Claims

1. A process for obtaining isobutene from an isobutene containing C4-hydrocarbon mixture (1) in a plant comprising an etherification unit (3), a first distillation unit (5), an ether cleavage unit (8) and a second distillation unit (10), the process comprising:

(a) contacting the C4-hydrocarbon mixture (1) with a primary alcohol or isopropyl alcohol (2) and reacting the mixture with the primary alcohol or isopropyl alcohol in the presence of an acidic catalyst to form the corresponding alkyl tert-butyl ether as an intermediate product and diisobutene as a by-product in the etherification unit (3);

(b) distilling the reaction mixture (4) from the etherification unit (3) in the first distillation unit (5), a C4-hydrocarbon raffinate being withdrawn as the overhead product (6), the alkyl tert-butyl ether and diisobutene being withdrawn as the liquid or vaporous bottom product (7), and vaporizing the bottom product (7) if it is withdrawn as a liquid;

(c) reacting the vaporous bottom product (7) in the presence of an acidic catalyst obtaining isobutene and the primary alcohol or isopropyl alcohol as reaction products in the ether cleavage unit (8);

(d) distilling the reaction mixture (9) from the ether cleavage unit (8) in the second distillation unit (10), isobutene being withdrawn as the overhead product (11), the primary alcohol or isopropyl alcohol and diisobutene being withdrawn as the bottom product (12) and being recycled to the etherification unit (3);

characterized in that the plant further comprises a byproduct separation unit (15) being fed by a bottom purge stream (13) of the first distillation unit (5) and/or by a part of the bottom product of the second distillation unit (10), this feed stream (13, 14) being split up in at least three byproduct streams wherein a first byproduct stream (16) is rich in diisobutene, a second byproduct stream (17) is rich in the primary alcohol or isopropyl alcohol, and a third byproduct stream (18) is rich in components with a normal boiling point higher than 110 °C.

2. The process according to claim 1, wherein the second byproduct stream (17) is recycled to the etherification unit.

3. The process according to claim 1 or 2, wherein the mass fraction of the primary alcohol or isopropyl alcohol in the second byproduct stream (17) is at least 90 wt.-%, preferably at least 95 wt.-%.

4. The process according to any one of claims 1 to 3, wherein the first byproduct stream (16) is further split up in at least two further byproduct streams wherein a fourth byproduct stream (19) is rich in diisobutene and a fifth byproduct stream (20) is rich in alkyl tert-butyl ether.

5. The process according to claim 4, wherein the mass fraction of diisobutene in the first byproduct stream (16) is at least 30 wt.-% and the mass fraction of diisobutene in the fourth byproduct stream (19) is at least 90 wt.-%, preferably at least 95 wt.-%, more preferably at least 98 wt.-%, in particular at least 99 wt.-%.

6. The process according to any one of claims 1 to 5, wherein the first distillation unit (5) comprises a distillation column, the bottom product (7) being withdrawn as a side stream from the distillation column at a stage below the feed stage, and a bottom purge stream (13) rich in high-boiling components being withdrawn from the sump of the distillation column.

7. The process according to claim 6, wherein the bottom purge stream (13) from the sump of the distillation column in the first distillation unit (5) is fed to the byproduct separation unit (15).

8. The process according to any one of claims 1 to 7, wherein the bottom product from the first distillation unit (5) is vaporized in an evaporator, a bottom purge stream (13) containing high boiling components with a normal boiling point higher than that of the alkyl tert-butyl ether being withdrawn from the evaporator.

9. The process according to claim 8, wherein the evaporator is a natural circulation evaporator, particularly a Robert type evaporator, and wherein the bottom purge stream (13) is withdrawn from the liquid phase in the bottom of the evaporator.

10. The process according to claim 8 or 9, wherein the bottom purge stream (13) from the evaporator is fed to the byproduct separation unit (15).

11. The process according to any one of claims 4 to 10, wherein the fifth byproduct stream (20) is at least partly recycled to the evaporator for evaporation and/or to the ether cleavage unit (8).

12. The process according to any one of claims 1 to 11, wherein the primary alcohol is isobutanol, and the alkyl tert-butyl ether is isobutyl tert-butyl ether (IBTBE).