

[54] STORAGE AND TRANSPORT SYSTEM

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220/88 R

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[58] Field of Search 169/2 A, 4, 2 R, 26, 57,
169/66; 220/13, 88 B, 88 R

[56] **References Cited**

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[57] **ABSTRACT**

System for reducing hazards in storing and transporting hazardous material. Container for material includes a chamber containing a phlegmatizer for the material. Chamber has a seal melting, rupturing or releasing at a temperature substantially below the self-accelerating decomposition temperature of the hazardous material, to release the phlegmatizer into the material.

18 Claims, 4 Drawing Figures

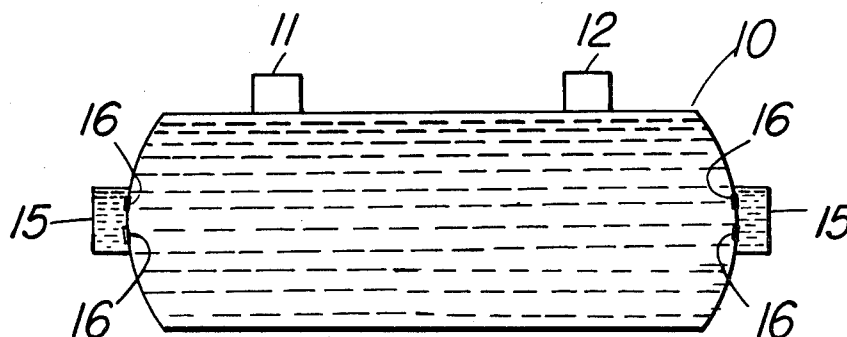


FIG. 1

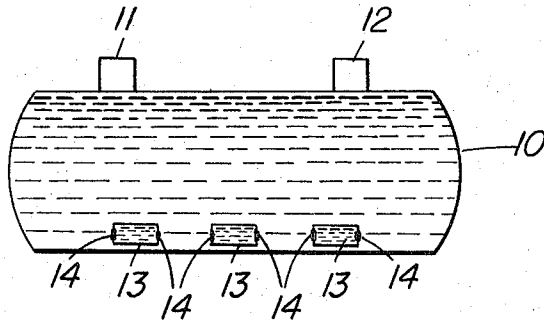


FIG. 2

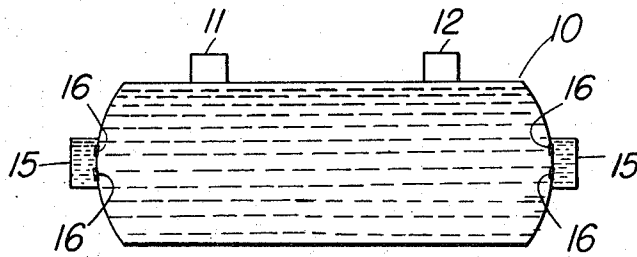


FIG. 3

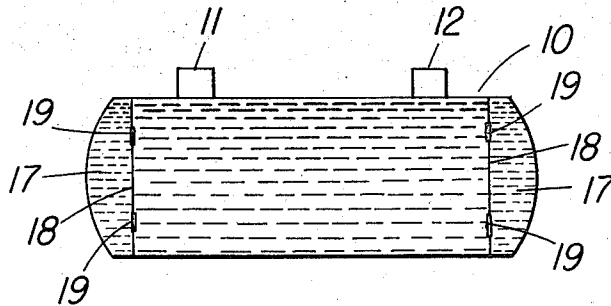
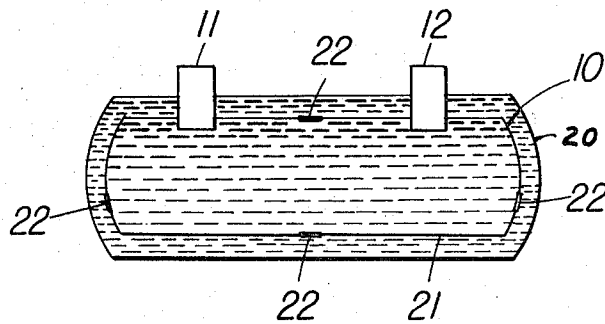


FIG. 4



STORAGE AND TRANSPORT SYSTEM

FIELD OF INVENTION

This invention has to do with the storage and transporting of hazardous materials, and to reducing hazards associated therewith. More specifically, it has to do with reducing such hazards in the storage and transportation of peroxides, particularly tertiary butyl hydroperoxide (TBHP).

