A composite house wrap is provided with a high insulation value and including three integral sections or layers. The first or front layer is a reinforcing grid or mesh that functions as a drainage plane and will face the outside cladding. The second or middle layer is a breathable, barrier film, such as a polyethylene (PE) or polytetrafluoroethylene (PTFE), is bonded to the first layer, such as through thermal bonding. The third or rear layer is a perforated foam layer, such as an expanded low density polyethylene foam that is bonded to the middle layer, such as through an adhesive.
COMPOSITE HOUSE WRAP

RELATED APPLICATION


BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a composite house wrap used generally in building construction.

[0004] 2. Background Information

[0005] House wrap is a worldwide multi-billion dollar yearly industry. The phrase “House wrap” (also called “housewrap”) has been defined as inclusive of all synthetic materials effectively designed for the replacement of traditional sheathing tar paper. These materials are all lighter in weight and usually wider than asphalt designs, so contractors can apply the material much faster to a house shell. A conventional house wrap is described as functioning as a moisture barrier, preventing rain from getting into the stud wall construction while allowing moisture vapor to pass out from the house’s interior living space to the exterior. If moisture from either direction is allowed to build up within stud or cavity walls, mold and rot can set in and fiberglass or cellulose insulation will lose its R-value (a measure of the efficiency of the insulation) due to heat-conducting moisture.

[0006] Conventional house wraps have been described as broadly including (1) asphalt-impregnated paper or fiberglass; (2) micro-perforated, cross-lapped films; films laminated to spun-bond non-woven materials; (3) films laminated or coated to polypropylene woven materials and calendered, wet-laid polyethylene fiber.

[0007] House wrap is generally described as requiring both a waterproof aspect and it must have a high moisture vapor transmission rate (MVTR) to be effective. It must also take handling abuse during installation and it is helpful if it is resistant to UV light. House wrap is often left exposed for some time after construction, awaiting exterior sheathing installation. House wrap is generally installed over the sheathing and behind the exterior siding. Siding can be vinyl, wood clapboard, cedar shingles or brick facade. In all cases, the house wrap, generally, is the last line of defense in stopping incoming water or exterior water condensation from getting into the wooden stud wall. For a general background and description of house wraps, see the June 2000 Department of Energy (DOE) publication (DOE/GO10099-769) entitled “Weather Resistant Barriers: How to Select and Install Housewrap and Other Types of Weather Resistant Barriers”

[0008] It is known to use micro-porous polyolefin films in house wrapping applications. One commercially available film heretofore used as a house wrap is made of high density polyethylene (HDPE) flash spun into fibers and pressured to form the film. The resulting flash-spun HDPE film has been described as suffering from both a high air permeability and a relatively low tear strength. Thus, such house wrap is subject to damage during shipment and installation.

[0009] Another commercially available film employed as a house wrap is melt blown, spun-bonded polyethylene. Like the flash-spun HDPE fiber film, the spun-bonded polyethylene has been described as providing a high permeability to air and even worse tensile properties, i.e. break strength, tear strength and puncture resistance. Thus, there is an unfilled need for a house wrap with both “breathability” and good physical and tensile properties.

[0010] U.S. Pat. No. 4,929,303 discloses a house wrap formed of a composite breathable film comprising a breathable polyolefin film heat laminated to a non-woven HDPE fabric. The breathable fabric is prepared by melt embossing a highly filled polyolefin film to impose a pattern of different film thickness therein, and stretching the embossed film. The non-woven fabric is made by cross-laminating HDPE fibers at the crossing points to form a thin open mesh fabric, and co-extruding a heat seal layer thereon. The composite is made by heat laminating the breathable film to the heat seal layer of the fabric.

[0011] The DuPont Company has long promoted its TYVEK® brand of house wrap. The TYVEK® brand of house wrap is sometimes described as being “a sheet of very fine, high-density polyethylene fibers”. It has been suggested that the sheet is produced by hot calendaring a web made by a flash-spin process where polyolefin polymer is converted into three-dimensional networks of thin continuous interconnected ribs called film-fibers or plexifilaments. This process is asserted to be disclosed in U.S. Pat. Nos. 3,081,519, 3,442,740, and 3,169,899.

[0012] U.S. Pat. No. 4,900,619 discloses a translucent non-woven fabric composite, suitable for use as a house wrap, wherein the composite comprises a melt-blown fabric layer laminated to a reinforcing fabric layer and may include tacking strips. The composite may be prepared by calendaring a melt-blown fabric and a reinforcing fabric together in a nip equipped with a resilient roll.

