ABSTRACT

Water-soluble, printable paper is disclosed. Methods of making and using water-soluble, printable paper are also disclosed.
WATER-SOLUBLE PRINTABLE PAPER AND METHODS OF MAKING AND USING THE SAME

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This patent application claims the benefit of priority to U.S. provisional patent application Ser. No. 61/828,262 entitled “WATER-SOLUBLE PRINTABLE PAPER AND METHODS OF MAKING AND USING THE SAME” filed on May 29, 2013, the subject matter of which is incorporated herein in its entirety.

FIELD OF THE INVENTION

[0002] The present invention relates generally to water-soluble printable paper. The present invention further relates generally to methods of making water-soluble printable paper, as well as methods of using water-soluble printable paper.

BACKGROUND OF THE INVENTION

[0003] Efforts continue to further reduce the amount of radioactive-contaminated product/clothing/supplies at a nuclear facility.

SUMMARY OF THE INVENTION

[0004] The present invention is directed to a water-soluble, printable paper. The water-soluble, printable paper of the present invention provides one or more of the following features: (i) the ability to be disposed of via solubilizing in hot water, (ii) the ability to provide a printable substrate, and (iii) the ability to provide a printable substrate in the form of printable paper, such as printable paper sized to be printable via commercially available laser jet or ink jet printers.

[0005] According to one exemplary embodiment of the present invention, the water-soluble, printable paper comprises a single layer of water-soluble polyvinyl alcohol fibers having opposite first and second major outer surfaces, wherein the water-soluble polyvinyl alcohol fibers represent at least 20 wt % of a total number of fibers present within said paper. Typically, the water-soluble polyvinyl alcohol fibers represent at least 90 wt % of a total number of fibers present within the paper, more typically, 100 wt % of a total number of fibers present within the paper.

[0006] In another exemplary embodiment of the present invention, the water-soluble, printable paper comprises (i) a single layer of water-soluble polyvinyl alcohol fibers having opposite first and second major outer surfaces, wherein the water-soluble polyvinyl alcohol fibers represent at least 20 wt % of a total number of fibers present within said paper, and (ii) a water-soluble polyvinyl alcohol resin impregnating coating applied onto the single layer.

[0007] The present invention is further directed to a reel of paper comprising multiple sheets of the herein-described water-soluble paper. The reel of paper may comprise any number of sheets of paper, but typically comprises from about 100 to about 1000 sheets of the herein-described water-soluble paper.

[0008] The present invention is also directed to roll of paper comprising a single sheet of paper having and a width of less than about 36 inches (in), where the single sheet of paper comprises the herein-described water-soluble paper.

[0009] The present invention is further directed to methods of making a water-soluble, printable paper. In one exemplary embodiment, the method of making a water-soluble, printable paper comprises forming a single layer of water-soluble polyvinyl alcohol fibers having opposite first and second major outer surfaces, wherein the water-soluble polyvinyl alcohol fibers represent at least 20 wt % of a total number of fibers present within the paper, contacting the single layer of water-soluble polyvinyl alcohol fibers with an aqueous solution comprising water-soluble polyvinyl alcohol; and drying the single layer of water-soluble polyvinyl alcohol fibers.

[0010] The present invention is even further directed to methods of using a water-soluble, printable paper. In one exemplary embodiment of the present invention, the method of using a water-soluble paper comprises printing one or more indicia onto at least one major surface of the water-soluble paper, the water-soluble paper comprising a single layer of water-soluble polyvinyl alcohol fibers having opposite first and second major outer surfaces, wherein the water-soluble polyvinyl alcohol fibers represent at least 20 wt % of a total number of fibers present within the paper. Methods of using the water-soluble, printable paper of the present invention may further include one or more additional steps including, but not limited to, loading one or more sheets of the water-soluble paper into a printer (e.g., an ink jet printer or a laser jet printer); removing the water-soluble paper from packaging; disposing of the water-soluble paper after use; exposing of the water-soluble paper to radiation so as to contaminate the water-soluble paper; disposing of the water-soluble paper after use, wherein the disposing step comprises solubilizing the water-soluble paper to form a radioactive aqueous solution, and separating radioactive material from the radioactive aqueous solution; providing the water-soluble paper to a user; and offering for sale the water-soluble paper.

