A reusable liquid containment system to capture and control spills or run-offs of hazardous liquids. The containment system consists of a reusable berm device which forms a perimeter dimension and conforms to various terrain elevations. The berm device consists of uniform elongated rectangular shaped foam units having an elastic memory, a rigid base, all encased in a fluid resistant protective cover with grommet protected openings to provide for horizontal and vertical connection. The berm devices are positioned in a single or multiple course to achieve appropriate elevation, with tapered berm devices to address varying topographic elevations. The containment system also consists of a draped containment liner or woven, knitted or braided fabric, or thermo-plastic material. The containment system allows wheeled vehicles and related equipment to cross without compromising the integrity of the perimeter berm and liner.
FIG. 7

FIG. 8
SPILL CONTAINMENT SYSTEM AND SOFT CROSSING DEVICE


FIELD OF INVENTION

[0002] This invention generally relates to the field of devices used to contain liquids, and especially such devices used as a secondary containment system to capture and control spills or run-offs of hazardous liquids and other substances which are dangerous to the environment. More particularly, this invention relates to such devices which provide a portable, transportable and reusable berm device and containment liner to accommodate a potential hazardous spill and which can be assembled in a quick and easy manner forming a containment barrier of a desired perimeter dimension and adaptable to various terrain elevations experienced in the field. Further, this invention relates to devices which permit wheeled vehicles to cross while still maintaining the elevation necessary to protect the liquid containment characteristics.

BACKGROUND OF THE INVENTION

[0003] There are various circumstances which require the physical control and containment of certain hazardous liquids in work environments, including but not limited to the oil and gas industry. Various means have been developed for containing chemical spills. The objective of all such containment means is to both prevent such liquids from infiltrating the environment at the time of the initial spill, and to contain the offending liquids until such time as they are removed from the site using environmentally safe removal systems.

[0004] As a practical matter, most work sites do not have a permanent spill containment system in place at the time of the initial construction. Therefore, it is necessary to install such containment systems on either a permanent or temporary bases in size and height configurations specific to the site itself. While many sites are graded prior to installation of such containment systems, many times such grading is inferior, not level, or the surface issues require height variations not know until the time of installation. Various attempts have been made to address these recognized needs, all of which presume the need for an elevated berm, wall or dike device which forms the exterior perimeter boundary of the containment system. Such historic attempts also incorporate some type of liner which in most instances is permanently attached to the berm structure. However, all previous attempts fail to address the height and grade variations necessary to construct and efficient and workable containment system. In addition, the ability to recycle the berm material, as well as other economic and safety considerations, have historically not been taken into consideration.

[0005] In the past, containment systems were constructed utilizing a solid berm wall constructed of compressed earth or concrete which is then draped with a leak proof plastic or woven fabric material. However, such containment systems are permanent in nature, costly to construct, and do not allow for modification and relocation as the need arises. Later, the berm walls were constructed of railroad cross-ties, which were extremely heavy, bulky, and would not allow access to the containment site by wheeled vehicles without potential damage both to the containment membrane, or to the wheeled vehicle itself. In addition, the rail-road cross ties presented an independent environmental challenge based upon the chemical used to treat the wood upon initial manufacture.

[0006] It is also accepted that during times when no liquid spills exist, the containment mechanism must allow for day-to-day movement both in and out of the protected site location by wheeled devices such as automobiles, trucks, fork-lifts, dollys, and the like. Initially, efforts were made to allow for wheeled vehicle access to rigid containment devices. For example, U.S. Pat. No. 5,478,625 to Wright shows a rigid containment device with double-sided ramps at each end of the device to enable a vehicle to be driven into and out of the device. Attempts were also made to construct the dike itself out of non-ridged material. U.S. Pat. No. 5,547,312 to Schmitz, Jr. shows a pool-like apparatus having a floor and side walls made of a flexible sheet material. The exterior containment walls are supported by a rigid frame having a peripheral upper member and a gate at one end which can be lowered and raised to provide entry and exit means for a vehicle. U.S. Pat. No. 5,924,461 to Shaw, et al. shows another liquid containment apparatus with flexible side walls. The side walls themselves are resilient and collapsible as they are supported by rigid brace members that hold the walls in an upright position.

