weight percent of microspheres based on the total weight of the reaction mixture, 1 to 30 parts by weight of a hydroxyl-terminated chain extender per 100 parts by weight of the polyether polyol(s), an aromatic polyisocyanate in amount to provide an isocyanate index of 80 to 130 and non-mercury catalyst, and 0.1 to 0.25% of a ß-diketone compound based on the combined weight of all components of the reaction mixture except the polyisocyanate(s), wherein the reaction mixture is essentially devoid of mercury compounds, wherein the non-mercury catalyst is a zinc carboxylate by itself or a mixture of a zinc carboxylate and metal carboxylate in which the metal is a group 3-12 metal other than mercury, in which the zinc carboxylate constitutes at least 90 weight percent of the mixture, and

b) curing the reaction mixture to form the syntactic polyurethane elastomer.

The process of the disclosure is suitable for applying a syntactic polyurethane elastomer to a substrate. Substrates of interest are parts that require thermal insulation. Subsea pipe and architecture is a substrate of particular interest.

In another aspect, the disclosure provides a process for producing a substrate having an applied syntactic polyurethane elastomer, comprising the steps of

a) forming a first section of syntactic polyurethane elastomer on at least a portion of the substrate by (i) applying a first reaction mixture containing at least one polyether polyol having a number average hydroxyl equivalent weight of at least 800 wherein the polyether polyols(s) contain no more than 60 μeq/g of terminal unsaturation, 5 to 50 weight percent of microspheres based on the total weight of the reaction mixture, 1 to 30 parts by weight of a hydroxyl-terminated chain extender per 100 parts by weight of the polyether polyol(s), an aromatic polyisocyanate in amount to provide an isocyanate index of 80 to 130, 0.1 to 0.25% of a ß-diketone compound based on the combined weight of all components of the reaction mixture except the polyisocyanate(s), and a non-mercury catalyst to at least a portion of the surface of the substrate and (ii) at least partially curing the first reaction mixture to form the first section of syntactic polyurethane elastomer, and then

b) forming a second section of syntactic polyurethane elastomer on at least a portion of the substrate by (i) applying a second reaction mixture containing at least one polyether polyol having a number average hydroxyl equivalent weight of at least 1000 wherein the polyether polyol(s) contain no more than 60 μeq/g of terminal unsaturation, 5 to 50 weight percent of microspheres based on the total weight of the reaction mixture, 1 to 30 parts by weight of a hydroxyl-terminated chain extender per 100 parts by weight of the polyether polyol(s), an aromatic polyisocyanate in amount to provide an isocyanate index of 80 to 130, 0.1 to 0.25% of a ß-diketone compound based on the combined weight of all components of the reaction mixture except the polyisocyanate(s), and a non-mercury catalyst to at least a portion of the surface of the substrate and in contact with the first section of syntactic polyurethane elastomer to form at least one bondline between the first section of syntactic polyurethane elastomer and the second reaction mixture and (ii) at least partially curing the second reaction mixture to form the second section of syntactic polyurethane elastomer adherent to the first section of syntactic polyurethane elastomer;

wherein the non-mercury catalyst in step (a) or (b) is independently a zinc carboxylate by itself or a mixture of a zinc carboxylate and metal carboxylate in which the metal is a group

3-12 metal other than mercury, in which the zinc carboxylate constitutes at least 90 weight percent of the mixture.

Figure 1 is a front view, in section, of a mold for making samples for bond strength testing.

Figure 2 is a front view of a tripartite elastomer for bond strength testing.