[0011] These and other features and advantages of the present invention will become apparent after a review of the following detailed description of the disclosed embodiments and the appended claims.

BRIEF DESCRIPTION OF THE FIGURES

[0012] The present invention is further described with reference to the appended figures, wherein:

[0013] FIG. 1 depicts a perspective view of an exemplary sheet of water-soluble, printable paper of the present invention;

[0014] FIG. 2 depicts a photograph of an exemplary sheet of water-soluble, printable paper of the present invention;

[0015] FIG. 3 depicts a reel of paper comprising multiple sheets of the exemplary water-soluble, printable paper shown in FIG. 1; and

[0016] FIG. 4 depicts a roll of paper comprising the exemplary water-soluble, printable paper shown in FIG. 1.

DETAILED DESCRIPTION OF THE INVENTION

[0017] The present invention is directed to water-soluble, printable paper. The present invention is further directed to methods of making and using water-soluble, printable paper. The water-soluble, printable paper of the present invention is particularly useful for use in the nuclear industry.

[0018] A sheet of exemplary water-soluble, printable paper 10 of the present invention is shown in FIG. 1. Exemplary water-soluble, printable paper 10 comprises a single layer 11 comprising water-soluble polyvinyl alcohol fibers 115 and
having a first major surface 110, and a second major surface 120. Exemplary water-soluble, printable paper 10 further comprises a water-soluble polyvinyl alcohol resin impregnating coating 12 applied onto single layer 11.

[0019] A detailed description of suitable materials for forming the water-soluble, printable paper of the present invention is provided below.

I. Water-Soluble, Printable Paper

[0020] The water-soluble, printable paper of the present invention may comprise, but are not limited to, one or more of the following components.

[0021] A. Water-Soluble, Printable Paper Components

[0022] The water-soluble, printable paper of the present invention may comprise one or more of the following components.

[0023] 1. Single Layer of Water-Soluble Fibers or Nonwoven Fabric


[0025] Suitable water-soluble polyvinyl alcohol (PVOH) fibers 115 and methods of making PVOH fibers are disclosed in U.S. Pat. Nos. 5,181,967; 5,207,837; 5,268,222; 5,620,786; 5,885,907; and 5,891,812; the disclosures of all of which are incorporated herein by reference in their entirety. An example of a suitable water-soluble polyvinyl alcohol fiber 115 for use in the present invention is a polyvinyl alcohol homopolymer fiber 115 that has been highly crystallized by post-drawing or by heat annealing. Any commercially available water-soluble polyvinyl alcohol fiber 115 is suitable for use in the present invention including, but not limited to, polyvinyl alcohol fibers 115 commercially available from SINOPEC SINCHUAN VINYLON WORKS Company (Sichuan, China); Fujian Textile and Chemical Fiber Group Co. Ltd. (Fujian, China); and Huan Xiangwei Co. Ltd. (Hunan, China).

[0026] Water-soluble polyvinyl alcohol fibers 115 are particularly suitable for the paper of the present invention due to their absorbency characteristics and hot water solubility. It is preferred that single layer 11 of water-soluble polyvinyl alcohol fibers 115 is soluble in water having a water temperature of greater than about 37°C. It is even preferred that single layer 11 of water-soluble polyvinyl alcohol fibers 115 is soluble in water having a water temperature of greater than about 50°C. It is even more preferred that single layer 11 of water-soluble polyvinyl alcohol fibers 115 is soluble in water having a water temperature of greater than about 90°C.

[0027] The polyvinyl alcohol fibers 115 of single layer 11 desirably have an average fiber diameter of less than about 100 microns. More desirably, the polyvinyl alcohol fibers 115 of single layer 11 have an average fiber diameter of from about 0.5 micron to about 40 microns. Even more desirably, the polyvinyl alcohol fibers 115 of single layer 11 have an average fiber diameter of from about 1.0 micron to about 30 microns.

