CLAIMS

1. A process for co-producing, from dialkyl maleates and hydrogen, dialkyl succinate and 1,4-butanediol, said process comprising the following steps:

a) hydrogenating a stream of dialkyl maleate in a first stage of reaction over suitable catalyst to produce dialkyl succinate;

b) further hydrogenating part of the dialkyl succinate produced in the first stage of reaction in a second stage of reaction, by using a different suitable catalyst, for producing an effluent comprising mainly 1,4-butanediol, together with minor amounts of gamma-butyrolactone and tetrahydrofuran as co-products; the effluent is subject to cooling, phase separation and distillation to produce 1,4-butanediol,

wherein,

the first stage of reaction operates from 80 to 130 °C as inlet temperature, from 30 to 80 bar as pressure and with liquid hourly space velocity from 0.5 to 2.0

the second stage of reaction operates from 160 to 190 °C as inlet temperature, from 30 to 80 bar as pressure and with liquid hourly space velocity from 0.1 to 0.3 hr^{-1}

in both stages of reaction, the conditions as hydrogen/organic feed ratio, pressure and temperature are such to maintain the reactors in mixed liquid/vapor phase

characterized in that:

the effluent from the first stage of reaction is separated in a flash vessel to produce a vapor phase and a liquid phase stream, rich in dialkyl succinate, and splitting this stream in three portions:

i) a first part, corresponding to less than 50 %mol of total production, is further subject to low pressure phase separation, to separate the absorbed hydrogen, and to distillation to produce high purity dialkyl succinate;

ii) a second part is sent to the second stage of reaction;

iii) a recirculation liquid, which by a pump is cooled in a heat exchanger and sent back to the inlet of the first stage of reaction;

the hydrogen/dialkyl maleate feed molar ratio is in the range from 15 to 30 in the first stage of reaction and from 30 to 60 in the second stage of reaction; and

the dialkyl succinate, not converted in the second stage of reaction and separated in the distillation section in mixture with some amount of gamma-butyrolactone, is recycled to the second stage of reaction.

2. The process according to claim 1, wherein the operation is performed on a continuous basis.

3. The process according to claim 1, wherein the catalyst used in the first stage of reaction comprises a low content between 0.1 and 2.0 % by weight, relative to the total weight of the catalyst, of an active metal selected from the group consisting of palladium, ruthenium, platinum or mixture thereof, applied to a support material comprising carbon, aluminum oxide, silicon oxide.

4. The process according to claim 1, wherein the catalyst used for hydrogenolysis in the second stage is a copper containing catalyst, selected from a copper-chromite and a copper-zinc oxide catalyst.

5. The process according to claim 1 the dialkyl maleate is dimethyl maleate and dialkyl succinate is dimethyl succinate.

6. The process according to claim 5, wherein the dimethyl maleate has very high purity, not less than 97 wt%.

7. The process according to any of claims 1 to 6, wherein both reaction stages are fixed bed adiabatic reactors.

8. The process according to any of claims 1 to 7, wherein the inlet temperature to the second stage of reaction is controlled by the recirculation rate at the first stage of reaction.

9. The process according to any of claims 1 to 8 wherein the amount of the liquid recirculated from the outlet to the inlet of the first stage of reaction is from 1 to 10 times the weight amount of the compound to be hydrogenated.

10. The process according to claim 9, wherein the amount of the liquid recirculated from the outlet to the inlet of the first stage of reaction is from 2 to 4 times the weight amount of the compound to be hydrogenated.

11. The process according to any of claims 1 to 10, wherein the required hydrogen/dialkyl maleate feed molar ratio is achieved by cooling the effluent from the second stage of reaction at a temperature between 20 to 60 °C, by separating the resulting liquid and gaseous phases in a dedicated vessel, by recirculating the gaseous phase through a recycle compressor.

12. The process according to any of claims 1 to 11, wherein both the purified dimethyl succinate produced in the first stage of reaction and the purified 1,4-butanediol produced in the second stage of reaction are used as raw materials of a polyester unit, producing polybutylene succinate alone or, by using butanediol, dimethyl succinate together with terephthalic acid or adipic acid or esters of the two dicarboxylic acids, as co-polymer.

13. The process according to claim 12 wherein the methanol produced in the polybutylene succinate unit by transesterification is used together with maleic anhydride for producing the dimethyl maleate fed to the first stage of hydrogenation.

14. The process according to claim 1 wherein the flash of the first reactor effluent occurs in an enlarged top section of the second stage of reaction,

equipped with a chimney tray, including an overflow device, of pipe or downcomer type.

15. The process according to claim 1 wherein the separation of the vapor phase and liquid phase is obtained using two stacked reactors, with intermediate separation of phases.