CLAIMS

1. A flame retardant composition comprised of or formed from components comprising at least one isocyanate-reactive sulfur-containing compound selected from sulfur-containing aromatic diamines and disulfides and at least one isocyanate-reactive brominated flame retardant selected from brominated aromatic diester diols, 2,3-dibromoallyl alcohol, tribromoneopentyl alcohol, dibromoneopentyl glycol and tetrabromobenzenedimethanol, with the provisos that

when the isocyanate-reactive sulfur-containing compound is a sulfur-containing aromatic diamine, the isocyanate-reactive brominated flame retardant is a brominated aromatic diester diol, 2,3- dibromoallyl alcohol, and/or tribromoneopentyl alcohol, and

when the isocyanate-reactive sulfur-containing compound is a sulfur-containing aromatic diamine and the isocyanate-reactive brominated flame retardant is a brominated aromatic diester diol, the composition also comprises another brominated flame retardant, another sulfur-containing compound, tris(1-chloro-2-propyl)phosphate, and/or a surface-modified montmorillonite nanoclay.

2. A flame retardant composition as in Claim 1 wherein the isocyanate-reactive brominated flame retardant is 2,3-dibromoallyl alcohol.

3. A flame retardant composition as in Claim 1 wherein

when the isocyanate-reactive sulfur-containing compound is a sulfur-containing aromatic diamine, the isocyanate-reactive brominated flame retardant is 2,3-dibromoallyl alcohol or tribromoneopentyl alcohol;

when the isocyanate-reactive sulfur-containing compound is a disulfide, the isocyanate-reactive brominated flame retardant is 2,3-dibromoallyl alcohol, tribromoneopentyl alcohol, or a brominated aromatic diester diol.

4. A flame retardant composition as in Claim 1 wherein the isocyanate-reactive brominated flame retardant is a brominated aromatic diester diol, wherein the composition further comprises tris(1-chloro-2-propyl)phosphate, and optionally a surface-modified montmorillonite nanoclay.

5. A flame retardant composition as in Claim 4 wherein the surface-modified montmorillonite nanoclay, when present, is a montmorillonite clay surface modified with 0.5 to 5 wt% aminopropyltriethoxysilane and 15 to 35 wt% octadecylamine.

6. A flame retardant composition as in any of Claims 1 or 4-5 wherein the brominated aromatic diester diol is a mixed ester of tetrabromophthalic anhydride with diethylene glycol and propylene glycol.

7. A flame retardant composition as in Claim 3 wherein

when the isocyanate-reactive sulfur-containing compound is a sulfur-containing aromatic diamine and the isocyanate-reactive brominated flame retardant is 2,3-dibromoallyl alcohol, the sulfur-containing aromatic diamine is in the range of 10 wt% to 45 wt%, and 2,3-dibromoallyl alcohol is in the range of 50 wt% to 80 wt%;

when the isocyanate-reactive sulfur-containing compound is a disulfide, and the isocyanate-reactive brominated flame retardant is

2,3-dibromoallyl alcohol, the disulfide is in the range of 10 wt% to 55 wt%, and 2,3-dibromoallyl alcohol is in the range of 45 wt% to 90 wt%;

tribromoneopentyl alcohol, the disulfide is in the range of 25 wt% to 75 wt%, and tribromoneopentyl alcohol is in the range of 25 wt% to 75 wt%; or

a brominated aromatic diester diol, the disulfide is in the range of 10 wt% to 60 wt%, and the brominated aromatic diester diol is in the range of 35 wt% to 90 wt%;

wherein the wt% are based on the total weight of the composition.

8. A flame retardant composition as in any of Claims 2-3 or 7 wherein the isocyanate-reactive sulfur-containing compound is bis(2-hydroxyethyl)disulfide.

