method according to Claim 8, wherein the activated carbon is selected from the group consisting of polymer-derived carbon, petroleum pitch carbon, wood-based carbon, coal-based carbon and coconut shell carbon.

10. A method according to Claim 9, wherein the activated carbon is pre-treated with acid or base.

11. A method according to Claim 9, wherein the activated carbon is pre-treated *in situ* by flowing nitrogen through the layer of coconut shell at an elevated temperature of at least 150°C.

12. A method according to any of Claims 8 to 11, wherein the activated carbon has an inorganic content of less than 1 wt. %.

13. A method according to any of Claim 1 to 7, wherein the non-zeolitic adsorbent is activated alumina.

14. A method according to Claim 13, wherein the activated alumina is pre-treated with base.

15. A method according to any of Claim 1 to 7, wherein non-zeolitic adsorbent is selected from the group consisting of wide pore silica gel, narrow pore silica gel and silicalite.

16. A method according to any of the preceding claims, wherein the adsorbent bed comprises an intermediate layer of activated carbon having an inorganic content of less than 1% located between the upstream and downstream layers.

17. A method according to any of the preceding claims, wherein the activated carbon of the intermediate layer is selected from the group consisting of polymer-derived carbon and petroleum pitch carbon.

18. A method according to any of the preceding claims, wherein the effluent gas has from 0% to about 0.5% by volume water and from about 0.1% to about 5% by volume ammonia with the rest of the gas consisting of a mixture of hydrogen and nitrogen in a ratio of about 3:1.

19. A method according to any of the preceding claims, wherein the cooled effluent gas is at a temperature in a range from about 15°C to about 100°C.

20. A method according to any of the preceding claims, wherein the elevated pressure of the cooled effluent gas is in a range from about 5 bar to about 40 bar.

21. A method according to any of the preceding claims, wherein the PSA tail gas has a back pressure in a range from about 0.2% to about 20% of the elevated pressure of the effluent gas.