[0007] U.S. Pat. No. 5,464,492 to Gregory, et al. shows a containment device with walls supported by a hollow foam member which is compressed by the vehicle wheel and which rebounds to create the wall when the vehicle wheel has passed. U.S. Pat. No. 5,090,588 to Van Romer, et al. shows a device made of a flexible sheet material, where the wall is supported by a combination of vertical members adjacent the wall, a peripheral upper member, and internal brace members mounted to the floor of the device. Both the support members and wall flex when a wheel passes over, and the internal brace members pull the wall back into an upright position after the wheel has passed.

[0008] However, based on the prior art, the present invention substantially departs from the conventional concepts and designs of the prior art both in scope and in function. It is the object of the present invention to provide a portable, easily configurable, economic, re-usable and transportable berm device and spill containment system which both contours to the site topography, and allows for height adjustment upon installation to insure that no potential for leakage occurs. Also, it is another object of the present invention to provide a berm device that is temporarily collapsible to allow wheeled vehicles to cross while still maintaining the elevation necessary to protect the liquid containment characteristics. Furthermore, it is an object of the present invention to provide a berm device and spill containment system that is both easy to assemble, and to disassemble, for installation at various sites as needed. It is also an object of the present invention to allow for height adjustments to be made at the time installation to address uneven or unleveled surfaces at the site. Lastly, it is an object of the present invention to provide a safe berm device and spill containment system that is easily transportable, and will not shift or move as wheeled vehicles enter and leave the containment site.

SUMMARY OF THE INVENTION

[0009] The present invention, as described below, addresses the shortcomings of the prior confinement systems
by providing a portable, easily configurable, economic, re-usable and transportable berm device which both contours to the site topography, and which temporarily compresses to allow wheeled vehicles to cross while still maintaining the elevation necessary to protect the liquid containment characteristics.

[0010] More particularly, a portable liquid spill containment system constructed according to a first aspect of the soft crossing device contains an elevated perimeter berm formed of uniform elongated rectangular shaped closed cell foam units having an elastic memory which is attached to a rigid base to provide stability. Both the foam unit and rigid base are then encased in a fluid resistant cover to protect the foam material and rigid base from atmospheric and chemical exposure. In addition, the cover of each soft crossing device may contain end, side, and top surface openings protected by grommets to allow the use of zip-ties, wire-ties or other such devices to connect, anchor and secure the soft crossing devices together, both end-to-end and horizontally when stacked to form either one, or multiple, courses as required to achieve appropriate elevation. The soft crossing devices described herein are in relative size proportion to a rail-road cross tie, but may be modified in both length, height and width dimension, dependent upon the need. The second aspect of the invention consists of a similar encased soft crossing device, which is horizontally tapered in shape to topographic challenges of the placement site.

[0011] Both aspects of the invention, when utilized to construct a perimeter containment berm, then allow the application of a draped containment base sheeting which is attachable to the soft crossing devices by use of zip-ties or other similar methods. Another method of securing the containment base sheeting would involve placement of rock, gravel or screenings on the portion of the sheeting which is exposed at ground level on the exterior portion of the containment perimeter. Once installation is complete, the fixed berm created by the soft crossing devices and the containment base sheeting form a complete containment system which allows wheeled vehicular access during use, and also allows for a quick and efficient disassembly for re-use and re-assembly at another location. Based upon the flat surfaces utilized in the soft crossing device, the units are easily stackable and secure during transportation, and likewise horizontally and vertically secure upon installation at the site.

[0012] The novel features which are incorporated into and characteristic of the invention are set forth with particularity in the drawings and description. Other objects and advantages of the invention will become apparent with reference to the accompanying drawings and the accompanying descriptive matter.

**BRIEF DESCRIPTION OF THE SEVERAL DRAWINGS**

[0013] FIG. 1 is a detailed side view of the foam core according to the present invention.

[0014] FIG. 2 is a detailed side view of a soft crossing device according to the present invention.

[0015] FIG. 3 is a detailed cross-section end view of a soft crossing device according to the present invention.

