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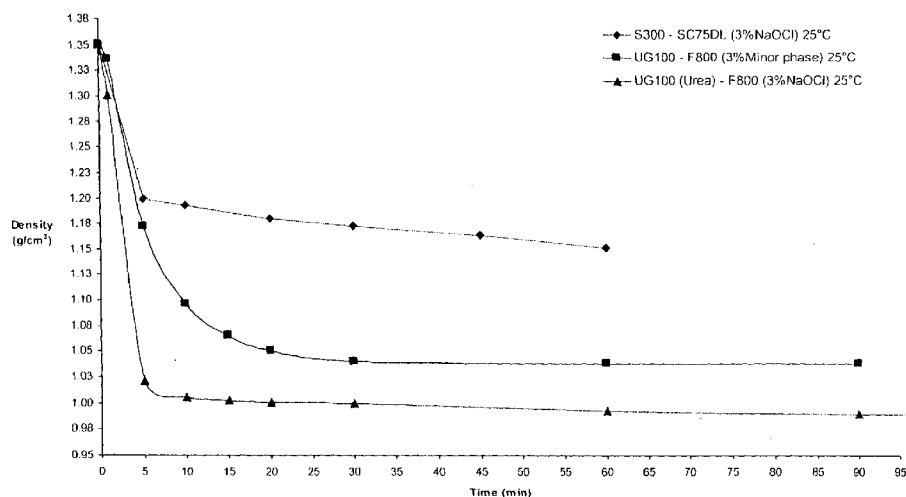


Figure 1

(57) Abstract: An emulsion explosive, formulated with a basic surfactant, which is sensitised by gassing with active sodium hypochlorite.

EMULSION EXPLOSIVE SENSITISING

BACKGROUND OF THE INVENTION

[0001] This invention relates generally to sensitising an emulsion explosive by gassing and more particularly to controlling the rate at which sensitising takes place.

5 **[0002]** The specification of PCT/AU2008/000013 contains a description of sensitising techniques for various types of explosives. In general terms the density of an explosive is reduced. In one technique this is achieved by forming small bubbles of nitrogen or another acceptable gas in situ in the explosive by means of a chemical reaction. One gassing method requires the addition of a substrate such as thiourea and acetic acid. The use of
10 thiourea is undesirable for it is believed to be a human carcinogen and the use of acetic acid requires modified equipment which adds to cost.

[0003] Hypochlorite gassing does not require thiourea nor acetic acid. However the rate of gassing is uncontrolled.

15 **[0004]** An object of the present invention is to control the rate of gassing in a hypochlorite gassing system.

SUMMARY OF THE INVENTION

[0005] The invention provides a method of sensitising an emulsion explosive by means of gassing which includes the steps of:

- a) preparing an emulsion which includes a continuous phase, a discontinuous phase
20 which contains ammonium nitrate as a nitrogen source, and a surfactant;
- b) maintaining the pH of the continuous phase at a value above 5; and
- c) adding active sodium hypochlorite to the emulsion,

wherein the surfactant is a suitable basic surfactant.

[0006] Preferably the surfactant is SC75 DL.

[0007] The continuous phase may comprise from 5,5% to 7,5% of the emulsion and preferably about 6,5% of the emulsion.

[0008] The surfactant may be present in the continuous phase in a range of from 15% to 25%, preferably of the order of 20%.

5 **[0009]** The remainder of the continuous phase may be a carbonaceous fuel such as diesel, paraffin or bio-oil. In one form of the invention the continuous phase includes from 35% to 45% diesel and from 35% to 45% waste oil.

[0010] Preferably the pH of the discontinuous phase is maintained at a value above 5,5. The pH may be maintained at a value of about 5,52.

10 **[0011]** The pH may be maintained at a desired value by the addition of at least one of the following: sodium hydroxide and sodium acetate. The sodium hydroxide may be added in a range of from 0,24% to 0,34%, preferably of the order of 0,29%. The sodium acetate may be added in a range of from 0,14% to 0,24%, preferably of the order of 0,19%.

