CLAIMS

1. Process for bio-1,3-butanediol purification from a fermentation broth comprising the following steps:

   (a) subjecting the fermentation broth to separation, wherein said step (a) comprises the following steps:

   (a_{1a}) microfiltration and (a_2) nanofiltration; or

   (a_{1b}) centrifugation and (a_2) nanofiltration;

   (b) subjecting the product obtained in step (a) to treatment with ion-exchange resins;

   (c) subjecting the product obtained in step (b) to a first evaporation;

   (d) subjecting the product obtained in step (c) to a second evaporation;

   (e) subjecting the product obtained in step (d) to a third evaporation, obtaining purified bio-1,3-butanediol.

~~2. Process for bio-1,3-butanediol purification from a fermentation broth according to claim 1, wherein said step (a) comprises the following steps:~~

~~(a_{1a}) microfiltration; and~~

~~(a_2) nanofiltration.~~

~~3. Process for bio-1,3-butanediol purification from a fermentation broth according to claim 1, wherein said step (a) comprises the following steps:~~

~~(a_{1b}) centrifugation; and~~

~~(a_2) nanofiltration.~~

~~4~~ 2. Process for bio-1,3-butanediol purification from a fermentation broth according to claim ~~2~~ 1, wherein said microfiltration step (a_{1a}) is carried out:

- by membranes having a mean pore diameter ranging from 0.01 µm to 1.0 µm, preferably ranging from 0.02 µm to 0.08 µm; and/or

- ~~operating~~ at a transmembrane pressure ranging from 0.1 bar to 8 bar, preferably ranging from 1 bar to 5 bar, said transmembrane pressure being defined as the average pressure between the pressure measured upstream and the pressure measured downstream of the microfiltration module; and/or
- at a temperature ranging from 20°C to 90°C, preferably ranging from 40°C to 70 °C~~, more preferably at the fermentation temperature~~; and/or
- by ceramic membranes which are submerged or in a cross flow configuration or in a dynamic cross flow configuration, or by flat or hollow-fibre polymer membranes which are submerged or in a cross flow configuration.

~~5~~ 3. Process for bio-1,3-butanediol purification from a fermentation broth according to claim ~~3~~ 1, wherein said centrifugation step (a_{1b}) is carried out:

- at a temperature ranging from 20°C to 90°C, preferably ranging from 25°C to 70°C, more preferably at room temperature (25 °C); and/or
- ~~operating~~ at a centrifugal feed rate ranging from 50 l/h to 1000 l/h, preferably ranging from 90 l/h to 500 l/h; and/or
- at a rotation speed ranging from 2000 rpm to 50000 rpm, preferably ranging from 3000 rpm to 9000 rpm.

~~6~~ 4. Process for bio-1,3-butanediol purification from a fermentation broth according to claim ~~2 or 3~~ 1, wherein said nanofiltration step (a_2) is carried out:

- by nanofiltration membranes having a “molecular weight cut-off” (MWCO) ranging from 100 daltons to 500 daltons, preferably ranging from 120 daltons to 400 daltons; and/or
- by nanofiltration membranes having a maximum operating temperature ranging from 15°C to 100°C, preferably ranging from 20°C to 80°C; and/or
- ~~operating~~ at a transmembrane pressure ranging from 10 bar to 50 bar,

preferably ranging from 20 bar to 40 bar, said transmembrane pressure being defined as the average pressure between the pressure measured upstream and the pressure measured downstream of the nanofiltration module.

~~7~~ 5. Process for bio-1,3-butanediol purification from a fermentation broth according to any of the previous claims, wherein said step (b) of treatment with ion-exchange resins comprises two steps:

(b_1) anion exchange step;

(b_2) cation exchange step.

~~8~~ 6. Process for bio-1,3-butanediol purification from a fermentation broth according to claim ~~7~~ 5, wherein said step (b_1) is carried out by means of a column containing a weak anionic resin.

~~9~~ 7. Process for bio-1,3-butanediol purification from a fermentation broth according to claim ~~7~~ 5, wherein said step (b_2) is carried out by means of a column containing a strong cationic resin.

~~10~~ 8. Process for bio-1,3-butanediol purification from a fermentation broth according to any of the claims from ~~7~~ 5 to ~~9~~ 7, wherein said steps (b_1) and (b_2) are carried out at a flow rate [litres of product obtained in step (a) per hour] ranging from 2 BV/h to 4 BV/h, preferably ranging from 2.5 BV/ h to 3.5 BV/h (BV = “Bed Volume” = volume of resin per single column).

~~11~~ 9. Process for bio-1,3-butanediol purification from a fermentation broth according to any of the claims from ~~7~~ 5 to ~~10~~ 8, wherein the product obtained from said steps (b_1) and (b_2) has a residual conductivity ranging from 0.1 µS/cm to 100 µS/cm, preferably ranging from 0.5 µS/cm to 15 µS/cm.

~~12~~ 10. Process for bio-1,3-butanediol purification from a fermentation broth in accordance with any of the claims from ~~7~~ 5 to ~~11~~ 9, wherein the product obtained in

step (a) obtained is fed to step (b_1) and subsequently to step (b_2), or is fed to step (b_2) and subsequently to step (b_1).

~~13~~ 11. Process for bio-1,3-butanediol purification from a fermentation broth according to any of the previous claims, wherein said first evaporation step (c) is carried out:

- at a temperature ranging from 30°C to 100°C, preferably ranging from 40°C to 70°C; and/or
- at a pressure ranging from 5 mbar to 100 mbar, preferably ranging from 10 mbar to 80 mbar.

~~14~~ 12. Process for bio-1,3-butanediol purification from a fermentation broth according to any of the previous claims, wherein said second evaporation step (d) is carried out:

- at a temperature ranging from 30°C to 150°C, preferably ranging from 40°C to 130°C; and/or
- at a pressure ranging from 1 mbar to 100 ~~bar~~ mbar, preferably ranging from 8 mbar to 80 mbar.

~~15~~ 13. Process for bio-1,3-butanediol purification from a fermentation broth according to any of the previous claims, wherein said third evaporation step (e) is carried out:

- at a temperature ranging from 30°C to 150°C, preferably ranging from 40°C to 130°C; and/or
- at a pressure ranging from 5 mbar to 100 ~~bar~~ mbar, preferably ranging from 8 mbar to 80 mbar.

~~16. Process for the preparation of bio-1,3-butadiene comprising:~~

- ~~feeding a mixture (i) containing bio-1,3-butanediol, obtained according to any of the previous claims, to a first reactor containing at least one dehydration catalyst, obtaining a stream (ii) comprising alkenols, water and, optionally, unreacted impurities and/or bio-1,3-butanediol, exiting from said first reactor;~~

- optionally, feeding said stream (ii) to a first purification section, obtaining:
- a stream (iii) comprising alkenols, water and, optionally, impurities;
- a stream (iv) comprising water and, optionally, impurities and/or unreacted bio-1,3-butanediol; and optionally
- a stream (v) comprising impurities;
- feeding said stream (iii) and/or said stream (iv) to a second reactor containing at least one dehydration catalyst, obtaining a stream (vi) comprising bio-1,3-butadiene, water and, optionally, impurities and/or unreacted alkenols, exiting from said second reactor;
- feeding said stream (vi) to a second purification section, obtaining:
- a stream (vii) comprising pure bio-1,3-butadiene;
- a stream (viii) comprising water and, optionally, unreacted alkenols; and optionally
- a stream (ix) comprising impurities.

17. Use of bio-1,3-butadiene obtained according to claim 16, as a monomer or as an intermediate in the production of elastomers and (co)polymers.