[0016] FIG. 4 is a detailed side view of an alternative tapered soft crossing device according to the present invention.

[0017] FIG. 5 is a detailed perspective view of a soft crossing device according to the present invention.

[0018] FIG. 6 is a detailed view of a spill containment system constructed utilizing the soft crossing device and containment base sheet forming a containment barrier around a chemical storage tank utilizing the present invention as installed on sloped site terrain.

[0019] FIG. 7 is a cross section view of the application of the containment base sheet over the soft crossing device according to the present invention.

[0020] FIG. 8 illustrates the placement of connectors on the soft crossing device with containment base sheet installed according to the present invention.

**DETAILED DESCRIPTION OF THE INVENTION AND A PREFERRED EMBODIMENT**

[0021] The invention, the scope of which being defined herein, is not limited in this application to the details of construction and arrangement of parts shown and described, since the invention is capable of other embodiments and of being practiced or assembled in various other ways. Also, it is to be understood that the terminology or phraseology used herein is for the purpose of description and not of limitation.

[0022] The present invention shall generally be described with reference to FIGS. 1, 2, 3, 4, 5, 6, 7, and 8. FIG. 1 is a detailed side view of the foam core according to the present invention. FIG. 2 is a detailed side view of a wrapped foam core device according to the present invention. FIG. 3 is a detailed cross-section end view of a wrapped foam core device according to the present invention. FIG. 4 is a detailed side view of an alternative tapered wrapped foam core device according to the present invention. FIG. 5 is a detailed perspective view of a wrapped foam core device according to the present invention. FIG. 6 is a detailed view of a spill containment system constructed utilizing the wrapped foam core device and containment base sheet forming a containment barrier around a chemical storage tank utilizing the present invention as installed on sloped site terrain. FIG. 7 is a cross section view of the application of the containment base sheet over the wrapped foam core device according to the present invention. FIG. 8 illustrates the placement of connectors on the wrapped foam core device with containment base sheet installed according to the present invention. One skilled in the art will recognize that the device shown in FIGS. 1, 2, 3, 4, 5, 6, 7 and 8 collective is a spill containment system and soft crossing device.

[0023] A soft crossing device constructed in accordance with the first aspect of the invention is indicated generally by reference (A) in the drawings. The device is constructed and assembled as follows. First, as shown in FIG. 1, the soft foam core of the device is comprised of an elongated rectangular shaped foam core (1) having an elastic memory. The foam core has a first end (2) and a second end (3). The material utilized in this form core (1) may be constructed of either open or closed cell foam, of various chemical compositions dependent upon the pliability needed for the site application, and the chemical sought to be contained. The foam material may be purchased in either large dimensions and cut to size, or formed individually.

[0024] As shown in FIG. 3, the foam core (1) is placed over a rigid base (4) to provide dimensional and structural stability. The rigid base (4) is constructed either of wood, plastic, or a similar solid and sound material. The rigid base (4) and foam core (1) may be permanently joined using a solvent based or heat set glue (5), forming a secure bond to prevent slippage during manufacture and subsequent usage. However, such
solvent based or heat set glue bond is optional, and not necessary for the performance of the device as described herein.

[0025] As illustrated in FIGS. 2 and 3, both the foam core (1) and the rigid base (4) are then wrapped in a fluid and abrasion resistant cover (6) to protect the foam core and rigid base from exposure to both atmospheric conditions and to the chemical sought to be contained. The material used for the cover wrap (6) is preferably made from continuous liquid impervious sheet material, cut to size, and consisting of a woven, knitted or braided fabric, or thermo-plastic material, which provides strength, durability and resiliency. However, the cover wrap material may be of various thicknesses and chemical compositions dependent upon the pliability needed for the site application, and the chemical sought to be contained.

[0026] As shown in FIGS. 3 and 5, the cover wrap (6) is applied around the foam core (1) and rigid base (4) in such a way that the ends of such wrap overlap (7), preferably at the bottom of the device contiguous to the rigid base (4). The length of the cover wrap material should allow for excess material at each end which is then folded and sealed to protect the two ends of the foam core and rigid base assembly. Once the cover wrap (6) material is applied, it is then stapled (8) or nailed in place, and may additionally be glued and heat sealed (9) along the seam created by the wrap overlap from the first end (2) to the second end (3). The excess ends of the cover wrap are then folded to form an end wrap termination (10) which is likewise sealed through the use of either glue or heat to form liquid impervious end barriers for the soft crossing device.

