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(54) Title: LAMINATED FABRIC SHIPPING SACKS, METHODS OF MANUFACTURING

(57) Abstract: A base fabric made of polypropylene and/or polyethylene tapes or fibers is laminated with a polyolefin film coating. The laminated fabric may be used to make a shipping sack.

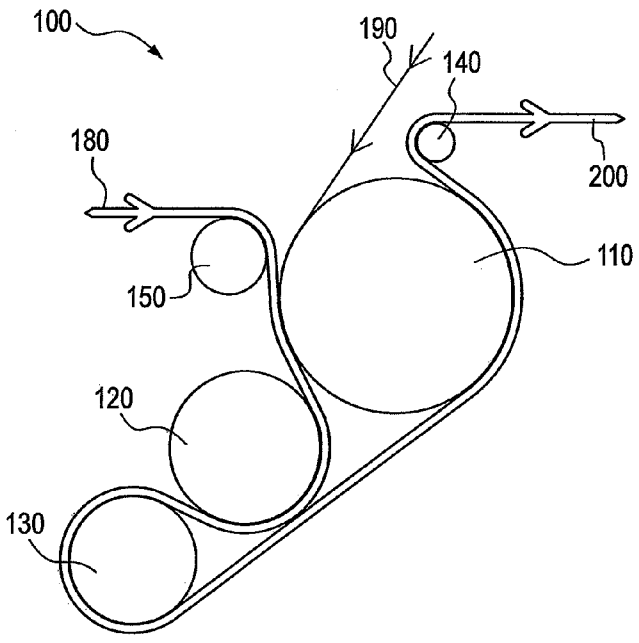


FIG. 1

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AMENDED CLAIMS
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WHAT IS CLAIMED IS:

1. A laminated fabric comprising:

(a) an HDPE-PP blend fabric comprising an HDPE blend fabric cross-woven with polypropylene tape cross material;

(b) a first lamination layer comprising;

(i) polypropylene copolymer having MFI (230°C/2.16 kg) of 22-45; and

(ii) a compatibilizer; and

(c) a polyolefin film layer, wherein the lamination layer binds together the HDPE-PP fabric and the polyolefin film layer.

2. The laminated fabric of claim 1 wherein the HDPE-PP blend fabric is woven.

3. The laminated fabric of any one of claims 1-2, wherein the cross material is non-woven.

4. The laminated fabric of any one of claims 1-3, wherein the first lamination layer further comprises (iii) at least one of LDPE and LLDPE having a MFI (190°C/2.16 kg) of 3-10.

5. The laminated fabric of any one of claims 1-4, further comprising:

(a) a second lamination layer comprising at least one of LDPE, LLDPE, and PP copolymer laminated to the HDPE blend fabric.

6. The laminated fabric of any one of claims 1-5, wherein the HDPE-PP blend fabric comprises tapes in first and second directions, wherein the tapes of the first direction comprise (I) an oriented polyolefin tape comprising an extruded and stretched melt blend comprising:

(a) 5-35 wt% 0.5-8 MFI (230°C/2.16 kg) polypropylene;

(b) 65-95 wt% 0.1-3.5 MFI (190°C/2.16 kg) high density polyethylene;

(c) 0-30 wt% of at least one filler;

(d) 0-3 wt% of at least one UV additive; and

(e) 0-5 wt% of at least one compatibilizer to form a melt blend; and

(II) the tapes of the second direction are cross tapes comprising a material which has a melt temperature different from the tapes of the first direction.

7. The laminated fabric of claim 6, wherein the tapes of the first direction have a melt temperature in the range of 100 to less than 135° C, and the tapes of the second direction have a melt temperature in the range of greater than 135° C to 168° C.

8. The laminated fabric of any one of claims 1-7, wherein the HDPE blend fabric includes a plurality of warp tapes and a plurality of weft tapes, wherein at least one of the (I) plurality of warp tapes and (II) the plurality of weft tapes are cross-woven, wherein:

(a) at least a portion of the warp tapes comprise:

(i) 90-100 wt% homopolymer or copolymer of polypropylene having MFI (230°C/2.16 kg) of 1-6;

(ii) 0-3 wt% of a first filler; and

(iii) 0-3 wt% of a first pigment; and

(b) at least a portion of the weft tapes comprise:

(i) 75-95 wt% 0.05-3 MFI (190°C/2.16 kg) HDPE;

(ii) 10-25 wt% 1-7 MFI (230°C/2.16 kg) polypropylene homopolymer;

(iii) 0-3 wt% of a second filler; and

(iv) 0-3 wt% of a second pigment.

