Guar Gum Resin Preparation and Water Purification Potential: An Overview

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ABSTRACT

The invention discloses a purification preparation method of a guar gum and derivatives of guar gum. The purification preparation method of the guar gum and the derivatives of guar gum is characterized in that a sprinkling washing and continuous belt vacuum dewatering combined device is used for preparing high-purity guar gum and the derivatives of guar gum. The purification preparation method of the guar gum and the derivatives of the guar gum has the advantages that the conventional centrifugal washing intermittent purification process of the guar gum derivatives is changed, the belt vacuum filter device is adopted, the automation degree and the production process of the washing purification process can be improved by use of a washing dewatering method combining sprinkling washing and belt vacuum filtration, and meanwhile, the amount of water needed by washing and wastewater generated by washing are reduced, and therefore, the wastewater disposal amount is reduced.

KEYWORDS: *guar gum, resin, water purification, potential, belt vacuum, filteration, wastewater, disposal, process.*

Introduction

Guar gum is as a kind of natural polygalactomannan, contain protein, the impurity such as grease, in the preparation process of industrial derivative, can introduce catalyzer again, etherifying agent, in reaction, [1,2]also can continue to generate some unwanted by products, therefore to prepare guar gum and the derivative thereof of High Purity, washing purifying is necessary step, the centrifugal washing lotion solution that goes after the direct agitator treating of main employing in current industry, purity requirement is higher, washing purification number of times is more, for adopting centrifugal a kind of so discontinuous desolventizing mode, there is following shortcoming: 1, water resource waste is serious, 2, the waste water that washing produces is more, and environmental benefit is poor, 3, batch operation, level of automation is not high, and detersive efficiency is lower, and human cost is higher.

Technical problem to be solved by this invention is to provide and a kind ofly can realizes the effective recycling of organic solvent and the reduction of water washing multiple, relatively traditional centrifugal repeatedly mode of washing, realized the continuous washing of material, improved detersive efficiency, make the consumption of material water doubly be reduced to 2-5 doubly from 15-20 simultaneously, greatly reduce the guar gum of consumption and the method for preparing purified of derivative thereof of washing water.[3,4]

For solving the problems of the technologies described above, the invention provides the method for preparing purified of a kind of guar gum and derivative thereof, it is characterized in that: the device that the method for preparing purified of described guar gum and derivative thereof adopts sprinkling washing and continuous band vacuum hydro-extraction to combine is prepared guar gum and the derivative thereof of High Purity, realized the continuous high-efficient washing purifying of guar gum and derivative thereof.

Further, described guar gum and derivative thereof are the former powder of guar gum, and hydroxyalkyl, positively charged ion, sulfonic group, a carboxymethyl modified replacement, two replace and three replacement guar gums.[5,6]

Further, the device front end that described sprinkling washing and continuous band vacuum hydro-extraction combine is provided with dispersed with stirring washing kettle.

Further, described guar gum has carried out abundant stirring and high speed dispersion before vacuum hydro-extraction, makes guar gum particle be dispersed into uniform fine particle.

Further, described sprinkling washing and continuous band vacuum dewatering plant comprise delivery wheel, travelling belt filtering net, the de-liquid case of vacuum, vacuum pump, surge tank, transferpump, filtering net high-pressure cleaning device, spray equipment, discharge zone.

Further, described dispersed with stirring washing kettle is comprised of stirring rake and high speed dispersion dish.[7,8]

Further, described filtering net adopts terylene, polypropylene fibre, polyvinyl, polyamide fibre material to make, described vacuum-drying box number saves at 3-20, and described vacuum pump can be hydraulic jet pump, water-ring pump, water spray pump, reciprocating vacuum pump, rotary-vane vaccum pump, slide-valve vacuum pump, Roots vaccum pump, gas jetpump.

