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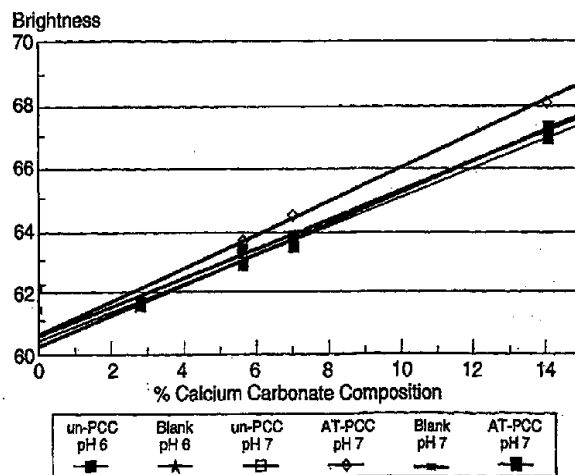


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(54) Title: ACID TOLERANT CALCIUM CARBONATE COMPOSITION AND USES THEREFOR



(57) Abstract

An improved form of calcium carbonate which is acid tolerant to enable its use as a filler material in the making of neutral to weakly acid paper, and a process for producing this acid tolerant calcium carbonate are provided. This acid tolerant calcium carbonate comprises a mixture of calcium carbonate with at least about 0.1 percent, based on the dry weight of the calcium carbonate, of sodium aluminat together with at least about 0.1 percent, based on the dry weight of the calcium carbonate, of one or more weak acids.

ACID TOLERANT CALCIUM CARBONATE COMPOSITION
AND USES THEREFOR

BACKGROUND OF THE INVENTION

This invention relates generally to calcium carbonate for
5 use in papermaking, and related industries, and more
particularly to a calcium carbonate having acid tolerant
properties.

Titanium dioxide and calcined clay have traditionally
been utilized as filler materials in the preparation of
10 neutral to weakly acidic paper in order to improve the
optical properties, especially the brightness, of the
resultant product. These materials, however, especially
titanium dioxide, have the disadvantage of being very
expensive, resulting in higher manufacturing costs and an
15 uncompetitively priced paper product.

Calcium carbonate, particularly precipitated calcium
carbonate, has been used as a filler material in the
making of wood-free alkaline paper. Such usage results
in a paper with enhanced optical properties, particularly
20 high brightness and opacity, without the expense incurred
in using titanium oxide fillers, resulting in a much less
expensive product. Calcium carbonate, however, cannot
generally be used as a filler in acidic paper made from
mechanical pulp furnishes because it decomposes in an
25 acidic environment. Since mechanical pulp sheets and
newsprint are made in the acidic range, there has long
been a need to develop a calcium carbonate composition
which is acid stabilized and resistant to decomposition

at low Ph, so that it can be utilized as a filler material in the manufacture of such paper, such as groundwood paper, where the use of an alkaline filler would have a negative impact on the final paper properties.

Paper made from mechanical pulps has been traditionally produced under acidic papermaking conditions because of "fiber alkaline darkening" that occurs as Ph rises. This means that there is a reduction in brightness of the paper (brightness reversion) when the pH is raised from acid to alkaline in wood-containing systems. Alkaline darkening will occur to some degree in any wood pulps with significant lignin content. The degree of darkening depends on the particular pulps, pH, and water quality.

In general, ground calcium carbonate and precipitated calcium carbonate fillers buffer wet end in the 7.5-8.2 pH range. Acid-resistant calcium carbonate compositions thus provide a means for reducing the degree of fiber alkaline darkening and brightness reversion due to their ability to maintain a stabilized pH.

U. S. Patent 5,043,017 discloses and claims an acid-stable calcium carbonate resistant to degradation in a mildly acidic environment which comprises a mixture of a calcium-chelating agent or a conjugate base, and a weak acid, such that calcium carbonate is coated by, and is in equilibrium with, the calcium-chelating agent or conjugate base and the weak acid. Preferred calcium carbonate compositions contain sodium hexametaphosphate

and phosphoric acid.

Sodium aluminate has been used in the manufacture of paper, principally as a replacement for, or in addition to, alum, which is used to set the size. It has been
5 noted that sodium aluminate is not an economical pH control chemical since only a small portion of the alkalinity is available as a free caustic, see, Thomas, "Sodium Aluminate in Paper Manufacture" 1979 Retention and Drainage Seminar Notes, published by Technical
10 Association of the Pulp and Paper Industry Inc, Atlanta Ga.

OBJECTS OF THE INVENTION

It is an object of the present invention to provide an acid tolerant calcium carbonate composition especially
15 suitable for use in papermaking applications.

It is a further object of the present invention to provide a process for the preparation of the aforesaid calcium carbonate compositions.

A still further object of the present invention is to
20 provide a paper having enhanced optical qualities prepared using the calcium carbonate compositions of the present invention.

SUMMARY OF THE INVENTION

The present invention relates to an improved form of calcium carbonate which is acid tolerant to enable its use as a filler material in the making of neutral to weakly acid paper, and a process for producing this acid tolerant calcium carbonate. More particularly, this invention concerns an acid tolerant calcium carbonate composition comprising a mixture of calcium carbonate with at least about 0.1 percent, based on the dry weight of the calcium carbonate, of a sodium aluminate, together with at least about 0.1 percent, based on the dry weight of the calcium carbonate, of one or more weak acids. It has surprisingly been found that the inclusion of sodium aluminate together with an amount of a weak acid sufficient to neutralize the composition confers a higher degree of acid resistance for the calcium carbonate composition in the presence of fiber slurry, and a longer term of pH stability than the prior art acid-stabilized calcium carbonate compositions. In an optional embodiment, the weak acid may consist of a mixture of phosphoric acid together with an organic, polymeric acid.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a graph comparing the brightness of pads made with various amounts of untreated calcium carbonate compositions (designated as un-PCC) to the brightness of pads made with various amounts of an acid tolerant precipitated calcium carbonate/sodium

aluminate/phosphoric acid composition (designated as ECCI-ATPCC).

FIGURE 2 is a graph comparing the pH of the pads made with various amounts of untreated calcium carbonate compositions (designated as un-PCC) to the pH of pads made with various amounts of an acid tolerant precipitated calcium carbonate/sodium aluminate/phosphoric acid composition (designated as ECCI-ATPCC).

FIGURE 3 is a graph comparing the various amounts of phosphoric acid needed to "buffer" the system at the desired pH (6.5 or 7.0).

FIGURE 4 is a graph comparing the brightness of the pads produced using various amounts of untreated precipitated calcium carbonate compositions (designated as un-PCC), and pads produced using various amounts of acid tolerant precipitated calcium carbonate/sodium aluminate/phosphoric acid compositions (designated as ECCI-ATPCC).

FIGURE 5 is a graph comparing the brightness of the pads produced using various amounts of untreated precipitated calcium carbonate compositions (designated as un-PCC), and pads produced using various amounts of acid tolerant precipitated calcium carbonate/sodium aluminate/phosphoric acid compositions (designated as ECCI-ATPCC).