9. The laminated fabric of any one of claims 1-8, wherein the HDPE blend fabric includes a plurality of warp tapes and a plurality of weft tapes, wherein at least one of (I) the plurality of warp tapes and (II) the plurality of weft tapes are cross-woven, wherein:

(a) at least a portion of the weft tapes comprise:

(i) 90-100 wt% polypropylene copolymer or homopolymer having MFI (230°C/2.16 kg) of 1-6;

(ii) 0-3 wt% of a first filler; and

(iii) 0-3 wt% of a first pigment; and

(b) at least a portion of the warp tapes comprise:

(i) 75-95 wt% HDPE, having MFI (190°C/2.16 kg) 0.05-3;

(ii) 10-25 wt% polypropylene homopolymer having MFI (230°C/2.16 kg) of 1-7;

(iii) 0-3 wt% of a second filler; and

(iv) 0-3 wt% of a second pigment.

10. The laminated fabric of any one of claims 8-9 wherein at least a portion of the warp tapes comprise polypropylene tapes.

11. The laminated fabric of any one of claims 8-10 wherein at least one of the first and second fillers is $CaCO_3$, and wherein at least one of the first and second pigments is TiO_2.

12. The laminated fabric of any one of claims 6-11, wherein the tape polypropylene has a MFI (230°C/2.16 kg) of 1-7.

13. The laminated fabric of any one of claims 6-12, wherein the tape high density polyethylene has a MFI (190°C/2.16 kg) of 0.1-3.

14. The laminated fabric of any one of claims 6-13, wherein the tape polypropylene has a density of 0.89-0.92 g/cc.

15. The laminated fabric of any one of claims 6-14, wherein the tape high density polyethylene has a density of 0.941-0.997 g/cc.

16. The laminated fabric of any one of claims 1-15, wherein the polyolefin film layer has a density of 0.7-0.92 g/cc.

17. The laminated fabric of any one of claims 1-16, wherein the polyolefin film layer has a density of 0.725-0.915 g/cc.

18. The laminated fabric of any one of claims 1-17, wherein the polyolefin film layer has a density of 0.75-0.91 g/cc.

19. The laminated fabric of any one of claims 1-18, wherein the polyolefin film layer has a thickness of 8 to 50 microns.

20. The laminated fabric of any one of claims 1-19, further comprising a tie layer.

21. The laminated fabric of claim 20, wherein the tie layer comprises at least one selected from the group consisting of HDPE, LLDPE, PP, LLDPE-EVA copolymer,

anhydride-modified acrylate copolymer and anhydride-modified LLDPE.

22. The laminated fabric of any one of claims 20-21, wherein the tie layer comprises at least one of an anhydride-modified acrylate copolymer and anhydride-modified LLDPE, wherein the anhydride is selected from the group consisting of acetic anhydride, maleic anhydride and an anhydride having the formula R^1-C(=O)OC(=O)-R^2 wherein R^1 and R^2 are independently C_1-C_{10} hydrocarbon chains.

23. The laminated fabric of any one of claims 20-22, wherein the tie layer comprises:
(a) 60-70 wt% polypropylene copolymer having MFI (230°C/2.16 kg) of 22-45;
(b) 10-20 wt% LDPE having MFI (190°C/2.16 kg) of 3-10; and
(c) 15-25 wt% of a compatibilizer.

24. The laminated fabric of any one of claims 1-23, wherein the polyolefin film layer comprises at least one selected from the group consisting of (a) biaxially oriented polypropylene, (b) a cast film of at least one selected from the group consisting of LDPE, LLDPE, MDPE, HDPE, PP, PET, (c) a blown film of at least one selected from the group consisting of LDPE, LLDPE, MDPE, and HDPE, (d) at least one mono-axially or biaxially oriented film selected from the group consisting of LDPE, LLDPE, MDPE and HDPE and any combination of the foregoing (a), (b), (c) and (d).

25. A method of making a laminated fabric comprising (I) cross-woven oriented polyolefin tapes and (II) a polyolefin film coating, the method comprising:
(a) providing a cross woven HDPE blend fabric and a polyolefin film; and
(b) laminating onto at least one side of said HDPE blend fabric the polyolefin film at a temperature of 225-325° C to form a laminated fabric.