[0028] Single layer 11 desirably has an overall basis weight (i.e., a basis weight of the single first layer 11 with optional coating 12) of less than or equal to about 60 grams per square meter (gsm). More desirably, single layer 11 has an overall basis weight of from about 25 gsm to about 55 gsm. Even more desirably, single layer 11 has an overall basis weight of about 45 gsm.

[0029] Single layer 11 may have an overall thickness (i.e., a thickness of single layer 11 with optional coating 12), which varies depending upon the particular end use of the paper. Desirably, single layer 11 with optional coating 12 has an overall thickness of less than about 1000 microns (μm). More desirably, single layer 11 with optional coating 12 has an overall thickness of from about 10 μm to about 500 μm. Even more desirably, single layer 11 with optional coating 12 has an overall thickness of from about 20 μm to about 100 μm.

[0030] In one exemplary embodiment, single layer 11 comprises a cross-lapped, spunlaced fabric of polyvinyl alcohol fibers 115, wherein the spunlaced fabric has a basis weight of about 60 gsm.

[0031] 2. Water-Soluble Polyvinyl Alcohol Coating/Impregnant

[0032] The water-soluble, printable paper 10 of the present invention may further comprise a water-soluble polyvinyl alcohol coating/impregnant 12 (referred to herein as “coating”) such as exemplary water-soluble polyvinyl alcohol coating 12 of exemplary water-soluble, printable paper 10 shown in FIG. 1.

[0033] 3. Additives

[0034] Any of the above-described water-soluble, printable paper 10 may further comprise one or more optional additives coated onto or incorporated into single layer 11 (e.g., within aqueous coating 12 applied onto/into single layer 11). Suitable additives include, but are not limited to, antimicrobial agents, colorants (e.g., pigments), softeners, additives to increase or decrease the coefficient of friction of single layer 11, additives to increase the hydrophobicity of single layer 11, flame retardants, etc. In one exemplary embodiment of the present invention, single layer 11 comprises an antimicrobial agent incorporated therein. Suitable antimicrobial agents include, but are not limited to, triclosan and other antimicrobial agents commercially available under the trade designation MICROBAN® from Microban International, Ltd. (New York, N.Y.).

[0035] The various additives may be added to a polymer melt and extruded to incorporate the additive into fibers 115. Alternatively, one or more additives may be coated onto fibers 115 during or after a single layer 11 forming process. Typically, when present, each of the one or more additives is present in an amount less than about 1.0 weight percent based on the total weight of the paper 10.

[0036] B. Water-Soluble, Printable Paper Features

[0037] By combining one or more of the above-described components, the water-soluble, printable paper 10 of the present invention possess one or more of the following features.

[0038] 1. Water-Solubility

[0039] As discussed above, the water-soluble, printable paper 10 of the present invention is water-soluble. Desirably, the water-soluble, printable paper 10 of the present invention is water-soluble in water having a water temperature of greater than about 37°C (or greater than about 50°C, or greater than about 75°C, or greater than about 90°C).

[0040] 2. Surface Printability

[0041] The water-soluble, paper 10 of the present invention also possesses a surface smoothness and ink/toner fixation
property that enables paper 10 to be printable, for example, via a conventional, commercially available ink jet or laser jet printer.

II. Methods of Making Water-Soluble, Printable Paper

[0042] The present invention is further directed to methods of making water-soluble, printable paper 10. As discussed above, in one exemplary embodiment, the method of making a water-soluble, printable paper 10 comprises forming a single layer 11 of water-soluble polyvinyl alcohol fibers 115 having opposite first and second major outer surfaces 110 and 120, wherein the water-soluble polyvinyl alcohol fibers 115 represent at least 20 wt % of a total number of fibers present within the paper 115. The method may further comprise contacting the single layer 11 of water-soluble polyvinyl alcohol fibers 115 with an aqueous solution comprising water-soluble polyvinyl alcohol 12 and drying the single layer 11 of water-soluble polyvinyl alcohol fibers 115.

