



Office de la Propriété

Intellectuelle
du Canada

Un organisme
d'Industrie Canada

Canadian
Intellectual Property
Office

An agency of
Industry Canada

CA 2326998 C 2004/07/13

(11)(21) 2 326 998

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(86) Date de dépôt PCT/PCT Filing Date: 1999/03/25
(87) Date publication PCT/PCT Publication Date: 1999/10/14
(45) Date de délivrance/Issue Date: 2004/07/13
(85) Entrée phase nationale/National Entry: 2000/10/02
(86) N° demande PCT/PCT Application No.: US 1999/006596
(87) N° publication PCT/PCT Publication No.: 1999/051819
(30) Priorité/Priority: 1998/04/03 (09/054,690) US

(51) Cl.Int.⁶/Int.Cl.⁶ D21H 25/18, D21H 17/11, D21H 17/06
(72) Inventeurs/Inventors:
LEINER, LEE H., US;
BURD, JAMES E., US;
GAYDOS, ROBERT M., US
(73) Propriétaire/Owner:
PRESERVATION TECHNOLOGIES, INC., US
(74) Agent: RIDOUT & MAYBEE LLP

(54) Titre : DESACIDIFICATION DE MATIERES A BASE DE CELLULOSE A L'AIDE DE VEHICULES
HYDROFLUOROETHER
(54) Title: DEACIDIFICATION OF CELLULOSE BASED MATERIALS USING HYDROFLUOROETHER CARRIERS

(57) Abrégé/Abstract:

An improved method of deacidifying books, imaged paper and other imaged materials having a cellulose base wherein, for a sufficient time to raise the pH of the materials, the materials are treated with alkaline particles of a basic metal oxide, hydroxide or salt dispersed in a hydrofluoroether carrier, alone, or in combination with a perfluorinated carrier. A surfactant is added.

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : D21H 25/18 // 17:06, 17:11		A1	(11) International Publication Number: WO 99/51819 (43) International Publication Date: 14 October 1999 (14.10.99)
(21) International Application Number: PCT/US99/06596 (22) International Filing Date: 25 March 1999 (25.03.99)		(81) Designated States: AU, CA, JP, KR, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).	
(30) Priority Data: 09/054,690 3 April 1998 (03.04.98) US		Published <i>With international search report.</i>	
(71) Applicant: PRESERVATION TECHNOLOGIES, L.P. [US/US]; 111 Thomson Park Drive, Cranberry Township, PA 16066 (US).			
(72) Inventors: LEINER, Lee, H.; 204 McIntyre Lane, New Kensington, PA 15068 (US). BURD, James, E.; 376 Freeport Street, Saxonburg, PA 16056 (US). GAYDOS, Robert, M.; 2365 Harrison City Road, Export, PA 15632 (US).			
(74) Agents: ETHRIDGE, Christine, R. et al.; Kirkpatrick & Lockhart LLP, 1500 Oliver Building, Pittsburgh, PA 15222 (US).			

(54) Title: DEACIDIFICATION OF CELLULOSE BASED MATERIALS USING HYDROFLUOROETHER CARRIERS

(57) Abstract

An improved method of deacidifying books, imaged paper and other imaged materials having a cellulose base wherein, for a sufficient time to raise the pH of the materials, the materials are treated with alkaline particles of a basic metal oxide, hydroxide or salt dispersed in a hydrofluoroether carrier, alone, or in combination with a perfluorinated carrier. A surfactant is added.

- 1 -

TITLE: DEACIDIFICATION OF CELLULOSE BASED MATERIALS
USING HYDROFLUOROETHER CARRIERS

5

BACKGROUND OF THE INVENTION:

The deterioration of paper, books and newspapers is well-known and of growing concern to librarians and archivists throughout the world. The causes of paper deterioration are numerous and include inherent acidity, photodegradation, oxidation, and even microbiological attack under certain conditions. These factors combined with initial paper quality have severely reduced the permanence of library and archival collections. It is becoming generally accepted that the most insidious problem is the acidity of most book paper produced in the last one hundred years.

