In one embodiment of the invention, a method of creating and sustaining earthen hard pan formations includes applying a sealant solution to an earthen formation to form a hard pan below a surface of the earthen formation, and subsequently applying magnesium chloride to the earthen formation to stabilize and sustain the hard pan.
FIG. 2A

FIG. 2B

FIG. 2C
FIG. 3

START

FORM A DRILLING RESERVE PIT

OBTAIN A SEALANT SOLUTION

ADD BENTONITE CLAY PARTICLES TO THE SEALANT SOLUTION

AGITATE THE SEALANT SOLUTION BEFORE APPLYING THE SEALANT SOLUTION

APPLY THE SEALANT SOLUTION TO THE DRILLING RESERVE PIT

SUBSEQUENTLY APPLY MAGNESIUM CHLORIDE TO THE DRILLING RESERVE PIT

DISPOSE CUTTINGS AND DRILLING FLUIDS INTO THE DRILLING RESERVE PIT WHILE DRILLING

FINISH
METHOD OF CREATING AND SUSTAINING EARTHEN HARD PAN FORMATIONS

RELATED APPLICATION
[0001] This application claims the benefit of U.S. provisional application Serial No. 60/689,276 filed Jun. 9, 2005, entitled Method for Creating Earthen Hard Pan Formations.

TECHNICAL FIELD OF THE INVENTION
[0002] The invention relates generally to the treatment of earthen formations and, more specifically, to a method of creating and sustaining earthen hard pan formations.

BACKGROUND OF THE INVENTION
[0003] Reserve pits are used in the drilling of earthen formations to produce, for example, wells for production of fluids, such as oil and gas. The cuttings and any fluid resulting from the drilling are pumped into the reserve pits. In order to prevent fluids, such as those containing sodium chloride, from seeping into the Earth, it is desirable to seal the pits; however, this is not always done. Typically, the reserve pits are sealed with sheet plastic. However, sheet plastic is susceptible to tears, which causes leaks, and is hard to clean up when the reserve pit is filled-in after use. In addition, the process of lining reserve pits with sheet plastic can be expensive.

SUMMARY OF THE INVENTION
[0004] In one embodiment of the invention, a method of creating an earthen hard pan formation includes applying a sealant solution to an earthen formation to form a hard pan below a surface of the earthen formation, and subsequently applying magnesium chloride to the earthen formation to stabilize and sustain the hard pan.

[0005] Embodiments of the invention provide a number of technical advantages. Embodiments of the invention may include all, some, or none of these advantages. In one embodiment, a method is utilized to seal drilling reserve pits, earthen livestock tanks, and other earthen formations. The method may include the use of magnesium chloride after the application of a sealant solution to create a hard pan within the earthen formation to prevent leaking of liquids into the surrounding environment. Such a method may be more economical than sheet plastic, may be applied with water in the pit/tank, requires no cleanup, and minimal labor is required.

[0006] Other technical advantages are readily apparent to one skilled in the art from the following figures, descriptions, and claims.

BRIEF DESCRIPTION OF THE DRAWINGS
[0007] For a more complete understanding of the invention, and for further features and advantages, reference is now made to the following description, taken in conjunction with the accompanying drawings, in which:

[0008] FIGS. 1A and 1B are elevation views illustrating a system for the formation and stabilization of a hard pan in an earthen formation according to one embodiment of the invention;

[0009] FIGS. 2A through 2C are partial cross-sectional views illustrating the formation and stabilization of a hard pan in an earthen formation according to one embodiment of the invention; and

[0010] FIG. 3 is a flowchart illustrating a method of creating and sustaining a hard pan in an earthen formation according to one embodiment of the invention.

DETAILED DESCRIPTION OF EXAMPLE EMBODIMENTS OF THE INVENTION
[0011] Example embodiments of the present invention and their advantages are best understood by referring now to FIGS. 1A through 3 of the drawings.