BACKGROUND OF INVENTION

In view of the nature of a variety of industrial accidents that have occurred in storage depots and in facilities used to transport diverse materials, regulations have been enacted to avoid or lessen the number of such accidents. Governmental agencies have placed strictures on the type and character of storage tanks, tank cars, tank trucks and the like. This is the case with a liquid organic peroxide solution such as aqueous TBHP which, until recently, has been given proper clearances only for relatively small quantity containers for solutions of up to 70 percent (weight), and for bulk solutions of only up to 65 percent (weight). Obviously, it is an economic disadvantage to accommodate a relatively large amount of water in storing or transporting the solutions. Therefore, as more concentrated solutions can be controlled, storage and transportation expenses are reduced. To date, however this economic problem remains because of overriding safety requirements.

SUMMARY OF THE INVENTION

In accordance with this invention, there is provided a system for storing a hazardous material contained in a container. The container has associated therewith a chamber containing a phlegmatizer for the hazardous material, the chamber having a discharge means in communication with the hazardous material and adapted to discharge the phlegmatizer into the hazardous material in the container. The discharge means includes a seal which melts, ruptures or releases at a temperature substantially below the self-accelerating decomposition temperature of the hazardous material, whereby the phlegmatizer is released from the chamber into the container.

As used herein, the term "phlegmatizer" denotes a material capable of desensitizing or reducing the decomposition susceptibilities of a hazardous material. Thus, a phlegmatizer slows or makes stolid the hazardous material.

DRAWINGS

FIG. 1 is a sectional side view of a tank having a plurality of drums therein.

FIG. 2 is a sectional side view of a tank having chambers secured to the ends thereof.

FIG. 3 is a sectional side view of a compartmented tank.

FIG. 4 is a sectional side view of a tank having an inner compartment to contain a hazardous material and an outer and adjacent compartment adapted to hold a phlegmatizer.

SPECIFIC EMBODIMENTS OF INVENTION

As illustrated in FIG. 1, tank 10 includes charging and discharging means 11 and 12, respectively, and has drums 13 disposed therein. Drums 13 are preferably

polyethylene containers of about 0.040 inch wall thickness. Drums 13 are fitted with metal seals 14, which can be in the form of discs or other suitable form. Tank 10 contains an aqueous solution of 70 percent (weight) TBHP, and drums 13 contain water. Drums 13 can be filled with water and a seal or seals 14 secured, before the drums are placed within tank 10. Drums 13 can be allowed to rest at the bottom of tank 10, due to a greater density than the TBHP solution, or can be secured by chains, cables, etc. (not shown).

Seals 14 are eutectic or non-eutectic alloys having a yield temperature or melting range substantially below the temperature at which an aqueous solution of TBHP decomposes rapidly. A particularly preferred eutectic alloy for seals 14 is Cerrobend which has a yield temperature of 70°C. (158°F.) and comprises the following metals (in weight percent):

Bi	50
Pb	26.7
Sn	13.3
Cd	10

A typical non-eutectic alloy is Cerrosafe having a yield temperature of 72.5°C. (162.5°F.), a melting range of 70°-90°C. (158°-194°F.), and the following composition (in weight percent):

Bi	42.5
Pb	37.7
Sn	11.3
Cd	8.5

Cerrobend and Cerrosafe are marketed by the Cerro Sales Corporation.

Other typical eutectic alloys and non-eutectic alloys suitable for use in the systems of this invention with a variety of hazardous materials, are shown at page 437 of The Condensed Chemical Dictionary; A.E. Rose; Reinhold Publishing Company, New York; 1966. It will be understood that an alloy selected will have a yield temperature or melting range substantially below the self-accelerating decomposition of a given hazardous material.

Thus, when the temperature of the system reaches the yield temperature or the melting range of metal seals 14, the seals no longer keep water within drums 13. The water is discharged into the TBHP solution and is sufficient to dilute the 70 percent TBHP solution to 65 percent in an emergency. A typical tank 10 would contain 40,000 pounds of a 70 percent aqueous TBHP solution and 3200 pounds of water in seven 55 gallon drums 13.

As indicated above, Cerrobend seals yield at 70°C. (158°F.) which is well below the temperature, 90.6°C. (195°F.), at which the 70 percent TBHP boils. Similarly, the Cerrosafe seals start to melt at 70°C. (158°F.) and have a melting range of 70°-90°C. peroxide 158°-194°F.).

FIG. 2 shows tank 10 with charging and discharging means 11 and 12, respectively. However, instead of drums 13, chambers 15 are secured to ends or side walls of the tank. Seals 16 are of the same character as seals 14 of FIG. 1, and are located in the common walls of tank 10 and chambers 15. Tank 10 contains a 70 percent TBHP solution and chambers 15 contain water. Chambers 15 have suitable inlet and outlet means

(not shown) for charging water thereto and removing water therefrom.

In FIG. 3, tank 10 is shown in modified form, with charging and discharging means 11 and 12, respectively, and with end compartments 17 separated from the main body of tank 10 by walls 18. Seals 19 (similar to seals 14 and 16, above) are located in walls 18. The 70 percent TBHP solution is contained in the main compartment of tank 10, and water is contained in compartments 17. It will be understood that tank 10 can include a plurality of compartments rather than one compartment. Compartments 17 have suitable charging and discharging means (not shown), similar to 11 and 12.

