CLAIMS

What is claimed is:

1. A method of producing an alkylaromatic by the alkylation of an aromatic with an alkylating agent, the method comprising:

Reactivating and fully regenerating a deactivated H-beta zeolite catalyst that has been subjected to at least one year of continuous alkylation conditions, and recovering a regenerated H-beta zeolite catalyst, wherein the regenerated H-beta zeolite catalyst has a deactivation rate that is ~~no more than 120% of~~less than a deactivation rate of a fresh H-beta zeolite catalyst;

providing at least one reaction zone containing the regenerated H-beta zeolite catalyst;

introducing a feed stream comprising an aromatic and an alkylating agent to the reaction zone; and

reacting at least a portion of the aromatic under alkylation conditions to produce an alkylaromatic;

wherein the production of the alkylaromatic with the regenerated H-beta zeolite catalyst is within 90% of a production rate of an alkylaromatic with a fresh H-beta zeolite;

wherein regenerating the deactivated H-beta zeolite catalyst comprises heating the deactivated H-beta zeolite catalyst to a temperature or a series of temperatures ranging from about 300°C to 600°C.

2. The method of claim 1, wherein the deactivated H-beta zeolite catalyst is an H-beta zeolite catalyst that has been subjected to continuous alkylation conditions for from 30 months to 42 months.

3. The method of claim 1, wherein the feed stream further comprises catalyst poisons averaging at least 30 ppb.

4. The method of claim 1, wherein the amount of H-beta catalyst in the at least one reaction zone is at least 3,000 pounds.

5. The method of claim 1, wherein the amount of H-beta catalyst in the at least one reaction zone is between 3,000 pounds and 50,000 pounds in a first preliminary alkylation system.

6. The method of claim 1, wherein the alkylaromatic production is at least 0,5 million pounds per day.

7. The method of claim 1, wherein the alkylaromatic is ethylbenzene, the aromatic is benzene and the alkylating agent is ethylene.

8. The method of claim 1, wherein the at least one reaction zone comprises at least one preliminary alkylation reactor and at least one primary alkylation reactor.

9. The method of claim 8, wherein the at least one preliminary alkylation reactor contains H-beta zeolite catalyst in a quantity of between at least 3,000 pounds to 50,000 pounds.

10. The method of claim 8, wherein the at least one preliminary alkylation system has a ran time of at least 12 months prior to regeneration.

11. The method of claim 8, wherein the at least one preliminary alkylation system has a run time of at least 24 months prior to deactivation requiring regeneration.

12. The method of claim 8, wherein the H-beta zeolite catalyst in the first preliminary alkylation system can be regenerated in-situ.

13. The method of claim 1, wherein the at least one reaction zone contains a mixed catalyst that includes H-beta zeolite catalyst and at least one other catalyst.

14. The method of claim 8, wherein the preliminary alkylation reactor contains a mixed catalyst that includes H-beta zeolite catalyst and at least one other catalyst.

15. The method of claim 8, wherein the primary alkylation reactor contains a mixed catalyst that includes H-beta zeolite catalyst and at least one other catalyst.

16. The method of claim 8, wherein the primary alkylation reactor experiences no catalyst deactivation when the preliminary alkylation reactor is in service.

17. A process of producing ethylbenzene from a high poison feed stream by the alkylation of benzene with ethylene, the process comprising:

reactivating and fully regenerating a deactivated H-beta zeolite catalyst that has been subjected to at least one year of continuous alkylation conditions, wherein the deactivated H-beta zeolite catalyst is regenerated under conditions effective to recover a regenerated H-beta zeolite catalyst that has a deactivation rate that is ~~no more than 120% of~~less than a deactivation rate of a fresh H-beta zeolite catalyst, wherein regenerating the deactivated H-beta zeolite catalyst comprises heating the deactivated H-beta zeolite catalyst to a temperature or a series of temperatures ranging from about 300°C to 600°C;

providing at least one reaction zone containing the regenerated H-beta zeolite catalyst;

introducing a feed stream comprising benzene and ethylene to the reaction zone, the feed stream containing at least 10 ppb poisons; and

reacting at least a portion of the benzene with ethylene under alkylation conditions to produce ethylbenzene;

wherein the regenerated H-beta zeolite catalyst has a deactivation rate of no more than 50 pounds of catalyst per million pounds of ethylbenzene produced.