The demand for large amounts of printing paper over the last century led to the introduction of pulp fiber produced from wood by chemical or mechanical means. However, paper made from untreated wood pulp is too absorbent to allow sharp image imprint. Therefore, chemicals have to be added to the wood fibers during processing. These additives allow the paper to accept inks and dyes and increase paper opacity. Unfortunately, most of these chemicals are either acidic or are deposited by acidic mechanisms which initiate the slow,

but relentless acidic deterioration of paper. Other contributions to the acidification of paper are supplied by man through industrial emissions of sulfur and nitrogen and carbon oxides or by natural processes such as sea salt spray.

5 Even books or paper of neutral and alkaline characters are not immune. As neighboring papers of acidic nature degrade, volatile acids are produced which either diffuse through adjoining books or permeate the atmosphere and may ultimately acidify even the "safe or stable" books.

10 In order to arrest this acidic degradation, paper materials must be deacidified and provided with an alkaline reserve or buffer to retard a return to an acidic state. There are several known processes for deacidifying paper whether bound or unbound. Numbering among these are

15 processes using volatile metal alkyls, e.g. U.S. Patent Nos. 3,969,549, and 4,051,276, and volatile amines e.g. U.S. Patent Nos. 3,472,611, 3,771,958 and 3,703,353. U.S. Patent No. 3,676,182 describes the treatment of cellulosic materials with alkali and alkaline earth bicarbonates, carbonates, and 20 hydroxides in a halogenated hydrocarbon solvent or lower aliphatic hydrocarbon such as n-butane with an optional plasticizing agent such as ethylene glycol. U.S. Patent No. 3,676,055 to Smith describes a nonaqueous deacidification solution for treating cellulosic materials comprising 1000 cc

25 of 7 percent magnesium methoxide in methanol and in addition 20 pounds (9.0 kg) of dichlorodifluoromethane (Freon 22™).

Canadian Patent No. 911,110 to Smith describes a deacidification solution of a 7% magnesium methoxide solution in methanol (10 parts) and a halogenated solvent or solvents (90 parts): and states that a magnesium alkoxide reacts with

water in paper to form a mildly alkaline milk of magnesia, being magnesium hydroxide. Improved results are reported with the use of the halogenated hydrocarbon solvents.

Unfortunately, all of these processes suffer from 5 one or more of a number of drawbacks that have prevented their wide-spread acceptance. These drawbacks include high cost, toxicity, complexity of treatment, residual odor, deleterious effects on certain types of paper and inks, lack of an alkaline reserve, and the necessity of drying the book 10 or paper to very low moisture contents before treatment.

Kundrot, U.S. Patent No. 4,522,843, provided a solution to the problems experienced with prior art systems. The method of the Kundrot patent utilizes a dispersion of 15 alkaline particles of a basic metal oxide, hydroxide or salt, such as magnesium oxide, in a gas or liquid dispersant. The MgO, when converted to Mg(OH)₂, according to the reaction MgO + H₂O → Mg(OH)₂, effectively neutralizes the initial acidity in the paper and provides an adequate alkaline reserve to counter future re-acidification. The deacidification 20 reactions occur later (a period of days) and are typically described as Mg(OH)₂ + H₂O₄ → MgSO₄ + 2 H₂O. The liquid dispersant or carrier, described in the Kundrot patent is an inert halogenated hydrocarbon. It does not take part in the 25 deacidification, but serves to carry the particles to the fabric of the paper. In several embodiments described, the halogenated hydrocarbons are Freons™, or chlorofluorocarbons (CFC). CFC's have since been found to harm public health and the environment by depleting ozone in the upper atmosphere. Manufacturers of CFC's presently place limits on the amounts

- Substitute Page 4 -

they will sell to any one purchaser and are phasing out production of CFC's entirely.

A replacement for the CFC carrier in the method of deacidifying books and other cellulose based materials described in the Kundrot patent was described in Leiner et al., U.S. Patent No. 5,409,736. The Leiner patent replaced the CFC's of the Kundrot patent with perfluorinated carriers, such as perfluoropolyoxy ether and perfluoromorpholine. Unlike CFC's, perfluorocarbons are not known to cause damage to the ozone layer. However, perfluorocarbons are classified as greenhouse gases because they decompose slowly and trap heat in the atmosphere. Related to the Leiner Patent, publication WO 97/26409, also to Leiner, provides a method for treating cellulose based materials by contacting the materials with a treating medium and producing relative movement between the materials and the treating medium in a direction generally parallel to the spine of the materials. The '409 Publication discloses that the treating medium may consist of a perfluoroalkane as an inert treatment carrier and perfluoropolyoxyether alkanoic acid as a surfactant and dispersed MgO₂ as the treatment species.