Further, the method for preparing purified of described guar gum and derivative thereof, the steps include: water washing again after first solvent wash, in dispersed with stirring still, add solvent, at vacuum hydro-extraction first segment, carry out the recovery of solvent, second section adopts water to spray washing, washings enters solvent recuperation, after the 3rd joint, adopt spray water to proceed washing, described solvent wash can adopt ethanol, Virahol, methyl alcohol, acetone, the mixture of butanone and above solvent and water, or the combination of several solvents, described washing water can be recycled, the washing that the washing water that each vacuum chamber is collected can be sprayed onto is above with, recycle, can significantly reduce the usage quantity of washing water.[9,10]

Discussion

1. the method for preparing purified of a guar gum and derivative thereof, it is characterized in that: the device that the method for preparing purified of described guar gum and derivative thereof adopts sprinkling washing and continuous band vacuum hydro-extraction to combine is prepared guar gum and the derivative thereof of High Purity, realized the continuous high-efficient washing purifying of guar gum and derivative thereof.

2. the method for preparing purified of a kind of guar gum according to claim 1 and derivative thereof, it is characterized in that: described guar gum and derivative thereof are the former powder of guar gum, hydroxyalkyl, positively charged ion, sulfonic group, a carboxymethyl modified replacement, two replace and three replacement guar gums.

3. the method for preparing purified of a kind of guar gum according to claim 1 and derivative thereof, is characterized in that: the device front end that described sprinkling washing and continuous band vacuum hydro-extraction combine is provided with dispersed with stirring washing kettle.

4. the method for preparing purified of a kind of guar gum according to claim 1 and derivative thereof, is characterized in that: described guar gum has carried out abundant stirring and high speed dispersion before vacuum hydro-extraction, makes guar gum particle be dispersed into uniform fine particle.[11,12]

5. the method for preparing purified of a kind of guar gum according to claim 1 and derivative thereof, is characterized in that: described sprinkling washing and continuous band vacuum

dewatering plant comprise delivery wheel, travelling belt filtering net, the de-liquid case of vacuum, vacuum pump, surge tank, transferpump, filtering net high-pressure cleaning device, spray equipment, discharge zone.

6. the method for preparing purified of a kind of guar gum according to claim 3 and derivative thereof, is characterized in that: described dispersed with stirring washing kettle is comprised of stirring rake and high speed dispersion dish.[13]

7. the method for preparing purified of a kind of guar gum according to claim 5 and derivative thereof, it is characterized in that: described filtering net adopts terylene, polypropylene fibre, polyvinyl, polyamide fibre material to make, described vacuum-drying box number saves at 3-20, and described vacuum pump can be hydraulic jet pump, water-ring pump, water spray pump, reciprocating vacuum pump, rotary-vane vaccum pump, slide-valve vacuum pump, Roots vaccum pump, gas jetpump.

8. the method for preparing purified of a kind of guar gum according to claim 5 and derivative thereof, it is characterized in that: the method for preparing purified of described guar gum and derivative thereof, the steps include: water washing again after first solvent wash, in dispersed with stirring still, add solvent, at vacuum hydro-extraction first segment, carry out the recovery of solvent, second section adopts water to spray washing, washings enters solvent recuperation, after the 3rd joint, adopt spray water to proceed washing, described solvent wash can adopt ethanol, Virahol, methyl alcohol, acetone, the mixture of butanone and above solvent and water, or the combination of several solvents, described washing water can be recycled, the washing that the washing water that each vacuum chamber is collected can be sprayed onto is above with, recycle, can significantly reduce the usage quantity of washing water.[14]

Results

Embodiment 1:

Guar gum is in reactor, add after buck alkalization, be warming up to 70 ℃, add propylene oxide to carry out etherificate, add after the ethanol of 2 times of guar gums, material is delivered to dispersed with stirring still (device 3), high-speed stirring is disperseed (device 1/2) 1h, material is evenly sprayed on travelling belt filtering net (device 5), through first segment (device 6) and second section (device 7) vacuum dealcoholysis, washing soln is recycled, with the water of 3 times, carry out spraying for 4 times (device 19/20/21/22) washing again, vacuum hydro-extraction, obtain highly purified hydroxypropylguar gum, sample drying, pulverize, after screening packing, obtain highly purified hydroxypropylguar gum product.

