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Declarations under Rule 4.17:

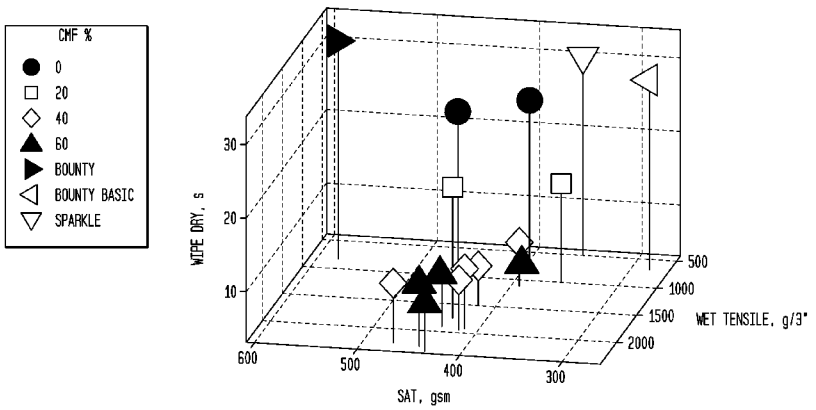
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

[Continued on next page]

(54) **Title**: BELT-CREPED, VARIABLE LOCAL BASIS WEIGHT MULTI-PLY SHEET WITH CELLULOSE MICROFIBER PREPARED WITH PERFORATED POLYMERIC BELT

FIG. 2
WIPE DRY TIMES FOR FRBC TWO-PLY WIPER



(57) **Abstract**: A multi-ply absorbent sheet includes at least a first and second ply bonded together. In one construction, the first and second ply are provided with from about 90% to about 25% by weight pulp-derived papermaking fiber and from about 10% to about 75% by weight fibrillated regenerated cellulosic microfiber having a CSF value of less than 175 ml; the sheet having a caliper of from 180-250 mils/8 sheets and exhibiting a wipe-dry time of less than 20 seconds, an SAT capacity in the range of 350-500 g/m^2, an SAT rate in the range of 0.05-0.25 g/s$^{0.5}$, a CD wet tensile in the range of 400-2500 g/3" and a wet/dry CD tensile ratio of from 35% to 60%. The multi-ply sheets have enough absorbent capacity for use as ordinary paper towels. Preferred products exhibit a differential pore volume for pores under 5 microns in diameter of at least about 75 mm^3/g/micron.

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AMENDED CLAIMS
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1. A multi-ply wiper/towel product comprising:
at least one wet laid web prepared by a belt-creping process, the at least one wet laid web comprising at least 10% fibrillated regenerated cellulosic microfibers, and at least about 40% wood pulp derived papermaking fibers, the at least one wet laid web having formed therein:

(i) a plurality of fiber-enriched hollow domed regions protruding from the upper side of the at least one wet laid web, the hollow domed regions having a sidewall formed along at least a leading edge thereof, the sidewall having a local basis weight that is higher than a mean basis weight of the at least one wet laid web;

(ii) connecting regions forming a network interconnecting the hollow domed regions of the at least one wet laid web, the connecting regions having a local basis weight that is lower than the local basis weight of the hollow domed regions; and

(iii) transition areas with consolidated fibrous regions that transition from the connecting regions into the hollow domed regions, by extending upwardly and inwardly from the connecting regions into the sidewalls of the hollow domed regions.

2. The multi-ply wiper/towel product according to claim 1, wherein the fibrillated regenerated cellulosic microfibers present in the at least one wet laid web form venation on the surface of the consolidated fibrous regions, such that the surface has raised, generally continuous ridges defined thereacross.

3. The multi-ply wiper/towel product according to claim 1, wherein the consolidated fibrous regions are saddle shaped, and more than 35% by weight of the fibrillated regenerated cellulosic microfibers have a CSF value of less than 175 mL.

