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(54) Title: AN ULTRA-HIGH SOLID CONTENT POLYURETHANE DISPERSION AND A CONTINUOUS PROCESS FOR PRODUCING ULTRA-HIGH SOLID CONTENT POLYURETHANE DISPERSIONS

(57) Abstract: The instant invention is an ultra-high solid content polyurethane dispersion, and a continuous process for producing ultra-high solid content polyurethane dispersions. The ultra-high solid content polyurethane dispersion includes the reaction product of: (1) a first component, wherein the first component is a first polyurethane prepolymer or a first polyurethane prepolymer emulsion; (2) a second component, wherein the second component is a second polyurethane prepolymer, a second polyurethane prepolymer emulsion, a low solid content polyurethane dispersion, a seed latex, or combinations thereof; (3) and a chain extender. The ultra-high solid content polyurethane dispersion has a solid content of at least 60 percent by weight of the solid, based on the total weight of the ultra-high solid content polyurethane dispersion, and a viscosity in the range of less than 5000 cps at 20 rpm at 21° C using spindle #4 with Brookfield viscometer. The method for producing a high-solid content polyurethane dispersion includes the following steps: (1) providing a first stream, wherein said first stream comprising a first polyurethane prepolymer or a first polyurethane prepolymer emulsion; (2) providing a second stream, wherein said second stream being a media phase selected from the group consisting of a second polyurethane prepolymer, a second polyurethane prepolymer emulsion, a polyurethane prepolymer dispersion, a seed latex emulsion, or combinations thereof; (3) continuously merging said first stream with said second stream in the presence of a chain extender; and (4) thereby forming a polyurethane dispersion having a solid content of at least 60 percent by weight of the solid, based on the total weight of the ultra-high solid content polyurethane dispersion, and a viscosity in the range of less than 5000 cps at 20 rpm at 21° C using spindle #4 with Brookfield viscometer.

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AMENDED CLAIMS
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WE CLAIM:

1. A continuous process for producing an ultra-high solid content polyurethane dispersion comprising the steps of:

providing a first stream, wherein said first stream comprises a first polyurethane prepolymer or a first polyurethane prepolymer emulsion;

providing a second stream, wherein said second stream is a media phase selected from the group consisting of a second polyurethane prepolymer, a second polyurethane prepolymer emulsion, a low solid content polyurethane dispersion, a seed latex, and combinations thereof ;

continuously merging said first stream with said second stream in the presence of a chain extender;

thereby forming said ultra-high solid content polyurethane dispersion, wherein said ultra-high solid content polyurethane dispersion having at least a solid content of at least 60 percent by weight of said solid, based on the total weight of said ultra-high solid content polyurethane dispersion, and a viscosity of less than 5000 cps at 20 rpm at 21° C using spindle #4 with Brookfield viscometer.

2. The continuous process for producing an ultra-high solid content polyurethane dispersion according to Claim 1, wherein said first stream comprises first polymer resins and said second stream comprises second polymer resins, and wherein said first polymer resin and said second polymer resin have a volume average particle size ratio in the range of 1:5 to 1:2.

3. The continuous process for producing an ultra-high solid content polyurethane dispersion according to Claim 2, wherein said first polymer resin and said second polymer resin have a volume average particle size ratio in the range of about 1:3.

4. The continuous process for producing an ultra-high solid content polyurethane dispersion according to Claim 1, wherein said first stream comprises first polymer resins and said second stream comprises second polymer resins, and wherein

said ultra-high solid content polyurethane dispersion comprises 20 to 40 percent by weight of said first polymer resins having a particle size in the range of 0.04 micron to 5.0 micron, and 60 to 80 percent by weight of said second polymer resins having a particle size in the range of 0.05 micron to 5.0 micron, based on the total weight of said first polymer resin and said second polymer resin.

5. The continuous process for producing an ultra-high solid content polyurethane dispersion according to Claim 1, wherein said seed latex is selected from the group consisting of a dispersion, emulsion, and latex of olefins, epoxies, silicon, styrene, acrylate, butadiene, isoprene, vinyl acetate, copolymers thereof, and blends thereof.