26. The method of claim 25, wherein providing a cross-woven HDPE blend fabric comprises:
(a) melt blending;
(i) 5-35 wt% 0.5-8 MFI (230°C/2.16 kg) PP;
(ii) 65-95 wt% 0.1-3.5 MFI (190°C/2.16 kg) HDPE;
(iii) 0-30 wt% of at least one filler;
(iv) 0-3 wt% of at least one UV additive; and

(v) 0-5 wt% of at least one compatibilizer to form an HDPE-PP melt blend;

(b) extruding the HDPE-PP melt blend at 220-295° C through a die to form an extrudate;

(c) water quenching the extrudate;

(d) slitting the extrudate to form at least one tape,

(e) heating and stretching the at least one tape at 50-500 m/min and 80-140° C; and

(f) weaving a plurality of said tapes into a fabric; and

(g) cross-weaving PP homopolymer or PP copolymer tapes into the fabric to form cross-woven HDPE blend fabric.

27. The method of any one of claims 25-26, further comprising: laminating a second lamination layer comprising LDPE or PP copolymer to the cross-woven HDPE blend fabric.

28. The method of any one of claims 26-27, wherein the tape PP has a MFI (230°C/2.16 kg) of 1-7.

29. The method of any one of claims 26-28, wherein the tape HDPE has a MFI (190°C/2.16 kg) of 0.1-3.

30. The method of any one of claims 26-29, wherein the tape PP has a density of 0.89-0.92 g/cc.

31. The method of any one of claims 26-30, wherein the tape HDPE has a density of 0.941-0.997 g/cc.

32. The method of any one of claims 26-31, wherein the polyolefin film layer has a density of 0.7-0.92 g/cc.

33. The method of any one of claims 26-32, wherein the polyolefin film layer has a density of 0.725-0.915 g/cc.

34. The method of any one of claims 26-33, wherein the polyolefin film layer has a density of 0.75-0.85 g/cc.

35. The method of any one of claims 26-34, further comprising laminating a tie layer to the fabric.

36. The method of claim 35, wherein the tie layer comprises at least one selected from the group consisting of HDPE, LLDPE, PP, LLDPE-EVA copolymer, anhydride-modified acrylate copolymer and anhydride-modified LLDPE.

37. The method of any one of claims 35-36, wherein the tie layer comprises at least one of an anhydride-modified acrylate copolymer and anhydride-modified LLDPE, wherein the anhydride is selected from the group consisting of acetic anhydride, maleic anhydride and an anhydride having the formula R^1-C(=O)OC(=O)-R^2 wherein R^1 and R^2 are independently C_1-C_{10} hydrocarbon chains.

38. The method of any one of claims 35-37, wherein the tie layer comprises:
(a) 60-70 wt% polypropylene copolymer having MFI (230°C/2.16 kg) of 22-45;
(b) 10-20 wt% LDPE having a MFI (190°C/2.16 kg) of 3-10; and
(c) 15-25 wt% of a compatibilizer.

39. A laminated fabric comprising:
(a) a cross woven HDPE blend fabric;
(b) a first lamination layer comprising;
(i) polypropylene copolymer having a MFI (230°C/2.16 kg) of 22-45; and
(ii) a compatibilizer; and
(c) a tie layer, wherein the tie layer comprises at least one selected from the group consisting of HDPE, LLDPE, PP, LLDPE-EVA copolymer, anhydride-modified acrylate copolymer and anhydride-modified LLDPE.

40. The laminated fabric of claim 39, wherein the tie layer comprises at least one of an anhydride-modified acrylate copolymer and anhydride-modified LLDPE, wherein the anhydride is selected from the group consisting of acetic anhydride, maleic anhydride and an anhydride having the formula R^1-C(=O)OC(=O)-R^2 wherein R^1 and R^2 are independently C_1-C_{10} hydrocarbon chains.

41. The laminated fabric of any one of claims 39-40 wherein the tie layer comprises:

(a) 60-70 wt% polypropylene copolymer having MFI (230°C/2.16 kg) of 22-45;

(b) 10-20 wt% LDPE having a MFI (190°C/2.16 kg) of 3-10; and

(c) 15-25 wt% of a compatibilizer.