[0043] The single layer 11 of polyvinyl alcohol fibers 115 may be formed using conventional processes including, but not limited to, meltblowing processes, spunbonding processes, spunlaceing processes, carding processes, needlepunching processes, etc. In some desired embodiments, the single layer 11 of polyvinyl alcohol fibers 115 is formed via a spunlacing process.

III. Methods of Using Water-Soluble Printable Paper

[0044] The present invention is further directed to methods of using the above-described water-soluble paper 10. As discussed above, in one exemplary embodiment, the method of using a water-soluble paper 10 of the present invention comprises printing one or more indicia 14 onto at least one major surface 110 and/or 120 of the water-soluble paper 10, the water-soluble paper 10 comprising a single layer 11 of water-soluble polyvinyl alcohol fibers 115 having opposite first and second major outer surfaces 110 and 120, wherein the water-soluble polyvinyl alcohol fibers 115 represent at least 20 wt % of a total number of fibers present within the paper 10.

[0045] Methods of using the water-soluble, printable paper 10 of the present invention may further include one or more additional steps including, but not limited to, loading one or more sheets 21 of the water-soluble paper 10 into a printer (e.g., an ink jet printer or a laser jet printer); removing the water-soluble paper 10 from packaging 22; disposing of the water-soluble paper 10 after use; exposing of the watersoluble paper 10 to radiation so as to contaminate the water-soluble paper 10; disposing of the water-soluble paper 10 after use, wherein the disposing step comprises solubilizing the water-soluble paper 10 to form a radioactive aqueous solution, and separating radioactive material from the radioactive aqueous solution; providing the water-soluble paper 10 to a user; and offering for sale the water-soluble paper 10.

Additional Embodiments

Water-Soluble Paper Embodiments

[0046] 1. Water-soluble paper 10 comprising: a single layer 11 of water-soluble polyvinyl alcohol fibers 115 having opposite first and second major outer surfaces 110 and 120, wherein said water-soluble polyvinyl alcohol fibers 115 represent at least 20 wt % of a total number of fibers present within said paper 10.

2. The paper 10 of embodiment 1, wherein said water-soluble polyvinyl alcohol fibers 115 represent at least 50 wt % of a total number of fibers present within said paper 10.

3. The paper 10 of embodiment 1 or 2, wherein said water-soluble polyvinyl alcohol fibers 115 represent at least 90 wt % of a total number of fibers present within said paper 10.

4. The paper 10 of any one of embodiments 1 to 3, wherein said water-soluble polyvinyl alcohol fibers 115 represent at least 90 wt % of a total number of fibers present within said paper 10.

5. The paper 10 of any one of embodiments 1 to 4, wherein said single layer 11 comprises a spunlaced nonwoven fabric of said water-soluble polyvinyl alcohol fibers 115.

6. The paper 10 of any one of embodiments 1 to 5, wherein said single layer 11 has a basis weight of from about 30 to about 90 grams per square meter (gsm).

7. The paper 10 of any one of embodiments 1 to 6, wherein said single layer 11 has a basis weight of less than about 36 in, where said single sheet 31 of paper 10 comprises the paper 10 of any one of embodiments 1 to 20.
23. The paper 10 of any one of embodiments 1 to 19 or the roll 30 of embodiment 22, further comprising printed material 14 along at least one of said first and second major outer surfaces 110 and 120.

24. The paper 10 of any one of embodiments 1 to 20 or the roll 30 of embodiment 21, further comprising printed material 14 along said first and second major outer surfaces 110 and 120.

25. The paper 10 of embodiment 23 or 24, wherein said printed material 14 comprises ink.

26. The paper 10 of embodiment 23 or 24, wherein said printed material 14 comprises ink.

27. A method of making the water-soluble paper 10 of any one of embodiments 1 to 26, said method comprising: forming the single layer 11 of water-soluble polyvinyl alcohol fibers 115; contacting the single layer 11 of water-soluble polyvinyl alcohol fibers 115 with an aqueous solution comprising water-soluble polyvinyl alcohol 12; and drying the single layer 11 of water-soluble polyvinyl alcohol fibers 115.