15 **[0012]** The active concentration of the sodium hypochlorite, added to the emulsion in step c), may be present in a range of from 8% to 14%, preferably of the order of 12%.

[0013] The emulsion, after mixing, may have a viscosity of the order of 18000 to 27200 cP.

[0014] The emulsion product and gassing solution are preferably in a ratio of from 96% to 98% (emulsion) and 4% to 2% (gassing solution), and preferably in the ratio of 97:3 percentage.

20 BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The invention is further described by way of examples with reference to the accompanying drawings in which:

Figure 1 compares curves of density versus time of an emulsion gassed according to the invention to control curves, at a fixed temperature;

Figure 2 is similar to Figure 1, but with gassing done at two temperatures;

Figure 3 depicts the effect of temperature on the gassing system of the invention; and

Figure 4 shows gassing rates of doped and undoped products.

DESCRIPTION OF PREFERRED EMBODIMENT

5 [0016] One aspect of the invention is based on the realisation that the fuel phase composition of the emulsion determines the gassing rate and performance of the final product. The surfactant constitutes approximately 20% of the fuel phase and forms an integral part in a barrier between the oxidising solution and the gassing solution.

10 [0017] Basic head groups on the PIBSA (poly-isobutylene succinic anhydride) surfactant have been used successfully in providing additional stability to the emulsion when oxidiser quality is a problem. These surfactants however have drawbacks in that a sodium nitrite gassing system does not provide sensitisation under normal operating conditions. The independence of a sodium hypochlorite gassing system to pH provides a suitable alternative for sensitising an emulsion system without requiring fundamental changes to operating
15 procedures or equipment.

[0018] In the present invention use is made of a surfactant composition that contains a different surfactant head group. The surfactant type is SC75 DL supplied by Lake International Technology.

EXPERIMENTAL PROTOCOL

20 [0019] Two explosive products were used, namely an emulsion product referred to as S300, and a doped emulsion product, referred to as S335, which contains 65% S300 emulsion and 35% PPAN (porous prill ammonium nitrate).

[0020] The fudge point of the emulsion formulation was kept at 56°C with the presence of about 5% urea prill in the formulation. The pH of the oxidiser was increased to 5,52 with the

addition of 0,29% sodium hydroxide and 0,19% sodium acetate. No use was made of thiourea nor acetic acid.

5 [0021] The fuel phase made up 6,5% of the emulsion and consisted of 20% SC75 DL surfactant, 40% diesel and 40% exol-C waste oil. The emulsion was mixed using a Hobart mixer and a viscosity of 27200 cP was reached after 5 minutes mixing time.

10 [0022] 12% active sodium hypochlorite was selected as the gassing solution. Gassing experiments were conducted with the emulsion product and the gassing solution present in a ratio of 97:3 percentage respectively. Experiments were performed at ambient temperature, a lower temperature of about 5°C, and at an upper temperature of about 50°C. For the cold testing condition the emulsion products (S300 and S335) were stored in a refrigerator for 48 hours prior to gassing tests. For the high temperature testing the explosive products were stored in an oven at about 50°C prior to the gassing tests.

15 [0023] The gassing rates for the products and the different tests were carefully monitored and observations were made of the slumping or collapsing effect, and of PPAN prill compatibility during gassing.

RESULT

20 [0024] Figures 1 and 2 show gassing curves as a function of time for the emulsion products S300 and S335 respectively. Figure 3 contains a comparison of the gassing rate of the explosive product S300 formulated with SC75 DL and gassed with 3% sodium hypochlorite, with the gassing rate of a control emulsion UG100 formulated with a surfactant F800.

25 [0025] The surfactant head group has a noticeable effect on the gassing rate. Although the SC75 DL surfactant slows down an initial induction period, its gassing rate is slow and gassing is not completed even after 30 minutes at 25°C. In comparison the UG100 emulsion with a different surfactant head group shows a fast reaction with the sodium hypochlorite gasser.