FIGURE 6 is a graph comparing the brightness of sheets formed using various amounts of an untreated precipitated

calcium carbonate composition (designated as untreated PCC) to sheets formed using various amounts of an acid tolerant precipitated calcium carbonate/sodium aluminate/phosphoric acid composition (designated as ECCI-ATPCC).

FIGURE 7 is a graph comparing the TAPPI brightness of pulp:newsprint formed using various amounts of an untreated precipitated calcium carbonate composition (designated as untreated PCC) to sheets formed using various amounts of an acid tolerant precipitated calcium carbonate/sodium aluminate/phosphoric acid composition (designated as ECCI-ATPCC).

FIGURE 8 is a plot comparing the brightness of paper formed using various amounts of differing forms of untreated calcium carbonate compositions (designated as Sc-PCC [scalenohedral precipitated calcium carbonate], Rh-PCC [rhombic precipitated calcium carbonate], to paper formed using various amounts of differing forms of an acid tolerant calcium carbonate composition (designated as AT-Sc-PCC [acid tolerant scalenohedral precipitated calcium carbonate/sodium aluminate/phosphoric acid composition] or AT-Rh-PCC [acid tolerant rhombic precipitated calcium carbonate/sodium aluminate/phosphoric acid composition])).

FIGURE 9 is a graph comparing the brightness of paper formed using various amounts of rhombic untreated calcium carbonate compositions (designated as un-Rh-PCC) to paper

formed using various amounts of an acid tolerant rhombic calcium carbonate composition (designated as ECCI Rh-ATPCC).

FIGURE 10 is a graph comparing the pH during ageing of an acid tolerant ground calcium carbonate composition containing 1% sodium aluminate, 2% phosphoric acid and 1% polyacrylate acid, with an acid tolerant ground calcium carbonate composition containing 1% sodium aluminate, 4% phosphoric acid and 1% polyacrylate acid, and an acid tolerant ground calcium carbonate composition containing 1% sodium aluminate, 6% phosphoric acid and 1% polyacrylate acid over a period of 180 hours.

FIGURE 11 is a graph comparing the pH during ageing of an acid tolerant scalenohedral precipitated calcium carbonate composition containing 0.5% sodium aluminate, 4% phosphoric acid and 1% polymaleic acid, with an acid tolerant scalenohedral precipitated calcium carbonate composition containing 0.5% sodium aluminate, 6% phosphoric acid and 1% polymaleic acid.

20 DETAILED DESCRIPTION OF THE INVENTION

The improved form of calcium carbonate prepared by the instant invention is acid tolerant to enable its use as a filler material in the making of neutral to weakly acid paper. While not wishing to be bound by any particular theory as to the operability of the present invention, it is believed that the acid resistance conferred upon the

calcium carbonate compositions of the present invention is a result of the inactivation of the surface of the calcium carbonate by the addition of the sodium aluminate and the weak acid.

- 5 In the practice of the present invention, the calcium carbonate compositions are rendered acid tolerant by the inclusion in the calcium carbonate composition of at least about 0.1 percent, based on the dry weight of the calcium carbonate, of sodium aluminate together with one
10 or more weak acids in an amount which is at least about 0.1 percent, based on the dry weight of the calcium carbonate. In an optional embodiment, the weak acid may consist of a mixture of weak acids wherein at least one of the components is derived from an organic, polymeric
15 acid.

Again not wishing to be bound by a particular theory, it is believed that the capability of the acid-stabilized calcium carbonate of the present invention to resist dissociation in an acidic environment is due to the
20 reaction of the surface of the calcium carbonate with the sodium aluminate. This mechanism of surface inactivation is distinct from absorption or reaction of the prior art sodium hexametaphosphate on the surface of calcium carbonate, and the resultant buffering action.

- 25 The sodium aluminate utilized in the compositions of the present invention is typically an aluminate compound containing the Al^{+3} ion in an ionic hydroxy- or oxo-

complex. Typical forms of sodium aluminate are expressed chemically as NaAlO_2 or $\text{Na}_2\text{Al}_2\text{O}_4$

The amount of sodium aluminate is at least 0.1 percent based on the dry weight of the calcium carbonate, and preferably is about 0.5 to about 1.0 percent by weight, based on the dry weight of the calcium carbonate.

The amount of the weak base utilized is at least 0.1 percent, based on the dry weight of the calcium carbonate, and is preferably about 1 to about 6 percent, based on the dry weight of calcium carbonate.

The weak acid utilized in the compositions of the present invention is preferably a weak acid selected from the group consisting of phosphoric acid, metaphosphoric acid, hexametaphosphoric acid, ethylenediaminetetraacetic acid (EDTA), citric acid, sulfurous acid, boric acid, acetic acid, and mixtures thereof. As noted above, the weak acid may be a mixture of a weak acids, together with a further organic, polymeric acids, such as polyacrylate acid, polymaleic acid and polycarboxylic acid, and mixtures thereof. The organic polymeric acid is typically an organic polymer having a weight average molecular weight, M_w , in the range of 750-1,000,000, consisting of regularly repeating units or chemically similar units, connected by primary covalent bonds. The total amount of the weak acid utilized is at least 0.1 percent, based on the dry weight of the calcium

carbonate, and is preferably about 1 to about 8 percent, based on the dry weight of the calcium carbonate. Typically, 2-4 % phosphoric acid is utilized in combination with 1-6 % of the organic, polymeric acid.

- 5 Preferred combinations for use in the present invention include sodium aluminate/phosphoric acid; sodium aluminate/phosphoric acid/polyacrylate acid; and sodium aluminate/phosphoric acid/polymaleic acid. Where the weak acid is a mixture, preferred combinations include 1%
10 sodium aluminate/6% phosphoric acid/1% polyacrylate acid; and 0.5% sodium aluminate/6% phosphoric acid/1% polymaleic acid combinations.

- The calcium carbonate utilized is preferably finely divided and it can be either a precipitated calcium
15 carbonate (PCC) or a natural ground limestone (GCC).

- The process for producing this acid tolerant calcium carbonate involves first adjusting the pH of the calcium carbonate to about 11 or 12, and then adding at least about 0.1 percent, based on the dry weight of the calcium
20 carbonate, of the sodium aluminate. Then, at least about 0.1 percent, based on the dry weight of the calcium carbonate, of one or more weak acids is added to this resultant mixture. Finally, the resultant mixture is blended for a sufficiently long period of time to ensure
25 uniform mixing of the ingredients.

The calcium carbonate can be utilized in the above-described process either as a dry powder or an aqueous slurry with up to about 60 percent by weight solids content.

- 5 The sodium aluminate can be utilized in the instant process either as a dry solid or as an aqueous solutions. When the calcium carbonate is used in dry powder form, it is preferable to utilize an aqueous solution of the sodium aluminate in order to facilitate homogeneous
10 mixing. Where a slurry of the calcium carbonate is utilized, the solid form of the sodium aluminate readily dissolves therein so that an aqueous solution is unnecessary.

- The weak acid (or acids) can be utilized in the process
15 of preparation in either a pure concentrated form or as aqueous solutions.