Embodiment 2:

Guar gum is in reactor, add after buck alkalization, be warming up to 60 ℃, add cationic etherifying agent to carry out etherificate, add after the Virahol of 2 times of guar gums, material is delivered to dispersed with stirring still (device 3), high-speed stirring is disperseed (device 1/2) 1.5h, material is evenly sprayed on travelling belt filtering net (device 5), through first segment (device 6) and second section (device 7) vacuum dealcoholysis, washing soln is recycled, with the water of 5 times, carry out 6 sprinkling washings again, vacuum hydro-extraction, obtain highly purified cation guar gum, sample drying, pulverize, after screening packing, obtain highly purified cation guar gum product.[15,16]

Embodiment 3:

Guar gum is in reactor, add after buck alkalization, be warming up to 50 ℃, add propylene oxide and sodium chloroacetate solution to carry out etherificate, add after the acetone of 2 times of guar gums, continue cooling and stir 1h, be cooled to below 15 ℃, material is delivered to dispersed with stirring

still, high-speed stirring is disperseed 2h, material is evenly sprayed on travelling belt filtering net, through first segment and the de-acetone of second section vacuum, washing soln is recycled, with the water of 4 times, carry out 7 sprinkling washings again, vacuum hydro-extraction, obtain highly purified hydroxypropyl carboxy methyl guar gum, sample drying, pulverize, after screening packing, obtain highly purified hydroxypropyl carboxy methyl guar products.

Embodiment 4:

Guar gum is in reactor, add after buck alkalization, be warming up to 50 ℃, add 3-chlorine-2-hydroxyl propyl sulfonic acid sodium solution to carry out etherificate, add after 80% ethanolic soln of 2 times of guar gums, continue cooling and stir 1h, be cooled to below 20 ℃, material is delivered to dispersed with stirring still, high-speed stirring is disperseed 1h, material is evenly sprayed on travelling belt filtering net, through first segment and the de-alcohol solvent of second section vacuum, washing soln is recycled, with the water of 4 times, carry out 5 sprinkling washings again, vacuum hydro-extraction, obtain highly purified hydroxypropyl carboxy methyl guar gum, sample drying, pulverize, after screening packing, obtain highly purified sulfonic group base guar products.

Embodiment 5:

Guar gum is in reactor, add after buck alkalization, be warming up to 65 ℃, add propylene oxide, sodium chloroacetate solution and 3-chlorine-2-hydroxyl propyl sulfonic acid sodium solution carry out etherificate, add after 80% aqueous isopropanol of 3 times of guar gums, continue cooling and stir 1h, be cooled to below 20 ℃, material is delivered to dispersed with stirring still, high-speed stirring is disperseed 1h, material is evenly sprayed on travelling belt filtering net, through first segment and the de-isopropanol solvent of second section vacuum, washing soln is recycled, with the water of 5 times, carry out 5 sprinkling washings again, vacuum hydro-extraction, obtain highly purified hydroxypropyl carboxy methyl sulfonic group guar gum, sample drying, pulverize, after screening packing, obtain highly purified hydroxypropyl carboxy methyl sulfonic group guar products.[17,18]

The foregoing is only better embodiment of the present invention; protection scope of the present invention is not limited with above-mentioned embodiment; in every case the equivalence that those of ordinary skills do according to disclosed content is modified or is changed, and all should include in the protection domain of recording in claims.

With the aim to explore new adsorbents for water purification, guar gum based hydrogels were synthesized by cross-linking with borax at different percentage. The cross-linking was confirmed through characterization by FTIR spectroscopy, SEM morphology, thermal studies and water absorption capacity. To examine the adsorption/absorption performance of different grades of hydrogels, their flocculation efficiency was studied in kaolin suspension at different pH by standard jar test procedure. The flocculation efficiency of the test materials was compared with the commercially used coagulant, alum and also residues of Al and K left in the treated water were comparatively studied. The synthesized hydrogels were also tested for their efficiency of removing Aniline Blue dye by UV-vis spectrophotometer study. The best grade hydrogel outperformed alum, at extremely low concentration and also showed dye removing efficiency up to 94%. The single step synthesized green products thus exhibited great potential as water purifying agents.

