

Claims:

1. A method of delivering an inhibited emulsion to a blasthole, the method comprising:
 - supplying an emulsion comprising a discontinuous oxidizer phase and a continuous fuel phase;
 - supplying a separate inhibitor solution comprising water, an inhibitor, and a crystallization point modifier;
 - mixing the emulsion with the inhibitor solution to form an inhibited emulsion; and
 - conveying the inhibited emulsion to a blasthole.
2. The method of claim 1, wherein the emulsion is supplied on a mobile processing unit, wherein the separate inhibitor solution is supplied on the mobile processing unit, wherein the emulsion is mixed with the inhibitor solution on the mobile processing unit to form the inhibited emulsion, and wherein the inhibited emulsion is conveyed to a blasthole from the mobile processing unit.
3. The method of claim 1 or claim 2, wherein supplying the separate inhibitor solution comprises mixing on the mobile processing unit water, the inhibitor, and the crystallization point modifier.
4. The method of any one of claims 1–3, wherein supplying the separate inhibitor solution comprises introducing the inhibitor solution into a reservoir disposed on the mobile processing unit.
5. The method of claim 1, wherein the emulsion is supplied in a plant, wherein the separate inhibitor solution is supplied in the plant, wherein the emulsion is mixed with the inhibitor solution in the plant to form the inhibited emulsion, and wherein the inhibited emulsion is conveyed to a blasthole from a mobile processing unit.
6. The method of any one of claims 1–5, wherein supplying the emulsion comprises supplying an emulsion matrix.
7. The method of claim 6, further comprising introducing a sensitizing agent to the emulsion matrix to form an emulsion explosive.
8. The method of claim 7, wherein the sensitizing agent is introduced to the emulsion matrix to form the emulsion explosive prior to introduction of the emulsion explosive into a delivery conduit.
9. The method of claim 7, wherein the sensitizing agent is introduced to the emulsion matrix to form the emulsion explosive proximal an outlet of a delivery conduit.
10. The method of any one of claims 1–5, wherein supplying the emulsion comprises supplying an emulsion explosive.
11. The method of any one of claims 1–5, further comprising introducing the inhibited emulsion to a delivery conduit, wherein the emulsion is mixed with the inhibitor

solution to form the inhibited emulsion prior to introduction of the inhibited emulsion to the delivery conduit.

12. The method of claim 1–5, further comprising introducing the emulsion and the inhibitor to a delivery conduit, wherein the emulsion is mixed with the inhibitor solution to form the inhibited emulsion proximal an outlet of the delivery conduit.

13. The method of any one of claims 1–12, further comprising determining a concentration, a flowrate, or both of the inhibitor solution to achieve a desired inhibition of reactive ground by the inhibited emulsion.

14. The method of any one of claims 1–12, further comprising varying a concentration, a flowrate, or both of the inhibitor solution to achieve a desired inhibition of reactive ground by the inhibited emulsion.

15. The method of claim 1, further comprising injecting an annulus of the inhibitor solution to lubricate conveyance of the emulsion along a delivery conduit.

16. The method of claim 1, further comprising injecting the inhibitor solution to a centerline of a stream of the emulsion within a delivery conduit.

17. The method of any one of claims 1–16, wherein the inhibitor is selected from at least one of urea, an amine, a basic solution, sodium nitrate, hydrotalcite, and zinc oxide.

18. The method of claim 17, wherein the basic solution comprises aqueous soda ash.

19. The method of any one of claims 1–18, wherein the crystallization point modifier is selected from at least one of calcium nitrate, sodium nitrate, and calcium chloride.

20. The method of any one of claims 1–5, wherein conveying the inhibited emulsion to the blasthole comprises inserting a delivery conduit into the blasthole and conveying the inhibited emulsion into the blasthole via the delivery conduit.

21. The method of any one of claims 1–20, wherein the weight percent (wt%) of the inhibitor in the inhibited emulsion is about 1 wt% to about 10 wt%, about 1.5 wt% to about 7.5 wt%, about 2 wt% to about 5 wt%, or about 3 wt%.

22. The method of any one of claims 1–21, wherein the wt% of the crystallization point modifier in the inhibited emulsion is about 0.1 wt% to about 8 wt%, about 0.5 wt% to about 6 wt%, about 1 wt% to about 5 wt%, or about 2 wt% to about 4 wt%.

23. The method of any one of claims 1–22, wherein the wt% of the water in the inhibited emulsion is about 0.5 wt% to about 10 wt%, about 1 wt% to about 9 wt%, about 2 wt% to about 7 wt%, or about 3 wt% to about 5 wt%.

24. The method of any one of claims 1–23, wherein the inhibitor solution further comprises ethylene glycol.

25. The method of claim 24, wherein the wt% of the ethylene glycol in the inhibited emulsion is about 0.1 wt% to about 1 wt%, about 0.2 wt% to about 0.8 wt%, about 0.3 wt% to about 0.7 wt%, or about 0.4 wt% to about 0.6 wt%.