SUMMARY OF THE INVENTION:

The present invention provides an improvement in a method for deacidifying cellulose based materials, such as books, magazines, newspapers, maps, documents, photographs and postcards, facsimile paper, folders, imaged paper and the like. The method involves generally treating the cellulose based materials with alkaline particles of a basic metal selected from the group consisting of oxides, hydroxide and salts, dispersed in a carrier liquid or similar dispersion medium, in an amount and for a time sufficient to pass the alkaline particles into the interstices of the materials and increase the pH of the materials. The improvement comprises dispersing the alkaline particles in an inert medium comprised of a hydrofluoroether carrier and a surfactant. Optionally, the carrier may include combinations of

- substitute Page 4a -

hydrofluoroether and a perfluorinated compound.

The hydrofluoroether carrier of the present invention does not damage the cellulose based materials by

discoloring pages or leather bindings and covers, nor does it cause inks to run or fade or weaken bindings. The new carrier has a relatively short lived atmospheric life time, disassociating into components in few years. The new carrier 5 has an ozone depletion potential of zero and is not classified as a greenhouse gas. Therefore, it is ecologically preferable to the CFC's used in the past.

The hydrofluoroether carriers have been found to provide a better dispersion of the alkaline particles with 10 less surfactant than the CFC or the perfluorinated carriers.

BRIEF DESCRIPTION OF THE FIGURE:

FIG. 1 is a graph showing the comparison between the settling rate for samples of alkaline particles dispersed in hydrofluoroether and that of samples of alkaline particles 15 dispersed in a perfluorinated compound.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS:

The cellulosic materials can be treated with any suitable basic metal oxide, hydroxide or salt as described in U.S. Patent No. 4,522,843 to Kundrot. Suitable materials, 20 according to the Kundrot patent, are the oxides, hydroxides, carbonates and bicarbonates of the Group I and II metals of the Periodic table and zinc. Preferred are the materials in which the cation is magnesium, zinc, sodium, potassium, or calcium. Particularly preferred are the relatively non-toxic oxides, carbonates and bicarbonates of magnesium and zinc and 25 the hydroxides of sodium, potassium and calcium. Representative examples include magnesium oxide, magnesium carbonate, magnesium bicarbonate, zinc carbonate, zinc

- Substitute Page 6 -

bicarbonate, zinc oxide, sodium hydroxide, potassium hydroxide and calcium hydroxide. Magnesium oxide is most preferred. The predominate particle size (95-99%) is preferably between 0.05 and 2.0 micron (between 5.0×10^{-6} and 2.0×10^{-6} m) Typical surface areas are between 50 and 200 m^2/g BET, preferably about 170-180 m^2/g .

The particles can be formed by burning the elemental metal and collecting the smoke, attrition of the preformed oxides or calcination of the elemental salts. For example, basic magnesium carbonate can be calcined at 450°C-550°C. to produce a polydisperse high activity magnesium oxide with an average particle size of 0.4 microns (4.0×10^{-7} m) and a predominant particle size between 0.1 and 1.0 micron (between 1.0×10^{-7} and 1.0×10^{-6} m). The smaller particles can be filtered out.

The particles can be applied in the paper making process or to the finished paper by immersing the paper in a suspension of the non-aqueous inert deacidifying fluid. Inert as used herein means that there is a very low interaction, and preferably no interaction, between the fluid medium and inks, dyes, bindings, cover materials and the like in the cellulose based materials. The inert fluid medium of the present invention is a hydrofluoroether carrier and a surfactant that will disperse the alkaline particles in the carrier.

