Claims

1. A method for producing isopropyl benzene, comprising:

step A: feeding a first stream containing benzene and a first stream containing propylene into a first reaction zone to contact a first catalyst for alkylation, and obtaining a first stream containing isopropyl benzene from the first reaction zone,

dividing the first stream containing isopropyl benzene into a stream Ia and a stream IIa, the stream Ia circulating back into the first reaction zone and the stream IIa entering a second reaction zone,

having the stream entering the second reaction zone to contact a second catalyst for alkylation, and obtaining a second stream containing isopropyl benzene from the second reaction zone, and

purifying at least a partial stream IIIa of the second stream containing isopropyl benzene, and obtaining a product isopropyl benzene.

2. The method according to claim 1, wherein the operating conditions in the first reaction zone comprise: a molar ratio of the benzene in the first stream containing benzene to the propylene in the first stream containing propylene being 0.5:1~3.0:1, a weight hourly space velocity of the first stream containing propylene calculated by propylene being 0.1~10 hr^{-1}, a reaction temperature being 90~180 ºC, a reaction pressure being 1.0~4.0 MPa, and a recycle ratio being 1~50,

preferably, the molar ratio of the benzene in the first stream containing benzene to the propylene in the first stream containing propylene is 1.0:1~3.0:1, the weight hourly space velocity of the first stream containing propylene calculated by propylene is 0.2~5.0 hr^{-1}, the reaction temperature is 95~150 ºC, the reaction pressure is 2.0~3.0 MPa, and the recycle ratio is 2~25; and/or

the operating conditions in the second reaction zone comprises: a reaction temperature being 80~160 ºC, a reaction pressure being 1.0~4.0 MPa, and a liquid phase weight hourly space velocity being 1~100 hr^{-1},

preferably, the reaction temperature is 90~150 ºC, the reaction pressure is 2.0~3.0 MPa, and the liquid phase weight hourly space velocity is 1~60 hr^{-1}.

3. The method according to claim 1 or claim 2, wherein the method comprises circulating a partial stream IVa of the second stream containing isopropyl benzene to the second reaction zone,

a recycle ratio of the first reaction zone being larger than that of the second reaction zone.

4. The method according to any one of claims 1 to 3, wherein the recycle ratio of the second reaction zone is 0.1~15, preferably 0.1~10.

5. The method according to any one of claims 1 to 4, wherein the ratio of the recycle ratio of the second reaction zone to that of the first reaction zone is 0~0.5, preferably 0.01~0.5.

6. The method according to any one of claims 1 to 5, wherein the method comprises feeding a second stream containing benzene and/or a second stream containing propylene into the second reaction zone, preferably,

wherein the weight hourly space velocity of the second stream containing benzene calculated by benzene is 0.5~30 hr^{-1}, and/or the weight hourly space velocity of the second stream containing propylene calculated by propylene is 0.1~5 hr^{-1}.

7. The method according to any one of claims 1 to 6, wherein the first catalyst and/or the second catalyst is/are selected from a group consisting of Beta zeolite, mordenite, and zeolite having MWW stratified structure.

8. The method according to any one of claims 1 to 7, wherein the first stream containing propylene enters the first reaction zone by stages, and/or

wherein the second stream containing propylene enters into the second reaction zone by stages.

9. The method according to any one of claims 1 to 8, wherein the first reaction zone comprises a plurality of reactors in parallel connection, and/or the second reaction zone comprises a plurality of reactors in parallel connection.

10. The method according to any one of claims 1 to 8, further comprising:

switching from step A to a step B when the activity of the first catalyst in the first reaction zone drops below a preset value, wherein step B comprises:

turning off the first stream containing benzene and the first stream containing propylene,

feeding only the second stream containing benzene and the second stream containing propylene into the second reaction zone to contact the second catalyst for alkylation, and

obtaining the second stream containing isopropyl benzene, and

dividing the second stream containing isopropyl benzene into a stream IIIa and a stream IVa, the stream IVa circulating back to the second reaction zone and the stream IIIa being purified, obtaining the product isopropyl benzene,

the first catalyst at this moment is in an activity recovery phase;

switching from step B to a step C after the activity of the first catalyst recovers, wherein step C comprises:

feeding the second stream containing benzene and the second stream containing propylene into the second reaction zone to contact the second catalyst for alkylation, and obtaining the second stream containing isopropyl benzene,

dividing the second stream containing isopropyl benzene into a stream IIIb and a stream IVb, the stream IVb circulating back to the second reaction zone and the stream IIIb entering into the first reaction zone,

having the stream entering the first reaction zone to contact the first catalyst for alkylation, and obtaining the first stream containing isopropyl benzene, and

purifying at least a partial stream IIb of the first stream containing isopropyl benzene and obtaining the product isopropyl benzene;

switching from step C to a step D when the activity of the second catalyst in the second reaction zone drops below a preset value, wherein step D comprises:

turning off the second stream containing benzene and the second stream containing propylene,

feeding only the first stream containing benzene and the first stream containing propylene into the first reaction zone to contact the first catalyst for alkylation, obtaining the first stream containing isopropyl benzene, and

dividing the first stream containing isopropyl benzene into a stream IIb and a stream Ib, the stream Ib circulating back to the first reaction zone and the stream IIb being purified, obtaining the product isopropyl benzene,

the second catalyst at this moment being at an activity recovery phase; and

switching from step D to step A after the activity of the second catalyst recovers.

11. The method according to claim 10, wherein in step C, the operating conditions of the second reaction zone comprise: a molar ratio of the benzene in the second stream containing benzene to the propylene in the second stream containing propylene being 0.5:1~3.0:1, a weight hourly space velocity of the second stream containing propylene calculated by propylene being

0.1~10 hr^{-1}, a reaction temperature being 90~180 ºC, a reaction pressure being 1.0~4.0 MPa, and a recycle ratio being 1~50,

preferably, the molar ratio of the benzene in the second stream containing benzene to the propylene in the second stream containing propylene is 1.0:1~3.0:1, the weight hourly space velocity of the second stream containing propylene calculated by propylene is 0.2~5.0 hr^{-1}, the reaction temperature is 95~150 ºC, the reaction pressure is 2.0~3.0 MPa, and the recycle ratio is 2~25; and/or

the operating conditions in the first reaction zone comprises: a reaction temperature being 80~160 ºC, a reaction pressure being 1.0~4.0 MPa, and a liquid phase weight hourly space velocity being 1~100 hr^{-1},

preferably, the reaction temperature is 90~150 ºC, the reaction pressure is 2.0~3.0 MPa, and the liquid phase weight hourly space velocity is 1~60 hr^{-1}.

12. The method according to claim 10 or claim 11, wherein in step C, a partial stream Ib of the first stream containing isopropyl benzene circulates to the first reaction zone, the recycle ratio of the second reaction zone being larger than that of the first reaction zone.

13. The method according to claim 11 or claim 12, wherein in step C, the recycle ratio of the first reaction zone is 0.1~15, preferably 0.1~10.

14. The method according to any one of claims 10 to 13, wherein in step C, the ratio of the recycle ratio of the first reaction zone to that of the second reaction zone is 0~0.5, preferably 0.01~0.5.

15. The method according to any one of claims 10 to 14, wherein step C comprises feeding the first stream containing benzene and/or the first stream containing propylene into the first reaction zone; preferably, the weight hourly space velocity of the first stream containing benzene calculated by benzene is 0.5~30 hr^{-1} and that of the first stream containing propylene calculated by propylene is 0.1~5 hr^{-1}.