agent BA2 can be HFC 365mfc ($CF_3CH_2CF_2CH_3$), or 365mfc/227ea (i.e. a mixture of 365mfc and 227ea).

[0020] A fourth nozzle 140 is positioned on the mixing chamber 100 at a lower height level than the third nozzle 130 (Figure 3), wherein the fourth nozzle 140 allows a third blowing agent BA3 to be injected into the mixing chamber 100. In one embodiment, the third blowing agent BA3 is a hydrofluorocarbon-containing compound having a boiling point of around 0 to 20 degrees Celsius. For example, the third blowing agent BA3 can be HFC 245fa ($CF_3CH_2CHF_2$).

[0021] A fifth nozzle 150 is positioned at a lower height level than the fourth nozzle 140, wherein the fifth nozzle 150 allows a fourth blowing agent BA4 to be injected into the mixing chamber 100. In one embodiment, the fourth blowing agent BA4 is a hydrocarbon-containing compound, hydrofluorocarbon-containing compound or hydrofluoroolefin-containing compound having a boiling point of around -30 to 0 degrees Celsius. For example, the fourth blowing agent BA4 can be R600a (C_4H_{10}), HFC 134a (CH_2F-CF_3), ~~HFC 227ea (C_3HF_7)~~ or HFO 1234ZE (trans-CHF=$CHCF_3$).

[0022] In one embodiment, the plurality of nozzles 110, 120, 130, 140, 150 are positioned at different heights of the sidewall 101 of the mixing chamber 100 as shown in Figures 2 and 3. In one embodiment, the plurality of nozzles 110, 120, 130, 140, 150 are positioned in a substantially radial equidistant R from each other (Figure 4).

[0023] Referring to Figure 5, the fourth nozzle 140 includes an orifice 141 for injecting the third blowing agent BA3 into the mixing chamber. Similarly, the other nozzles 110, 120, 130 and 150 each have an orifice for injection of the respective chemical compounds. It can be appreciated that the orifice of the nozzles 110, 120, 130, 140, 150 can be designed with different diameters to facilitate the injection of the different types of chemical compounds (i.e. the polyol and blowing agents). In one embodiment, the nozzles 110, 120, 130, 140, 150 are inserted through pre-formed holes in the sidewall 101 of the chamber 100 and secured in place by adhesive, sealants or O-rings. In one

CLAIMS

What is claimed is:

1. A mixing apparatus for preparing a mixture from polyol and blowing agents for the manufacture of polyurethane foam, the mixing apparatus comprising:

a mixing chamber including

a first nozzle to allow a polyol having a boiling point of around 200 to 250 degrees Celsius to be injected into the mixing chamber;

a second nozzle positioned at a lower height level than the first nozzle to allow a first blowing agent to be injected into the mixing chamber, wherein the first blowing agent is a hydrocarbon-containing compound having a boiling point of around 40 to 60 degrees Celsius;

a third nozzle positioned at a lower height level than the second nozzle to allow a second blowing agent to be injected into the mixing chamber, wherein the second blowing agent is a hydrofluorocarbon-containing compound having a boiling point of around 20 to 40 degrees Celsius;

a fourth nozzle positioned at a lower height level than the third nozzle to allow a third blowing agent to be injected into the mixing chamber, wherein the third blowing agent is a hydrofluorocarbon-containing compound having a boiling point of around 0 to 20 degrees Celsius;

a fifth nozzle positioned at a lower height level than the fourth nozzle to allow a fourth blowing agent to be injected into the mixing chamber, wherein the fourth blowing agent is a hydrocarbon-containing compound, hydrofluorocarbon-containing compound or hydrofluoroolefin-containing compound having a boiling point of around -30 to 0 degrees Celsius; and

7. The mixing apparatus of claim 1 further comprising:

a plurality of container modules coupled to the mixing chamber, the plurality of container modules maintain the polyol and the first, the second, the third, and the fourth blowing agents in a liquid phase.

8. A method of ~~mixing~~ preparing a mixture from polyol and blowing agents for the manufacture of polyurethane foam, the method comprising:

injecting a stream of polyol having a boiling point of around 200 to 250 degrees Celsius into a mixing chamber via a first nozzle;

injecting a stream of first blowing agent into the mixing chamber via a second nozzle positioned at a lower height level than the first nozzle, wherein the first blowing agent is a hydrocarbon-containing compound having a boiling point of around 40 to 60 degrees Celsius;

injecting a stream of second blowing agent into the mixing chamber via a third nozzle positioned at a lower height level than the second nozzle, wherein the second blowing agent is a hydrofluorocarbon-containing compound having a boiling point of around 20 to 40 degrees Celsius;

injecting a stream of third blowing agent into the mixing chamber via a fourth nozzle positioned at a lower height than the third nozzle, wherein the third blowing agent is a hydrofluorocarbon-containing compound having a boiling point of around 0 to 20 degrees Celsius;

injecting a stream of fourth blowing agent into the mixing chamber via a fifth nozzle positioned at a lower height level than the fourth nozzle, wherein the fourth blowing agent is a hydrocarbon-containing compound, hydrofluorocarbon-containing compound or hydrofluoroolefin-containing compound having a boiling point of around -30 to 0 degrees Celsius,