[0013] U.S. Pat. No. 7,148,160 discloses a composite sheet material useful as a house wrap that is water vapor permeable and substantially liquid water impermeable, in which the composite sheet material includes an outer non-woven fiber layer, a film, and a reinforcing layer.

[0014] U.S. Pat. No. 7,393,799 discloses composite sheet material that is moisture vapor permeable and substantially liquid impermeable, the composite sheet material including as layers a lightweight, non-wet laid polyester nonwoven, a polyurethane breathable film, a polymer-coated, high tensile strength polyester mesh, and a lightweight, non-wet laid, polyester nonwoven material. The material is also abrasion, tear, mildew and fire resistant.

[0015] U.S. Pat. No. 5,308,691 discloses a “controlled porosity composite sheet” useful as a house wrap that comprises a melt blown polypropylene fiber web having a spun-bonded polypropylene fiber sheet laminated to at least one side thereof.

[0016] The above identified patents are incorporated herein by reference in their entireties. These patents describe calendaring techniques and composite layer attachment techniques that can be utilized in the present invention as will be apparent form a review of the following description.

[0017] Some commercially available house wraps are three-dimensionally textured to better channel intruding water away from the structure. Like their smooth-faced predecessors, these permeable products also diffuse moisture vapors from inside the structure. For example, GreenGuard’s RainDrop™ brand house wrap is non-perforated cross-woven (breathable) coated polyolein scrim wherein woven black vertical strands create vertical grooves to direct water down. Manufacturing giant DuPont introduced Tyvek DrainWrap™
in 2004 that was made of the same non-woven material as its Tyvek Home wrap, and wherein it has vertical grooves.

[0018] The WeatherTrek™ brand house wrap by Valeron Strength Films, has a non-directional “pebbled” texture finish to funnel water, wherein, because of its overall pattern, it can be installed in any direction, which may save installation time, versus those with vertical channels. Its rough, crush-resistant texture creates a standoff property to allow an air space between sheathing and siding.

[0019] As a further type of house wrap, foil-faced house wraps have been designed, such as Super R Premium™ brand “radiant” barrier from Innovative Insulation and Low-E™ brand House-Wrap from Environmentally Safe Products. There is some question of the effectiveness of the foil as a radiant barrier after the outer cladding is attached to the building.

[0020] Despite the wide commercial acceptance and application of currently available house wraps there have been those that have objected to their viability and efficiency. Joseph Listburek of the Building Science Corporation issued a report entitled “Problems with Housewraps” in 2001 in which he noted that “the energy aspects of [currently commercially available] housewraps are vastly overstated”.

[0021] There is little doubt that the currently available house wraps improve upon the earlier structures of traditional sheathing tar paper and they do provide insulating properties that are advantageous. However there is clearly a need to significantly improve upon the operational characteristics of house wraps. It is an object of the present invention to address the deficiencies of the prior art discussed above and to provide an efficient house wrap that can be produced in a cost effective manner.

SUMMARY OF THE INVENTION

[0022] The various embodiments and examples of the present invention as presented herein are understood to be illustrative of the present invention and not restrictive thereof and are non-limiting with respect to the scope of the invention. The present invention provides a composite house wrap that comprises an insulation function, a moisture vapor transmission function, a moisture barrier function, a drainage function and further provides for ease of installation.

[0023] According to one non-limiting embodiment of the present invention, a composite house wrap is provided with three integral sections or layers. The first or front or outer layer is a reinforcing grid or mesh that functions to form a drainage plane between the house wrap and the outer cladding and thus it will face the outside cladding. The second or middle layer is a breathable, barrier film, such as a polyethylene (PE) or polyurethane (PUR), is bonded to the first layer, such as through thermal bonding. The term breathable within the meaning of this application references a structure that allows water vapor transmission. The term barrier with regard to the film layer references that it is resistant or impervious to liquid transmission. The third or rear layer is a perforated foam layer, such as an expanded low density polyethylene foam that is bonded to the middle layer, such as through an adhesive.

[0024] The house wrap according to the present invention will provide barrier protection plus moisture vapor transmission and yield an insulation R-value of at least R2, and typically R3, R4 or even higher being achievable. This house wrap is specifically designed to add enhanced insulating characteristics as opposed to conventional house wraps, while maintaining a cost effective and easy to handle house wrap.