[0012] FIGS. 1A and 1B are elevation views illustrating a system 100 for the formation and stabilization of a hard pan in an earthen formation 102 according to one embodiment of the invention. In the illustrated embodiment, earthen formation 102 is a drilling reserve pit that is used for disposal of suitable cuttings and fluids from the drilling of a well bore (not illustrated). However, earthen formation 102 may be any suitable earthen formation, such as an earthen livestock tank and an earthen pond. Earthen formation 102 may have any suitable size and shape. As one example, earthen formation 102 may be a reserve drilling pit that has a generally square shape of one hundred feet in width, one hundred feet in length, and five to ten feet in depth. As described in greater detail below, the creation of a hard pan in earthen formation 102 prevents, among other benefits, leaking of potentially hazardous liquids into the subsurface of earthen formation 102 and the surrounding environment.

[0013] In the embodiment illustrated in FIG. 1A, system 100 includes a user 104 utilizing an application device 106 to apply a sealant solution 108 to a surface 103 of earthen formation 102. System 100 also includes bentonite 110, an agitator 112, and a pump 107. The present invention contemplates more, fewer, or different components for system 100 than those illustrated in FIG. 1A.

[0014] User 104 may be any suitable person, robot, or machine that utilizes application device 106 to apply sealant solution 108 to surface 103. Application device 106, in the illustrated embodiment, is a suitable hose with a nozzle at its end that is coupled to pump 107 in order to apply sealant solution 108 to surface 103. Application device 106 may be other suitable devices for applying sealant solution 108 to surface 103. In addition, any suitable pressure may be created by pump 107 in order to apply sealant solution 108. For example, sealant solution 108 may be applied to surface 103 at a pressure of at least approximately 20 psi. In a more particular embodiment of the invention, sealant solution 108 is applied to surface 103 at a pressure between approximately 20 psi and approximately 40 psi.

[0015] The application of sealant solution 108 to surface 103 may be performed in any suitable manner. For example, in one embodiment of the invention, user 104 starts applying sealant solution 108 at a base 120 of a wall 122 of earthen formation 102 and works upward on wall 128 towards a top 123 of wall 122. After a hard pan is formed within wall 122 of earthen formation 102, then a hard pan may be formed within bottom 125 of earthen formation 102. Any suitable dispersion of sealant solution 108 is contemplated by the present invention; however, in a preferred embodiment, the
dispersion is a relatively narrow dispersion that results in a more concentrated spray on surface 103. Generally, sealant solution 108 may be applied to surface 103 by user 104 until user 104 starts seeing puddling on surface 103. This is an indication to user 104 that a hard pan has started to form within earthen formation 102.

[0016] Sealant solution 108 is any suitable sealant solution operable to form a hard pan below surface 103 of earthen formation 102. In one embodiment of the invention, sealant solution 108 comprises a combination of sodium chloride and magnesium chloride. In one particular embodiment of the invention, sealant solution 108 is a magnesium chloride-rich brine that is obtained from a reservoir below the surface of the Earth. In one embodiment, this magnesium chloride-rich brine may be two or three parts sodium chloride to one part magnesium chloride.

[0017] As described in greater detail below in conjunction with FIGS. 2A through 2C, sealant solution 108 disperses clay within earthen formation 102 to plug up drainage capillaries within earthen formation 102 to create a hard pan. In lieu of sodium chloride, potassium chloride or other suitable monovalent salts may be utilized as a main constituent of sealant solution 108.

[0018] Most earthen materials except maybe sands and gravels contain enough clay to form a hard pan. However, in some embodiments, bentonite clay particles 110 may be added to sealant solution 108. Any suitable bentonite clay particles are contemplated by the present invention, such as dry clay particles, and they may be added to sealant solution 108 in any suitable manner. Sealant solution 108 may also be agitated by agitator 112 before being applied to surface 103 of earthen formation 102. Any suitable agitator is contemplated by the present invention for agitating sealant solution 108.

