The apparatuses for washing a crude lignin slurry according to the present invention are characterized by what is presented in claims 15, 18 and 19.

The soluble carbohydrate containing fraction according to the present invention is characterized by what is presented in claim 20.

The solid fraction according to the present invention is characterized by what is presented in claim 21.

The use of the soluble carbohydrate containing fraction according to the present invention is characterized by what is presented in claim 22.

The use of the solid fraction according to the present invention is characterized by what is presented in claim 23.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are included to provide a further understanding of the invention and constitutes a part of this specification, illustrate some embodiments of the invention and together with the description help to explain the principles of the invention. In the drawings:

Fig. 1 is a flow chart illustration of a method according to one embodiment of the present invention,

Fig. 2 is a flow chart illustration of a method according to another embodiment of the present invention,

Fig.3 shows pumping pressure curves,

Fig. 4 shows pressure of the pumping in one example carried out according to one method embodiment of the present invention, and

CLAIMS

1. A method for washing a crude lignin slurry (5) formed from plant based raw material (1), wherein the method comprises

- separating a soluble carbohydrate containing fraction (10) from the crude lignin slurry (5) which has been formed by means of an enzymatic hydrolysis (4) by using displacement washing in at least one solid-liquid separation stage (6) so that the crude lignin slurry is prepressed, washed and pressed, and
- recovering a solid fraction (11) and the soluble carbohydrate containing fraction (10).

2. The method according to claim 1, wherein the crude lignin slurry (5) has been processed by means of an acid treatment.

3. The method according to claim 1 or 2, wherein the soluble carbohydrate containing fraction (10) is separated from the crude lignin slurry (5) by means of filtration, centrifugal treatment or their combinations.

4. The method according to any one of claims 1 to 3, wherein the solid-liquid separation stage (6) comprises a filtration in which the filtration is carried out by pressure, vacuum or overpressure.

5. The method according to any one of claims 1 to 4, wherein the displacement washing of the crude lignin slurry (5) is carried out with small amount washing water in which the ratio of the washing water to solids is 0.5:1 – 6:1 (w/w), preferably, 0.5:1 – 5:1 (w/w), more preferable 0.5:1 – 4:1 (w/w), most preferable 0.5:1 – 3:1 (w/w), in the washing.

6. The method according to any one of claims 1 to 5, wherein the pressure is increased step by step

or gradually in the pumping to the solid-liquid separation stage (6).

7. The method according to any one of claims 1 to 6, wherein the prepressing is performed in the presence of pressure which is between 4 – 10 bar, or between 4.5 – 9 bar, or between 5 – 8 bar.

8. The method according to any one of claims 1 to 7, wherein the pressure of the prepressing is similar or higher than pressure in the feeding.

9. The method according to any one of claims 1 to 8, wherein the pressure of the prepressing is kept during the washing.

10. The method according to any one of claims 1 to 9, wherein the pressure of the pressing is similar or higher than the pressure of the prepressing.

11. The method according to any one of claims 1 to 10, wherein the total soluble concentrate of the soluble carbohydrate containing fraction is between 20 to 280 g/l.

12. The method according to any one of claims 1 to 11, wherein dry matter content of the solid fraction is 30 – 60 % by weight, preferably 40 – 60 % by weight, more preferably 45 – 55 % by weight.

13. The method according to any one of claims 1 to 12, wherein the solid-liquid separation stage (6) comprises more than one separation steps.

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 washing a crude lignin slurry (5) formed from plant based raw material (1), wherein the apparatus comprises

- at least one solid-liquid separation device (6) in which a soluble carbohydrate containing fraction (10) is separated from the crude lignin

slurry (5) which has been formed by means of an enzymatic hydrolysis (4) by using displacement washing and in which the crude lignin slurry is prepressed, washed and pressed,

- at least one feeding device for feeding the crude lignin slurry (5) into the separation device (6), and
- means for supplying a solid fraction (11) and the soluble carbohydrate containing fraction (10) out from the separation device (6).

16. The apparatus according to claim 15, wherein the separation device (6) is selected from the group consisting of filtration device, centrifugal device and their combinations.

17. The apparatus according to claim 15 or 16, wherein the separation device (6) is selected from the group consisting of pressure filtration device, vacuum filtration device, filtration device based on underpressure, filtration device based on overpressure, filter press, other suitable press, centrifugal device and their combinations.

18. An apparatus for washing a crude lignin slurry (5) formed from plant based raw material (1), wherein the apparatus comprises at least one belt filtration device in which a soluble carbohydrate containing fraction (10) is separated from the crude lignin slurry (5) which has been formed by means of an enzymatic hydrolysis (4) by filtration and washing, and at least one feeding device for feeding the crude lignin slurry (5) into the belt filtration device, and means for supplying a solid fraction (11) and the soluble carbohydrate containing fraction (10) out from the belt filtration device.

19. An apparatus for washing a crude lignin slurry (5) formed from plant based raw material (1), wherein the apparatus comprises at least one solid-

liquid separation device in which a soluble carbohydrate containing fraction (10) is separated from the crude lignin slurry (5) which has been formed by means of an enzymatic hydrolysis (4) by at least two pressing steps and the crude lignin slurry is diluted between two pressing steps, and at least one feeding device for feeding the crude lignin slurry (5) into the separation device, and means for supplying a solid fraction (11) and the soluble carbohydrate containing fraction (10) out from the separation device.

20. A soluble carbohydrate containing fraction obtainable by the method according to any one of claims 1 to 14.

21. A solid fraction obtainable by the method according to any one of claims 1 to 14.

22. A Use of the soluble carbohydrate containing fraction obtainable by the method according to any one of claims 1 to 14, wherein the soluble carbohydrate containing fraction is used as a source material in fermentation, hydrolysis, catalytic process, polymerization process, enzymatic process, manufacture of binder, manufacture of feed, manufacture of food or their combination.

23. A Use of the solid fraction obtainable by the method according to any one of claims 1 to 14, wherein the solid fraction is used as a source material in hydrolysis, polymerization process, manufacture of a composite material, manufacture of binder, manufacture of feed, manufacture of food, combustion process or their combination.