[0026] Figures 2 and 3 show that although the gassing rate of the S300 was slow, with a good initial induction period similar to that produced by nitrite gassing, it was less affected by a variation in temperature compared to the situation prevailing with nitrite gassing.

[0027] Figure 4 illustrates the gassing reaction of the S300 product (undoped) and of the S335 product (doped). The undoped product exhibits faster gassing with respect to the initial reaction rate. This could be explained by the presence of the ammonia prill in the products. The doped and gassed S335 product was observed, visually, to be stable.

[0028] The hot gassing rates, achieved after sample storage in an oven, as described, were extremely fast and the products gassed out while being mixed. This made it difficult to monitor the gassing rates accurately. Cooling of the emulsion prior to making use of the hypochlorite system is indicated.

[0029] The SC75 DL surfactant improved the gassing rate of the S300 emulsion by providing a long initial inductive period similar to that achieved with nitrite gassing. Final gassing rates were reduced and this resulted in a slightly higher final density of the gas product. This increase in density could be addressed by the addition of more gasser (in excess of 3%) into the product, or by increasing the percentage of active sodium hypochlorite in the gassing solution. In the case of the doped product the ammonium nitrate prill could be introduced after the emulsion and gasser have been blended.

CLAIMS

1. A method of sensitising an emulsion explosive by means of gassing which includes the steps of:
- 5 a) preparing an emulsion which includes a continuous phase, a discontinuous phase which contains ammonium nitrate as a nitrogen source, and a surfactant;
- b) maintaining the pH of the continuous phase at a value above 5; and
- c) adding active sodium hypochlorite to the emulsion,
- 10 wherein the surfactant is a basic surfactant.
2. A method according to claim 1 wherein the surfactant is SC75 DL.
3. A method according to claim 1 or 2 wherein the continuous phase comprises from 5,5% to 7,5% of the emulsion and the surfactant is present in the continuous phase in a range of from 15% to 25%.
- 15 4. A method according to claim 1, 2 or 3 wherein the continuous phase includes up to 80% of a carbonaceous fuel.
5. A method according to any one of claims 1 to 4 wherein the pH of the discontinuous phase is maintained at a value above 5,5 by the addition of at least one of the following: sodium hydroxide and sodium acetate.
- 20 6. A method according to any one of claims 1 to 5 wherein in step c) the active concentration of the sodium hypochlorite, added to the emulsion, is in a range of from 8% to 14%.
7. A method according to any one of claims 1 to 6 wherein the ratio of the emulsion to the sodium hypochlorite is 97:3 percentage.