Optionally, the carrier may be comprised of a combination of hydrofluoroether and perfluorinated compounds. Hydrofluoroether is miscible in all proportions with perfluorinated compounds so the carriers blend readily. The volatility of the carrier medium can be adjusted by adding varying amounts of perfluorinated compounds to achieve a

- 7 -

desired volatility. Perfluorohexane is more volatile than perfluoroheptane, so would be preferred in combination with hydrofluoroether where a greater volatility is desired.

It is believed that samples representative of the 5 entire range of papers used in the United States were included in testing of the hydrofluoroether carrier; papers such as those found in hard cover and soft cover books, encyclopedias, periodicals, newspapers, magazines, comic books and other documents. In addition, tests were run on a 10 variety of bindings including backrams, leathers, synthetic leathers and polymers.

While any suitable known surfactant may be used, it is important that the surfactant not cause damage or leave any telltale odor. It must also be soluble in 15 hydrofluoroether. A preferred surfactant is perfluoropolyoxyether alkanoic acid. In prior carrier media, the surfactant is important for the proper dispersion of the alkaline particles throughout the carrier. It was soon discovered, however, that when hydrofluoroether is used as 20 the dispersant for the alkaline particle, a better dispersion is achieved with much less surfactant than is used in the prior systems. Tests were done to compare the settling times for dispersions wherein perfluorinated carriers or 25 hydrofluoroether carriers were used. The values set forth in the Table were obtained by measurements using a light transmission method. The values are reported in 30 Nephelometric Turbidity Units (NTU). As the NTU value drops, more light is transmitted through the sample, meaning that more of the dispersed phase, in this case alkaline particles, have settled out of the dispersion. Settling rate is

- 8 -

directly correlated to the average particle size in the dispersion. The perfluorinated carrier tested was perfluoroheptane, identified as PF5070 in the Table. The hydrofluoroether tested was nonafluoromethoxybutane, 5 identified as HFE7100 in the Table. The surfactant used in the testing was perfluoropolyoxyether alkanoic acid (Fomblin® monoacid). The results are set forth in Table 1.

- 9 -

Table 1
DISPERSION STUDIES

NTU	Elapsed Minutes	DROP	CUMUL	%LOSS	Regression Output:
HFE 7100 MgO .4g/l Surfactant .1g/l					
1196	0	0	0	0	3.082244
1122	15	74	74	0	2.1224
1046	30	76	150	12.54181	0.962225
1071	45	-25	125	10.45151	
1001	60	70	195	16.30435	11
968	75	33	228	19.06355	9
938	90	30	258	21.57191	
890	105	48	306	25.58528	X Coefficient(s) 0.204267
837	120	53	359	30.01672	Std Err of Coef. 0.013491
841	135	-4	355	29.68227	
825	150	16	371	31.02007	
PFE 5070 MgO .4g/l Surfactant .1g/l					
923	0	0	0	0	Regression Output:
816	15	107	107	11.59263	Constant 7.199842
749	30	67	174	18.85157	Std Err of Y Est 5.258791
678	45	71	245	26.54388	R Squared 0.942268

- 10 -

		No. of Observations	Degrees of Freedom	
576	60	347	357	37.5948
566	75	10	119	38.67822
447	90	476	502	51.57096
421	105	26	54.38787	X Coefficient(s)
409	120	12	55.68797	0.405135
388	135	21	535	Std Err of Coef.
364	150	24	559	0.033427
				57.96316
				60.56338

Elapsed Minutes	%Loss (NRU)	%Loss (CUMUL)
0	0	0
250	100	100
500	350	250
750	650	450
1000	950	850

HFE 7100 MgO:4g/l Surfactant:0.75g/l

CUMULATIVE DROP

%LOSS

Regression Output:		
1037	0	0
981	15	56
964	30	17
905	45	59
863	60	132
818	80	174
803	95	42
769	110	219
738	135	234
687	160	219
663	185	234
2.945552	2.01327	0.973994
5.400193	7.039537	12.72903
56	73	132
15	73	174
30	17	45
45	17	59
60	56	132
80	73	174
95	73	174
110	73	174
135	73	174
160	73	174
185	73	174
2.945552	2.01327	0.973994
5.400193	7.039537	12.72903
56	73	132
15	73	174
30	17	45
45	17	59
60	56	132
80	73	174
95	73	174
110	73	174
135	73	174
160	73	174
185	73	174

