CLAIMS

What is claimed is:

1. A method of manufacturing a foamed sulfur asphalt stabilized soil comprising the steps of:

introducing an asphalt binder, elemental sulfur, foaming air, and foaming water into a foaming mixer, where the foaming water has a water introduction pressure, where the foaming air has an air introduction pressure, and where the water introduction pressure is greater than the air introduction pressure;

operating the foaming mixer such that a foamed sulfur asphalt forms, where the foamed sulfur asphalt has a foam half-life equal to or greater than 6 seconds and has a foam expansion ratio equal to or greater than 8, and where the foaming mixer operates at a temperature of no greater than 150 °C;

introducing the foamed sulfur asphalt, an aggregate having a moisture content, and Portland cement into an aggregate mixer; and

operating the aggregate mixer such that the foamed sulfur asphalt stabilized soil forms.

2. The method of claim 1 where an amount of Portland cement introduced into the aggregate mixer is in a range of from 0.1 wt. % to 2 wt. % of the weight of the aggregate on an air-dried basis.

3. The method of claim 1 or claim 2 where the moisture content of the introduced aggregate is the optimum moisture content for compaction of the aggregate.

4. The method of claim 1 further comprising the step of introducing moisturizing water to the introduced aggregate such that the combination of the moisturizing water and the introduced aggregate forms an aggregate having a moisture content of the optimum moisture content for compaction of the aggregate, where the moisture content of the introduced aggregate in weight percent of the aggregate as air-dried aggregate is in a range of from the moisture content of air-dried aggregate to less than the optimum moisture content for compaction of the aggregate.

5. The method of claim 1 further comprising the step of introducing moisturizing water to the introduced aggregate such that the combination of the moisturizing water and the introduced aggregate forms an aggregate having a moisture content of $0.5(W_{OMC}) + 1$, where

W_{OMC} is a determined optimum moisture content for introduced aggregate in weight percent and where the moisture content of the introduced aggregate in weight percent of the aggregate as air-dried aggregate is in a range of from the moisture content of air-dried aggregate to less than the optimum moisture content for compaction of the aggregate.

6. The method of any one of claims 1 to 5 where an amount of foamed sulfur asphalt introduced into the aggregate mixer is in a range of from 5 wt. % to 10 wt. % of the foamed sulfur asphalt stabilized soil.

7. A foamed sulfur asphalt stabilized soil comprising foamed sulfur asphalt, an aggregate having a moisture content, and Portland cement, where the foamed sulfur asphalt has a foam half-life equal to or greater than 6 seconds and has a foam expansion ratio equal to or greater than 8.

8. The foamed sulfur asphalt stabilized soil of claim 7 having a Marshall stability greater than 6.672 kNs.

9. The foamed sulfur asphalt stabilized soil of claim 7 or claim 8 having an Indirect Tensile Strength greater than 200 kPa.

10. The foamed sulfur asphalt stabilized soil of any one of claims 7 to 9 having a Durability greater than 70%.

11. The foamed sulfur asphalt stabilized soil of any one of claims 7 to 10 where the aggregate is selected from the group consisting of dune sand, marl soil, sabkha soil, roads aggregate base, roads aggregate subbase, reclaimed asphalt pavement mix and combinations thereof.

12. A method of manufacturing a foamed sulfur asphalt comprising the steps of:

introducing an asphalt binder, elemental sulfur, foaming air and foaming water into a foaming mixer, where the foaming water has a water introduction pressure, where the foaming air has an air introduction pressure, and where the water introduction pressure is greater than the air introduction pressure; and

operating the foaming mixer such that a foamed sulfur asphalt forms, where the foamed sulfur asphalt has a foam half-life equal to or greater than 6 seconds and has a foam expansion ratio equal to or greater than 8, and where the foaming mixer operates at a temperature of no greater than 150 °C.

13. The method of claim 12 where the introduced asphalt binder is a Performance Grade asphalt binder.

14. The method of claim 12 or claim 13 where the asphalt binder and the elemental sulfur are introduced as a sulfur asphalt binder.

15. The method of any one of claims 12 to 14 where the sulfur asphalt binder has an elemental sulfur content in a range of from 10 wt. % to 50 wt. % of the sulfur asphalt binder.

16. The method of any one of claims 12 to 15 further comprising the steps of introducing the asphalt binder and elemental sulfur into a pre-mixer such that the sulfur asphalt binder forms, and then introducing the sulfur asphalt binder into the foaming mixer in place of both the asphalt binder and elemental sulfur.

17. The method of any one of claims 12 to 16 where the elemental sulfur is introduced into the foaming mixer as a molten liquid.

18. The method of any one of claims 12 to 17 where an amount of the foaming water introduced is operable to produce the foamed sulfur asphalt having a water content in a range of from 2.3 % to 4.7 % by weight.

19. A foamed sulfur asphalt comprising an asphalt binder, elemental sulfur, foaming air, and foaming water, where the foamed sulfur asphalt has a foam half-life equal to or greater than 6 seconds, has a foam expansion ratio equal to or greater than 8, and has an amount of elemental sulfur in a range of from 10% to 50% by weight of the combined amount of elemental sulfur and the asphalt binder in the foamed sulfur asphalt.

20. The foamed sulfur asphalt of claim 19 where the foamed sulfur asphalt has a water content in a range of from 2.3 % to 4.7 % by weight.