- The composition of the present invention can be utilized to improve the optical properties of neutral to weakly acidic paper by its addition to the paper during standard
20 manufacturing processes. Typically, the calcium carbonate composition of the present invention is added to a first paper furnish containing components necessary for making acidic paper to thereby form a second paper furnish. The amount of the calcium carbonate composition
25 which is added to the paper furnish is dependent upon the particular characteristics of the particular furnish, and the desired degree of brightness desired in the finished

product. Representative amounts of the composition for typical paper furnishes range from about 1 to about 15% by weight of the finished product weight. Most preferably, the calcium carbonate compositions are
5 utilized in the range of about 5 to about 10 % by weight of the finished product.

The invention will be further illustrated by the following Examples, which are to be considered illustrative of the invention, and not limited to the
10 precise embodiments shown.

EXAMPLE 1

Calcium Carbonates for Wood Containing Furnishes

To demonstrate the utility of the compositions of the present invention in the use of paper such as mechanical
15 pulp sheets and newsprint, made in the acidic pH range, the following experiments were conducted with wood containing paper furnishes which normally experience alkaline darkening and calcium carbonate decomposition at
20 acidic pHs.

Experimental

I. Brightness Pads

Acid Tolerant Precipitated Calcium Carbonate Composition (ATPCC)

25 To a carbonate slurry, 1 % of sodium aluminate was added. This resultant slurry containing the sodium aluminate was mixed at 250 rpm for 1 hour. At the end of the mixing,

4% of phosphoric acid was added. The slurry was stirred for 1 minute and aged without stirring for an additional 3 hours.

Pad Formation

5 1. Variable pH

The pulp slurry (0.5 % consistency) was adjusted to the desired pH with phosphoric acid or sodium hydroxide. The stock utilized was obtained from a mechanical pulp mill in the South. The calcium carbonate composition was added to the pulp slurry and it was gently mixed (200 rpm) for 30 minutes. Afterwards, it was stirred at 950 rpm for 30 sec. The slurry was filtered in a Buchner filter equipped with a Whatman 41 filter paper. The pads were double pressed and dried in the drum drier. The brightness of each pad was measured with a Teledyne Micro S-5.

2. Constant pH

The pH of the pulp (Consistency = 0.5 %) was adjusted to 7.0 or 6.5 with sodium hydroxide or dilute phosphoric acid. The stock was the same as the one used in the previous experiments. After adjusting the pH, a known amount of calcium carbonate was added to the previously described furnish. The pH was kept constant by periodic additions of 5 % phosphoric acid to the slurry. The slurry was slowly mixed and the pH kept constant for 1/2 hour. The weight of the phosphoric acid used to keep the pH constant was recorded at the end of each experiment. Afterwards the slurry was mixed at a high speed of 950

rpm for 30 seconds. A brightness pad was formed by pouring the slurry through a Buchner funnel equipped with a Whatman 42 ashless filter. The pads were pressed twice and dried in a drum drier (two passes). Again, the
5 brightness was measured with a Teledyne Micro S-5.

II. M/K Sheet Former

M/K Sheet Former Parameters

An M/K Series 9000 Computerized Sheet Former was used for making sheets. The sheet former consist of a forming and
10 pressing/drying sections, a white water recirculation system and a chemicals and stock feed system. The furnish consisted of deinked recycled newspaper from a southern mill. The basis sheet weight was kept constant. Eighty percent of the white paper was recycled for the
15 making of the sheets. The pH of the white water was kept constant at 6.5. This was accomplish by adding phosphoric acid to the white water holding tank.

The calcium carbonate/1% sodium aluminate/4%phosphoric acid composition was prepared as described in part I of
20 this example.

III. Herty Foundation Trial

A trial was conducted in a No. 1 Pilot Paper Machine. This machine is a conventional 36" low speed fourdrinier machine. The furnish was obtained by repulping newspaper
25 from a Wester Canadian newsprint mill. The basis weights of the produced final sheet was around 45 gsm. The speed was 175 fpm. The retention aide consisted of a dual

polymer system. The addition rate was of 0.2 to 0.3
#/Ton of Eclipse 1200 and Stylus 100.

Paper Machine Running Parameters

The paper machine running parameters are given in Table I
5 below. A 5 % Phosphoric Acid solution was added at in
the paper machine tray white water to control the headbox
pH.

TABLE I
Hefty Newsprint Trial
November 13-14-15, 1995

		Head Box										
Date	Time	Filter Type	Addition %	pH	°C	Specific Conduct, mV	PCD	Zeta Potential mV	Constat. %	Ash %	Drain Time 50 ml sec	100 ml sec
13 Nov	3:00 PM	Unfilled		5.96	23	0.122	0.9	-13.44				
13 Nov	4:10 PM	Unfilled		3.6	29	0.267	0.7	-16.75	0.40	1.65	6	36
	7:15 PM	Unfilled		3.6	31	0.365	0.25	-13.65	0.43	1.84	8	40
13 Nov	9:15 PM	Unfilled		4.4	27	0.145	1	-20.94	0.48	0.69	12	570
15 Nov	9:30 AM	Untreated PCC	3.00	6.5	28	0.196	1.05	-19.81	0.50	2.61	9	70
15 Nov	10:00 AM	Untreated PCC	6.00	6.8	26	0.196	1	-21.07	0.50	6.50	12	70
15 Nov	10:20 AM	Untreated PCC	11.20	8.5	26	0.198	0.9	-23.78	0.61	9.22	12	70
15 Nov	3:10 PM	ECCL-ATPCC	4.80	6.5	26	0.349	0.5	-18.91	0.48	4.13	8	45
15 Nov	3:30 PM	ECCL-ATPCC	10.10	6.7	26	0.365	0.45	-18.03	0.48	6.14	9	45
15 Nov	3:55 PM	ECCL-ATPCC	6.60	6.6	26	0.35	0.4	-24.04	0.49	3.67	8	45

TABLE 1 - continued

		Tray										
Date	Time	Filter Type	Addition %	pH	*C	Specific Conduct. mV	PCD	Zeta Potential mV	Consist. %	Ash %	Drain Time 50 ml sec	100 ml sec
13 Nov	3:00 PM	Unfilled			25	0.260	0.60	-15.66				
13 Nov	4:10 PM	Unfilled		3.7	31	0.307	0.90	-16.67	0.01	4.76	97.60	92.70
	7:15 PM	Unfilled		4.3	30	0.144	0.30	-19.58	0.02	6.56	95.35	85.95
13 Nov	9:15 PM	Unfilled		6.7	27	0.191	0.90	-20.92	0.08	3.67	83.33	11.35
15 Nov	9:30 AM	Untreated PCC	3.00	6.4	26	0.191	1.15	-19.29	0.08	11.39	84.00	30.18
15 Nov	10:00 AM	Untreated PCC	6.00	6.6	24	0.192	0.90	-19.18	0.10	20.59	80.00	36.65
15 Nov	10:20 AM	Untreated PCC	11.20	8.5	24	0.322	0.45	-23.17	0.13	24.31	74.61	32.70
15 Nov	3:10 PM	ECCL-ATPCC	4.80	6.6	25	0.343	0.40	-18.79	0.07	11.43	85.42	59.64
15 Nov	3:30 PM	ECCL-ATPCC	10.10	6.7	26	0.329	0.40	-19.40	0.08	17.10	83.33	55.68
15 Nov	3:55 PM	ECCL-ATPCC	6.60	6.7	26	0.35	0.4	-21.54	0.07	22.86	85.71	11.02

Physical Properties of the Calcium Carbonates

The physical properties of the calcium carbonates are given in Table 2 below.