HFE 7100 MgO .4g/l Surfactant .025g/l

Regression Output:	
Constant	2.634468
Std Err of Y Est	8.342481
R Squared	0.963476
No. of Observations	19.31943
Degrees of Freedom	20.96597
191	15
0	0
0	911
0	24
15	887
30	835
45	768
60	735
67	176
33	143
67	15.69704
52	76
0	24
0	0

- 12 -

		X Coefficient(s)	
			Std Err of Coef.
717	90	3	21.29528
697	105	20	23.49067
653	120	44	28.32053
608	135	45	33.26015
601	150	7	303
570	165	31	310
571	180	-1	34.02854
546	195	25	340
			37.43139
			37.32162
			40.06586

- 13 -

The data from Table 1 is presented in FIG. 1. From the values shown, it can be seen that the settling rate for hydrofluoroether 7100 (HFE7100) is about half that of the perfluorinated compound tested (PF5070). From Stokes law for the free-settling velocity of spherical particles at low Reynolds Number, this corresponds to a decrease in effective particle size of approximately 50%. In gravitational sedimentation methods, particle size is determined from settling velocity. The equation relating particle size to

settling velocity is known as Stokes Law: $d_{st} = \sqrt{\frac{18\eta u}{(p_s - p_f)g}}$ where 10 d_{st} is the Stokes diameter, η is viscosity, u is the particle settling velocity under gravity, p_s is the particle density, p_f is the fluid density and g is the acceleration due to gravity. Therefore, Stokes diameter is directly proportional 15 to the square root of the settling velocity and inversely proportional to the difference in particle and fluid density. See, Perry's Chemical Engineering Handbook, 20-7 (7th ed).

It can also be seen from the results in Table 1, that a decrease in the amount of surfactant by a factor of 20 four has no effect on the settling rate of MgO in HFE7100.

As provided in the Kundrot patent, a suitable carrier for a liquid suspension of particles is preferably inert and possesses a high enough vapor pressure to allow its removal from the paper following treatment. The boiling 25 point for the hydrofluoroethers are within the range of 40°C-100°C. The boiling point for the preferred carrier is 60°C.

An odor test was conducted by fanning books, magazines and other cellulose based material being evaluated after treatment using hydrofluoroether and Fomblin® monoacid

as the surfactant and recording the first impression on a scale of 0 to 5, from no odor at all to an overpowering odor. No odor was detected in dry books. Fomblin® monoacid is completely soluble in HFE 7100.

5 In use, a bath of an inert carrier and its suitable associated surfactant is prepared by adding to the carrier an amount of the appropriate surfactant, preferably 1×10^{-3} wt %. The alkaline particles are then added and dispersed throughout the carrier-surfactant medium.

10 The amount of surfactant and alkaline material will depend in part on the length of treatment and the amount of deposition desired. The carrier is present in excess amounts, sufficient to immerse the quantity of materials being treated. Generally, however, the concentration of 15 alkaline material will be between about 0.01 and about 0.6 weight percent. A most preferred range for the basic material particles is between about 0.01% and about 0.2%, the preferred range for the surfactant is between about 6.25×10^{-4} and 3.74×10^{-2} . The preferred alkaline particles, MgO, 20 are generally present in a dispersion maintained at approximately 0.3 - 6.0 g/L MgO based on the volume of the carrier.

25 The suspension of alkaline particles in the hydrofluoroether carrier and surfactant is preferably sprayed onto the pages of a book or other document. Alternatively, the cellulose based materials may be immersed into a bath, and preferably moved as described in U.S. Patent No. 5,422,147 and in US patent application serial number 08/586,252 filed January 16, 1996, "now U.S. Patent No.

5,770,148". The movement is preferably continued for 10-30 minutes at room temperature.

The suspension permeates the fibers of the paper leaving alkaline particles behind when the carrier and surfactant medium are evaporated. The pH of the paper is thereby raised and an alkaline reserve of at least 300 milliequivalents reserve per kilogram of paper typically remains in the fiber of the paper. Paper treated with the improved process of the present invention typically show a pH value ranging from 7.5 to 9.5.

The following example demonstrates that the pH of test strips of paper was raised using the improved process of the present invention.