[0027] As shown in FIGS. 2, 3 and 5, the cover wrap material of the preferred embodiment contains end, top, and side surface openings each protected by grommets (11). The grommets add to the strength of the cover wrap, and also protect the openings from tears and abrasion from the connective appliances used. The spacing and location of the cover wrap openings (11) is determined based upon the connection requirements of the site application, and the preference of the manufacturer. For example, the cover wrap openings (11) may be used only on the exterior surface of one side of the soft crossing device if connections are necessary only to the exterior perimeter of the constructed berm. However, if multi-course stacking of the soft crossing devices is anticipated, then the cover wrap openings (11) may be used on both the interior and exterior sides and top of the device to allow more connection points.

[0028] As shown in FIGS. 7 and 8, the cover openings (11) allow for the insertion of zip-ties, wire ties, or other similar connecting devices (12) to join the soft crossing devices both end-to-end (13), as well by horizontally when stacked into courses (14), to unify the individual units into a solid berm structure upon completion of assembly.

[0029] A second aspect of the soft crossing device is shown in FIG. 4 and is generally referenced as (H) in the drawings. Here, the foam core (1) is tapered horizontally (15) beginning at the first end (2) and ending at the second end (3) in such a way as to provide for a bottom angled soft crossing device for use in addressing slope conditions that may exist at the job site. As shown in FIG. 4, the rigid base (4) is oriented to the bottom of the foam core (1), which is then encased in a cover wrap (6) and attached and sealed as with the first aspect of the invention described herein. This aspect may also contain end, side and top openings protected by grommets (11). As with the first aspect, the spacing and location of the openings (11) with the second aspect is determined based upon the installation and connection requirements of the site application, and the preference of the manufacturer.

[0030] As can be seen in FIGS. 6 and 8, a spill containment system is illustrated comprised of fixed berm (C) constructed with the soft crossing devices (A) and (B) aligned horizontally and stacked in multi-run courses end-to-end (13) with the ends of each device abutted together. The corners are formed by abutting the end of the soft crossing device to the side of the 90 degree oriented soft crossing tie and secured using zip-ties, wire-ties or other similar connectors (16). Because of this construction, no corner adaptors are required. The size, height and contour of the containment berm (C) are dictated by the size and slope of the site. The site shown is not level, but rather contains a downoward grade (17). To accommodate the downward grade (17), it is necessary to establish a level desired top elevation to insure that any liquid spill will not flow down the slope and escape the containment perimeter. A horizontal level plane (18) is shown, which establishes the overall desired height to be obtained in the construction of the fixed berm (C). To achieve this level height, the base row, or first course, of soft crossing devices (19) is assembled using soft crossing devices of the first aspect of the design (A) to address the flat portions of the site. To accommodate the graded slope portion of the site (17), soft crossing devices are used which are tapered in design under the second aspect of the design (B). The second row, or second course, (20) is also constructed with soft crossing devices utilizing both the first aspect (A) and second aspect (B) of the design as required by the downward slope of the site (17). As illustrated, the third row, or third course, (21) is also constructed with soft crossing devices which form the completed top portion of the fixed containment berm (C). Additional rows, or courses, may be required dependent upon the slope and size of the containment area involved. In addition, depending on the overall height of the berm, constructions adjustments may be made to the overall width and height of the soft crossing device to accomplish a more stable base and overall structure.

[0031] In the construction of a multi-course berm as shown in FIG. 6, the soft crossing devices (A and B) are connected together prior to installation of the containment base sheet (22). Such connections are accomplished as illustrated in FIGS. 7 and 8. As shown, zip-ties, wire-ties, or other similar connecting devices (12) are inserted into and exit the openings (11) and tightened to join the soft crossing devices both end-to-end (13), as well as in horizontal stacked row alignment (14), to unify the individual soft crossing devices into a fixed berm structure (C). Upon completion of the construction of the fixed berm utilizing the soft crossing devices (C), confirmation of connections and top course level should be obtained prior to installation of the containment base sheet (22).