TABLE II

5 Physical Properties of Fillers

		ECCI-ATPCC	PCC
	Brightness	94.1	94.9
	L	97.76	98.19
	a	-0.04	0.03
10	b	1.49	0.93
	BET	11.2	7.4
	Blaine	25,478	25,300
	PSD		
	%<10.00	94	99
15	%<5.00	68	99
	%<2.00	20	54
	%<1.00	12	15
	%<0.5	10	9
	%<0.25	10	9
20			

The calcium carbonate/sodium aluminate/phosphoric acid composition was prepared as described in Part I of this example.

IV. Syracuse Trial (State University of New York-
5 College of Environmental Sciences and Forestry)

Acid Tolerant Calcium Carbonate Composition

The acid tolerant calcium carbonate was prepared as described in Section I.

Running Parameters

- 10 Newsprint from Western Canada was repulped in the Barracuda Pulper. The pH was immediately adjusted to 5.0 with concentrated sulfuric acid. After transferring the furnish to the high consistency storage tanks, the pH was again adjusted to 5.0 with concentrated sulfuric acid.
- 15 From the high consistency tanks, the pulp was diluted to low consistency in the feed tank that was situated before the fan pump. The pH was adjusted to the desired headbox pH by adding 0.5 % phosphoric acid to the head of the fan pump. The flow of the phosphoric was recorded for each
- 20 pH and filter level. The calcium carbonate was added at a "T" joint between the fan pump and the headbox. The pH was measured at a tab on the headbox. The gramage of the produced paper was kept around 45 gsm. The formation was around 45.

Results and Conclusions

I. Brightness Pads

Unadjusted pH

In our first investigation, the initial pH was pH 6.0 or
5 7.0; but it was allowed to drift. The results for the
acid tolerant PCC and untreated PCC samples are given in
Figure 1. The brightness increase for all of the samples
was the same. This can be explained by observing the pH
changes. For all of the samples, the pH went up, as
10 shown in the graph of Figure 2. The amount was dependent
on treatment and concentration of the PCC. The
brightness vs. pH curve for mechanical pulps is a typical
"S" curve with the equivalent point around pH 7. At pH
of 7.5, the brightness decreases to an almost constant
15 level; therefore, since, all of the samples drifted to
pHs higher than 8, alkaline darkening was observed in all
of the samples. It was therefore concluded that it is
necessary to adjust the system pH so that the pH does not
drift.

20 Constant pH

1. Acid Composition

The use of various amounts of phosphoric acid to "buffer"
the system at the desired pH (6.5 or 7.0) is shown in the
graph of Figure 3. At pH 7.0, the amount of phosphoric
25 acid consumed was about 1/2 the amount of acid used up at
pH 6.5. The acid tolerant precipitated calcium carbonate
composition (AT-PCC) consumed less phosphoric acid than
the untreated PCC.

2. Brightness

Several conclusions can be reached by analyzing the graphs shown in Figures 4 & 5:

- a. Phosphoric acid imparts a degree of acid tolerance to the calcium carbonate. The furnishes that were adjusted with phosphoric acid have higher brightness and the curve intercept at the blanks brightness.
- b. It takes approximately 4 % of untreated scalenohedral calcium carbonate in a non-phosphoric acid system to reach the original blank brightness.

II. M/K Sheet Formation

The results, shown by the graph of Figure 6, obtained with the M/K Sheet Former validated the previous conclusions. The samples containing the acid tolerant calcium carbonate/sodium aluminate/phosphoric acid composition gave the higher brightness.

III. Herty Foundation Trial

The results are plotted in the graph shown in Figure 7. The performance of the acid tolerant precipitated calcium carbonate/sodium aluminate/phosphoric acid composition outperformed the untreated calcium carbonate samples. The brightness results obtained in this trial were similar to the brightness pads experiments. The brightness curves for these two samples parallel each other and it requires approximately 4% of untreated precipitated calcium carbonate to get back to the original blank brightness.

IV. Syracuse Trial (State University of New York -
College of Environmental Science and Forestry)

At a pH of 7.0, the data shown by the plot of Figure 8
and the graph of Figure 9 clearly shows two trends. The
5 acid tolerant calcium carbonates showed a greater
brightness than the corresponding untreated calcium
carbonates.

The rhombic calcium carbonate compositions showed some
advantages; however, these advantages may be attributed
10 to the condition of the furnish.

At a pH of 6.5, the treated calcium carbonate rhombic
samples outperformed the untreated rhombic samples.

EXAMPLE 2

Ground Calcium Carbonate Compositions

15 Acid tolerant ground calcium carbonate slurry can be
obtained by the addition of sodium aluminate, followed by
the addition of a weak acid such as phosphoric acid and a
polymeric acid such as polyacrylate acid.

Initially, 1% sodium aluminate, based on the dry weight
20 of calcium carbonate, was added into a 20% solids slurry
of ground calcium carbonate. The initial pH of the
calcium carbonate slurry was 8.01. After mixing, 2-6%
phosphoric acid and 1% polyacrylate acid, based on the
dry weight of calcium carbonate, were added. A plot of
25 the pH was measured for each sample after 167 hours

ageing, as shown graphically in Figure 10. The initial pH of the slurry treated with 1% sodium aluminate/1% polyacrylate acid/4% phosphoric acid was measured and found to be 5.12. After 167 hours of ageing, the pH was again measured and found to be 5.83.

EXAMPLE 3

Scalenohedral Precipitated Calcium Carbonate Compositions

Acid tolerant scalenohedral precipitated calcium carbonate slurry can be obtained by the addition of sodium aluminate, followed by the addition of a weak acid such as phosphoric acid and a polymeric acid such as polymaleic acid.

Initially, 0.5% sodium aluminate, based on the dry weight of calcium carbonate, was added into a 19.7% solids slurry of scalenohedral precipitated calcium carbonate. The initial pH of the calcium carbonate slurry was 8.83. After mixing, 4-6% phosphoric acid and 1% polymaleic acid, based on the dry weight of calcium carbonate, were added. A plot of the pH was measured for each sample after 27 hours ageing, as shown graphically in Figure 11. The initial pH of the slurry treated with 0.5% sodium aluminate/1% polymaleic acid/4% phosphoric acid was measured and found to be 5.76. After 27 hours of ageing, the pH was again measured and found to be 6.69

EXAMPLE 4**Ground Calcium Carbonate Compositions**

Acid tolerant ground calcium carbonate slurry can be obtained by the addition of sodium aluminate, followed by
5 the addition of a weak acid such as phosphoric acid and a polymeric acid such as polyacrylate acid.

Initially, 3% sodium aluminate, based on the dry weight of calcium carbonate, was added into a 20% solids slurry of ground calcium carbonate. The initial pH of the
10 calcium carbonate slurry was 8.01. After mixing, 6% phosphoric acid and 1% polyacrylate acid, based on the dry weight of calcium carbonate, were added. The initial pH of the slurry was measured and found to be 6.29.
After 65 hours of ageing, the pH was again measured and
15 found to be 6.74.