[0019] Pump 107 may be coupled to application device 106 and sealant solution 108 in any suitable manner. Any suitable pump operable to pump sealant solution 108 from its storage location and out through an end of application device 106 is contemplated by the present invention.

[0020] After the formation of a hard pan in earthen formation 102, then the hard pan is stabilized by a suitable stabilizer. One such stabilizer is illustrated in FIG. 1B. Referring to FIG. 1B, user 104 is illustrated as applying magnesium chloride 114 to surface 103 of earthen formation 102. Generally, magnesium chloride 114 causes clay particles that form the hard pan to become cross linked and form aggregates, thus sustaining the hard pan. In addition, since magnesium chloride is hydrosopic, the hard pan may be kept moist so that cracks do not develop over time. Any suitable application device, such as application device 106, may be utilized to apply magnesium chloride 114 to surface 103. In addition, magnesium chloride 114 may be applied to surface 103 using any suitable pressure. In one embodiment, magnesium chloride is applied to surface 103 at a pressure that is less than the pressure that was used to apply sealant solution 108. For example, if sealant solution 108 was applied at a pressure of approximately 20 psi, then magnesium chloride 114 is applied to surface 103 at a pressure somewhere below 20 psi. One reason for this is to keep the hard pan that was formed in FIG. 1A intact and undisturbed by forces resulting from the application of magnesium chloride 114.

[0021] The application of magnesium chloride 114 may be performed in any suitable manner. In a particular embodiment of the invention, a dispersion, as indicated by reference numeral 129, of magnesium chloride 114 is broader and less concentrated than the dispersion for sealant solution 108 in FIG. 1A. Some advantages of magnesium chloride as a stabilizer is that it is easier and cheaper to apply and is not a hazardous material. In fact, magnesium chloride is a fertilizer and may help the surrounding environment. After the application of magnesium chloride 114, as illustrated in FIG. 1B, earthen formation 102 may then be used for disposal of suitable materials, such as cuttings and fluids from the drilling of a wellbore.

[0022] FIGS. 2A through 2C are partial cross-sectional views illustrating the formation of a hard pan 250 (FIG. 2) within earthen formation 102 according to one embodiment of the invention. Referring first to FIG. 2A, a portion of earthen formation 102 is illustrated as having a plurality of clay particles 202 interspersed with various earthen materials 203, such as stone, sand, caliche, gypsum, and other suitable deposits. As described above in conjunction with FIG. 1A, sealant solution 108 is first applied to surface 103 of earthen formation 102, as indicated by reference numeral 200 in FIG. 2A. This causes the clay particles 202 to migrate downward into the soil, as indicated by reference numeral 208 in FIG. 2B, and plug up the drainage capillaries to form hard pan 250.

[0023] Hard pan 250 is illustrated in FIG. 2B as having a particular thickness 210. Thickness 210 of hard pan 250 may be any suitable thickness. In one particular embodiment of the invention, thickness 210 of hard pan 250 is between approximately two and six inches.

[0024] Referring now to FIG. 2C, the application of magnesium chloride 114 to surface 103 is illustrated by arrows 212. This magnesium chloride 114, as described above, acts as a stabilizer for hard pan 250 in order to sustain hard pan 250.

[0025] FIG. 3 is a flowchart illustrating an example method of creating a hard pan in an earthen formation according to one embodiment of the invention. The method begins at step 300 where a drilling reserve pit is formed. A sealant solution 108 is then obtained, as indicated by step 302. Sealant solution 108 may be obtained in any suitable manner; however, as described above, in one embodiment, sealant solution 108 is obtained from a reservoir below the surface of the Earth that contains a magnesium chloride-rich brine. As described above, bentonite particles may be added to sealant solution 108, as indicated by step 304. Sealant solution 108 is then agitated at step 306 before applying sealant solution 108 to surface 103 of earthen formation 102.

