Claims

1. An abatement system for pyrophoric chemicals comprising:

at least one hazard volume;

at least one vaporizer;

at least one reaction column; and

at least one sensor configured to detect the presence of an unintended release of pyrophoric materials;

wherein the at least one hazard volume, the at least one vaporizer and the at least one reaction column are in fluid communication with each other;

wherein the at least one sensors initiate, cause to cease or otherwise alter the operation of the system; and

wherein pyrophoric material present in the hazard volume is prevented from combustion by means of inerting gas therein and is abated in an oxygen-controlled environment of the at least one reaction column.

2. The system of claim 1, wherein nitrogen gas is introduced therein to control the combustion of the pyrophoric material and wherein the rate of nitrogen introduction is at any rate via at least one port from at least one source.

3. The system of claim 1, wherein the passageway leading from the at least one hazard volume to the at least one vaporizer remains free of oxygen via at least one nitrogen gas source introducing nitrogen gas thereto.

4. The system of claim 3, wherein the pyrophoric materials are maintained in the at least one hazard chamber via the nitrogen gas introduced in the passageway.

5. The system of claim 1, wherein the at least one vaporizer comprises at least one means of heating and at least one means of cooling in thermal communication with the pyrophoric materials therein.

6. The system of claim 1, wherein the vapors moving from the at least one vaporizer to the at least one reaction column are shrouded by nitrogen gas introduced in proximity to the exit of the at least one vaporizer.

7. The system of claim 1, wherein the pyrophoric materials either in the at least one hazard volume, the at least one vaporizer or the passageway are heated such as by at least one vaporizer heater and at least one sump heater.

8. The system of claim 1, wherein nitrogen, heat and time are used to clear the system of the pyrophoric materials prior to the reintroduction of oxygen thereto, wherein the oxygen is reintroduced gradually to ensure the absence of pyrophoric materials.

9. The system of claim 1, wherein the re-introduction of oxygen into the hazard volume after an abatement event is gradual to facilitate detection of low-level reaction products without the risk of flame or excessive exothermic reaction.

10. The system of claim 1, wherein the at least on reaction column includes swirl vanes configured to mix the reaction and prevent the deposition of solid reaction products therein.

11. The system of claim 1, wherein the at least one senor is restricted from sampling during the abate state and post-abate state wherein excessive exposure to pyrophoric material is prevented.

12. An abatement system for pyrophoric chemicals comprising:

at least one hazard volume, the hazard volume comprising an enclosed space configured to reduce or eliminate potential collection features to facilitate the collection of pyrophoric liquid in at least one gravity capture basin;

at least one reaction column; and

at least one sensor configured to detect the presence of an unintended release of pyrophoric materials from the at least one hazard volume;

wherein the at least one hazard volume and the at least one reaction column are in fluid communication with each other;

wherein the at least one sensors initiate, cause to cease, and alter the operation of the system; and

wherein pyrophoric material present in the hazard volume is prevented from combustion therein and is abated in an oxygen-controlled environment of the at least one reaction column.

13. The system of claim 12, wherein nitrogen gas is introduced therein to control the combustion of the pyrophoric material and wherein the rate of nitrogen introduction is at any rate via at least one port from at least one source.

14. The system of claim 12, wherein the passageway leading from the at least one hazard volume to the at least one reaction column remains free of oxygen via at least one nitrogen gas source introducing nitrogen gas thereto.

15. The system of claim 12, wherein the at least one reaction column includes swirl vanes configured to mix the reaction and prevent the deposition of solid reaction products therein.

16. The system of claim 12, wherein the at least one sensor is restricted from sampling during the abate state and post-abate state wherein excessive exposure to pyrophoric material is prevented.

17. The system of claim 1, comprising:

a ready state;

an access state; and

a standby state each able to transition an abate state by the signal of an alarm from a sensor in the system, the ready state and access state transition therebetween;

an abate state wherein leaked material is abated upon an alarm condition;

a post-abate state set for a duration of time to ensure that escaped pyrophoric materials have abated; and

a recovery state that begins to initialize the sensors in the system to ascertain the presence of uncontrolled pyrophoric material therein.

18. The method of abating spilled, escaped or otherwise uncontrolled pyrophoric materials given the system of claim 1, comprising:

allowing access to the hazard volume for the addition or inspection of pyrophoric materials therein;

closing and restricting access to the hazard volume;

controlling the environment within the hazard volume to prevent excessive exothermic reaction of leaked pyrophoric material;

allowing the system to monitor the environment in the hazard volume and other parts of the system for escaped pyrophoric material, its byproducts or other indicators constituting an alarm condition;

allowing the system to abate any escaped pyrophoric material;

removing the residual escaped pyrophoric material from the system;

verifying the absence of the escaped pyrophoric materials;

allowing access or transitioning from the abate sequence; and

resuming normal operation when the escaped pyrophoric material is removed.

19. The system of claim 12, comprising:

a ready state;

an access state; and

a standby state each of the ready state, the access state and the standby state able to transition between an abate state by the signal of an alarm from a sensor in the system, the ready state and access state transition therebetween;

the abate state wherein leaked material is abated upon an alarm condition;

a post-abate state set for a duration of time to ensure that escaped pyrophoric materials have abated; and

a recovery state that begins to initialize the sensors in the system to ascertain the presence of uncontrolled pyrophoric material therein.