4. The multi-ply wiper/towel product according to claim 1, wherein the fiber-enriched hollow domed regions exhibit a local basis weight of at least 5% higher than the mean

basis weight of the wiper/towel product, and the fibrillated regenerated cellulosic microfibers have a number average diameter of less than about 2 microns.

5. The multi-ply wiper/towel product according to claim 1, wherein the fiber-enriched hollow domed regions exhibit a local basis weight of at least 10% higher than the mean basis weight of the wiper/towel product, and the fibrillated regenerated cellulosic microfibers have a weight average diameter of less than 1 micron, a weight average length of less than 400 microns, and a fiber count of greater than 2 billion fibers/gram.

6. The multi-ply wiper/towel product according to claim 1, wherein at least a portion of the fiber-enriched hollow domed regions or the transition areas exhibits a cross machine direction (CD) fiber orientation bias, and the fibrillated regenerated cellulosic microfibers have a weight average diameter of less than 0.5 microns, a weight average length of less than 300 microns, and a fiber count of greater than 10 billion fibers/gram.

7. The multi-ply wiper/towel product according to claim 1, wherein at least a portion of the connecting regions exhibits a cross machine direction (CD) fiber orientation bias.

8. The multi-ply wiper/towel product according to claim 1, wherein at least a portion of the sidewalls of the hollow domed regions exhibits a matted structure on both their outer and inner surfaces, and fibrillated regenerated cellulosic microfibers form venation thereupon, such that the surfaces have raised, generally continuous ridges defined thereacross.

9. The multi-ply wiper/towel product according to claim 1, wherein the fibrillated regenerated cellulosic microfibers have a characteristic CSF value of less than 175 ml, the multi-ply wiper/towel product has a caliper of from 7.5 to 12 mils/8 sheets/per pound per ream, and exhibits a wipe-dry time of less than 20 seconds, an SAT capacity in the range of 9.5 to 11.0 g/g, an SAT rate in the range of 0.05 to 0.25 $g/s^{0.5}$, a cross

machine direction (CD) wet breaking length in the range of 300 to 800 m, and a wet/dry CD tensile ratio of from 40% to 60%.

10. The multi-ply wiper/towel product according to claim 9, wherein the fibrillated regenerated cellulosic microfibers exhibit a CD wet breaking length in the range of 350 to 800 m.

11. The multi-ply wiper/towel product according to claim 9, wherein the fibrillated regenerated cellulosic microfibers exhibit a CD wet breaking length in the range of 400 to 800 m.

12. The multi-ply wiper/towel product according to claim 1, wherein the fibrillated regenerated cellulosic microfibers have a number average diameter of less than about 2 microns.

13. The multi-ply wiper/towel product according to claim 1, wherein the fibrillated regenerated cellulosic microfibers have a number average diameter of from about 0.1 to about 2 microns.

14. The multi-ply wiper/towel product according to claim 1, wherein the fibrillated regenerated cellulosic microfibers have:
(i) a weight average diameter of less than 2 microns,
(ii) a weight average length of less than 500 microns; and
(iii) a fiber count of greater than 400 million fibers/gram.

15. The multi-ply wiper/towel product according to claim 1, wherein the fibrillated regenerated cellulosic microfibers have:
(i) a weight average diameter of less than 0.25 microns,

(ii) a weight average length of less than 200 microns; and
(iii) a fiber count of greater than 50 billion fibers/gram.

16. The multi-ply wiper/towel product according to claim 1, wherein the fibrillated regenerated cellulosic microfibers have a fiber count greater than 200 billion fibers/gram.