The polymeric ion exchange resin has found extensive applications in recovery and removal of transition metal ions from process solutions due to their selectivity particularly against alkali metal ions. The ion exchanger based on guar gum is hydrophilic and biodegradable, whereas ion exchangers pre¬pared from petrochemical products are hydrophobic and not biodegradable. Its cost is low, locally available in large quantities from agricultural resources and is environment friendly. N,N-Dimethylaniline group has been incorporated in Guar gum based polysaccharide by a modified Porath's method of functionalization of polysaccharide in order to develop a hydrophilic, flocculants

cum ion exchanger. The characterization of synthesized resin [GGMA] was carried out by FT-IR spectrum, moisture content, ion exchange capacity, solubility of resin in different solvent, resin durability and elemental analysis. The adsorption of different metal ions on GGMA resin follows the order: Fe2+> Cu2+> Zn2+> Cd2+>Pb2+. The adsorbency of different metal ions on GGMA resin was studied up to 10 cycles. The effects of pH, treatment time, treatment temperature, and resin dose on the removal of metal ions from industrial effluent were also studied. [19,20]

Implications

Guar gum is the gum derived from seeds of the guar plant (Cyamopsis tetragonoloba).

Local name: Guar gum

Plant Source: *Cyamopsis tetragonolobus* (L.) Taub

Family: Fabaceae

Distribution: The guar or cluster bean is an agricultural crop grown in arid zones of West and North-West India, Pakistan, Sudan and parts of USA. India grows over 850,000 tons, or 80% of the total guar produced all over the world. 75% of the guar gum or derivatives produced in India are exported, mainly to USA and to European countries.

Rajasthan in western lndia is the major guar producing state, accounting for 70% of the production. Guar is also grown in Gujarat, Haryana, Punjab and in some pars of Uttar Pradesh and Madhya Pradesh.

Production in India:

Guar seeds - 8,50,000 tons per annum (approx.)

Guar gurn - 2,10,000 tons per annum

Other producing countries: Pakistan, Sudan, Australia and USA.

Guar is being grown in India since ancient time. The tender green guar is an important source of nutrition to animals and humans and is consumed as a vegetable and cattle feed. Guar is a drought-tolerant plant which needs moderate legume crop, which grows best in sandy soils and needs Moderate, intermittent rainfall with lots of sunshine. below the soil surface. lts roots develop well in lateral direction also. Some of the varieties ave small hair on all parts of plant whereas some have glabrous (smooth, no hairs) leaves, stems and pods. The leaves are alternate trifoliate and are borne on long petioles. Plants have single stem, fine branching or basal branching and grow as high as 45-100 cm. The flowers are small, and white. The pods are oblong and 5 to 10 cm in length. Pods normally contain 5 to 12 seeds of oval or cube shape of variable size and color.[21]

For optimum plant growth, guar requires rain before planting and again to induce maturation of the seeds. Too much precipitation can cause the plant to become more "leafy" thereby reducing the number of pods and/or the number of seeds per pod that affects the size and yield of seeds.

Guar is a pod-bearing plant with six to nine seeds per pod. Each seed or bean is composed of hull, endosperm and germ parts, typically in a weight proportion of l5%, 40% and 45% respectively. The germ portion is predominantly protein, and the endosperm predominantly guar galactomannan or guar gum. Germ and hull are used as animal feed after proper treatment.

During processing, all these three constituents are separated. The guar gum powder is obtained after removing the hull and germ from the seed and grinding the endosperm into fine powder. The endosperm ranges from 32-42 percent depending on the variety and maturity of the crop. So, the main unit operations involved in processing of guar seeds are cleaning, grading, dehusking, splitting and separation of endosperm, grinding and purification of powder. On arrival at the processing plant,

seeds are screened for removal of dirt, stones, sand, metal debris, chaffs and broken seeds. Standard seed cleaning vibrators, electromagnets, and shifter are used for cleaning.

