SACCHARIFICATION OF ANY CELLULOSIC RESOURCE BY IRRADIATION

ABSTRACT:

In this method saccharification of any cellulosic resource is achieved, first by pre- treatment with alkali- sulfur solution and than subjecting it to ionizing radiation under oxidation-reducing gaseous environment. This method eliminates the need for enzymatic step in saccharification process.

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DESCRIPTION

Field of the Invention:

The present invention relates to a method of saccharification of a cellulose resources. Industry uses and technical procedure are provided.

BACKGROUND OF THE INVENTION

Waste cellulose resources constitute a family of abundant non-depletive recyclable energy sources. Active efforts are being made to convert waste cellulose resources into glucose for the bioethnol industry.

Two methods are available for saccharifying waste cellulose resources: An acid saccharification process and an enzyme saccharification process. The first approach requires the recovery of spent acid and involves problems such as the formation of inhibitors that are deleterious to a subsequent fermentation step. Increasing attention, therefore, is being directed to the second approach which can be implemented under milder process conditions.

Waste cellulose resources such as chaff, straw, and waste paper are composites wherein cellulose, hemicellulose, and lignin are strongly bonded to one another, both physically and chemically. In this second approach, in order to realize efficient saccharification of the cellulose by an enzyme, the starting material must be broken down by some preliminary treatment so that good contact is established between the cellulose in the feed and the enzyme. Among preliminary treatments under study is one using a chemical such as acid or alkali to remove the lignin and other unwanted components and provide for the easy access of the anzyme to the starting material, and one that depends on mechanical grinding to provide larger surface areas. The first method uses large amounts of acids or alkalis as a sole chemical to remove lignin and other unwanted components and, therefore, is not only costly but also disadvantageous in terms of the recovery of the spent chemical. The second method is also uneconomical since it uses electric power to mechanically grind the starting material. Several reports have been written on the effects of ionizing radiation (hereunder simply referred to as radiation) on treatment of waste cellulose resources. Studies have also been made on the effects of the addition of delignifiers such as sulfuric acid, alcohols, and cadoxen, and a method has been proposed for illuminating cleaned waste cellulose resources with radiation after they have been swollen by such delignifiers. However, no report has been made of success in significantly saccharifing waste cellulose without the need for enzymatic process.

SUMMARY OF THE INVENTION

The primary object, therefore, of the present invention is to provide a method for cellulose saccharification without the need for enzymatic process in achieving this goal. This object can be achieved first, by pre treatment the waste cellulose resource with alkaline- sulfur solution and than subjecting it to ionizing radiation under oxidation- reducing gaseous environment.

DETAILED DESCRIPTION OF THE INVENTION

The method of the present invention is effective only when waste cellulose resources are irradiated under oxidation reducing gaseous environment, in the presence of an aqueous alkali-sulfur solutions.Under those conditions, excited nuclides and reaction intermediates are formed and react with the waste cellulose resources so as to degrade the constituents of the structure of the waste resources to saccharide derivatives.

The radiation dose can be at low levels ranging from 5 to 30 Mrad, preferably 20 Mrad. The material that can be treated by the method of the present invention may be any of the cellulose-containing waste materials such as chaff, straw, bagasse and waste paper.

The alkali- sulfur solutions used in the method of the present invention is a relatively low concentration that typically ranges from2 to 4 weight %. A sufficient amount of the aqueous solution may be added to wet the surface of the waste cellulose resource, that is, 5-30 vol % of the resource. Any method may be used to add the aqueou alkaline solution to the waste cellulose resource; for example, the resource can be immersed in the aqueous alkali-sulfur solution, immediately recovered therefrom, and then drained of excess by squeezing it in preparation for irradiation.

Any kind of high energy radiation may be used, such as electron beam or gamma-rays. For practical applications that require continuous and efficient radiation, it is preferred to treat the waste cellulose resource with accelerated electrons, while it is carried along a conveyor.

The irradiated waste cellulose resource may be immediately subjected to alkali hydroxide solution in order to obtain free souluble sacharides.

As will be apparent from the foregoing description, the method of the present invention is simple to operate since it is based on the irradiation of waste cellulose resources in the presence of a small amount of an aqueous solution with a low concentration of alkali.

The following examples illustrate the advantages of the method of the present invention on some of the possible cellulose-containing materials.

EXAMPLE 1

Corn clovers in a powder form (1,000 gr.) was sprayed with 75 ml of 2% aqueous NaOH and 75 ml of 2% NA2S solution and then mixed so that a uniform coating of the aqueous solution was formed. The powder was then placed in a layer of 2-3 cm. thick on the accelerator conveyor and was exposed to a dose of 20 Mrads under oxidation-reducing gsseuos environment of NITROUS OXIDE.

As a control, the same weight of powder was irradiated in the same dose but under free air environment and without the pre treatment of sodium-sulfur solution.The resultant powder both from the experimnt and control were immersed in 1000 ml of 2% NaOH aqueous solution. The soluble sacchrides from the sample irradiated under the invention conditions were 40% by weight whereas the soluble saccarides from the control were 4% only.

EXAMPLE 2

Paper pulp(1,000gr.) was sprayed with 100 ml of 2% aqueous NaOH solution and then was exposed to a dose of 25 Mrad under oxidation- reducing environment in the same way as in Example 1.

As a control, paper pulp was exposed to the same dose but without the pre-treatment of NaOH solution, and under free air environment.

.The resultant powder both from the experimnt and from control were immersed in 1000 ml of 2% NAOH aqueous solution. The soluble sacchrides from the sample irradiated under the invention conditions were 25% by weight whereas the soluble saccarides from the control were 1% only.

EXAMPLE 3

Corn clovers in a powder form (1,000 gr.) was sprayed with 75 ml of 2% aqueous NaOH and 75 ml of 2% NA2S solution and then mixed so that a uniform coating of the aqueous solution was formed. The powder was then placed in a layer of 2-3 cm. thick on the accelerator conveyor and was exposed to a dose of 20 Mrads under oxidation-reducing gaseous environment of NITROUS OXIDE.

As a control, the same weight of powder was irradiated in the same dose but under free air environment and without addition of sodium-sulfur solution.

The resultant powder both from the experiment and control were submitted to ruminant animal feed chemical analysis. The results from the sample irradiated under the invention conditions shows 54% total digestability by weight and 1.22 Mcal/Kg NEL (net energy value) whereas the control shows 22% and 0.5 accordingly.

EXAMPLE 4

Paper pulp(1,000gr.) was sprayed with 100 ml of 2% aqueous NaOH solution and than was exposed to a dose of 20 Mrad under oxidation- reducing environment in the same way as in Example 1.

As a control, paper pulp was exposed to the same dose but without addition of NaOH solution, and under free air environment.

The resultant powder both from the experimnt and control were submitted to ruminant animal feed chemical analysis. The results from the sample irradiated under the invention conditions shows 68% total digestability by weight and 1.1 Mcal/Kg NEL (net energy value) whereas the control shows 19% and 0.3 accordingly.

CLAIMS:

A method for saccharifiction of any cellulosic resource to produce Glucose, xylose and other saccharides derivatives comprising:

(1) Subjecting said cellulosic resource with a sufficient amount of an aqueous solution to wet the surface of said cellulosic resource, said aqueous solution of alkali- sulfur compounds;

(2) Irradiating the resulting wetted cellulosic resource with ionizing radiation under oxidation-reducing gaseous environment and;

(3) Extracting saccharide derivatives from the resultant cellulosic resource with alkali hydroxide solution.