17. The multi-ply wiper/towel product according to claim 1, wherein:

(i) the consolidated fibrous regions are saddle shaped, and more than 35% by weight of the fibrillated regenerated cellulosic microfibers have a CSF value of less than 175 mL;

(ii) the fiber-enriched hollow domed regions exhibit a local basis weight of at least 10% higher than the mean basis weight of the wiper/towel product;

(iii) at least a portion of the fiber-enriched hollow domed regions or the transition areas exhibits a cross machine direction (CD) fiber orientation bias, and the fibrillated regenerated cellulosic microfibers have a weight average diameter of less than 0.5 microns, a weight average length of less than 300 microns, and a fiber count of greater than 10 billion fibers/gram;

(iv) at least a portion of the connecting regions exhibits a CD fiber orientation bias;

(v) at least a portion of the sidewalls of the hollow domed regions exhibits a matted structure on both their outer and inner surfaces, and the fibrillated regenerated cellulosic microfibers form venation thereupon, such that the surfaces have raised, generally continuous ridges defined thereacross; and

(vi) the multi-ply wiper/towel product has a caliper of from 7.5 to 12 mils/8 sheets/per pound per ream, and exhibits a wipe-dry time of less than 20 seconds, an SAT capacity in the range of 9.5 to 11.0 g/g, an SAT rate in the range of 0.05 to 0.25 $g/s^{0.5}$, a CD wet breaking length in the range of 300 to 800 m, and a wet/dry CD tensile ratio of from 40% to 60%.

18. The multi-ply wiper/towel product according to claim 17, wherein the fibrillated regenerated cellulosic microfibers exhibit a CD wet breaking length in the range of 350 to 800 m.

19. The multi-ply wiper/towel product according to claim 17, wherein the fibrillated regenerated cellulosic microfibers exhibit a CD wet breaking length in the range of 400 to 800 m.

20. The multi-ply wiper/towel product according to claim 1, wherein the fibrillated regenerated cellulosic microfibers have a weight average diameter of less than 0.5 microns, a weight average length of less than 300 microns, and a fiber count of greater than 10 billion fibers/gram, and fibrillated regenerated cellulosic microfibers present in the web form venation on the surface of the consolidated fibrous regions, such that the surface has raised, generally continuous ridges defined thereacross.

21. The multi-ply wiper/towel product according to claim 20, wherein the consolidated fibrous regions are saddle shaped.

22. The multi-ply wiper/towel product according to claim 20, wherein the consolidated fibrous regions comprise saddle shaped regions about the base of the dome of the hollow domed regions, and wherein the fibrillated regenerated cellulose microfibers have a weight average diameter of less than 0.25 microns, a weight average length of less than 200 microns, and a fiber count of greater than 50 billion fibers/gram, the wiper/towel product exhibiting a differential pore volume for pores under 5 microns in diameter of at least about 75 $mm^3/g/micron$.

23. The multi-ply wiper/towel product according to claim 20, wherein the wiper/towel product has a caliper of from 7.5 to 12 mils/8 sheets/per pound per ream, and exhibits a wipe-dry time of less than 20 seconds, an SAT capacity in the range of 9.5 to 11.0 g/g, an SAT rate in the range of 0.05 to 0.25 $g/s^{0.5}$, a cross machine direction (CD) wet breaking length in the range of 300 to 800 m, and a wet/dry CD tensile ratio of from 40% to 60%.

24. The multi-ply wiper/towel product according to claim 23, wherein the fibrillated regenerated cellulosic microfibers exhibit a CD wet breaking length in the range of 350 to 800 m.

25. The multi-ply wiper/towel product according to claim 23, wherein the fibrillated regenerated cellulosic microfibers exhibit a CD wet breaking length in the range of 400 to 800 m.

26. The multi-ply wiper/towel product according to claim 23, wherein the transition areas at least partially circumscribe the domes of the hollow domed regions at the bases of the domes, and wherein the fibrillated regenerated cellulosic microfibers have a weight average diameter of less than 0.25 microns, a weight average length of less than 200 microns, and a fiber count of greater than 50 billion fibers/gram, the wiper/towel product exhibiting a differential pore volume for pores under 5 microns in diameter of at least about 100 mm^3/g/micron.

27. The multi-ply wiper/towel product according to claim 26, wherein the transition areas are densified in a bowed shape around a portion of the bases of the domes, and the multi-ply wiper/towel product exhibits a wipe-dry time of from 5 seconds to 15 seconds.

