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 producing a polyester, the method comprising: (a) providing a biomass based composition comprising ethylene glycol and having a UV transmittance at 275 nm determined in accordance with ASTM method E2193-16 of less than 40%; (b) contacting the biomass based composition with at least one reagent to form the polyester.

In one example, the biomass based composition has a UV transmittance at 275 nm determined in accordance with ASTM method E2193-16 of no greater than 35%, such as no greater than 30%, such as no greater than 20%.

In one example, the biomass based composition has a UV transmittance at 275 nm determined in accordance with ASTM method E2193-16 of no less than 10%.

In one example, the biomass based composition comprises ethylene glycol in an amount of no less than 97 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 biomass based composition. The biomass based composition has a natural upper limit of ethylene glycol of 100 wt.%.

In one example, the 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 biomass based composition.

In one example, the 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 biomass based composition in step (a) is provided by: (I) subjecting a biomass based composition to at least one distillation step to provide a distillation product, wherein the concentration of ethylene glycol in the distillation product is greater than in the biomass based composition; and (II) subjecting the distillation product to at least one melt crystallisation step to form crystals and a mother liquor, such that the crystals provide a purified biomass based composition, wherein the concentration of ethylene glycol in the purified biomass based composition is greater than in the distillation product. That is, the purified biomass based composition is the biomass based composition in step (a).

In one example, the biomass based composition in step (a) is provided by: (I) providing a biomass based composition comprising water in an amount of at least 0.1 wt.%, based on the weight of the biomass based composition; and (II) 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. That is, the purified biomass based composition is the biomass based composition in step (a).

In one example, the biomass based composition in step (a) is provided by: (I) providing a biomass based composition comprising water in an amount of at least 0.1 wt.%, based on the weight of the biomass based composition; (II) contacting the biomass based composition with a solid acid catalyst and contacting the biomass based composition with an aldehyde removal resin to provide a first purified biomass based composition; and (III) subjecting the first purified biomass based composition from (II) to at least one distillation step to provide a distillation product, wherein the concentration of ethylene glycol in the distillation product is greater than in the first purified biomass based composition, wherein the distillation product is a second purified biomass based composition. That is, the second purified biomass based composition is the biomass based composition in step (a).

In one example, the biomass based composition in step (a) is provided by: (I) providing a biomass based composition comprising water in an amount of at least 0.1 wt.%, based on the weight of the biomass based composition; (II) contacting the biomass based composition with a solid acid catalyst and contacting the biomass based composition with an aldehyde removal

resin to provide a first purified biomass based composition; (III) subjecting the first purified biomass based composition from (II) to at least one distillation step to provide a distillation product, wherein the concentration of ethylene glycol in the distillation product is greater than in the first purified biomass based composition, wherein the distillation product is a second purified biomass based composition; and (IV) subjecting the distillation product to at least one melt crystallisation step to form crystals and a mother liquor, such that the crystals provide a third purified biomass based composition, wherein the concentration of ethylene glycol in the third purified biomass based composition is greater than in the distillation product. That is, the third purified biomass based composition is the biomass based composition in step (a).

In one example, the biomass based composition in step (a) is provided by: (I) subjecting a biomass based composition to at least one distillation step to provide a distillation product, wherein the concentration of ethylene glycol in the distillation product is greater than in the biomass based composition, wherein the distillation product is a first purified biomass based composition; (II) subjecting the distillation product to at least one melt crystallisation step to form crystals and a mother liquor, such that the crystals provide a second purified biomass based composition, wherein the concentration of ethylene glycol in the second purified biomass based composition is greater than in the distillation product, and optionally diluting the second purified biomass based composition; and (III) contacting the second purified biomass based composition (e.g. the diluted second purified biomass based composition) with a solid acid catalyst and contacting the second purified biomass based composition (e.g. the diluted second purified biomass based composition) with an aldehyde removal resin to provide a third purified biomass based composition, wherein the second purified biomass based composition (e.g. the diluted second purified biomass based composition) comprises water in an amount of at least 0.1 wt.%, based on the weight of the second purified biomass based composition (e.g. the diluted second purified biomass based composition). That is, the third purified biomass based composition is the biomass based composition in step (a).

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 biomass based polyester obtained by a method of producing a polyester as described herein.

In one example, 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, such as no less than 85; a* of from -4 to 4, such as from -2 to 2; and b* of from -4 to 4, such as from -2 to 2.

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

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

In one aspect of the present disclosure, there is provided a biomass based composition comprising ethylene glycol having a UV transmittance at 275 nm determined in accordance with ASTM method E2193-16 of less than 40% and an APHA colour after heating determined according to ASTM D1209-05 of no greater than 20 mg/L PtCo.

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

Method of Producing a Polyester

As discussed herein, in an aspect of the present invention there is provided a method of producing a polyester, the method comprising: (a) providing a biomass based composition comprising ethylene glycol and having a UV transmittance at 275 nm determined in accordance with ASTM method E2193-16 of less than 40%; (b) contacting the biomass based composition with at least one reagent to form the polyester.

UV transmittance is used as a simple measure for the absence of low concentration impurities in ethylene glycol having adverse effect on the colour in a PET obtained therefrom, i.e. higher transmittance means less impurities. When removing low concentration impurities from ethylene glycol, the purity of ethylene glycol becomes higher as a consequence of removing the impurities. Hitherto, a widely accepted understanding in the art of the present invention is that ethylene glycol compositions require a high UV transmittance in order to be suitable for producing polyesters having an acceptable polymer quality. This is particularly applicable in the context of bottle manufacture, e.g. polyethylene terephthalate bottle manufacture. Purification of biomass based ethylene glycol to achieve a high UV transmittance can be expensive and complex, if possible at all (See e.g. WO 2015/028156, WO 2018/089600 and WO 2018/089605). This inability to deliver biomass based ethylene glycol meeting the