EXTERNAL HOMOGENIZATION SYSTEMS AND METHODS RELATED THERETO

TECHNICAL FIELD

[0001] The present disclosure relates generally to explosives. More specifically, the present disclosure relates to external homogenization systems and methods related thereto.

SUMMARY

[0001a] In one aspect, the present disclosure refers to an explosives delivery system comprising:

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

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 and thereby reduce a size of oxidizer phase droplets in the fuel phase, 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.

[0001b] In another aspect, the present disclosure refers to a method of delivering explosives comprising:

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

mixing a homogenizing agent with the emulsion matrix into a mixed product;

homogenizing the mixed product into a homogenized product and thereby reducing a size of oxidizer phase droplets in the fuel phase;

sensitizing the homogenized product; and

conveying the sensitized product to a blasthole.

BRIEF DESCRIPTION OF THE DRAWINGS

[0002] The embodiments disclosed herein will become more fully apparent from the following description and appended claims, taken in conjunction with the accompanying drawings. The drawings depict primarily generalized embodiments, which embodiments will be described with additional specificity and detail in connection with the drawings in which:

[0003] FIG. 1 is a process flow diagram of an embodiment of an explosives delivery system.

[0004] FIG. 2 is a process flow diagram of another embodiment of an explosives delivery system.

[0005] FIG. 3 is a process flow diagram of another embodiment of an explosives delivery system.

[0006] FIG. 4 is a process flow diagram of another embodiment of an explosives delivery system.

[0007] FIG. 5 is a graph depicting the storage modulus (G') of sprayed and non-sprayed samples.

[0008] FIG. 6 is a graph depicting the spray viscosity of multiple samples.

[0009] FIG. 7 depicts a microscope image of two different samples before and after spraying.

DETAILED DESCRIPTION

[0010] Emulsion explosives are commonly used in the mining, quarrying, and excavation industries for breaking rocks and ore. Generally, a hole, referred to as a "blasthole," is drilled in a surface, such as the ground. Emulsion explosives may then be pumped or augered into the blasthole. Emulsion explosives are generally transported to a bench as oxidizers and not as explosives. In general, the emulsion needs to be "sensitized" in order for the emulsion to become an explosive and detonate successfully. Sensitizing is often accomplished by introducing small voids into the emulsion. These voids act as hot spots for propagating detonation. These voids may be introduced by blowing a gas into the emulsion and thereby forming gas bubbles, adding microspheres or other porous media, and/or injecting chemical gassing agents to react in the emulsion and thereby form gas.

[0011] Some emulsion matrices may be configured for underground use (also referred to herein as an underground emulsion matrix) and some emulsion matrices may be configured

Claims

1. An explosives delivery system comprising:

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

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 and thereby reduce a size of oxidizer phase droplets in the fuel phase, 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 comprises sorbitan monooleate (SMO).

6. The explosives delivery system of any one of claims 1–5, wherein the emulsion matrix is supplied with an emulsifier distinct from the homogenizing agent.

7. The explosives delivery system of any one of claims 1–6, 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; and

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.

8. The explosives delivery system of any one of claims 1–7, 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, wherein the first gassing agent is a pH control agent;

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; and

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.

9. The explosives delivery system of claim 8, further comprising:

a fourth reservoir configured to store a second gassing agent, and

a second mixer configured to mix the second gassing agent with the first homogenized product.

10. The explosives delivery system of claim 9, further comprising a spray nozzle coupled to a downstream end of the delivery conduit, wherein the spray nozzle is configured for mixing.

11. A method of delivering explosives comprising:

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

mixing a homogenizing agent with the emulsion matrix into a mixed product;

homogenizing the mixed product into a homogenized product and thereby reducing a size of oxidizer phase droplets in the fuel phase;

sensitizing the homogenized product; and

conveying the sensitized product to a blasthole.

12. The method of claim 11, wherein the blasthole is an underground blasthole and wherein the emulsion matrix comprises an emulsion matrix used for surface blasting.

13. The method of claim 11 or claim 12, further comprising selecting an emulsion matrix tailored to the hardness of the rock to be blasted.

14. The method of any one of claims 11-13, wherein the emulsion matrix is supplied substantially devoid of the homogenizing agent.

15. The method of any one of claims 11-14, 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%.

16. The method of any one of claims 11-15, wherein the homogenized product is substantially devoid of crystallization.

17. The method of any one of claims 11-16, wherein the homogenizing agent is mixed with the emulsion matrix prior to disposition of the mixed product on a mobile processing unit.

18. The method of any one of claims 11-16, wherein the homogenizing agent is mixed with the emulsion matrix after disposition of the mixed product on a mobile processing unit.

19. The method of any one of claims 11-18, 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, and 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.