

Claims

1. An explosives delivery system comprising:
a first reservoir configured to store an emulsion matrix;
a second reservoir configured to store a homogenizing agent;
a first homogenizer configured to homogenize the emulsion matrix and the homogenizing agent into a first homogenized product, the first homogenizer operably connected to the first reservoir and the second reservoir; and
a delivery conduit operably connected to the first homogenizer, wherein the delivery conduit is configured to convey the homogenized product to a blasthole.
2. The explosives delivery system of claim 1, further comprising a first mixer configured to mix the emulsion matrix and the homogenizing agent, the first mixer operably connected to the first reservoir, the second reservoir, and the first homogenizer, wherein the first mixer is disposed upstream of the first homogenizer.
3. The explosives delivery system of claim 2, wherein the first mixer is a static mixer.
4. The explosives delivery system of any one of claims 1–3, wherein the homogenizing agent is selected from at least one of sorbitan monooleate, sorbitan dioleate, sorbitan trioleate, sorbitan sesquioleate, sorbitan diisostearate, oleic acid, oleic acid TEA, oleic acid/stearate TEA, adipic DEEA, adipic TEA, animal fats, lard, PIBSA, PIBSA derivatives, dicarboxylic acids, dimerized fatty acids, trimerized fatty acids, and vegetable oil.
5. The explosives delivery system of any one of claims 1–3, wherein the homogenizing agent is selected from at least one of sorbitan monooleate (SMO), sorbitan dioleate, sorbitan trioleate, sorbitan sesquioleate, sorbitan diisostearate, oleic acid, oleic acid TEA, oleic acid/stearate TEA, adipic DEEA, adipic TEA, and vegetable oil.
6. The explosives delivery system of any one of claims 1–3, wherein the homogenizing agent comprises sorbitan monooleate (SMO).
7. The explosives delivery system of any one of claims 1–6, wherein the emulsion matrix is supplied with an emulsifier distinct from the homogenizing agent.
8. The explosives delivery system of any one of claims 1–7, further comprising a first pump, wherein a first inlet of the first pump is fluidically connected to the first reservoir and an outlet of the first pump is fluidically connected to the first homogenizer.
9. The explosives delivery system of claim 8, wherein a second inlet of the first pump is fluidically connected to the second reservoir.

10. The explosives delivery system of claim 8, further comprising a second pump, wherein an inlet of the second pump is fluidically connected to the second reservoir and an outlet of the second pump is fluidically connected to the first homogenizer.

11. The explosives delivery system of any one of claims 1–10, further comprising: a third reservoir configured to store a first gassing agent, wherein a stream of the first gassing agent is fluidically coupled to a stream including the emulsion matrix upstream of the first homogenizer.

12. The explosives delivery system of claim 11, wherein the first gassing agent is a pH control agent.

13. The explosives delivery system of claim 11 or claim 12, further comprising a third pump, wherein an inlet of the third pump is fluidically connected to the third reservoir and an outlet of the third pump is fluidically connected to the first homogenizer.

14. The explosives delivery system of any one of claims 1–13, further comprising a second homogenizer disposed between the first homogenizer and a downstream end of the delivery conduit, the second homogenizer configured to further homogenize the first homogenized product into a second homogenized product.

15. The explosives delivery system of claim 14, wherein the first and second homogenizers are independently selected from one of a dynamic homogenizer or a static homogenizer.

16. The explosives delivery system of any one of claims 11–15, further comprising a fourth reservoir configured to store a second gassing agent, wherein a stream of the second gassing agent is fluidically coupled to a stream of the first homogenized product downstream of the first homogenizer.

17. The explosives delivery system of claim 16, further comprising a second mixer configured to mix the second gassing agent with the first homogenized product.

18. The explosives delivery system of claim 16 or claim 17, further comprising a spray nozzle coupled to a downstream end of the delivery conduit, wherein the spray nozzle is configured for mixing.

19. The explosives delivery system of any one of claims 16–18, wherein the second gassing agent comprises a chemical gassing agent.

20. The explosives delivery system of any one of claims 11–15, further comprising:

a fourth reservoir configured to store a second gassing agent, wherein a stream of the second gassing agent is fluidically coupled to the stream including the emulsion matrix upstream of the first homogenizer.

21. The explosives delivery system of claim 20, further comprising a second mixer configured to mix the second gassing agent with the stream including the emulsion matrix.