6. The continuous process for producing an ultra-high solid content polyurethane dispersion according to Claim 1, wherein said seed latex is an oil phase emulsified in water.

7. A continuous process for producing an ultra-high solid content polyurethane dispersion comprising the steps of:

providing a first stream, wherein said first stream is a first polyurethane prepolymer stream;

providing a second stream, wherein said second stream is a media phase;

continuously merging said first and said second stream together in the presence of a surfactant at a temperature in the range of 10^0C to 70^0C, wherein the ratio of said second stream to first stream being in the range of 0.1 to 0.6, and wherein said surfactant being present in a concentration range of 0.1 to 3.0 percent, based on the total weight of said first stream, said second stream, and said surfactant;

thereby forming said ultra-high solid content polyurethane dispersion, wherein said ultra-high solid content polyurethane dispersion having at least a solid content of at least 60 percent by weight of said solid, based on the total weight of said ultra-high solid content polyurethane dispersion, and a viscosity of less than 5000 cps at 20 rpm at 21° C using spindle #4 with Brookfield viscometer.

8. An ultra high solid content polyurethane dispersion prepared according to the continuous process of either Claim 1 or Claim 7.

9. The ultra-high solid content polyurethane dispersion according to Claim 8, wherein said ultra high solid content polyurethane dispersion further comprises an inorganic filler.

10. The continuous process for producing an ultra-high solid content polyurethane dispersion according to either Claim 1 or Claim 7, wherein said first or second polyurethane prepolymer is a reaction product of at least one polyisocyanate and at least one polyol.

11. The continuous process for producing an ultra-high solid content polyurethane dispersion according to Claim 10, wherein said polyisocyanate is aromatic or aliphatic.

12. The continuous process for producing an ultra-high solid content polyurethane dispersion according to Claim 11, wherein said polyol is selected from the group consisting of polyether, polyester, polycarbonate, natural seed oil polyol, and combinations thereof.

13. The continuous process for producing an ultra-high solid content polyurethane dispersion according to Claim 12, wherein said first or second polyurethane prepolymer is ionic or non-ionic.

14. The continuous process for producing an ultra-high solid content polyurethane dispersion according to Claim 8, wherein said first or second polyurethane prepolymer is isocyanate terminated or hydroxyl terminated.

15. The continuous process for producing an ultra-high solid content polyurethane dispersion according to Claim 8, wherein said first or second polyurethane prepolymer is isocyanate terminated or hydroxy! terminated.

16. A method for producing an article comprising the steps of:

providing a first stream, wherein said first stream comprises a first polyurethane prepolymer or a first polyurethane prepolymer emulsion;

providing a second stream, wherein second stream is a media phase selected from the group consisting of a second polyurethane prepolymer, a second polyurethane prepolymer emulsion, a polyurethane dispersion, a seed latex emulsion, or combinations thereof;

continuously merging the first stream with the second stream optionally in the presence of a chain extender; (4) thereby forming a polyurethane dispersion having a solid content of at least 60 percent by weight of the solid, based on the total weight of the ultra-high solid content polyurethane dispersion, and a viscosity of less than 5000 cps at 20 rpm at 21° C using spindle #4 with Brookfield viscometer;

applying the dispersion to a substrate

drying the dispersion; and

thereby forming the article.

17. A method for producing an article comprising the steps of:

providing a first stream, wherein said first stream comprises a first polyurethane prepolymer or a first polyurethane prepolymer emulsion;

providing a second stream, wherein second stream is a media phase selected from the group consisting of a second polyurethane prepolymer, a second polyurethane prepolymer emulsion, a polyurethane dispersion, a seed latex emulsion, or combinations thereof;

continuously merging the first stream with the second stream optionally in the presence of a chain extender; (4) thereby forming a polyurethane dispersion having a solid content of at least 60 percent by weight of the solid, based on the total weight of the ultra-high solid content polyurethane dispersion, and a viscosity of less than 5000 cps at 20 rpm at 21° C using spindle #4 with Brookfield viscometer;

frothing the dispersion;
thereby forming a foam;
drying the foam; and
thereby forming the article.

18. An article produced according to the method of either Claim 16 or Claim 17.