15

Examples

Example 1

Twenty-five percent (25%) rag bond paper having an initial pH of 5.5 and an initial alkaline reserve of 0% was dipped in a dispersion of 0.3g/l MgO, 0.075 g/l Fomblin® in HFE 7100 for 15 minutes at room temperature. Following drying, the pH of the paper was 9.9 and the alkaline reserve was 1.75% (reported as weight percent calcium carbonate equivalent).

Example 2

Experiment 1 was repeated using a dispersion of 0.6 g/l MgO and 0.15 g/l Fomblin® in HFE 7100. The pH of the paper rose to 9.8 and the alkaline reserve rose to 2.35% (wt % calcium carbonate equivalent).

- Substitute Page 16 -

Example 3

Experiment 1 was repeated using a dispersion of 0.3g/l MgO, 0.3 g/l ZnO, 0.15 g/l Fomblin® in HFE7100. The 5 treated paper had a pH of 9.4 and an alkaline reserve of 1.65% (wt % calcium carbonate equivalent).

Example 4

Experiment 1 was repeated, dipping the bond paper into a dispersion of 4.0 g/l MgO and 1.2 g/l Fomblin® in HFE 10 7100. The treated paper had a pH of 9.6 and an alkaline reserve of 1.98% (wt % calcium carbonate equivalent).

Example 5

A dispersion of 4.0 g/l MgO, 1.2 g/l Fomblin® in HFE 15 7100 was sprayed evenly onto the entire surface of both sides of a standard 8-1/2 x 11 inch (21.59 x 27.94 cm) sheet of paper having a pH of 5.5 and an alkaline reserve of zero, at a rate of 90 ml/min. for 2.5 seconds per side. Approximately 7.5 ml dispersion was applied. The treated 20 paper had a pH of 9.5 and an alkaline reserve of 1.6% (wt % calcium carbonate equivalent).

- 17 -

WHAT IS CLAIMED IS:

1. In a method of deacidifying cellulose based materials which includes the step of treating said material with alkaline particles of a basic metal selected from the group consisting of oxides, hydroxides and salts dispersed in a liquid carrier in an amount and for a time sufficient for the particles to pass into the interstices of the cellulose based materials and increase the pH thereof, the improvement comprising:

dispersing said particles of metal in an inert medium comprised of a carrier and an associated surfactant, the carrier consisting of a hydrofluoroether.

2. The improvement of claim 1 wherein the surfactant is perfluoropolyoxyether alcanoic acid.

3. The improvement of claim 1 wherein the surfactant is present in amounts between 6.25×10^{-4} and 3.84×10^{-2} weight percent.

4. The improvement of claim 1 wherein the alkaline particles are present in amounts between about 0.01 and 0.6 weight percent.

5. The improvement of claim 1 wherein the carrier is additionally comprised of an amount of perfluorinated compounds.

6. A method of treating a cellulose based material, comprising:

dispersing alkaline particles in an inert medium

- 18 -

that includes a carrier and an associated surfactant to form a deacidification medium, the alkaline particles being a basic metal selected from the group consisting of oxides, hydroxides and salts, the carrier consisting essentially of one of a hydrofluoroether or the combination of a perfluorinated compound and a sufficient amount of a hydrofluoroether to increase the dispersion of the alkaline particles relative to a perfluorinated carrier; and

applying the medium to the cellulose based material.

7. The method of claim 6, wherein the metal includes a cation selected from the group consisting of magnesium, zinc, sodium, potassium, and calcium.

8. The method of claim 6, wherein the surfactant is soluble in hydrofluoroether.

9. The method of claim 8, wherein the surfactant is perfluoropolyoxyether alcanoic acid.

10. The method of claim 6, wherein the hydrofluoroether is nonafluoromethoxybutane.

11. The method of claim 6, wherein the carrier is inert and possesses a sufficiently high vapor pressure to allow its removal from the material following treatment.

12. The method of claim 8, wherein the surfactant is present in amounts between 6.25×10^{-4} and 3.84×10^{-2} weight percent.

- 19 -

13. The method of claim 6, wherein the alkaline particles are present in amounts between about 0.01 and 0.6 weight percent.