28. The multi-ply wiper/towel product according to claim 1, wherein the plurality of fiber-enriched regions include (A) hollow domed portions and (B) pileated fiber-enriched portions with a cross machine direction (CD) fiber orientation bias adjacent to the hollow domed portions, the wiper/towel product having a caliper of from 7.5 to 12 mils/8 sheets/per pound per ream, and exhibiting a wipe-dry time of less than 20 seconds, an SAT capacity in the range of 9.5 to 11.0 g/g, an SAT rate in the range of 0.05 to 0.25 $g/s^{0.5}$, a CD wet breaking length in the range of 300 to 800 m, and a wet/dry CD tensile ratio of from 40% to 60%.

29. The multi-ply wiper/towel product according to claim 28, wherein the fibrillated regenerated cellulosic microfibers exhibit a CD wet breaking length in the range of 350 to 800 m.

30. The multi-ply wiper/towel product according to claim 28, wherein the fibrillated regenerated cellulosic microfibers exhibit a CD wet breaking length in the range of 400 to 800 m.

31. The multi-ply wiper/towel product according to claim 1, wherein the fibrillated regenerated cellulosic microfibers have a weight average diameter of less than 2 microns, a weight average length of less than 500 microns, and a fiber count of greater than 400 million fibers/gram, and the plurality of fiber-enriched hollow domed regions haveconsolidated caps.

32. The multi-ply wiper/towel product according to claim 31, wherein the fibrillated regenerated cellulosic microfibers have a weight average diameter of less than 0.25 microns, a weight average length of less than 200 microns, and a fiber count of greater than 50 billion fibers/gram.

33. The multi-ply wiper/towel product according to claim 32, wherein the consolidated caps of the fiber-enriched hollow domed regions have the general shape of a portion of a spheroidal shell.

34. The multi-ply wiper/towel product according to claim 32, wherein the consolidated caps of the fiber-enriched hollow domed regions have the general shape of an apical portion of a spheroidal shell.

35. The multi-ply wiper/towel product according to claim 34, wherein the wiper/towel product has a caliper of from 7.5 to 12 mils/8 sheets/per pound per ream, and exhibits a wipe-dry time of less than 20 seconds, an SAT capacity in the range of 9.5 to 11.0 g/g, an SAT rate in the range of 0.05 to 0.25 $g/s^{0.5}$, a cross machine direction (CD) wet breaking length in the range of 300 to 800 m, and a wet/dry CD tensile ratio of from 40% to 60%.

36. The multi-ply wiper/towel product according to claim 35, wherein the fibrillated regenerated cellulosic microfibers exhibit a CD wet breaking length in the range of 350 to 800 m.

37. The multi-ply wiper/towel product according to claim 35, wherein the fibrillated regenerated cellulosic microfibers exhibit a CD wet breaking length in the range of 400 to 800 m.

40. The multi-ply wiper/towel product according to claim 1, wherein the fiber-enriched hollow domed regions include an inclined sidewall.

54. The multi-ply wiper/towel product according to claim 1, wherein the fibrillated regenerated cellulosic microfibers have a CSF value of less than 175 mL, and the at least one wet laid web exhibits a differential pore volume for pores under 5 microns in a diameter of at least about 100 $mm^3/g/micron$.

56. The multi-ply wiper/towel product according to claim 54, wherein the fibrillated regenerated cellulosic microfibers have a weight average diameter of less than 2 microns, a weight average length of less than 500 microns, and a fiber count of greater than 400 million fibers/gram.

57. The multi-ply wiper/towel product according to claim 56, wherein the at least one wet laid web has a caliper of from 7.5 to 12 mils/8 sheets/per pound per ream, and exhibits a wipe-dry time of less than 20 seconds, an SAT capacity in the range of 9.5 to 11.0 g/g, an SAT rate in the range of 0.05 to 0.25 $g/s^{0.5}$, a cross machine direction (CD) wet breaking length in the range of 300 to 800 m, and a wet/dry CD tensile ratio of from 40% to 60%.