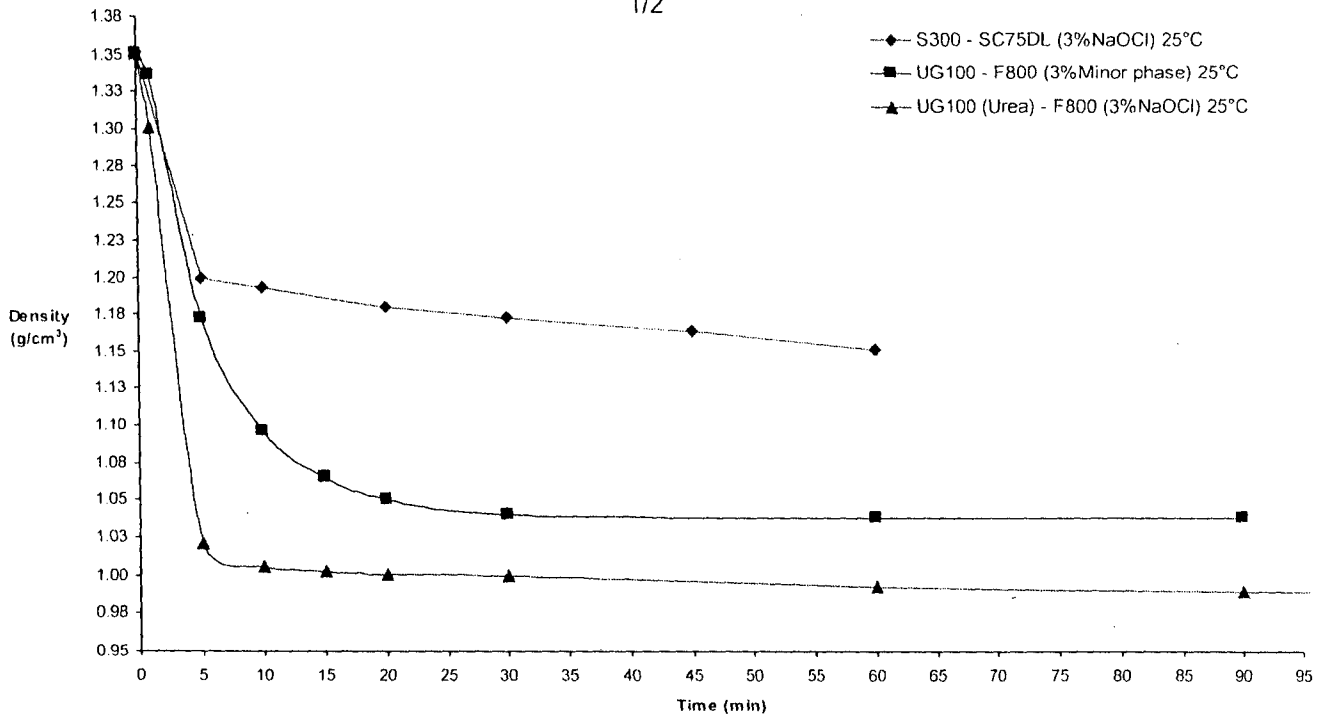


Figure 1