21. The foamed sulfur asphalt of claim 19 or claim 20 where the asphalt binder is a PG 64-10 asphalt binder.

22. The foamed sulfur asphalt of any one of claims 19 to 21 where the foamed sulfur asphalt has a foam half-life of 9.1 seconds and has a foam expansion ratio of 8.8.

CLAIMS

1. A method of manufacturing a foamed sulfur asphalt stabilized soil comprising the steps of:

introducing an asphalt binder, elemental sulfur, foaming air, and foaming water into a foaming mixer, where the foaming water has a water introduction pressure, where the foaming air has an air introduction pressure, and where the water introduction pressure is greater than the air introduction pressure;

operating the foaming mixer such that a foamed sulfur asphalt forms with a water content of about 3.45%, where the foamed sulfur asphalt has a foam half-life equal to or greater than about 6 seconds and has a foam expansion ratio equal to or greater than 8, and where the foaming mixer operates at a temperature of about 150°C.;

introducing the foamed sulfur asphalt, an aggregate having a moisture content, and Portland cement into an aggregate mixer; and

operating the aggregate mixer such that the foamed sulfur asphalt stabilized soil forms.

2. The method of claim 1 where an amount of Portland cement introduced into the aggregate mixer is in a range of from about 0.1 wt. % to about 2 wt. % of the weight of the aggregate on an air-dried basis.

3. The method of claim 1 where the moisture content of the introduced aggregate is about the optimum moisture content for compaction of the aggregate.

4. The method of claim 1 further comprising the step of introducing moisturizing water to the introduced aggregate such that the combination of the moisturizing water and the introduced aggregate forms an aggregate having a moisture content of about the optimum moisture content for compaction of the aggregate, where the moisture content of the introduced aggregate in weight percent of the aggregate as air-dried aggregate is in a range of from about the moisture content of air-dried aggregate to less than about the optimum moisture content for compaction of the aggregate.

5. The method of claim 1 further comprising the step of introducing moisturizing water to the introduced aggregate such that the combination of the moisturizing water and the

introduced aggregate forms an aggregate having a moisture content of about $0.5(W_{OMC})+1$, where W_{OMC} is a determined optimum moisture content for introduced aggregate in weight percent and where the moisture content of the introduced aggregate in weight percent of the aggregate as air-dried aggregate is in a range of from about the moisture content of air-dried aggregate to less than about the optimum moisture content for compaction of the aggregate.

6. The method of claim 1 where an amount of foamed sulfur asphalt introduced into the aggregate mixer is in a range of from about 5 wt. % to about 10 wt. % of the foamed sulfur asphalt stabilized soil.

7. A foamed sulfur asphalt stabilized soil comprising foamed sulfur asphalt water content of about 3.45% when produced at a temperature of about 150°C., an aggregate having a moisture content, and Portland cement, where the foamed sulfur asphalt has a foam half-life equal to or greater than about 6 seconds and has a foam expansion ratio equal to or greater than 8.

8. The foamed sulfur asphalt stabilized soil of claim 7 having a Marshall stability greater than about 6.672 kNs.

9. The foamed sulfur asphalt stabilized soil of claim 7 having an Indirect Tensile Strength greater than 200 kPa.

10. The foamed sulfur asphalt stabilized soil of claim 7 having a Durability greater than 70%.

11. The foamed sulfur asphalt stabilized soil of claim 7 where the aggregate is selected from the group consisting of dune sand, marl soil, sabkha soil, roads aggregate base, roads aggregate subbase, reclaimed asphalt pavement mix and combinations thereof.

12. A method of manufacturing a foamed sulfur asphalt comprising the steps of:
introducing an asphalt binder, elemental sulfur, foaming air, and foaming water into a foaming mixer, where the foaming water has a water introduction pressure, where the

foaming air has an air introduction pressure, and where the water introduction pressure is greater than the air introduction pressure; and

operating the foaming mixer such that a foamed sulfur asphalt forms with a water content of about 3.45%, where the foamed sulfur asphalt has a foam half-life equal to or greater than about 6 seconds and has a foam expansion ratio equal to or greater than 8, and where the foaming mixer operates at a temperature of about 150°C.

13. The method of claim 12 where the introduced asphalt binder is a Performance Grade asphalt binder.

14. The method of claim 12 where the asphalt binder and the elemental sulfur are introduced as a sulfur asphalt binder.

15. The method of claim 12 where the sulfur asphalt binder has an elemental sulfur content in a range of from about 10 wt. % to about 50 wt. % of the sulfur asphalt binder.

16. The method of claim 12 further comprising the steps of introducing the asphalt binder and elemental sulfur into a pre-mixer such that the sulfur asphalt binder forms, and then introducing the sulfur asphalt binder into the foaming mixer in place of both the asphalt binder and elemental sulfur.

17. The method of claim 12 where the elemental sulfur is introduced into the foaming mixer as a molten liquid.

18. A foamed sulfur asphalt comprising an asphalt binder, elemental sulfur, foaming air, and foaming water, where the foamed sulfur asphalt has a water content of about 3.45% when produced at a temperature of about 150°C., a foam half-life equal to or greater than about 6 seconds, has a foam expansion ratio equal to or greater than 8, and has an amount of elemental sulfur in a range of from about 10% to about 50% by weight of the combined amount of elemental sulfur and the asphalt binder in the foamed sulfur asphalt.

19. The foamed sulfur asphalt of claim 18 where the asphalt binder is a PG 64-10 asphalt binder.

20. The foamed sulfur asphalt of claim 18 where the foamed sulfur asphalt has a foam half-life of about 9.1 seconds and has a foam expansion ratio of about 8.8.