58. The multi-ply wiper/towel product according to claim 57, wherein the fibrillated regenerated cellulosic microfibers exhibit a CD wet breaking length in the range of 350 to 800 m.

59. The multi-ply wiper/towel product according to claim 57, wherein the fibrillated regenerated cellulosic microfibers exhibit a CD wet breaking length in the range of 400 to 800 m.

60. The multi-ply wiper/towel product according to claim 54, wherein the at least one wet laid web has a caliper of from 7.5 to 12 mils/8 sheets/per pound per ream, and exhibits a wipe-dry time of less than 20 seconds, an SAT capacity in the range of 9.5 to 11.0 g/g, an SAT rate in the range of 0.05 to 0.25 $g/s^{0.5}$, a cross machine direction (CD) wet breaking length in the range of 300 to 800 m, and a wet/dry CD tensile ratio of from 40% to 60%.

61. The multi-ply wiper/towel product according to claim 60, wherein the fibrillated regenerated cellulosic microfibers exhibit a CD wet breaking length in the range of 350 to 800 m.

62. The multi-ply wiper/towel product according to claim 60, wherein the fibrillated regenerated cellulosic microfibers exhibit a CD wet breaking length in the range of 400 to 800 m.

63. The multi-ply wiper/towel product according to claim 60, wherein the fibrillated regenerated cellulosic microfibers have a weight average diameter of less than 0.25 microns, a weight average length of less than 200 microns, and a fiber count of greater than 50 billion fibers/gram.

64. The multi-ply wiper/towel product according to claim 60, wherein the fibrillated regenerated cellulosic microfibers have a weight average diameter of less than 0.5 microns, a weight average length of less than 300 microns, and a fiber count of greater than 10 billion fibers/gram.

65. The multi-ply wiper/towel product according to claim 54, wherein the fibrillated regenerated cellulosic microfibers have a weight average diameter of less than 0.5

microns, a weight average length of less than 300 microns, and a fiber count of greater than 10 billion fibers/gram.

66. The multi-ply wiper/towel product according to claim 1, wherein the wiper/towel product has a bulk of from about 9 to about 19 cm^3/g and exhibits a wipe-dry time of less than 20 seconds, an SAT capacity in the range of 9.5 to 11.0 g/g, an SAT rate in the range of 0.05 to 0.25 $g/s^{0.5}$, a cross machine direction (CD) wet breaking length in the range of 300 to 800 m, and a wet/dry CD tensile ratio of from 40% to 60%.

67. The multi-ply wiper/towel product according to claim 66, wherein the fibrillated regenerated cellulosic microfibers exhibit a CD wet breaking length in the range of 350 to 800 m.

68. The multi-ply wiper/towel product according to claim 66, wherein the fibrillated regenerated cellulosic microfibers exhibit a CD wet breaking length in the range of 400 to 800 m.

69. The multi-ply wiper/towel product according to claim 66, wherein the fibrillated regenerated cellulosic microfibers have a weight average diameter of less than 0.25 microns, a weight average length of less than 200 microns, and a fiber count of greater than 50 billion fibers/gram, the wiper/towel product exhibiting a differential pore volume for pores under 5 microns in diameter of at least about 100 $mm^3/g/micron$.

70. The multi-ply wiper/towel product according to claim 66, wherein the fibrillated regenerated cellulosic microfibers have a weight average diameter of less than 0.5 microns, a weight average length of less than 300 microns, and a fiber count of greater than 10 billion fibers/gram.

71. The multi-ply wiper/towel product according to claim 1, wherein the fibrous composition of the web, the fibrillated regenerated cellulosic microfiber geometry, and the number average count are chosen such that the multi-ply wiper/towel product

exhibits a wipe-dry time of less than 20 seconds, and an SAT capacity in the range of 9.5 to 11.0 g/g.

72. The multi-ply wiper/towel product according to claim 71, the wiper/towel product exhibiting a wipe-dry time of 10 seconds or less.