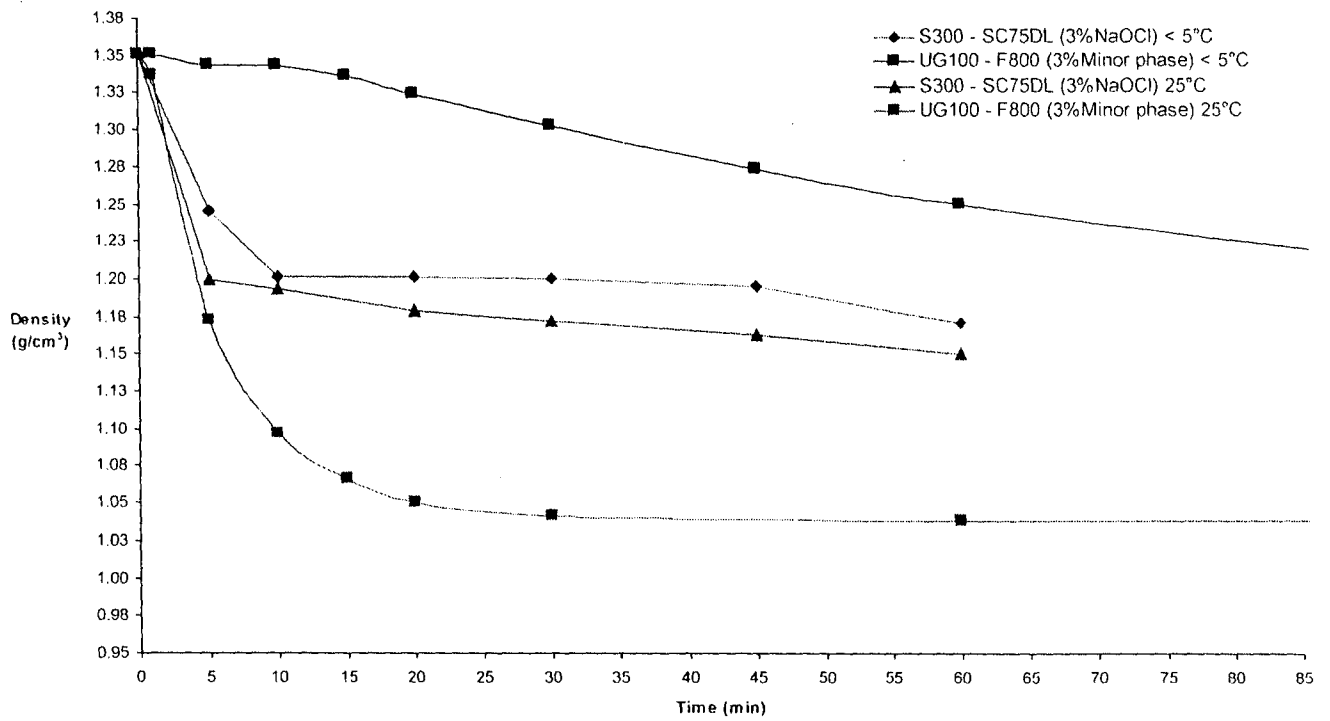


Figure 2

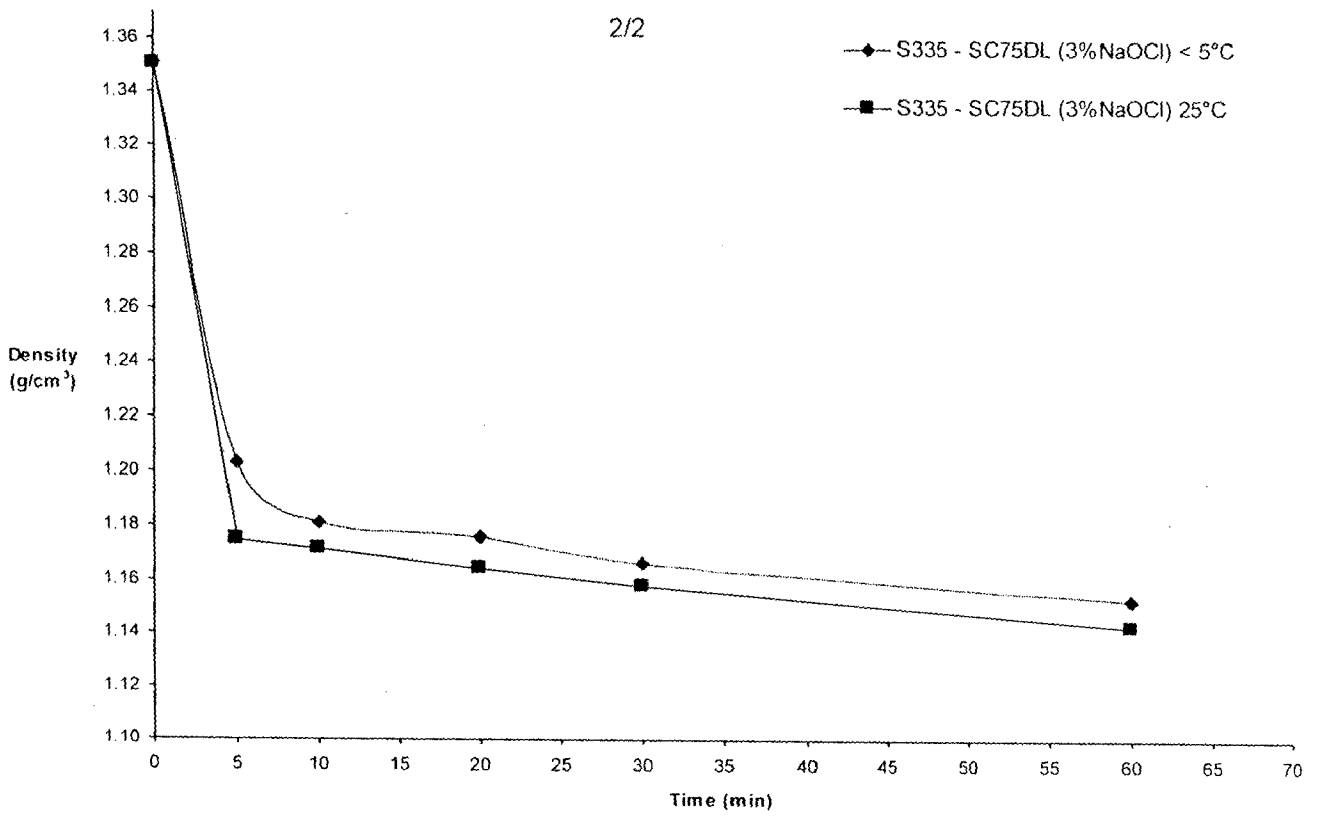