29. The method of embodiment 27 or 28, wherein said forming step comprises thermforming the single layer 11 of water-soluble polyvinyl alcohol fibers 115 via a spuncasting step.

30. The method of any one of embodiments 27 to 29, wherein said contacting step comprises dipping the single layer 11 of water-soluble polyvinyl alcohol fibers 115 into an aqueous bath comprising water-soluble polyvinyl alcohol 12. The dwell time within the aqueous bath comprising water-soluble polyvinyl alcohol 12 may vary, but is typically less than 60 seconds (or any time less than 60 seconds, in increments of 1.0 seconds (e.g., 5.0 seconds), or any range of times less than 60 seconds (e.g., from about 5.0 to about 15.0 seconds).

31. The method of any one of embodiments 27 to 30, wherein said contacting step comprises dipping the single layer 11 of water-soluble polyvinyl alcohol fibers 115 into an aqueous bath comprising (i) up to about 5.0 wt % water-soluble polyvinyl alcohol 12 and (ii) from about 95 wt % to less than 100 wt % of water, the weight percentages being based on a total weight of the aqueous bath.

32. The method of any one of embodiments 27 to 31, wherein said contacting step comprises dipping the single layer 11 of water-soluble polyvinyl alcohol fibers 115 into an aqueous bath comprising (i) from about 1.0 wt % to about 2.5 wt % water-soluble polyvinyl alcohol 12 and (ii) from about 99.0 wt % to about 97.5 wt % of water, the weight percentages being based on a total weight of the aqueous bath.

33. The method of any one of embodiments 27 to 31, wherein said contacting step comprises dipping the single layer 11 of water-soluble polyvinyl alcohol fibers 115 into an aqueous bath consisting essentially of (i) from about 1.0 wt % to about 2.5 wt % water-soluble polyvinyl alcohol 12 and (ii) from about 99.0 wt % to about 97.5 wt % of water, the weight percentages being based on a total weight of the aqueous bath.

34. The method of any one of embodiments 27 to 31, wherein said contacting step comprises dipping the single layer 11 of water-soluble polyvinyl alcohol fibers 115 into an aqueous bath consisting of (i) from about 1.0 wt % to about 2.5 wt % water-soluble polyvinyl alcohol 12 and (ii) from about 99.0 wt % to about 97.5 wt % of water, the weight percentages being based on a total weight of the aqueous bath.

35. A method of using the water-soluble paper 10 of any one of embodiments 1 to 26, said method comprising: printing one or more indicia 14 onto at least one major surface 110 and/or 120 of the water-soluble paper 10.

36. The method of embodiment 35, wherein said printing step comprises moving the water-soluble paper 10 through a printer (not shown).

37. The method of embodiment 35 or 36, wherein said printing step comprises moving the water-soluble paper 10 through an ink jet printer.

38. The method of embodiment 35 or 36, wherein said printing step comprises moving the water-soluble paper 10 through a laser jet printer.

39. The method of any one of embodiments 35 to 38, further comprising: removing the water-soluble paper 10 from packaging 22. See, for example, FIG. 3.

40. The method of any one of embodiments 35 to 39, further comprising: removing the water-soluble paper 10 from packaging 22, the packaging 22 comprising an outer covering 23 for a ream 20 of paper 10.

41. The method of any one of embodiments 35 to 40, further comprising: loading the water-soluble paper 10 into a printer.

42. The method of any one of embodiments 35 to 41, further comprising: disposing of the water-soluble paper 10 after use.

43. The method of embodiment 42, wherein said disposing step comprising solubilizing the water-soluble paper 10.

44. The method of any one of embodiments 35 to 42, further comprising: exposing of the water-soluble paper 10 to radiation so as to contaminate the water-soluble paper 10.

45. The method of embodiment 44, wherein said exposing step comprising using the water-soluble paper 10 at a nuclear facility.

46. The method of embodiment 44 or 45, further comprising: disposing of the water-soluble paper 10 after use, said disposing step comprising solubilizing the water-soluble paper 10 to form a radioactive aqueous solution, and separating radioactive material from the radioactive aqueous solution.