[0032] The containment base sheet (22) is used to provide a fluid impervious floor and fixed berm wall liner to insure that the hazardous liquid chemicals will not permeate into the ground, or escape through the fixed berm structure (C). The containment base sheet (22) is preferably made from continuous seamless sheet material consisting of a woven, knitted or braided fabric, or thermo-plastic material, which provides strength, durability and resiliency. The pliable nature of the containment base sheet (22) enables the sheet to conform to the unevenness of the site surface, and also fold upward to lay flat against the fixed berm wall (26). Once the containment base sheet is installed, the ends of the base sheet (27) are then
wrapped over the top course of soft crossing devices (21) and folded downward on the outside edge of the top course of soft crossing devices, as illustrated in FIGS. 6, 7 and 8. The containment base sheet (22) is then anchored to the top course of soft crossing devices using zip-ties, wire-ties, or other similar connecting devices (12) which are inserted through the containment base sheet through small puncture holes made for this purpose, and then run through the cover wrap openings (11) in the soft crossing devices (29). Such puncture holes are not necessary in the containment base sheet located on the interior of the fixed berm (C), because the anchor points described hold the containment base sheet in place as intended. Another option for securing the containment base sheet involves application of rock, gravel or screenings on the containment base sheet located on the exterior of the fixed berm after draping over the soft crossing device structure. Once installation is complete, the fixed berm and containment base sheet form a complete fluid impervious containment system which allows wheeled vehicular access during use, and also allows for a quick and efficient disassembly for re-use and re-assembly at another location. Based upon the flat surfaces utilized in the soft crossing device, the units are easily stackable and secure during transportation, and likewise horizontally and vertically secure upon installation at the site.

[0033] The deformable characteristics of the soft crossing device, combined with the resilient nature of the containment base sheet, enable the fixed berm to flex downward to a generally flat profile enabling wheeled vehicles to pass over the fixed berm wall. As illustrated in FIG. 6, the portion of the fixed berm wall utilizing only one row, or course, of soft crossing devices (30) is the preferred location for wheeled vehicle entry. This location allows maximum compression of the soft crossing device with the ground when contacted by the wheels, and also is the up-hill point in the containment system where the least amount of liquids will accumulate (31).

[0034] Once the need for the above described spill containment system is no longer recognized, the system may be dismantled by cutting the zip-tie, wire-tie or other similar connectors (12), which then allows the containment base sheet to be rolled up and removed for storage and transportation. For reuse, the punctures made in the containment base sheet, or any tears that may have otherwise occurred, can be sealed using a similar material affixed to the containment base sheet with an appropriate adhesive. The connectors (12) attaching the soft crossing devices can likewise be cut allowing a complete removal of the connectors through the openings (11). Once the connectors associated with the soft crossing devices are removed, the soft crossing devices can then be removed from the site for storage and transportation. Once the spill containment system is disassembled and removed, there is no residual trace of the system on the site.

[0035] Although the preferred embodiments of this invention have been shown and described in detail, it is recognized that the invention is not limited to the precise form and structure shown and various modifications and rearrangements as will occur to those skilled in the art upon full comprehension of this invention may be resorted to without departing from the scope of the invention as defined herein.

[0036] Applicants reserve the right to provide further detail regarding the invention if the need should arise.

What is claimed is:

1. A soft crossing device for use in creating an on site installed spill containment area for surrounding and containing hazardous materials comprising:

a) an elongated rectangular shaped foam core having a first end and a second end with an elastic memory for placement on the ground at the site to create a containment barrier;

b) a rigid base attached to the foam core to enable support and secure contact with the ground;

c) said foam core and rigid base wrapped in a fluid and abrasion resistant cover to protect from contact with the elements;

d) said wrapped foam core and rigid base being connected end-to-end to form a free standing perimeter berm wall to define the containment area;

2. The soft crossing device of claim 1 including at least one wrapped foam core and rigid base tapered horizontally beginning at the first end and ending at the second end to provide for a bottom angle to provide for ground elevation changes at the site.