9. A formulation comprising at least one polyol, at least one blowing agent, at least one catalyst, at least one surfactant, at least one isocyanate-reactive sulfur-containing compound selected from sulfur-containing aromatic diamines and disulfides, and at least one isocyanate-reactive brominated flame retardant selected from brominated aromatic diester diols, 2,3-

dibromoallyl alcohol, tribromoneopentyl alcohol, dibromoneopentyl glycol and tetrabromobenzenedimethanol, with the provisos that

when the isocyanate-reactive sulfur-containing compound is a sulfur-containing aromatic diamine, the isocyanate-reactive brominated flame retardant is a brominated aromatic diester diol, 2,3-dibromoallyl alcohol, and/or tribromoneopentyl alcohol, and

when the isocyanate-reactive sulfur-containing compound is a sulfur-containing aromatic diamine and the isocyanate-reactive brominated flame retardant is a brominated aromatic diester diol, the composition also comprises another brominated flame retardant, another sulfur-containing compound, tris(1-chloro-2-propyl)phosphate, and/or a surface-modified montmorillonite nanoclay

10. A formulation as in Claim 9 wherein the polyol is a polyether polyol and/or a polyester polyol.

11. A formulation as in Claim 9 wherein the polyol has a functionality of 3 to 7.

12. A formulation as in Claim 9 wherein the blowing agent is water, 1,1,1,3,3-pentafluoropropane, *trans*-1-chloro-3,3,3-trifluoropropene, and/or 1,2-bis(trifluoromethyl)ethene.

13. A formulation as in Claim 9 wherein the isocyanate-reactive brominated flame retardant is 2,3-dibromoallyl alcohol.

14. A formulation as in Claim 9 wherein the isocyanate-reactive sulfur-containing compound is a sulfur-containing aromatic diamine, the isocyanate-reactive brominated flame retardant is a brominated aromatic diester diol, wherein the formulation further comprises tris(1-chloro-2-propyl)phosphate; and optionally a montmorillonite clay surface modified with 0.5 to 5 wt% aminopropyltriethoxysilane and 15 to 35 wt% octadecylamine.

15. A formulation as in any of Claims 9-12 wherein

the isocyanate-reactive sulfur-containing compound is a sulfur-containing aromatic diamine and the isocyanate-reactive brominated flame retardant is 2,3-dibromoallyl alcohol;

the isocyanate-reactive sulfur-containing compound is a disulfide, and the isocyanate-reactive brominated flame retardant is 2,3-dibromoallyl alcohol, tribromoneopentyl alcohol, and/or a brominated aromatic diester diol.

16. A formulation as in any of Claims 13-15 wherein the sulfur-containing aromatic diamine is a mixture of 3,5-dimethylthio-toluene-2,4-diamine and 3,5-dimethylthio-toluene-2,6-diamine, and/or the disulfide is bis(2-hydroxyethyl)disulfide.

17. A rigid polyurethane foam formed from components comprising a polyisocyanate and a formulation as in any of Claims 9-12 or 13-16.

18. A process for forming a rigid polyurethane foam, which process comprises

contacting A) a polyisocyanate, and B) a formulation formed from at least one polyol, at least one blowing agent, at least one catalyst, at least one surfactant, at least one isocyanate-reactive sulfur-containing compound selected from sulfur-containing aromatic diamines and disulfides and at least one isocyanate-reactive brominated flame retardant selected from brominated aromatic diester diols, 2,3-dibromoallyl alcohol, tribromoneopentyl alcohol, dibromoneopentyl glycol and tetrabromobenzenedimethanol, to form a mixture,

with the provisos that

when the isocyanate-reactive sulfur-containing compound is a sulfur-containing aromatic diamine, the isocyanate-reactive brominated flame retardant is a brominated aromatic diester diol, 2,3-dibromoallyl alcohol, and/or tribromoneopentyl alcohol, and

when the isocyanate-reactive sulfur-containing compound is a sulfur-containing aromatic diamine and the isocyanate-reactive brominated flame retardant is a brominated aromatic diester diol, the composition also comprises another brominated flame retardant, another sulfur-containing compound, tris(1-chloro-2-propyl)phosphate, and/or a surface-modified montmorillonite nanoclay; and

allowing the mixture to cure to form a rigid polyurethane foam.

19. A process as in Claim 18 wherein A) and B) are in amounts such that the Isocyanate Index of the mixture is 85 to 1000, and wherein a rigid polyurethane foam is formed.