42. A laminated cross woven fabric comprising:

(a) a cross-woven HDPE blend fabric;

(b) a first lamination layer laminated to a first side of the HDPE blend fabric, the lamination layer comprising:

(i) 70-100% of 5-10 MFI (190°C/2.16 kg) LDPE or LLDPE; and

(ii) 0-30% of 22-45 MFI (230°C/2.16 kg) polypropylene copolymer;

(c) a tie layer laminated to a second side of the blend fabric, the tie layer comprising:

(i) 22-45 MFI (230°C/2.16 kg) polypropylene copolymer;

(ii) a compatibilizer; and

(iii) at least one selected from the group consisting of from the group consisting of HDPE, LLDPE, PP, LLDPE-EVA copolymer, anhydride-modified acrylate copolymer and anhydride-modified LLDPE; and

(d) a polyolefin film layer bonded to the tie layer.

43. A laminated cross-woven fabric comprising:

(a) a cross-woven HDPE blend fabric;

(b) a lamination layer comprising:

(i) 70%-100% 5-10 MFI (190°C/2.16 kg) LDPE or LLDPE;

(ii) 0-100% 22-45 MFI (230°C/2.16 kg) PPCP;

(iii) 0-10% of a filler; and

(iv) 0-4% of a pigment.

44. A packaging comprising a laminated fabric of any one of claims 1-24 or 39-43.

45. A packaging comprising a laminated fabric made by the method of any of claims 25-38.

46. A method for laminating a first film to a second film to form a composite laminated film, the method comprising:

simultaneously conveying a first film onto a nip roll and a second film onto a laminating roll;

pressing the first film into contact with the second film between the nip roll and the laminating roll to form the composite laminated film, said composite laminated film having a first film side facing away from the laminating roll and a second film side in contact with the laminating roll;

conveying the composite laminated film from the laminating roll onto an intermediate roll, wherein the first film side contacts the intermediate roll and the second film side faces away from the intermediate roll;

conveying the composite laminated film from the intermediate roll onto a return roll, wherein the second film side contacts the return roll and the first film side faces away from the return roll;

conveying the composite laminated film from the return roll onto the laminating roll, wherein the second film side contacts the laminating roll and the first film side faces away from the laminating roll; and

conveying the composite laminated film from the laminating roll onto a discharge roll, wherein the first film side contacts the discharge roll and the second film side faces away from the discharge roll.

47. The method according to claim 46, wherein the laminating roll has a larger diameter than the intermediate roll.

48. The method according to claim 47, wherein the return roll has a smaller diameter than the intermediate roll.

49. The method according to claim 47, wherein the return roll has the same diameter as the intermediate roll.

50. The method according to any one of claims 46-49, wherein the laminating roll is cooled.

51. The method according to any one of claims 46-50, wherein at least one of the intermediate roll and the return roll are cooled.

52. The method according to any one of claims 46-51, wherein the first film comprises a polyolefin and the second film comprises polyethylene.

53. A film lamination station comprising:

a nip roll;

a laminating roll;

an intermediate roll;

a return roll; and

a discharge roll;

wherein the nip roll is configured to press a first film conveyed thereon into contact with a second film conveyed by the laminating roll to form a composite laminated film having a first film side facing away from the laminating roll and a second film side in contact with the laminating roll,

wherein the intermediate roll is configured to receive the laminated film from the laminating roll with the first film side in contact with the intermediate roll and the second film side facing away from the intermediate roll,

wherein the return roll is configured to receive the laminated film from the intermediate roll with the second film side in contact with the return roll and the first film side facing away from the return roll,

wherein the laminating roll is configured to receive the laminated film from the return roll with the second film side in contact with the laminating roll and the first film side facing away from the laminating roll, and

wherein the discharge roll is configured to receive the laminated film from the laminating roll with the first film side in contact with the discharge roll and the second film side facing away from the discharge roll.

54. The film lamination station according to claim 53, wherein the laminating roll has a larger diameter than the intermediate roll.

55. The film lamination station according to claim 54, wherein the return roll has a smaller diameter than the intermediate roll.

56. The film lamination station according to claim 54, wherein the return roll has the same diameter as the intermediate roll.

57. The film lamination station according to any one of claims 53-56, wherein the laminating roll is cooled.

58. The film lamination station according to any one of claims 53-57, wherein at least one of the intermediate roll and the return roll are cooled.

59. The film lamination station according to any one of claims 53-58, wherein the first film comprises a polyolefin and the second film comprises polyethylene.

60. A packaging comprising the composite laminated film made by the method of any one of claims 46-52.