EXAMPLE 5**Ground Calcium Carbonate Compositions**

Acid tolerant ground calcium carbonate slurry can be obtained by the addition of sodium aluminate, followed by
20 the addition of a weak acid such as phosphoric acid and a polymeric acid such as polyacrylate acid.

Initially, 1% sodium aluminate, based on the dry weight of calcium carbonate, was added into a 20% solids slurry of ground calcium carbonate. The initial pH of the
25 calcium carbonate slurry was 8.01. After mixing, 1%

phosphoric acid and 6% polyacrylate acid, based on the dry weight of calcium carbonate, were added. The initial pH of the slurry was measured and found to be 6.02.

After 64 hours of ageing, the pH was again measured and
5 found to be 6.59.

WHAT IS CLAIMED IS:

- 2 1. An acid tolerant calcium carbonate comprising a
3 mixture of calcium carbonate with at least about 0.1
4 percent, based on the dry weight of the calcium
5 carbonate, of sodium aluminate, together with at least
6 about 0.1 percent, based on the dry weight of the calcium
7 carbonate, of one or more weak acids.
- 1 2. The acid tolerant calcium carbonate of claim 1
2 wherein the weak acid is selected from the group
3 consisting of phosphoric acid, and mixtures with a
4 polymeric weak acid selected from the group consisting of
5 polyacrylate acid, polymaleic acid, polycarboxylic acid,
6 and mixtures thereof.
- 1 3. The acid tolerant calcium carbonate of claim 1
2 wherein the weak acid is phosphoric acid.
- 1 4. The acid tolerant calcium carbonate of claim 1
2 wherein the weak acid is a mixture of phosphoric acid and
a polyacrylate acid.
- 1 4. The acid tolerant calcium carbonate of claim 1
2 wherein the weak acid is a mixture of phosphoric acid and
polymaleic acid.
- 1 5. The acid tolerant calcium carbonate of claim 1
2 wherein the weak acid is a mixture of phosphoric acid and
3 polycarboxylic acid.

4

5 6. The acid tolerant calcium carbonate of claim 1
6 wherein the sodium aluminate is present in an amount of
7 about 1 to about 6 percent, based on the dry weight of
the calcium carbonate.

1

2 7. The acid tolerant calcium carbonate of claim 1
3 wherein the total amount of the weak acid is present in
4 an amount of about 1 to about 8 percent, based on the dry
weight of the calcium carbonate.

1 8. A process for the preparation of an acid tolerant
2 calcium carbonate which comprises:

3 a) adjusting the pH of a slurry of calcium
4 carbonate to about 11 or 12;

5 b) adding thereto, with mixing, at least about 0.1
6 percent, based on the dry weight of the calcium
7 carbonate, of sodium aluminate;

8 c) adding to the mixture of b, with mixing, an
9 amount of a weak acid sufficient to bring the pH of the
resultant mixture to about 7 or lower.

1 9. The process according to claim 8 wherein the weak
2 acid is selected from the group consisting of phosphoric
3 acid, and mixtures with a polymeric weak acid selected
4 from the group consisting of polyacrylate acid,
5 polymaleic acid, polycarboxylic acid, and mixtures
6 thereof.

- 1 10. The process according to claim 8 wherein the weak
2 acid is phosphoric acid.
- 1 11. The process according to claim 8 wherein the weak
2 acid is a mixture of phosphoric acid and polyacrylate
acid.
- 1 12. The process according to claim 8 wherein the weak
2 acid is a mixture of phosphoric acid and polymaleic acid.
- 1 13. The process according to claim 8 wherein the weak
2 acid is a mixture of phosphoric acid and a polycarboxylic
3 acid.
- 1 14. The process according to claim 8 wherein the sodium
2 aluminate is present in an amount of about 1 to about 6
3 per cent, based on the dry weight of the calcium
4 carbonate.
- 1 15. The process according to claim 8 wherein the weak
2 acid is present in an amount of about 1 to about 8 per
3 cent, based on the dry weight of the calcium carbonate.
- 1 16. A method of improving the optical properties of
2 neutral to weakly acidic paper by the addition of the
3 composition of claim 1.

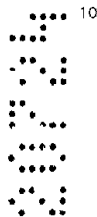
17. An acid tolerant calcium carbonate, substantially as hereinbefore described with reference to any one of the Examples.

18. A process for the preparation of an acid tolerant calcium carbonate, substantially as hereinbefore described with reference to any one of the Examples.

5 19. A method of improving the optical properties of neutral to weakly acidic paper, substantially as hereinbefore described with reference to any one of the Examples.

Dated 24 September, 1998
ECC International Inc.

Patent Attorneys for the Applicant/Nominated Person
SPRUSON & FERGUSON



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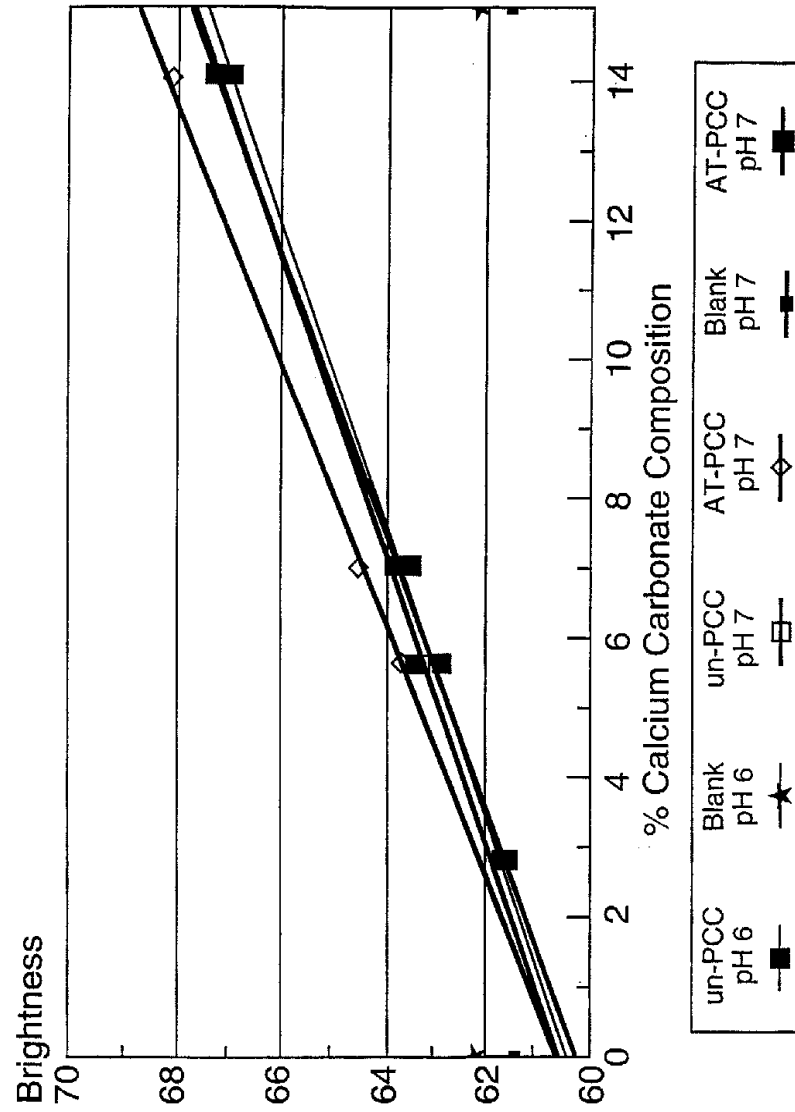


