resin to produce polyester grade ethylene glycol. However, there is still no example of a polyester produced from the disclosed polyester grade ethylene glycol, nor do they measure UV transmittance or APHA colour of the purified ethylene glycol composition, produce an actual PET or measure the CIELAB colour of such PET. The sequential setup for purifying ethylene glycol is suggested to avoid the metal ions to interfere with the aldehyde adsorbing resin.

It would be desirable to provide biomass based compositions comprising ethylene glycol that can be used to produce polyesters and packaging articles satisfying the requisite or desired technical specifications for polyesters and packaging articles. It also would be desirable to provide economical and industrially feasible methods of producing such biomass based compositions and polyesters.

Summary

According to an aspect of the present disclosure, there is provided a method of purifying a biomass based composition comprising ethylene glycol, the method comprising: (a) providing the biomass based composition comprising water in an amount of at least 0.1 wt.%, based on the weight of the biomass based composition; and (b) contacting the biomass based composition with a solid acid catalyst and contacting the biomass based composition with an aldehyde removal resin to provide a purified biomass based composition.

In one example, the solid acid catalyst comprises sulfonic acid functional groups.

In one example, the solid acid catalyst comprises one or more of a resin and a zeolite.

In one example, the aldehyde removal resin comprises one or more of: primary amine functional groups; secondary amine functional groups; tertiary amine functional groups; and quaternary ammonium functional groups. In one example, the quaternary ammonium functional groups are quaternary ammonium bisulfite salt functional groups.

In one example, the purified biomass based composition has a total aldehyde concentration of no greater than 50 ppm, such as no greater than 20 ppm, such as no greater than 18 ppm, such as no greater than 15 ppm, such as no greater than 10 ppm, based on the weight of the purified biomass based composition.

In one example, the biomass based composition in step (a) has a total aldehyde concentration of no less than 100 ppm, such as no less than 200 ppm, such as no less than 300 ppm, such

as no less than 500 ppm, such as no less than 1000 ppm, based on the weight of the biomass based composition.

In one example, the solid acid catalyst and the aldehyde removal resin are provided in a common bed.

In one example, the solid acid catalyst is provided in a first bed and the aldehyde removal resin is provided in a second bed, wherein the second bed is downstream from the first bed.

In one example, one or each of the contacting the biomass based composition with the solid acid catalyst and the contacting the biomass based composition with the aldehyde removal resin is performed at a temperature of from 10°C to 70°C, such as from 35°C to 65°C, such as from 40°C to 60°C, such as from 45°C to 55°C.

In one example, the method comprises, after the contacting the biomass based composition with the solid acid catalyst and the contacting the biomass based composition with the aldehyde removal resin, contacting the purified biomass based composition with an aldehyde removal resin.

In one example, the purified biomass based composition is characterised by an APHA colour value determined according to ASTM D1209-05 of no greater than 5 mg/L PtCo.

In one example, the purified biomass based composition is characterised by an APHA colour value after heating determined according to ASTM D1209-05 of no greater than 20 mg/L PtCo.

In one example, the method comprises, after the contacting the biomass based composition with the solid acid catalyst and the contacting the biomass based composition with the aldehyde removal resin, subjecting the biomass based composition to at least one distillation step and/or subjecting the biomass based composition to at least one melt crystallisation step.

In one example, the purified biomass based composition is exposed to a water removal step (e.g. by distillation), after which the purified biomass based composition comprises ethylene glycol in an amount of no less than 98 wt.%, such as no less than 99 wt.%, such as no less than 99.25 wt.%, such as no less than 99.5 wt.%, such as no less than 99.75 wt.%, such as no less than 99.9 wt.%, based on the weight of the purified biomass based composition. The purified biomass based composition has a natural upper limit of ethylene glycol of 100 wt.%.

In one example, the method comprises, prior to the contacting the biomass based composition with the solid acid catalyst and the contacting the biomass based composition with the

aldehyde removal resin, subjecting the biomass based composition to at least one distillation step.

In one example, the biomass based composition is obtained by thermolytic fragmentation and subsequent hydrogenation of a sugar.

According to another aspect of the present disclosure, there is provided a purified biomass based composition obtained by the method of purifying a biomass based composition as described herein, the purified biomass based composition being characterised by an APHA colour after heating of below 20 mg/L PtCo as determined according to ASTM D1209-05 and a UV transmittance at 275 nm of below 40% as determined by ASTM method E2193-16.

According to another aspect of the present disclosure, there is provided a use of the purified biomass based composition obtained by the method of purifying a biomass based composition as described herein to produce a polyester where the polyester is characterised by one or more of the following CIELAB colour space values determined according to ASTM D6290-19: L* of no less than 65; a* of from -4 to 4; and b* of from -4 to 4.

According to another aspect of the present disclosure, there is provided a method of producing a polyester, the method comprising contacting the purified biomass based composition obtained by the method of purifying a biomass based composition as described herein with at least one reagent to form the polyester characterised by one or more of the following CIELAB colour space values determined according to ASTM D6290-19: L* of no less than 65; a* of from -4 to 4; and b* of from -4 to 4.

According to another aspect of the present disclosure, there is provided a polyester obtained by the method of producing a polyester as described herein, the polyester being characterised by one or more of the following CIELAB colour space values determined according to ASTM D6290-19: L* of no less than 65; a* of from -4 to 4; and b* of from -4 to 4.

In one example, the polyester is characterised by one or more of the following CIELAB colour space parameter values determined according to ASTM D6290-19: L* of no less than 85; a* of from -2 to 2; and b* of from -2 to 2. In one example, the polyester is characterised by the CIELAB colour space parameter value b* determined according to ASTM D6290-19 of from -4 to 4, preferably -2 to 2. In one example, the polyester is characterised by the CIELAB colour

space parameter value a* determined according to ASTM D6290-19 of from -4 to 4, preferably -2 to 2. In one example, the polyester is characterised by the CIELAB colour space parameter value L* determined according to ASTM D6290-19 of no less than 65, preferably no less than 85.

According to another aspect of the present disclosure, there is provided a packaging article or a preform formed from the polyester as described herein.

According to another example of the present disclosure, there is provided a method of purifying a biomass based composition comprising ethylene glycol, the method comprising: (a) providing the biomass based composition comprising water in an amount of at least 0.1 wt.%, based on the weight of the biomass based composition; and (b) contacting the biomass based composition with an aldehyde removal resin to provide a purified biomass based composition.

In any one of the above examples or aspects of the present disclosure, the polyester may comprise polyethylene terephthalate.

The features of any example or aspect of the present disclosure may be combined with any feature or features of any other example or aspect of the present disclosure.

Detailed Description

As discussed herein, in an aspect of the present invention there is provided a method of purifying a biomass based composition comprising ethylene glycol, the method comprising: (a) providing the biomass based composition comprising water in an amount of at least 0.1 wt.%, based on the weight of the biomass based composition; and (b) contacting the biomass based composition with a solid acid catalyst and contacting the biomass based composition with an aldehyde removal resin to provide a purified biomass based composition.

Ethylene glycol (monoethylene glycol) has many applications, including as antifreeze and as a monomer for making polyesters. We have found that biomass based compositions comprising ethylene glycol can comprise small amounts of free aldehydes and acetals, and that the presence of these components (e.g. at the ppm scale) can lead to colouration in polyesters formed from the biomass based compositions. This is problematic when an end product (e.g. bottle) having a particular colour profile (e.g. reduced colour such as substantially colourless) is desired or required. We have found that treatment of biomass based compositions comprising ethylene glycol with an aldehyde removal resin *per se* can be ineffective. For example, we have found that biomass based compositions comprising ethylene