47. The method of any one of embodiments 35 to 46, further comprising: providing the water-soluble paper 10 to a user.

48. The method of any one of embodiments 35 to 47, further comprising: offering for sale the water-soluble paper 10.

[0047] It should be understood that the foregoing relates to exemplary embodiments of the invention and that modifications may be made without departing from the spirit and scope of the invention as set forth in the following claims. It should also be understood that ranges of values set forth above inherently include end values, as well as all incremental values and ranges therebetween. For example, a fabric layer thickness of from 10.0 microns (μm) to about 1000 μm includes (1) end points 10.0 μm and 1000 μm, (2) all individual fabric layer thickness values between end points 10.0 μm and 1000 μm, in any increment (e.g., 10.1 μm, 10.2 μm, 10.3 μm, . . . 999.8 μm, and 999.9 μm, etc.), and (3) any range of fabric layer thickness values between end points 10.0 μm and 1000 μm (e.g., from about 100.0 μm to about 247.3 μm, etc.).

[0048] It should be understood that although the above-described water-soluble papers, such as water-soluble paper 10, and methods are described as "comprising" one or more components, features or steps, the above-described water-soluble papers and methods may "comprise," "consist of," or "consist essentially of" any of the above-described components and/or features and/or steps of the water-soluble papers and methods. Consequently, where the present invention, or a portion thereof, has been described with an open-ended term such as "comprising," it should be readily understood that
(unless otherwise stated) the description of the present invention, or the portion thereof, should also be interpreted to describe the present invention, or a portion thereof, using the terms “consisting essentially of” or “consisting of” or variations thereof as discussed below.

[0049] As used herein, the terms “comprised,” “comprising,” “includes,” “including,” “has,” “having,” “contains,” “containing,” “characterized by” or any other variation thereof, are intended to encompass a non-exclusive inclusion, subject to any limitation explicitly indicated otherwise, of the recited components. For example, a water-soluble paper 10 and/or method that “comprises” a list of elements (e.g., components or features or steps) is not necessarily limited to only those elements (or components or features or steps), but may include other elements (or components or features or steps) not expressly listed or inherent to the water-soluble paper 10 and/or method.

[0050] As used herein, the transitional phrases “consists of” and/or “consisting of” exclude any element, step, or component not specified. For example, “consists of” or “consisting of” used in a claim would limit the claim to the components, materials or steps specifically recited in the claim except for impurities ordinarily associated therewith (i.e., impurities within a given component). When the phrase “consists of” or “consisting of” appears in a clause of the body of a claim, rather than immediately following the preamble, the phrase “consists of” or “consisting of” limits only the elements (or components or steps) set forth in that clause; other elements (or components) are not excluded from the claim as a whole.

[0051] As used herein, the transitional phrases “consists essentially of” and “consisting essentially of” are used to define water-soluble papers (e.g., water-soluble paper 10) and/or method that includes materials, steps, features, components, or elements, in addition to those literally disclosed, provided that these additional materials, steps, features, components, or elements do not materially affect the basic and novel characteristic(s) of the claimed invention. The term “consisting essentially of” occupies a middle ground between “comprising” and “consisting of”.

[0052] Further, it should be understood that the herein-described water-soluble papers (e.g., water-soluble paper 10) and/or methods may comprise, consist essentially of, or consist of any of the herein-described components and features, as shown in the figures with or without any additional feature(s) not shown in the figures. In other words, for example, in some embodiments, the water-soluble paper 10 and/or method of the present invention may have any additional feature that is not specifically shown in the figures. In some embodiments, the water-soluble paper (e.g., water-soluble paper 10) and/or method of the present invention does not have any additional features other than those (i.e., some or all) shown in the figures, and such additional features, not shown in the figures, are specifically excluded from the water-soluble paper (e.g., water-soluble paper 10) and/or method.

