Claims

1. Process for removing polyunsaturated hydrocarbons from olefin-containing C4 hydrocarbon streams that, in addition to C4 hydrocarbons, also contain C5 hydrocarbons in the range between 0.01 and 5% by weight and mercaptans and/or disulfides in the range between 0.01 and 200 ppm by weight, wherein

in a first step, at least some of the polyunsaturated hydrocarbons from the olefin-containing C4 hydrocarbon stream is hydrogenated and/or reacts with the mercaptans and/or disulfides from the olefin-containing C4 hydrocarbon stream in a first reaction zone, which consists of one or more reactors connected in parallel and/or in series, wherein the first step is carried out using a first catalyst which contains at least two metals of the 10^{th} group of the periodic table, preferably palladium and platinum, and in the presence of hydrogen and in the absence of carbon monoxide, wherein not more than 80 mol% of the available polyunsaturated hydrocarbons from the C4 hydrocarbon stream is hydrogenated and/or reacts in the first step, and wherein the molar ratio of hydrogen to polyunsaturated hydrocarbons in the first step is between 0.01 and 0.8;

in a second step, the polyunsaturated hydrocarbons in the olefin-containing C4 hydrocarbon stream that did not react in the first step are selectively hydrogenated using a second catalyst which contains a single metal of the 10^{th} group of the periodic table, preferably palladium, in the presence of hydrogen and carbon monoxide in a second reaction zone, which consists of one or more reactors connected in parallel and/or in series,

wherein at least one removal of high boilers takes place between the first step and the second step, and

wherein the first and second catalysts are different from one another.

2. Process according to Claim 1, wherein the molar ratio of hydrogen to polyunsaturated hydrocarbons in the first step is between 0.1 and 0.5.

3. Process according to Claim 1 or 2, wherein the inlet temperature of the C4 hydrocarbon stream in the inflow of the first reaction zone, which consists of one or more reactors connected in parallel and/or in series, is between 0°C and 180°C, preferably between 60°C and 150°C, more preferably between 80°C and 130°C.

4. Process according to any of Claims 1 to 3, wherein the first step is carried out exclusively in the liquid phase and the hydrogen present has been dissolved completely in the liquid phase.

5. Process according to any of Claims 1 to 4, wherein, in the second step, the content of carbon monoxide in the C4 hydrocarbon stream in the inflow of the second reaction zone, which consists of one or more reactors connected in parallel and/or in series, is 0.05 to 20 ppm based on the total amount of the hydrocarbon stream.

6. Process according to any of Claims 1 to 5, wherein the inlet temperature of the C4 hydrocarbon stream in the inflow of the second reaction zone, which consists of one or more reactors connected in parallel and/or in series, is between 0°C and 100°C, preferably between 20°C and 80°C, more preferably between 30°C and 60°C.

7. Process according to any of Claims 1 to 6, wherein the pressure in the second reaction zone, which consists of one or more reactors connected in parallel and/or in series, is in the range from 2 to 50 bar, preferably in the range from 6 to 30 bar, more preferably in the range from 10 to 25 bar.

8. Process according to any of Claims 1 to 7, wherein the second step is carried out exclusively in the liquid phase.

9. Process according to any of Claims 1 to 8, wherein the first reaction zone consists of a single reactor.

10. Process according to any of Claims 1 to 9, wherein the second reaction zone consists of at least two reactors connected in parallel or in series.