WHAT IS CLAIMED IS:

1. A method for making a syntactic polyurethane elastomer, comprising

a) forming a reaction mixture containing at least one polyether polyol having a number average hydroxyl equivalent weight of at least 800 wherein the polyether polyol(s) no more than 60 μeq/g of terminal unsaturation, 5 to 50 weight percent of microspheres based on the total weight of the reaction mixture, 1 to 30 parts by weight of a hydroxyl-terminated chain extender per 100 parts by weight of the polyether polyol(s), an aromatic polyisocyanate in amount to provide an isocyanate index of 80 to 130 and non-mercury catalyst, and 0.1 to 0.25% of a ß-diketone compound based on the combined weight of all components of the reaction mixture except the polyisocyanate(s), wherein the reaction mixture is essentially devoid of mercury compounds, wherein the non- mercury catalyst is a zinc carboxylate by itself or a mixture of a zinc carboxylate and metal carboxylate in which the metal is a group 3-12 metal other than mercury, in which the zinc carboxylate constitutes at least 90 weight percent of the mixture, and

b) curing the reaction mixture to form the syntactic polyurethane elastomer.

2. The process of claim 1 wherein in step b) is performed on the surface of a substrate to form a coating of the syntactic polyurethane elastomer on the substrate.

3. A process for producing a substrate having an applied syntactic polyurethane elastomer, comprising the steps of

a) forming a first section of syntactic polyurethane elastomer on at least a portion of the substrate by (i) applying a first reaction mixture containing at least one polyether polyol having a number average hydroxyl equivalent weight of at least 800 wherein the polyether polyols(s) contain no more than 60 μeq/g of terminal unsaturation, 5 to 50 weight percent of microspheres based on the total weight of the reaction mixture, 1 to 30 parts by weight of a hydroxyl-terminated chain extender per 100 parts by weight of the polyether polyol(s), an aromatic polyisocyanate in amount to provide an isocyanate index of 80 to 130, 0.1 to 0.25% of a ß-diketone compound based on the combined weight of all components of the reaction mixture except the polyisocyanate(s), and a non-mercury catalyst to at least a portion of the surface of the substrate and (ii) at least partially curing the first reaction mixture to form the first section of syntactic polyurethane elastomer, and then

b) forming a second section of syntactic polyurethane elastomer on at least a portion of the substrate by (i) applying a second reaction mixture containing at least one polyether polyol having a number average hydroxyl equivalent weight of at least 1000 wherein the polyether polyol(s) contain no more than 60 μeq/g of terminal unsaturation, 5 to 50 weight percent of microspheres based on the total weight of the reaction mixture, 1 to 30 parts by weight of a hydroxyl-terminated chain extender per 100 parts by weight of the polyether polyol(s), an aromatic polyisocyanate in amount to provide an isocyanate index of 80 to 130, 0.1 to 0.25% of a ß-diketone compound based on the combined weight of all components of the reaction mixture except the polyisocyanate(s), and a non-mercury catalyst to at least a portion of the surface of the substrate and in contact with the first section of syntactic polyurethane elastomer to form at least one bondline between the first section of syntactic polyurethane elastomer and the second reaction mixture and (ii) at least partially curing the second reaction mixture to form the second section of syntactic polyurethane elastomer adherent to the first section of syntactic polyurethane elastomer;

wherein the non-mercury catalyst in step (a) or (b) is independently a zinc carboxylate by itself or a mixture of a zinc carboxylate and metal carboxylate in which the metal is a group 3-12 metal other than mercury, in which the zinc carboxylate constitutes at least 90 weight percent of the mixture.

4. The process of claim 3 wherein the reaction mixtures are essentially devoid of mercury compounds.

5. The process of claim 3 or 4 wherein the bondline has a bond strength of at least 8.0 MPa.

6. The process of claim 3, 4 or 5 wherein the bondline has no visible defects when visualized microscopically at a magnification of 100X.

7. The process of any of claims 2-6 wherein the substrate is an undersea pipe or undersea architecture.

8. The process of claim 7 wherein the undersea pipe or undersea architecture is branched, curved or has another non-linear configuration.

9. The process of claim 7 or 8 wherein the undersea pipe or undersea architecture has one or more external features that protrude partially or completely through the applied syntactic polyurethane elastomer.

14. The process of claim 13, wherein the chain extender is 1,4-butanediol.

15. The process of any one of the preceding claims, wherein the non-mercury catalyst is a mixture of 98-99.99 weight percent of one or more zinc carboxylates and 0.01 to 2 weight percent of one or more zirconium carboxylates.