26. The method of any one of claims 1–25, further comprising determining whether the blasthole is disposed in reactive ground, high temperature ground, or both.

27. A method of blasting in reactive ground, high temperature ground, or both, the method comprising:

supplying an emulsion comprising a discontinuous oxidizer phase and a continuous fuel phase;

supplying an inhibitor;

mixing the inhibitor at a determined concentration, flowrate, or both with the emulsion to form an inhibited emulsion with sufficient inhibitor to achieve a desired inhibition of particular reactive ground, high temperature ground, or both, by the inhibited emulsion; and

conveying the inhibited emulsion to a blasthole in the particular reactive ground, high temperature ground, or both.

28. The method of claim 27, wherein the emulsion is supplied on a mobile processing unit, wherein the inhibitor is supplied on the mobile processing unit, wherein the inhibitor is mixed with the emulsion on the mobile processing unit to form the inhibited emulsion, and wherein the inhibited emulsion is conveyed to a blasthole from the mobile processing unit.

29. The method of claim 27, wherein the emulsion is supplied in a plant, wherein the inhibitor is supplied in the plant, wherein the inhibitor is mixed with the emulsion in the plant to form the inhibited emulsion, and wherein the inhibited emulsion is conveyed to a blasthole from a mobile processing unit.

30. The method of any one of claims 27–29, wherein the inhibitor is a component of an inhibitor solution further comprising water and a crystallization point modifier.

31. The method of claim 30, wherein the inhibitor solution further comprises ethylene glycol.

32. The method of any one of claims 27–31, further comprising determining the concentration, the flowrate, or both of the inhibitor solution to achieve a desired inhibition of particular reactive ground, high temperature ground, or both, by the inhibited emulsion.

33. The method of any one of claims 27–32, further comprising determining whether the ground is reactive ground, high temperature ground, or both.

34. An inhibitor solution comprising:

water;

an inhibitor; and

a crystallization point modifier.

35. The inhibitor solution of claim 34, wherein the inhibitor is selected from at least one of urea, an amine, a basic solution, sodium nitrate, hydrotalcite, and zinc oxide.

36. The inhibitor solution of claim 35, wherein the basic solution comprises aqueous soda ash.

37. The inhibitor solution of any one of claims 34–36, wherein the weight percent (wt%) of the inhibitor in the inhibitor solution is about 10 wt% to about 50 wt%, about 20 wt% to about 50 wt%, about 30 wt% to about 50 wt%, or about 40 wt% to about 50 wt%.

38. The inhibitor solution of any one of claims 34–37, wherein the crystallization point modifier is selected from at least one of calcium nitrate, sodium nitrate, and calcium chloride.

39. The inhibitor solution of any one of claims 34–38, wherein the wt% of the crystallization point modifier in the inhibitor solution is about 5 wt% to about 35 wt%, about 10 wt% to about 30 wt%, about 12 wt% to about 25 wt%, or about 14 wt% to about 20 wt%.

40. The inhibitor solution of any one of claims 34–39, wherein the wt% of the water in the inhibitor solution is about 15 wt% to about 50 wt%, about 20 wt% to about 45 wt%, about 25 wt% to about 42 wt%, or about 30 wt% to about 40 wt%.

41. The inhibitor solution of any one of claims 34–40, further comprising ethylene glycol.

42. The inhibitor solution of claim 41, wherein the wt% of the ethylene glycol in the inhibitor solution is about 1 wt% to about 10 wt%, about 2 wt% to about 8 wt%, about 4 wt% to about 6 wt%, or about 5 wt%.

43. An explosives delivery system comprising:

an emulsion reservoir configured to store an emulsion comprising a discontinuous oxidizer phase and a continuous fuel phase;

an inhibitor solution reservoir configured to store a separate inhibitor solution comprising water, an inhibitor, and a crystallization point modifier;

an inhibitor solution injector operably connected to the emulsion reservoir and the inhibitor solution reservoir, the inhibitor solution injector configured to introduce the inhibitor solution to the emulsion;

a delivery conduit operably connected to the inhibitor solution injector, wherein the delivery conduit is configured to convey the emulsion and the inhibitor solution, and wherein the delivery conduit is configured for insertion into a blasthole; and

a mixer disposed proximal of an outlet of the delivery conduit, wherein the mixer is configured to mix the emulsion and the inhibitor solution to form an inhibited emulsion.

44. The explosives delivery system of claim 43, wherein the inhibitor solution injector comprises a lubricant injector configured to inject an annulus of the inhibitor solution to lubricate conveyance of the emulsion along the delivery conduit.

45. The explosives delivery system of claim 43, wherein the inhibitor solution injector is configured to inject the inhibitor solution to a centerline of a stream of the emulsion within the delivery conduit.

46. The explosives delivery system of any one of claims 43–45, further comprising a heater operably connected to the inhibitor solution reservoir.