Dehulling and splitting of the two processes seed is done by i.e. dry grinding and wet grinding. In some of the industries, charring of the hull is done by flame treatment and then separation of husk is done. Recovery in wet processing method is 8 to 10% higher than in dry processing. However, the quality of the gum is not good. Hence, dry processing or charring the seed is used in most of the industries. Bun mills, pin mills and modified hammer mills are usually used for splitting of guar seeds into two halves so as to separate the germ and endosperm. The splits are then heated in kilns and passed through the dehusking machines usually consisting of a two-tired chamber, each with a rotating saw-toothed blade. Splits stripped of their hull pass to sifters that separates the clean endosperm pieces on a 20-mesh screen.[22]

Guar gum powder is produced from by grinding in attrition mills, hammer mills, ultra fine endosperm splits simply grinders or other size reduction equipment, However, guar gum with the best thickening power and fastest hydration rate is produced when the splits are first soaked in water and then flaked, extruded or ground.

The guar gum powder is usually modified with chemicals to give them new properties for broader applications. For industrial applications, many guar gum products are formulated with additives that control the rate of hydration, enzyme resistance, dispercibility, dry flow, or other special properties. The most common commercial derivatives of guar gum are hydroxypropylguar, carboxymethylguar and 2-hydrixy-3 (trimethylammonium chloride) propylguar.

Storage and handling: Guar gum powders are generally packed in sound clean, dry and unused polythene bags placed inside gunny bags or multiply craft paper sacks

Guar gum powders and its derivatives are stable in dry form. It has a long storage life in its dry form provided that it is warehoused properly. The properties of guar gum remain unchanged for 12-18 months. However, when exposed to humid condition, guar gum absorbs moisture which results in microbiological degradation, fermentation and lumping of the powder and the properties of the gum is adversely affected. Hence, guar gum should be packed in moisture proof packets/containers and stored in a cool dry place away from heat and sunlight. Ir is advised to consume the guar gum within a reasonable time period once the bag is opened. The shelf life of guar gum may be extended by adding suitable preservatives.

Quality control : The commercially available guar gum powder must meet the standards of United States FCA and European Union Specifications This standard is mainly for food uses.

A new guar gum-based resin containing nitrilotriacetic acid group has been synthesized. Nitrilotriacetic acid group has been incorporated into guar gum by a modified Porath's method of functionalisation of polysaccharides. The guar gum nitrilotriacetic acid (GNTAA) resin was characterized by FTIR, ion exchange capacity, thermogravimetric and elemental analysis techniques. GNTAA resin can selectively remove trace toxic metal ions from industrial wastewater. Various factors affecting adsorption, pH, distribution coefficients (K d) and percentage of removal of metal ions were studied. The adsorbed metal ions were effectively eluted by different strength of acid solution. The resin is amenable for continuous process and can be regenerated several times. The adsorption of different metal ions on GNTAA resin follows the order Fe(II) > Zn(II) > Cu(II) > Cd(II) > Pb(II).[23]

Conclusions

The increasing amount of oil wastewater is causing serious damage to the environment. Oily water is a worrisome by-product of the oil industry due to its growing volume in mature basins and complex chemical composition. Low-cost polymers are being used as alternative materials to treat oily waters

after treatment by conventional methods, oil and grease (O&G) concentration being the primary parameter for final disposal. In this respect, guar gum can be used to treat petroleum-contaminated waters, with the advantage of being a low-cost, highly-hydrophilic natural polymer. In this study, guar gum, under specific conditions, shapes itself into three-dimensional structures with interesting physicochemical properties. The salting out effect occurs with reticulation of the polymeric chains by borate ions and in the presence of electrolytes, reducing the solubility of the polymeric network in the solution and leading to an electrolyte- and polymer-rich phase. When the guar gum gel was prepared in situ in the produced water, after the salting out effect, the oil was imprisoned in the interstices of the collapsed gel. The gelling guar gum was highly efficient in synthetic oily waters. In the case of initial O&G above 100 ppm, the oil removal percentage was above 90%.[23]

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