[0053] The present invention is further illustrated by the following examples, which are not to be construed in any way as imposing limitations upon the scope thereof. On the contrary, it is to be clearly understood that resort may be had to various other embodiments, modifications, and equivalents thereof which, after reading the description herein, may suggest themselves to those skilled in the art without departing from the spirit of the present invention and/or the scope of the appended claims.

EXAMPLE 1
Preparation of Polyvinyl Alcohol Paper

[0054] Water-soluble paper comprising polyvinyl alcohol fibers was formed using a spunlacing process. The resulting polyvinyl alcohol fabric comprised 100 wt % polyvinyl alcohol fibers and had a basis weight of about 60 grams per square meter (gsm). The fabric was then dipped into an aqueous solution comprising (i) from about 1.0 wt % to about 2.5 wt % water-soluble polyvinyl alcohol, and (ii) from about 99.0 wt % to about 97.5 wt % of deionized water, the weight percentages being based on a total weight of the aqueous solution. The dwell time in the aqueous solution was about 5 seconds. The impregnated polyvinyl alcohol fabric was then dried to form the water-soluble paper.

[0055] While the specification has been described in detail with respect to specific embodiments thereof, it will be appreciated that those skilled in the art, upon attaining an understanding of the foregoing, may readily conceive of alterations to, variations of, and equivalents to these embodiments. Accordingly, the scope of the present invention should be assessed as that of the appended claims and any equivalents thereto.

What is claimed is:

1. Water-soluble paper comprising:
   a single layer of water-soluble polyvinyl alcohol fibers having opposite first and second major outer surfaces, wherein said water-soluble polyvinyl alcohol fibers represent at least 20 wt % of a total number of fibers present within said paper.

2. The paper of claim 1, wherein said water-soluble polyvinyl alcohol fibers represent at least 50 wt % of a total number of fibers present within said paper.

3. The paper of claim 2, wherein said water-soluble polyvinyl alcohol fibers represent at least 90 wt % of a total number of fibers present within said paper.

4. The paper of claim 3, wherein said water-soluble polyvinyl alcohol fibers represent 100 wt % of a total number of fibers present within said paper.

5. The paper of claim 1, wherein said single layer comprises a spunlaced nonwoven fabric of said water-soluble polyvinyl alcohol fibers.

6. The paper of claim 1, further comprising a water-soluble polyvinyl alcohol resin impregnating coating applied onto said single layer.

7. The paper of claim 1, wherein said paper has a basis weight of from about 30 to about 90 gsm.

8. The paper of claim 1, wherein said paper has a basis weight of about 60 gsm.

9. The paper of claim 1, wherein said paper consists essentially of polyvinyl alcohol.

10. The paper of claim 1, wherein said paper consists of polyvinyl alcohol.

11. The paper of claim 1, wherein said at least one of said first and second major outer surfaces has a surface smoothness that enables printing by an ink jet printer or laser printer thereon.

12. The paper of claim 1, wherein said paper is soluble in water having a water temperature of greater than 50°C.

13. The paper of claim 1, wherein said paper is soluble in water having a water temperature of greater than 90°C.

14. The paper of claim 1, wherein said paper is sized to be printable within a laserjet or ink jet printer.
15. The paper of claim 1, wherein said paper has a rectangular shape and a width of about 8.5 inches (in) and a length of about 11 in.

16. A ream of paper comprising multiple sheets of paper, where each sheet of paper comprises the paper of claim 1.

17. A roll of paper comprising a single sheet of paper having and a width of less than about 36 in, where said single sheet of paper comprises the paper of claim 1.

18. The paper of claim 1, further comprising printed material along at least one of said first and second major outer surfaces.

19. A method of making the water-soluble paper of claim 1, said method comprising:
   forming the single layer of water-soluble polyvinyl alcohol fibers;
   contacting the single layer of water-soluble polyvinyl alcohol fibers with an aqueous solution comprising water-soluble polyvinyl alcohol; and
   drying the single layer of water-soluble polyvinyl alcohol fibers.

20. A method of using the water-soluble paper of claim 1, said method comprising:
   printing one or more indicia onto at least one major surface of the water-soluble paper.

* * * * *