[0025] These and other advantages of the present invention will be clarified in the description of the preferred embodiments taken together with the attached figures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] FIG. 1 is a schematic cross section of a house wrap with high insulating properties in accordance with one embodiment of the present invention; and

[0027] FIG. 2 is schematic enlarged front view of the house wrap of FIG. 1; and

[0028] FIG. 3 is a schematic front view of the house wrap of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0029] In summary, the present invention relates to a composite house wrap 10 is provided with three integral sections or layers 20, 30 and 40 as described below. The house wrap 10 according to the present invention will provide barrier protection plus moisture vapor transmission and an insulation R-value of approximately R2 or higher. The terms about or approximately or similar terms should be read as meaning within ten percent within this application. This house wrap 10 is specifically designed to add enhanced insulating characteristics as opposed to conventional house wraps, while maintaining a cost effective and easy to handle house wrap.

[0030] The house wrap 10 has a total thickness of about 25-30 mils, generally less than 40 mils, preferably less than 75 mils and effectively always less than 175 mils. The house wrap 10 can be attached to a building in any conventional fashion, such as nail guns, or the like. The house wrap 10 has the flexibility and durability that is comparable to, and actually better than many, existing commercial house wraps.

[0031] The house wrap 10 of the present invention can also be used as a roof paper or roof underlay.

[0032] The first or front layer 20 is a reinforcing grid or mesh that functions as a drainage plane and will face the outside cladding. The mesh layer 20 can be formed effectively from polyethylene, however substantially any material providing the structural equivalent and suitable for the desired work environment could be used. The thickness of the mesh layer is approximately 1 mil, generally less than 5 mils, preferably less than 25 mils. The mesh layer can be formed effectively of a wide variety of grid patterns, even a non grid pattern of structural as suggested again below.

[0033] The front layer 20 serves a drainage function by providing a space for water drainage. Secondly, the front layer 20 serves as a reinforcing member for the house wrap 10 to provide structural integrity to the entire assembly. The front layer could take other forms, such as spaced ribs. Essentially the spaced ribs alternative design would be the mesh layer 20 without the cross bracing. The spaced ribs could be vertical or angled at essentially any angle to form more definitive drainage channels. A “vertical” orientation of such ribs would also allow the house wrap 10 to be easily rolled up in one direction (i.e. rolled about an axis parallel to the ribs). The ribs need not be straight members, but each rib could be a zig-zag or herringbone shaped construction. The interconnected mesh layer of the preferred embodiment is believed to add structural integrity while still allowing for an efficient drainage plane for the house wrap 10.
The second or middle layer 30 is a breathable, barrier film 30 which is bonded to the first layer. The second or middle layer 30 may be formed of a polyethylene (PE) or a Polyurethane (PUR) material, but a myriad of other breathable film layer materials could be used assuming the cost concerns could be addressed, such as a PVC film or polytetrafluoroethylene (PTFE) film. The PE or PUR material may prove to be the most cost-effective. In one embodiment the film is bonded to the layer 20 through thermal bonding. Other bonding techniques may be used, such as adhesives. The film layer 30 should be about 8-30 mils, typically less than 25 mils and effectively always less than 50 mils in thickness and have acceptable breathability for the field of house wraps.

The third or rear layer 40 is a perforated foam layer 40, such as an expanded low density polyethylene foam that is bonded to the middle layer 30, such as through an adhesive 42. The term foam within this application references both open or closed cell structures, and can broadly be described as a dispersion of gas bubbles throughout a solid substrate. Low density polyethylene (LDPE) is a thermoplastic which is defined by a density range of 0.910-0.940 g/cm³. It is un-reactive at room temperatures, except by strong oxidizing agents. It is known as being quite flexible, and tough. LDPE has more branching (on about 2% of the carbon atoms) than high density polyethylene (HDPE). The LDPE molecules are less tightly packed and less crystalline than HDPE because of the side branches, and thus its density is lower.

The low density polyethylene foam layer 40 can be made, for example, by a process comprising mixing low density polyethylene with a blowing agent, a surface activation agent and, preferably, a separation agent, heating the resultant mixture to form a softened mass, raising the temperature of the softened mass to gasify the blowing agent for foaming and expanding the cells of the polyethylene, reducing the temperature of the foamed and expanded polyethylene to partially shrink and harden the polyethylene cells, introducing a gaseous blowing agent into the polyethylene mass to cause additional foaming and expansion of the polyethylene cells, cooling the mass to a temperature suitable for cutting, cutting and heating the mass to a temperature suitable for extruding, extruding the mass, forming the mass into a sheets, and cooling the sheet or tube for a setting time to form a low density polyethylene sheet characterized by superior buoyancy and thermal resistance. A process for forming such foam is described, for example, in U.S. Pat. Nos. 4,952,532 and 4,746,564 which are incorporated herein by reference.