18. The process of claim 17, wherein the regenerated H-beta catalyst has a deactivation rate of no more than 30 pounds of catalyst per million pounds of ethylbenzene produced.

19. The process of claim 17, wherein the regenerated H-beta catalyst has a deactivation rate of no more than 10 pounds of catalyst per million pounds of ethylbenzene produced.

20. The process of claim 17, wherein the regenerated H-beta catalyst has a deactivation rate of no more than 2.5 pounds of catalyst per million pounds of ethylbenzene produced.

21. The process of claim 17, wherein the amount of catalyst in the at least one reaction zone is from 3,000 to 7,000 pounds and produces over 1,000 million pounds of ethylbenzene prior to regeneration of the catalyst.

22. The process of claim 17, wherein the amount of catalyst in the at least one reaction zone is from 10,000 to 12,000 pounds and produces over 2,000 million pounds of ethylbenzene prior to regeneration of the catalyst.

23. The process of claim 17, wherein the amount of catalyst in the at least one reaction zone is from 20,000 to 22,000 pounds and produces over 4,000 million pounds of ethylbenzene prior to regeneration of the catalyst.

24. The process of claim 17, wherein the at least one reaction zone contains a mixed catalyst that includes regenerated H-beta zeolite catalyst and at least one other catalyst.

25. A process of producing ethylbenzene from a high poison feed stream by the alkylation of benzene with ethylene, the process comprising:

providing at least one reaction zone containing 20,000 to 25,000 pounds of H-beta zeolite catalyst;

introducing a high poison feed stream comprising benzene containing at least 10 ppb poisons and ethylene to the at least one reaction zone in amounts averaging at least 16 million pounds benzene per day;

reacting at least a portion of the benzene with ethylene under alkylation conditions to produce ethylbenzene averaging at least 7.0 million pounds per day, for a cumulative run time of over 24 months to produce a total of at least 5,000 million pounds of ethylbenzene prior to regeneration;

wherein the H-beta zeolite catalyst has a deactivation rate of no more than 5 pounds of catalyst per million pounds of ethylbenzene produced; and

reactivating and fully regenerating the H-beta zeolite catalyst under conditions effective to recover a regenerated H-beta zeolite catalyst that has a deactivation rate that is ~~no more than 120% of~~less than the deactivation rate of a fresh H-beta zeolite catalyst, wherein regenerating the H-beta zeolite catalyst comprises heating the H-beta zeolite catalyst to a temperature or a series of temperatures ranging from about 300°C to 600°C.

26. The process of claim 25, wherein the H-beta zeolite catalyst has a deactivation rate of no more than 2 pounds of catalyst per million pounds of ethylbenzene produced.

~~27. The process of claim 25, wherein the regenerated H-beta zeolite catalyst has a deactivation rate that is no more than the deactivation rate of a fresh H-beta zeolite catalyst.~~

~~28~~27. The process of claim 25, wherein the H-beta zeolite catalyst is regenerated in-situ.

~~29~~28. The method of claim 1, wherein the at least one reaction zone comprises a preliminary alkylation reactor containing the regenerated H-beta zeolite catalyst, and a primary alkylation reactor that contains an alkylation catalyst;

wherein regenerating the ~~regenerated~~ deactivated H-beta zeolite catalyst ~~is regenerated by heating an at least partially deactivated H-beta zeolite catalyst to a series of temperatures ranging from 300°C to 600°C by~~comprises:

heating the at least partially deactivated H-beta zeolite catalyst to a first temperature with a gas containing nitrogen;

staging an oxygen content of the gas upward to about 2 mol. % or less oxygen to increase the temperature;

staging the oxygen content of the gas upward to about 2.0 mol. % oxygen to maintain a catalyst regeneration temperature for a time sufficient to provide an output stream having an oxygen content of 0.2 mol. % or less; and

holding the at least partially deactivated H-beta zeolite catalyst at a second temperature for a period of time.