3. The soft crossing device of claim 1 including a cover wrap material constructed from a continuous liquid impervious sheet material consisting of a woven, knitted or braided fabric, or thermo-plastic material.

4. The soft crossing device of claim 1 including a cover wrap material which contains end, top, or side surface openings each protected by grommets,

5. The soft crossing device of claim 1 including the use of zip-ties, wire ties, or other similar connecting devices to join the soft crossing devices end-to-end.

6. The soft crossing device of claim 1 including wrapped foam core and rigid base units stacked and aligned horizontally in multi-run courses end-to-end.

7. The soft crossing device of claim 1 including the use of zip-ties, wire ties, or other similar connecting devices to join the soft crossing devices horizontally when stacked into multiple courses.

8. A containment system which may be configured on site for surrounding and containing hazardous materials comprising:

a) an elongated rectangular shaped foam core having a first end and a second end with an elastic memory for placement on the ground at the site to create a containment barrier;

b) a rigid base attached to the foam core to enable support and secure contact with the ground;

c) said foam core and rigid base wrapped in a fluid and abrasion resistant cover to protect from contact with the elements;

d) said wrapped foam core and rigid base being connected end-to-end to form a free standing perimeter berm wall to define the containment area;

e) said wrapped foam core and rigid base being flexible in an upright configuration to contain the hazardous liquids.
and a deformed configuration enabling wheeled vehicles and equipment to pass over said device wall to enter and exit said containment area;
f) a containment area base sheet to provide a fluid impervious floor and wall liner to insure that the hazardous liquids will not permeate into the ground, or escape through the perimeter berm wall structure.

9. The system of claim 8 including at least one wrapped foam core and rigid base tapered horizontally at the first end and ending at the second end to provide for a bottom angle to provide for ground elevation changes at the site.

10. The system of claim 8 including a cover wrap material constructed from a continuous liquid impervious sheet material consisting of a woven, knitted or braided fabric, or thermo-plastic material.

11. The system of claim 8 including a cover wrap material which contains end, top, or side surface openings each protected by grommets.

12. The system of claim 8 including the use of zip-ties, wire ties, or other similar connecting devices to join the soft crossing devices end-to-end.

13. The system of claim 8 including wrapped foam core and rigid base units stacked and aligned horizontally in multi-run courses end-to-end.

14. The system of claim 8 including the use of zip-ties, wire ties, or other similar connecting devices to join the soft crossing devices horizontally when stacked into multiple courses.

15. A method for forming a containment area from soft crossing devices connected on site to form the periphery of the containment area at a desired size for surrounding and containing hazardous materials comprising:
a) providing a free standing berm wall constructed of said soft crossing devices extending upward and longitudinally along said base creating said containment barrier;
b) connecting said soft crossing devices end to end to prevent movement;
c) providing a free standing berm wall constructed of said soft crossing device being flexible in an upright configuration to contain the hazardous liquid and a deformed configuration enabling wheeled vehicles and equipment to pass over said berm wall to enter and exit said containment area;
d) providing a containment base sheet and wall liner formed from a continuous seamless sheet material;
e) connecting said containing base sheet to said free standing berm wall;
f) forming a secure and continuous liquid containment unit.

16. The method of claim 15 including at least one wrapped foam core and rigid base tapered horizontally at the first end and ending at the second end to provide for a bottom angle to provide for ground elevation changes at the site.

17. The method of claim 15 including a cover wrap material constructed from a continuous liquid impervious sheet material consisting of a woven, knitted or braided fabric, or thermo-plastic material.

18. The method of claim 15 including a cover wrap material which contains end, top, or side surface openings each protected by grommets.

19. The method of claim 15 including the use of zip-ties, wire ties, or other similar connecting devices to join the soft crossing devices end-to-end.

20. The method of claim 15 including wrapped foam core and rigid base units stacked and aligned horizontally in multi-run courses end-to-end.

21. The method of claim 15 including the use of zip-ties, wire ties, or other similar connecting devices to join the soft crossing devices horizontally when stacked into multiple courses.

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