[0026] Sealant solution 108 is then applied to the drilling reserve pit, as indicated by step 308, to form the hard pan. Magnesium chloride is subsequently applied to the drilling reserve pit to stabilize the hard pan, as indicated by step 310. The drilling reserve pit may then be used to dispose cuttings and drilling fluids and other suitable materials into the drilling reserve pit, as indicated by step 312. This then ends the example method.

[0027] Thus, a method of the present invention includes the use of magnesium chloride after the application of a sealant solution to create and sustain a hard pan within an
earthen formation to prevent leaking of liquids and other potential hazardous materials into the surrounding environment. Such a method may be more economical than prior methods, such as the application of sheet plastic, and may be applied with water in the earthen formation, requires no cleanup, and minimal labor is required.

[0028] Although embodiments of the invention and their advantages are described in detail, a person skilled in the art could make various alterations, additions, and omissions without departing from the spirit and scope of the present invention.

What is claimed is:

1. A method of creating an earthen hard pan formation, comprising:
   forming a drilling reserve pit;
   obtaining a sealant solution from a reservoir below a surface of the Earth;
   applying the sealant solution to the drilling reserve pit at a pressure of at least 20 psi to form a hard pan below a surface of the drilling reserve pit;
   subsequently applying magnesium chloride to the drilling reserve pit to stabilize the hard pan.

2. The method of claim 1, wherein the sealant solution comprises a combination of sodium chloride and magnesium chloride.

3. The method of claim 1, further comprising adding bentonite clay particles to the sealant solution.

4. The method of claim 1, further comprising agitating the sealant solution before applying the sealant solution.

5. The method of claim 1, wherein applying the sealant solution to the drilling reserve pit at a pressure of at least 20 psi comprises applying the sealant solution to the drilling reserve pit at a pressure between approximately 20 psi and approximately 40 psi.

6. The method of claim 1, wherein applying magnesium chloride to the drilling reserve pit comprises applying the magnesium chloride to the drilling reserve pit at a pressure less than a pressure that was used for applying the sealant solution.

7. The method of claim 1, further comprising disposing cuttings and drilling fluids into the drilling reserve pit while drilling.

8. A method of creating an earthen hard pan formation, comprising:
   applying a sealant solution to an earthen formation to form a hard pan below a surface of the earthen formation; and
   subsequently applying magnesium chloride to the earthen formation to stabilize the hard pan.

9. The method of claim 8, wherein applying the sealant solution to the earthen formation comprises applying the sealant solution to a drilling reserve pit.

10. The method of claim 8, wherein the sealant solution comprises a combination of sodium chloride and magnesium chloride.

11. The method of claim 8, further comprising obtaining the sealant solution from a magnesium chloride-rich brine.

12. The method of claim 8, further comprising adding bentonite clay particles to the sealant solution.

13. The method of claim 8, further comprising agitating the sealant solution before applying the sealant solution.

14. The method of claim 8, wherein applying the sealant solution to the earthen formation comprises applying the sealant solution to the earthen formation at a pressure between approximately 20 psi and approximately 40 psi.

15. A system for creating an earthen hard pan formation, comprising:
   an earthen formation;
   a sealant solution;
   an application device operable to apply the sealant solution to the earthen formation to form a hard pan below a surface of the earthen formation;
   magnesium chloride; and
   the application device operable to apply the magnesium chloride to the earthen formation after the application of the sealant solution to stabilize the hard pan.

16. The system of claim 15, wherein the earthen formation is selected from the group consisting of a drilling reserve pit and an earthen livestock tank.

17. The system of claim 15, wherein the sealant solution comprises a combination of sodium chloride and magnesium chloride.

18. The system of claim 15, further comprising bentonite clay particles mixed with the sealant solution.

19. The system of claim 15, further comprising an agitator operable to agitate the sealant solution before application.

20. The system of claim 15, wherein the application device is operable to apply the sealant solution to the earthen formation at a pressure between approximately 20 psi and approximately 40 psi.

* * * * *