14. A method of deacidifying a cellulose based material, comprising:

applying a dispersion to the cellulose bases material, the dispersion including alkaline particles in an inert medium, the alkaline particles being a basic metal selected from the group consisting of oxides, hydroxides and salts, the inert medium including a carrier and an associated surface, the carrier consisting essentially of one of a hydrofluoroether or the combination of a perfluorinated compound and a sufficient amount of a hydrofluoroether to increase the dispersion of the alkaline particles relative to a perfluorinated carrier.

15. The method of claim 14, wherein the cation of the metal is selected from the group consisting of magnesium, zinc, sodium, potassium, and calcium.

16. The method of claim 14, wherein the surfactant is soluble in hydrofluoroether.

17. The method of claim 14, wherein the surfactant is perfluoropolyoxyether alcanoic acid.

18. The method of claim 14, wherein said applying is accomplished by spraying.

- 20 -

19. A deacidification dispersion medium, comprising:

alkaline particles being a basic metal compound selected from the group consisting of oxides, hydroxides, and salts; and

an inert medium that includes a carrier and an associated surfactant, the carrier including a sufficient amount of hydrofluoroether to increase the dispersion of the alkaline particles relative to a perfluorinated carrier, the surfactant being soluble in the hydrofluoroether to form the deacidification dispersion medium.

20. The deacidification medium of claim 19, wherein the metal compound includes a cation selected from the group consisting of magnesium, zinc, sodium, potassium, and calcium.

21. The deacidification medium of claim 19, wherein the surfactant is perfluoropolyoxyether alkanoic acid.

22. The deacidification medium of claim 19, wherein the hydrofluoroether is nonafluoromethoxybutane.

23. The deacidification medium of claim 19, wherein the surfactant is present in amounts between 6.25×10^{-4} and 3.84×10^{-2} weight percent.

24. The deacidification medium of claim 19, wherein the alkaline particles are present in amounts between about 0.01 and 0.6 weight percent.

- 21 -

25. The deacidification medium of claim 19, wherein the carrier includes an amount of a perfluorinated compound.

26. A deacidification medium, comprising:

alkaline particles being a basic metal compound selected from the group consisting of oxides, hydroxides, and salts; and

an inert dispersion medium that includes a carrier and an associated surfactant, the carrier including one of a hydrofluoroether or the combination of a perfluorinated compound and hydrofluoroether, the hydrofluoroether being present in a sufficient amount to increase the dispersion of the alkaline particles relative to a perfluorinated carrier, the surfactant being soluble in the hydrofluoroether to form the deacidification dispersion medium.

27. The deacidification medium of claim 26, wherein the metal compound includes a cation selected from the group consisting of magnesium, zinc, sodium, potassium, and calcium.

28. The deacidification medium of claim 26, wherein the surfactant is perfluoropolyoxyether alcanoic acid.

29. The deacidification medium of claim 26, wherein the hydrofluoroether is nonafluoromethoxybutane.

30. The deacidification medium of claim 26, wherein the surfactant is present in amounts between 6.25×10^{-4} and 3.84×10^{-2} weight percent.

- 22 -

31. The deacidification medium of claim 26, wherein the alkaline particles are present in amounts between about 0.01 and 0.6 weight percent.

32. A method of forming a deacidification dispersion medium, comprising:

dispersing alkaline particles in an inert medium that includes a carrier and an associated surfactant to form the deacidification dispersion medium, the alkaline particles being a basic metal compound selected from the group consisting of oxides, hydroxides and salts, the carrier including one of a hydrofluoroether or the combination of a perfluorinated compound and hydrofluoroether, the hydrofluoroether being present in a sufficient amount to increase the dispersion of the alkaline particles relative to a perfluorinated carrier, the surfactant being soluble in the hydrofluoroether.

33. The method of claim 32, wherein the surfactant is perfluoropolyoxyether alcanoic acid.

34. The method of claim 32, wherein the hydrofluoroether is nonafluoromethoxybutane.

35. The method of claim 32, wherein the surfactant is present in amounts between 6.25×10^{-4} and 3.84×10^{-2} weight percent.

36. The method of claim 32, wherein the alkaline particles are present in amounts between about 0.01 and 0.6 weight percent.

1/1