Figure 3

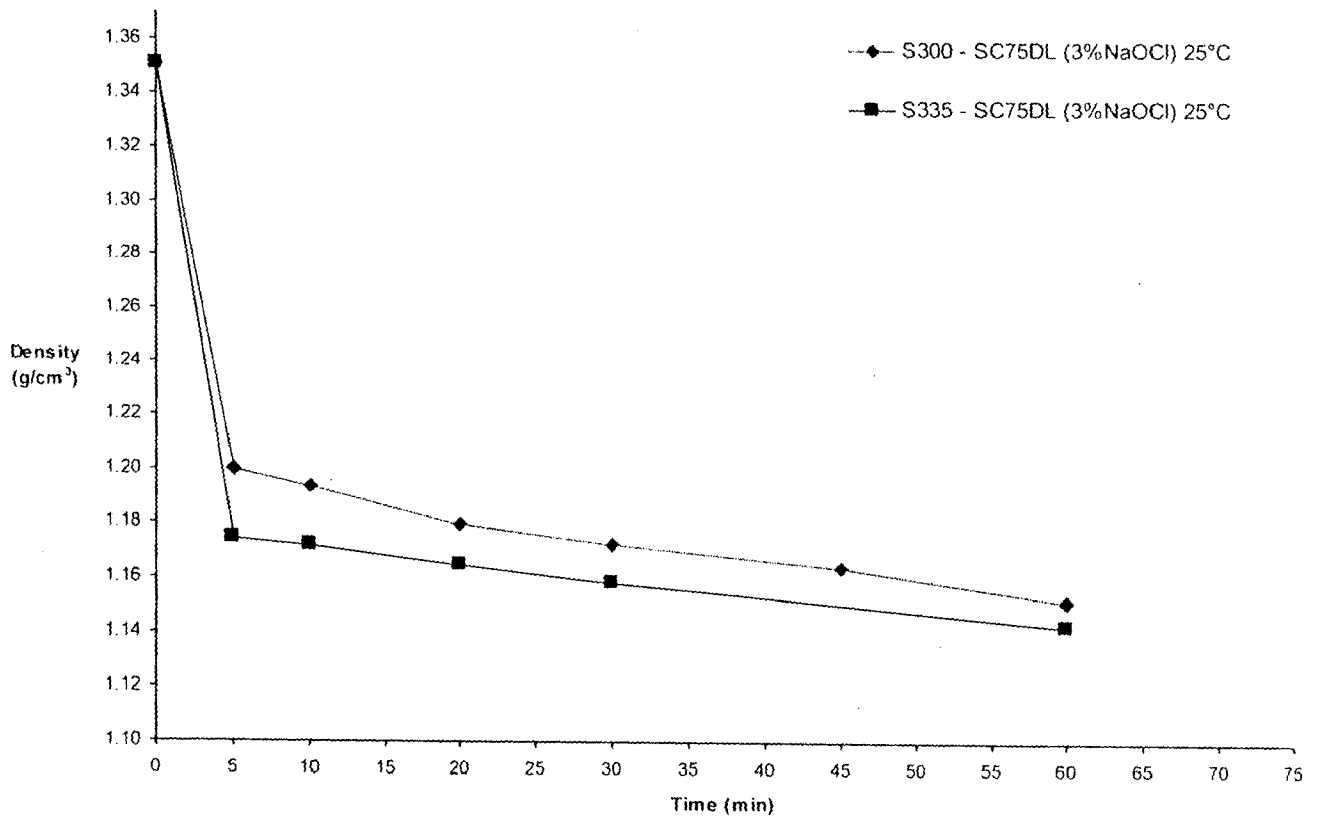


Figure 4