A further detailed process for forming such expanded polyethylene foam for layer 40 is described in Korean Patent Registration No. 10-0428429 that issued Mar. 29, 2004. The process as described may be summarized as including the steps of adding a low density polyethylene (LDPE) with dual co-blowing agents, a surfactant and a release agent to form an LDPE composition. The LDPE composition is then mixed with a flame retardant and antimony oxide in a hopper container. The mixed composition is next heated in the hopper past the effective gasification temperature of the dual blowing agents (which is described as generally 120-150°C) to form expanded beads and the hopper is then cooled. Following the expansion and cooling, the hopper is heated to an extraction temperature and the expanded product is extracted and allowed to stand at room temperature for a setting period. Suitable LDPE material is available from Innovative Designs, Inc. of Pittsburgh under the INSUL-TEX™ brand. The expanded product can then be formed into sheets to form the layer 40 with the perforations 44 as described below.

The third or rear LDPE foam layer 40 is a perforated, wherein a series of equally spaced perforations 44 extend through the layer 40. The perforations 44 can be conical which may provide certain advantages to the house wrap 10 of the present invention. However, cylindrical shaped perforations for perforations 44 would also be acceptable. The perforations 44 can be formed on layer 40 through a perforation roller which has a series of perforation pins thereon. For the conical shaped perforations as shown the pins would have a shape similar to the final desired shape of the perforations. The layer 40 can be perforated before it is assembled, or the perforations can be made after the house wrap is assembled.

The film layer 40 should be about 15-20 mils in thickness, generally less than 40 mils and almost always less than 75 mils. This design will provide insulation R-values of R2 or better. The layer 40 is bonded to the layer 30 through adhesives, which would have a thickness of about 1 mil, typically less than 3 mils, and almost always less than 10 mils.

Whereas particular embodiments of the invention have been described above for purposes of illustration, it will be evident to those skilled in the art that numerous variations of the details of the present invention may be made without departing from the spirit and scope of the present invention.

What is claimed is:
1. A house wrap for a building comprises:
   A first layer including a reinforcing grid providing a drainage plane for the house wrap and configured to face the outside of the building;
   A second layer including a breathable, barrier film bonded to the first layer; and
   A third layer including a perforated foam layer is bonded to the middle layer.
2. The house wrap for a building according to claim 1 wherein the barrier film is polyethylene (PE).
3. The house wrap for a building according to claim 1 wherein the barrier film is polytetrafluoroethylene (PTFE).
4. The house wrap for a building according to claim 1 wherein the barrier film is bonded to the first layer through thermal bonding.
5. The house wrap for a building according to claim 1 wherein the foam layer is formed of expanded low density polyethylene foam.
6. The house wrap for a building according to claim 5 wherein the foam layer is formed of expanded low density polyethylene foam and adhesive.
7. The house wrap for a building according to claim 5 wherein the barrier film is polytetrafluoroethylene (PTFE).
8. The house wrap for a building according to claim 7 wherein the barrier film is bonded to the first layer through thermal bonding.
9. The house wrap for a building according to claim 5 wherein the barrier film is polyethylene (PE).
10. The house wrap for a building according to claim 7 wherein the barrier film is bonded to the first layer through thermal bonding.
11. A house wrap for a building comprises:
   A first reinforcing layer providing a drainage plane for the house wrap and configured to face the outside of the building;
   A second layer including a breathable, barrier film bonded to the first layer; and
A third layer including a perforated low density polyethylene foam layer is bonded to the middle layer.

12. The house wrap for a building according to claim 11 wherein the barrier film is polyethylene (PE).

13. The house wrap for a building according to claim 11 wherein the barrier film is polytetrafluoroethylene (PTFE).

14. The house wrap for a building according to claim 11 wherein the barrier film is bonded to the first layer through thermal bonding.

15. The house wrap for a building according to claim 11 wherein the house wrap has an insulating R-Value of 2.

16. The house wrap for a building according to claim 15 wherein the low density polyethylene foam layer is bonded to the second layer through an adhesive.

17. The house wrap for a building according to claim 15 wherein the barrier film is polytetrafluoroethylene (PTFE).

18. The house wrap for a building according to claim 17 wherein the barrier film is bonded to the first layer through thermal bonding.

19. The house wrap for a building according to claim 15 wherein the barrier film is polyethylene (PE).

20. The house wrap for a building according to claim 17 wherein the barrier film is bonded to the first layer through thermal bonding.

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