73. The multi-ply wiper/towel product according to claim 71, the wiper/towel product exhibiting a CD wet breaking length in the range of 300 to 800 m.

74. The multi-ply wiper/towel product according to claim 71, the wiper/towel product exhibiting a CD wet breaking length in the range of 400 to 800 m.

75. The multi-ply wiper/towel product according to claim 71, the wiper/towel product exhibiting an SAT rate in the range of 0.05 to 0.25 $g/s^{0.5}$.

76. The multi-ply wiper/towel product according to claim 71, the wiper/towel product exhibiting a differential pore volume of at least about 10% for pores under 5 microns in diameter.

77. The multi-ply wiper/towel product according to claim 1, wherein the wiper/towel product exhibits a relative wipe dry time that is less than 50% of the wipe dry time exhibited by a conventional wipe of the same fibrous composition, but without fibrillated regenerated cellulosic microfibers.

78. The multi-ply wiper/towel product of claim 77, wherein the wiper/towel product exhibits a differential pore volume for pores under 5 microns in diameter of at least about 100 $mm^3/g/micron$.

80. The multi-ply wiper/towel product of claim 77, wherein the wiper/towel product exhibits a relative wipe dry time that is less than 40% of the wipe dry time exhibited by a conventional wipe of the same fibrous composition, but without fibrillated regenerated cellulosic microfibers.

81. The multi-ply wiper/towel product of claim 77, wherein the fibrillated regenerated cellulosic microfibers have a weight average diameter of less than 1 micron, a weight average length of less than 400 microns, and a fiber count of greater than 2 billion fibers/gram.

82. The multi-ply wiper/towel product of claim 81, wherein the wiper/towel product exhibits a differential pore volume for pores under 5 microns in a diameter of at least about 100 $mm^3/g/micron$.

88. The multi-ply wiper/towel product according to claim 1, wherein the fibrous composition of the web, the fibrillated regenerated cellulosic microfiber geometry, and the number average count are chosen such that the multi-ply wiper/towel product exhibits a differential pore volume of at least about 10% for pores under 5 microns in diameter, and wherein the wiper/towel product exhibits a relative wipe dry time that is less than 50% of the wipe dry time exhibited by a conventional wipe of the same fibrous composition, but without fibrillated regenerated cellulosic microfibers.

89. The multi-ply wiper/towel product of claim 88, the wiper/towel product exhibiting a wipe-dry time of 10 seconds or less.

90. The multi-ply wiper/towel product according to claim 88, the wiper/towel product exhibiting a CD wet breaking length in the range of 300 to 800 m.

91. The multi-ply wiper/towel product according to claim 88, the wiper/towel product exhibiting a CD wet breaking length in the range of 400 to 800 m.

92. The multi-ply wiper/towel product according to claim 88, the wiper/towel product exhibiting an SAT rate in the range of 0.05 to 0.25 $g/s^{0.5}$.

93. The multi-ply wiper/towel product according to claim 88, the wiper/towel product exhibiting an SAT capacity in the range of 9.5 to 11.0 g/g.

94. The multi-ply wiper/towel product according to claim 1, wherein the fibrous composition of the web, the fibrillated regenerated cellulosic microfiber geometry, and the number average count are chosen such that the multi-ply wiper/towel product exhibits a wipe-dry time of less than 20 seconds, a differential pore volume of at least about 10% for pores under 5 microns in diameter, and an SAT capacity in the range of 9.5 to 11.0 g/g.

95. The multi-ply wiper/towel product of claim 94, the wiper/towel product exhibiting a wipe-dry time of 10 seconds or less.

96. The multi-ply wiper/towel product according to claim 94, the wiper/towel product exhibiting a CD wet breaking length in the range of 300 to 800 m.

97. The multi-ply wiper/towel product according to claim 94, the wiper/towel product exhibiting a CD wet breaking length in the range of 400 to 800 m.

98. The multi-ply wiper/towel product according to claim 94, the wiper/towel product exhibiting an SAT rate in the range of 0.05 to 0.25 $g/s^{0.5}$.