In FIG. 4, tank 10 is shown with charging means 11 and 12, respectively, and with outer water compartment 20. Wall 21 separates the main body of tank 10 from compartment 20 and has seals 22 located therein. Here again, the 70 percent TBHP solution is contained in the main tank body and water is in compartment 20. Seals 22 are similar to seals 14, 16 and 19, above. Compartment 20 has charging and discharging means (not shown) similar to 11 and 12.

In connection with FIGS. 1-4 wherein tank 10 is part of a tank truck, discharge means 12 can be located conveniently at a lower portion of tank 10.

The effect of a 70 percent aqueous TBHP solution on Cerrosafe seals is illustrated by the following.

One Cerrosafe disc, 2 inches in diameter by 0.125 inch thick and weighing 54.5710 grams, was placed in 5 gallons of 70 percent TBHP contained in a 5 gallon polyethylene pail which was tightly covered. The system was allowed to stand at ambient temperatures for 1 week.

At the end of this period, the disc has turned black in several places and had lost 0.0630 grams in weight. There was no discoloration or any other signs of decomposition of the peroxide.

The five gallon quantity was then transferred to a 5 gallon steel pail. The disc was placed in the liquid and the pail covered with a steel cover with four 0.25 inch holes in it. This container was placed on cinder blocks on the testing grounds and a wood-kerosene fire built beneath it.

Five minutes after the fire was started the peroxide was noted burning through the holes in the cover and a short time later from under the edges of the cover. The rate of burning was moderate such as would be observed with a flammable solvent such as toluene, benzene or ethyl ether.

Burning at this rate continued for one hour. The rate of burning then increased and, after a total elapsed time from start of fire of one hour and 9 minutes, the flame was very large and rate of burning greatly accelerated. There was then a mild report, the top of the pail was bent very appreciably and blown off and the pail was blown off the cinder blocks. The fire ceased immediately. Examination of the pail showed that neither the bottom nor the sidewalk were distorted. No trace of the metal of the disc could be found in the pail or on the ground around the fire.

This sequence of events is typical of this product under these conditions. It is considered that the presence of the fusible metal alloy did not increase or decrease the rate of burning and/or decomposition of the peroxide to any degree which could be detected by visible observation.

Analysis of the 70 percent aqueous TBHP solution after contact with a Cerrosafe seal at 21°C. (70°F.) for various periods of time is given in TABLE 1 below in weight percent.

TABLE 1

COMPONENT	1 DAY	7 DAYS	14 DAYS
TBHP	69.85	68.66	69.10
METHANOL	0.014	0.020	0.018
ACETONE	0.14	0.13	0.12
TERTIARY	0.40	0.42	0.41
BUTANOL			
UNKNOWN	0.17	0.17	0.17

Fire tests were conducted on a 70 percent aqueous TBHP solution. Testing has shown that when containers of 70 percent TBHP (aqueous) are exposed to open fires that the chemical product burns away quietly during most of the test. A very short time before all of the peroxide is consumed (less than 5 percent of material remains) a very rapid - almost explosive - decomposition occurs. Sixty-five percent TBHP in water does not show this rapid decomposition at any time during fire exposure. A 70 percent aqueous TBHP solution containing vessels which contain sufficient water to dilute the 70 percent solution to about 65 percent, also does not exhibit this rapid decomposition.

The water vessels used in the fire tests were four ounce polyethylene bottles with screw caps. Two-inch diameter holes were cut in the bottoms of the bottles and 1.25 inch holes in the tops. These were filled with fusible metal discs 0.125 inch thick having a melting point of 70°C. (150°F.), namely, Cerrobend discs.

In the first test, four of these bottles containing a total of 1.9 pounds of water were placed on their sides in an unlined, steel, 5 gallon open head pail. 37.12 pounds of 70 percent TBHP were then added and the pail loosely covered with a steel cover with four 0.25 inch holes drilled in it. This was placed on concrete blocks and a wood-kerosene fire kindled beneath it. Eight minutes after the fire was started the peroxide was noted burning at the top of the pail. The burning continued for 1 hour and 40 minutes at which time both the peroxide and the wood fire were out. Examination of the pail showed that it was still about one-third full of liquid. A larger fire was then built under it. Ten minutes later the peroxide fire increased considerably in volume and then went out. At no time was there any sign of sudden or violent decomposition.

The same set-up was used in a second test except that the bottles were held in an inverted, vertical position in the peroxide in a stainless steel frame. The tops of the bottles (which were, of course, nearest the bottom of the pail) were 4 inches from the bottom of the 5 gallon drum.