22. The explosives delivery system of claim 20 or claim 21, further comprising a spray nozzle coupled to a downstream end of the delivery conduit, wherein the spray nozzle is configured for mixing.

23. The explosives delivery system of any one of claims 1–22, further comprising a water injector configured to introduce water into the delivery conduit.

24. The explosives delivery system of claim 23, wherein the water injector comprises a water ring.

25. The explosives delivery system of claim 23 or claim 24, wherein a second gassing agent is included in the water.

26. The explosives delivery system of any one of claims 1–25, wherein the first homogenizer is configured to introduce high shear on a stream comprising the emulsion matrix.

27. A method of delivering explosives comprising:
supplying an emulsion matrix;
mixing a homogenizing agent with the emulsion matrix into a mixed product;
homogenizing the mixed product into a homogenized product;
sensitizing the homogenized product; and
conveying the sensitized product to a blasthole.

28. The method of claim 27, wherein the blasthole is an underground blasthole and wherein the emulsion matrix comprises an emulsion matrix used for surface blasting.

29. The method of claim 27 or claim 28, further comprising selecting an emulsion matrix tailored to the hardness of the rock to be blasted.

30. The method of any one of claims 27–29, wherein the emulsion matrix is supplied substantially devoid of the homogenizing agent.

31. The method of any one of claims 27–30, wherein the homogenizing agent is selected from at least one of sorbitan monooleate (SMO), sorbitan dioleate, sorbitan trioleate, sorbitan sesquioleate, sorbitan diisostearate, oleic acid, oleic acid TEA, oleic acid/stearate TEA, adipic DEEA, adipic TEA, animal fats, lard, PIBSA, PIBSA derivatives, dicarboxylic acids, dimerized fatty acids, trimerized fatty acids, and vegetable oil.

32. The method of any one of claims 27–30, wherein the homogenizing agent is selected from at least one of sorbitan monooleate (SMO), sorbitan dioleate, sorbitan

trioleate, sorbitan sesquioleate, sorbitan diisostearate, oleic acid, oleic acid TEA, oleic acid/stearate TEA, adipic DEEA, and adipic TEA.

33. The method of any one of claims 27–30, wherein the homogenizing agent comprises sorbitan monooleate (SMO).

34. The method of any one of claims 27–33, wherein the emulsion matrix is supplied with an emulsifier distinct from the homogenizing agent.

35. The method of any one of claims 27–34, wherein the weight percent (wt%) of the homogenizing agent in the mixed product is about 0.2 wt% to about 1.5 wt%, about 0.3 wt% to about 1.3 wt%, about 0.5 wt% to about 1 wt%, about 0.7 wt% to about 0.8 wt%, or about 0.75 wt%.

36. The method of any one of claims 27–35, wherein the homogenized product is substantially devoid of crystallization.

37. The method of any one of claims 27–36, wherein the homogenizing agent is mixed with the emulsion matrix prior to disposition of the mixed product on a mobile processing unit.

38. The method of any one of claims 27–36, wherein the homogenizing agent is mixed with the emulsion matrix after disposition of the mixed product on a mobile processing unit.

39. The method of any one of claims 27–38, wherein the viscosity of the emulsion matrix is between about 20 to 70 kcP, between about 25 to 60 kcP, between about 25 to 50 kcP, or less than about 40 kcP.

40. The method of any one of claims 27–39, wherein the viscosity of the homogenized product is greater than about 120 kcP, greater than about 140 kcP, greater than about 150 kcP, or greater than about 160 kcP.

41. The method of any one of claims 27–40, wherein the viscosity of the homogenized product is about 120 kcP to about 300 kcP, about 140 kcP to about 275 kcP, or about 160 kcP to about 250 kcP.

42. The method of any one of claims 27–41, wherein the change in viscosity from the emulsion matrix to the homogenized product is about 50 kcP to about 300 kcP, about 60kcP to about 250 kcP, or about 70 kcP to about 200 kcP.

43. An explosives delivery system comprising:
a first reservoir configured to store an emulsion matrix;
a second reservoir configured to store a homogenizing agent;

a first mixer configured to mix the emulsion matrix and the homogenizing agent, the first mixer operably connected to the first reservoir, the second reservoir, and the first mixer; and

a delivery conduit operably connected to the first mixer, wherein the delivery conduit is configured to convey the mixed product to a mobile processing unit.

44. The explosives delivery system of claim 43, wherein the first mixer is a static mixer.

45. The explosives delivery system of claim 43, wherein the first mixer is a dynamic mixer.