FIG. 1

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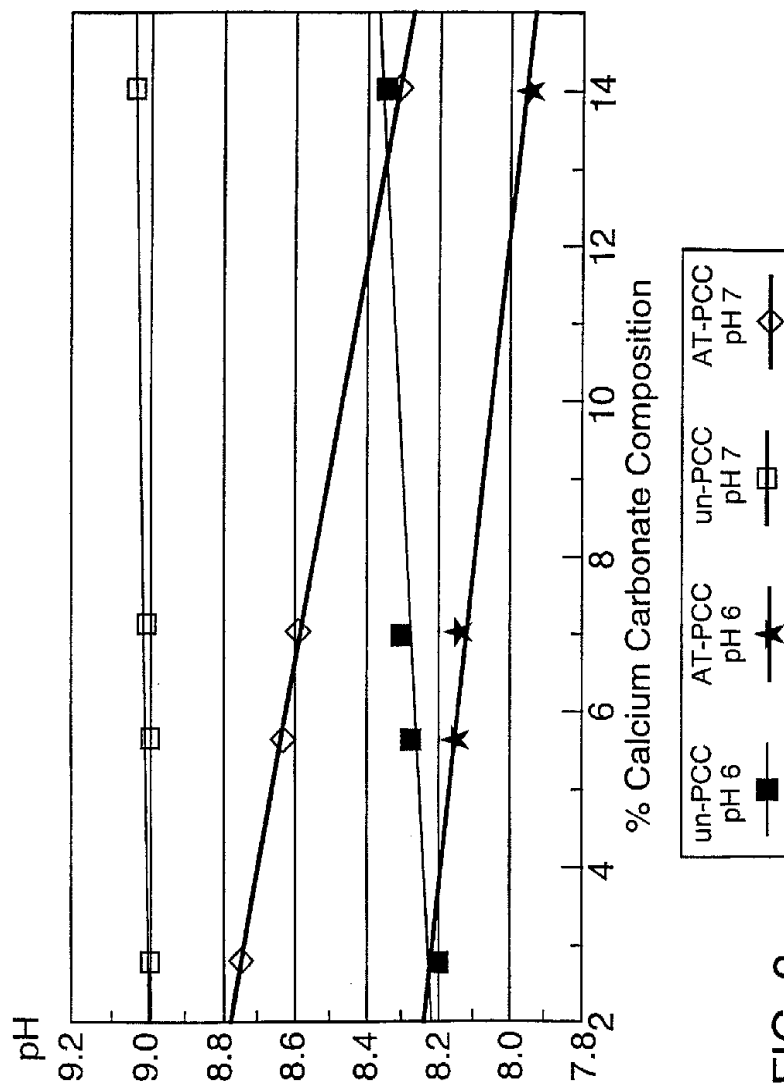


FIG. 2

SUBSTITUTE SHEET (RULE 26)

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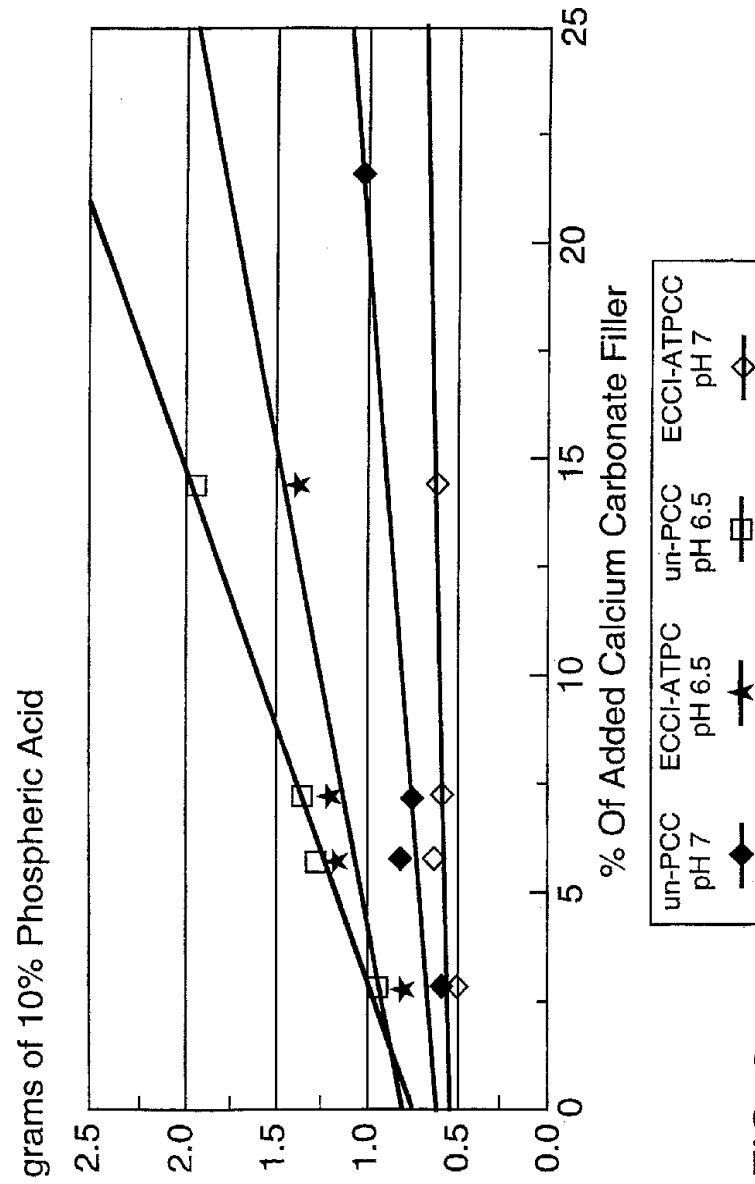