The wood-kerosene fire was larger than that in the first test and the peroxide was noted burning at the top of the vessel 4 minutes after start of fire. Thirteen minutes after the fire was started the liquid boiled over and increased the intensity of the fire, but did not dislodge the cover. Forty-three minutes after start of fire the flame from the burning peroxide enlarged greatly, reaching a maximum height of 10-12 feet, burned this way for about 30 seconds and then went out. Once again there was no sudden or violent decomposition.

These tests demonstrate that a system such as that described above can be used to reduce the hazard of a

70 percent TBHP to that of one containing 65 percent by weight when it is exposed to fire conditions.

Although the invention has been illustrated above by discussion of aqueous TBHP solutions, it is to be understood that the invention is useful also for storage and transport of solutions of other peroxides such as cumene hydroperoxide, diisopropylbenzene hydroperoxide, p-menthene hydroperoxide and tertiary butyl isopropyl hydroperoxide.

Other phlegmatizers which can be used include glycols (e.g. dipropylene glycol), phthalates (e.g. diisopropyl phthalate), mineral oil and mineral spirits. It will be understood that the phlegmatizer selected is one which is substantially compatible with a particular peroxide or peroxides.

Included by the term "seal," in addition to the alloys mentioned above, are membranes formed of plastics. Suitable plastics include polyvinyl chloride, polyvinyl chloride-polyvinylidene chloride and polyethylene glycols.

Numerous modifications and variations of the invention may be made without departing from the spirit and scope thereof. Accordingly, it is to be understood that the invention is not to be limited, but is to be construed in the light of the language of the appended claims.

We claim:

1. System for reducing hazards in storing and transporting a hazardous material contained in a container, comprising:

a chamber having therein a phlegmatizer for said hazardous material and having discharge means in communication with said hazardous material and said phlegmatizer, separating said hazardous material and said phlegmatizer, and adapted to discharge said phlegmatizer into said hazardous material in said container, said discharge means including a metallic seal in thermal communication with at least said hazardous material and which seal melts, ruptures or releases at a temperature substantially below the self-accelerating decomposition temperature of said hazardous material, whereby said phlegmatizer is released from said chamber into the container.

2. System adapted for storage or transportation of a hazardous material comprising:

a. a container having charging and discharging means,
b. a hazardous material contained in said container,

c. a chamber having charging and discharging means, the latter discharging means being in communication with said container, separating said hazardous material and a phlegmatizer for said hazardous material, and adapted to discharge contents thereof into said container, and including therein a metallic seal in thermal communication with at least said hazardous material and which seal melts, ruptures or releases at a temperature substantially below the self-accelerating decomposition temperature of said hazardous material, said chamber containing said phlegmatizer which is released from said chamber into said container as said seal is melted, ruptured or released.

3. System adapted for storage or transportation of an aqueous solution of tertiary butyl hydroperoxide

(TBHP) comprising:

a. a container having charging and discharging means,

b. an aqueous solution of TBHP having a concentration of from about 65 to about 70 percent by weight of TBHP, contained in said first container,

c. a chamber having charging and discharging means, the latter discharging means being in communication with and adapted to discharge contents thereof into said container and including therein a metallic seal which melts at a temperature substantially below the temperature at which said aqueous solution of TBHP boils, said chamber containing water in an amount sufficient to reduce said concentration of said TBHP substantially when said seal is melted and said water is released from said chamber into said container.

4. System of claim 3, wherein said aqueous solution of TBHP in (b) has a concentration of about 70 percent by weight, and wherein the amount of water in (c) in said chamber is sufficient to reduce said concentration to 65 percent by weight or less.

5. System of claim 3, wherein said metallic seal in (c) is an eutectic alloy.

6. System of claim 3, wherein said metallic seal in (c) is an eutectic alloy melting at about 70°C. and having the following approximate concentration, by weight

Bi	50
Pb	26.7
Sn	13.3
Cd	10

7. System of claim 3, wherein said container of (a) is a steel tank and said chamber is a polyethylene drum.

8. System of claim 3, including a plurality of said chambers.

9. System of claim 3, wherein said chamber is immersed in said aqueous solution of TBHP in (b).

10. System of claim 3, wherein said chamber is affixed to said container.

11. System of claim 3, wherein said chamber is a partitioned section of said container.

12. System of claim 11, wherein said discharge means is in the partition.

13. System of claim 3, wherein said chamber surrounds said container.

14. System of claim 13, wherein said discharge means is in a wall between said chamber and said container.

15. System of claim 1, wherein said seal is also in thermal communication with said phlegmatizer.

16. System of claim 1, including a wall between said chamber and said container, said discharge means being in said wall between said chamber and container.

17. System of claim 2, wherein said seal is also in thermal communication with said phlegmatizer.

18. System of claim 2, including a wall between said chamber and said container, said discharge means being in said wall between said chamber and container.

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