

CLAIMS

1. A method for an enzymatic hydrolysis in which plant based raw material is hydrolysed by means of enzymes, wherein
- the plant based raw material (1) is fed to the first enzymatic hydrolysis stage (2),
 - the plant based raw material (1) is hydrolysed in at least two enzymatic hydrolysis stages (2,4),
 - a liquid fraction (5a,5b) comprising carbohydrates is separated from a solid fraction (6a,6b) in a solid-liquid separation stage (7a,7b) after each enzymatic hydrolysis stage (2,4), and
 - the solid fraction (6a) is supplied to the next enzymatic hydrolysis stage (4) in which the solid fraction is treated, and the solid fraction (6b) is recovered after the last solid-liquid separation stage (7b).
2. The method according to claim 1, wherein the residence time of the first enzymatic hydrolysis stage (2) is 2 - 48 hours.
3. The method according to claim 1 or 2, wherein consistency of the plant based raw material (1) is 4 - 40 % in the first enzymatic hydrolysis stage (2).
4. The method according to any one of claims 1 to 3, wherein the residence time of the second or any later enzymatic hydrolysis stage (4) is 6 - 72 hours.
5. The method according to any one of claims 1 to 4, wherein consistency of the solid fraction (6a) is 10 - 40 % in the second or any later enzymatic hydrolysis stage (4).
6. The method according to any one of claims 1 to 5, wherein the method comprises at least one mixing

stage (11,12) in connection with the enzymatic hydrolysis stage (2,4).

7. The method according to any one of claims 1 to 6, wherein the plant based raw material (1) or solid fraction (6a) is diluted with liquid before the enzymatic hydrolysis.

8. The method according to any one of claims 1 to 7, wherein the liquid fraction (5a,5b) is separated from the solid fraction (6a,6b) by means of filtration, centrifugal treatment or their combinations.

9. The method according to any one of claims 1 to 8, wherein the liquid fraction (5a,5b) is recovered after each solid-liquid separation stage (7a,7b).

10. The method according to any one of claims 1 to 9, wherein the plant based raw material (1) or solid fraction (6a) is fed to the enzymatic hydrolysis stage (2,4) step by step or gradually.

11. The method according to any one of claims 1 to 10, wherein the enzyme is added in the second or any later enzymatic hydrolysis stage (4).

12. The method according to any one of claims 1 to 11, wherein the second or any later enzymatic hydrolysis stage (4) is carried out without an enzyme addition.

13. The method according to any one of claims 1 to 12, wherein lignin (14) is separated in a lignin separation stage (13) from the solid fraction (6b) after the last solid-liquid separation stage (7b).

14. The method according to any one of claims 1 to 13, wherein the plant based raw material (1) is wood based material or a mixture comprising wood based material.

15. An apparatus for an enzymatic hydrolysis in which plant based raw material is hydrolysed by means of enzymes, wherein the apparatus comprises

- at least two enzymatic hydrolysis stages (2,4) in which the plant based raw material (1) is hydrolyzed,
 - at least one feeding device for feeding the plant based raw material (1) to at least the first enzymatic hydrolysis stage (2), and
 - at least two solid-liquid separation stages (7a,7b) in which a liquid fraction (5a,5b) is separated from a solid fraction (6a,6b) after each enzymatic hydrolysis stage (2,4), and
 - the enzymatic hydrolysis stage (4) after the first enzymatic hydrolysis stage (2) is arranged to treat the solid fraction (6a) separated in the solid-liquid separation stage (7a).
16. The apparatus according to claim 15, wherein the apparatus comprises at least one solid-liquid separation device.
17. The apparatus according to claim 15 or 16, wherein the solid-liquid separation device is selected from the group consisting of filtration device, vacuum filtration device, press filter, belt press, centrifugal device and their combinations.
18. The apparatus according to any one of claims 15 to 17, wherein the apparatus comprises means for supplying the solid fraction (6a) to the next enzymatic hydrolysis stage (4).
19. The apparatus according to any one of claims 15 to 18, wherein the apparatus comprises means for recovering the solid fraction (6b) after the last solid-liquid separation stage (7b).
20. The apparatus according to any one of claims 15 to 19, wherein the apparatus comprises means for recovering the liquid fraction (5a,5b) after each solid-liquid separation stage (7a,7b).

21. A liquid fraction (5a,5b) comprising carbohydrates which has been formed by the method according to any one of claims 1 to 14.

22. A solid fraction (6b) comprising lignin
5 which has been formed by the method according to any one of claims 1 to 14.

23. A Use of the liquid fraction (5a,5b) obtainable by the method according to any one of claims 1 to 14, wherein the liquid fraction is used as a source
10 material in a fermentation, hydrolysis, chemical treatment, catalytic treatment, polymerization process, depolymerization process, degradation process, enzymatic treatment, manufacture of binder, manufacture of feed, manufacture of food or other suitable process or their
15 combinations.

24. A Use of the solid fraction (6b) obtainable by the method according to any one of claims 1 to 14, wherein the solid fraction is used as a source material in a hydrolysis, polymerization process, depolymeriza-
20 tion process, degradation process, chemical treatment, manufacture of a composite material, lignin composite, activated carbon, carbon fiber, binder material, polymers, resins, phenolic component, dispersion agent or absorbent material, manufacture of feed, manufacture
25 of food, combustion process or other suitable process or their combinations.