FIG. 3

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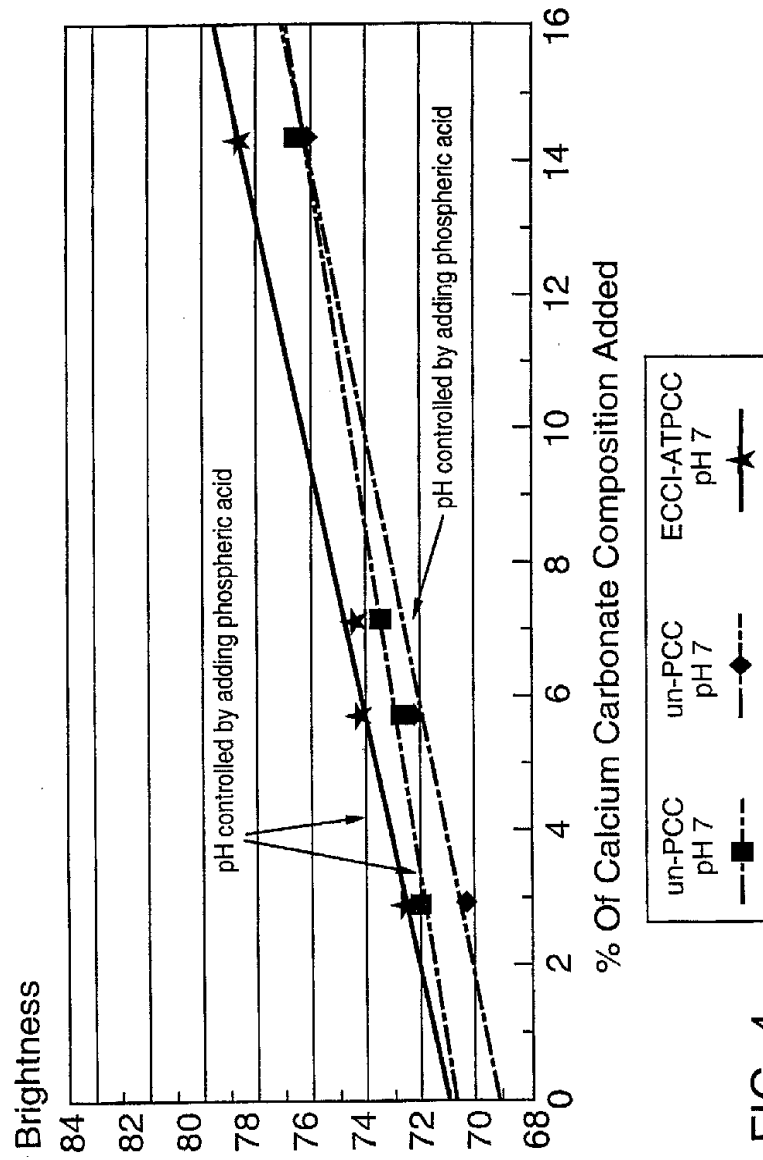


FIG. 4

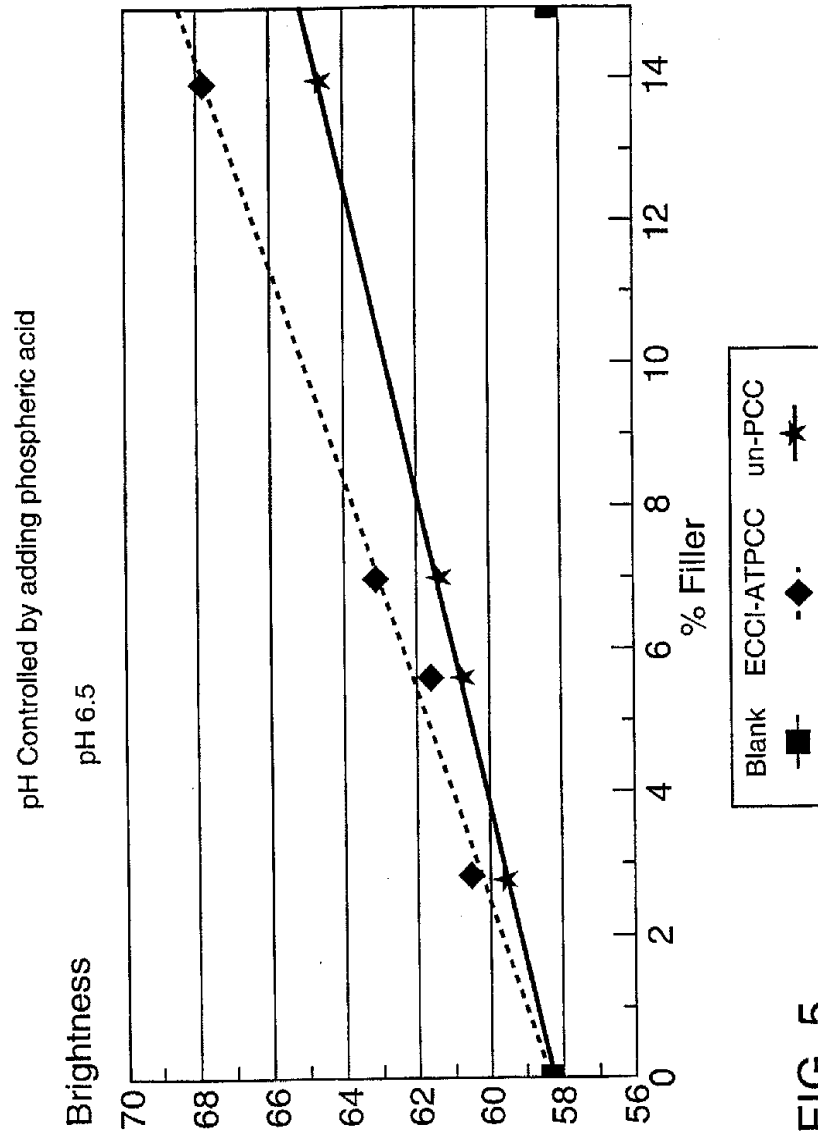


FIG. 5

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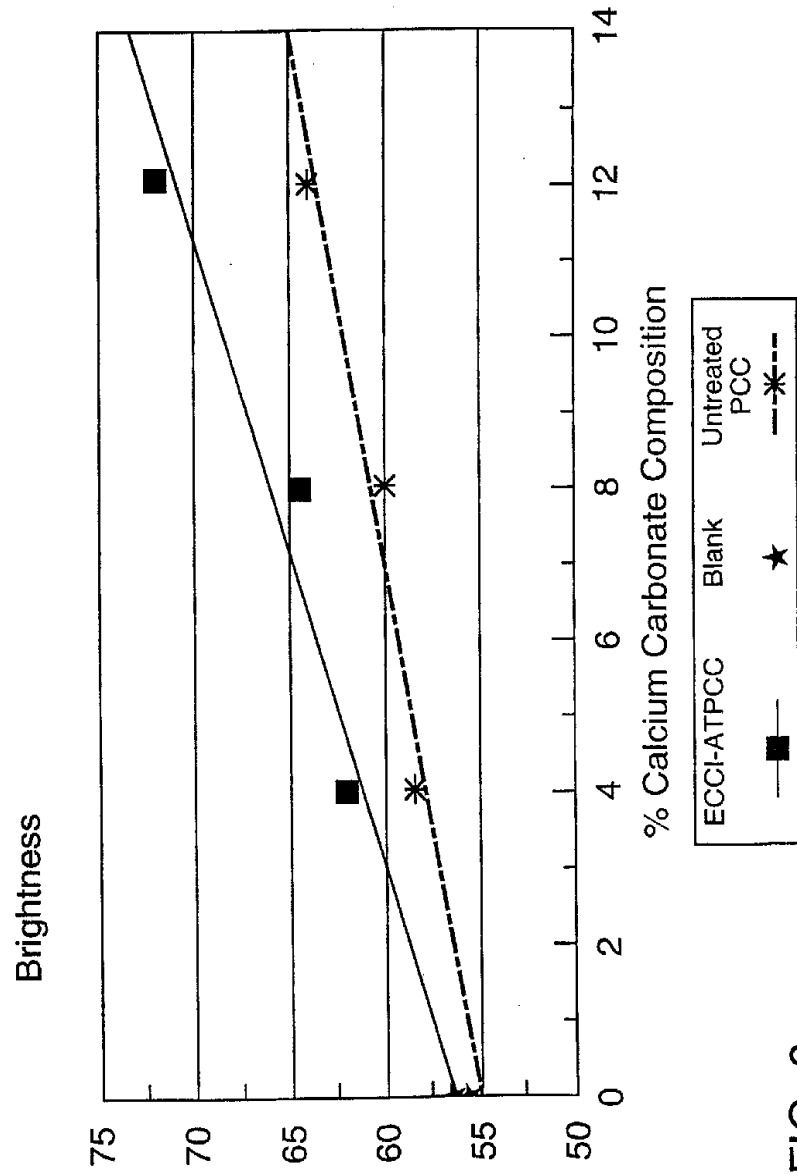


FIG. 6

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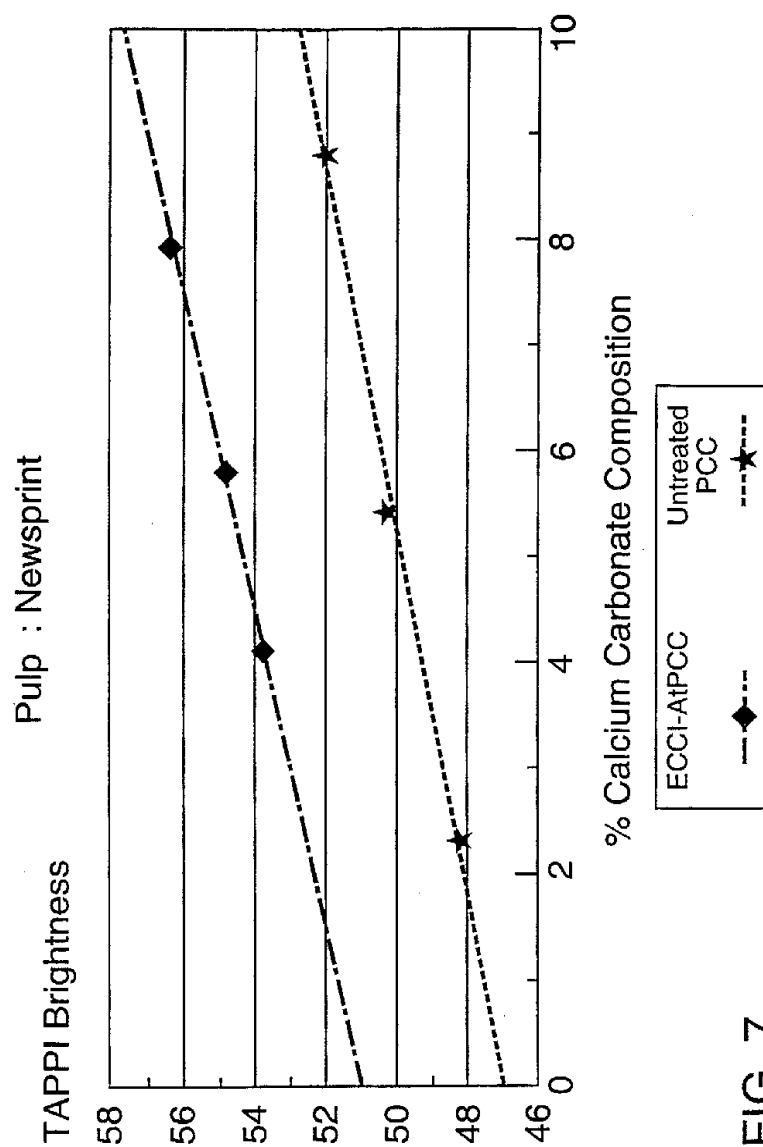


FIG. 7

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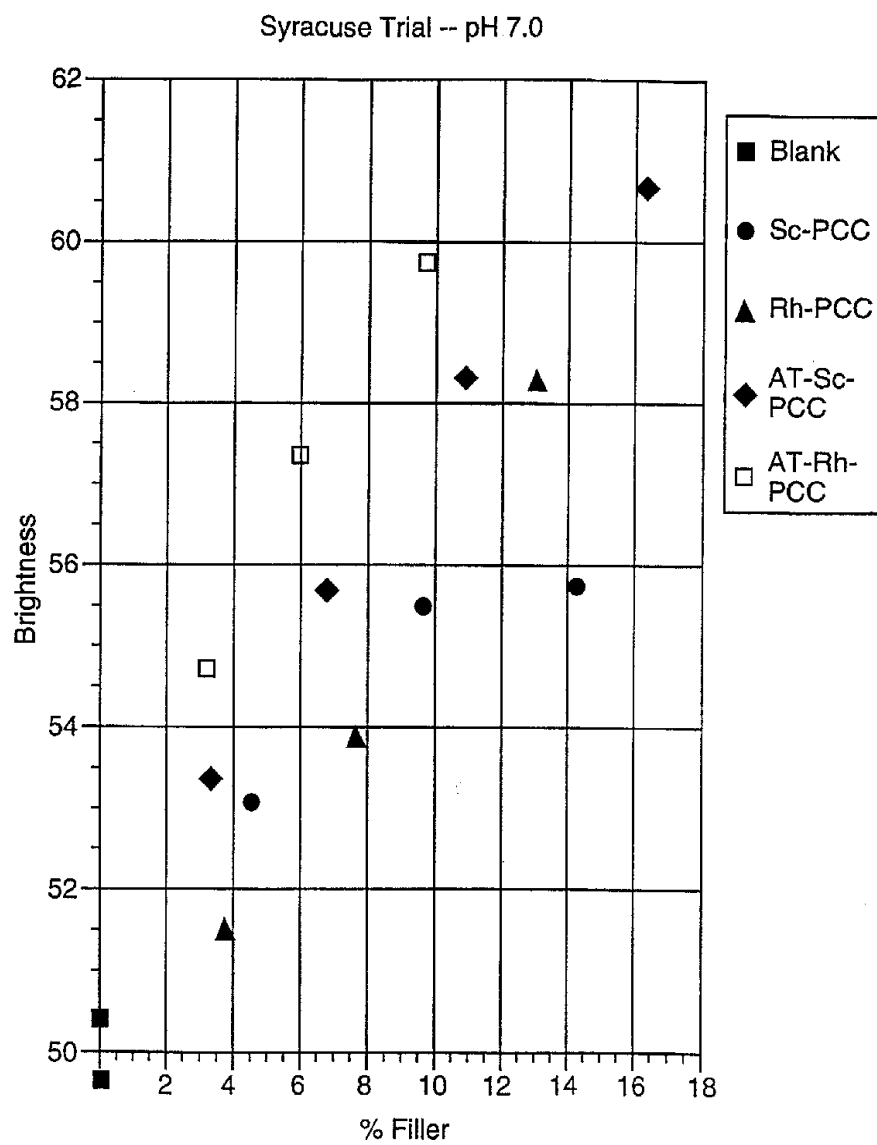


FIG. 8

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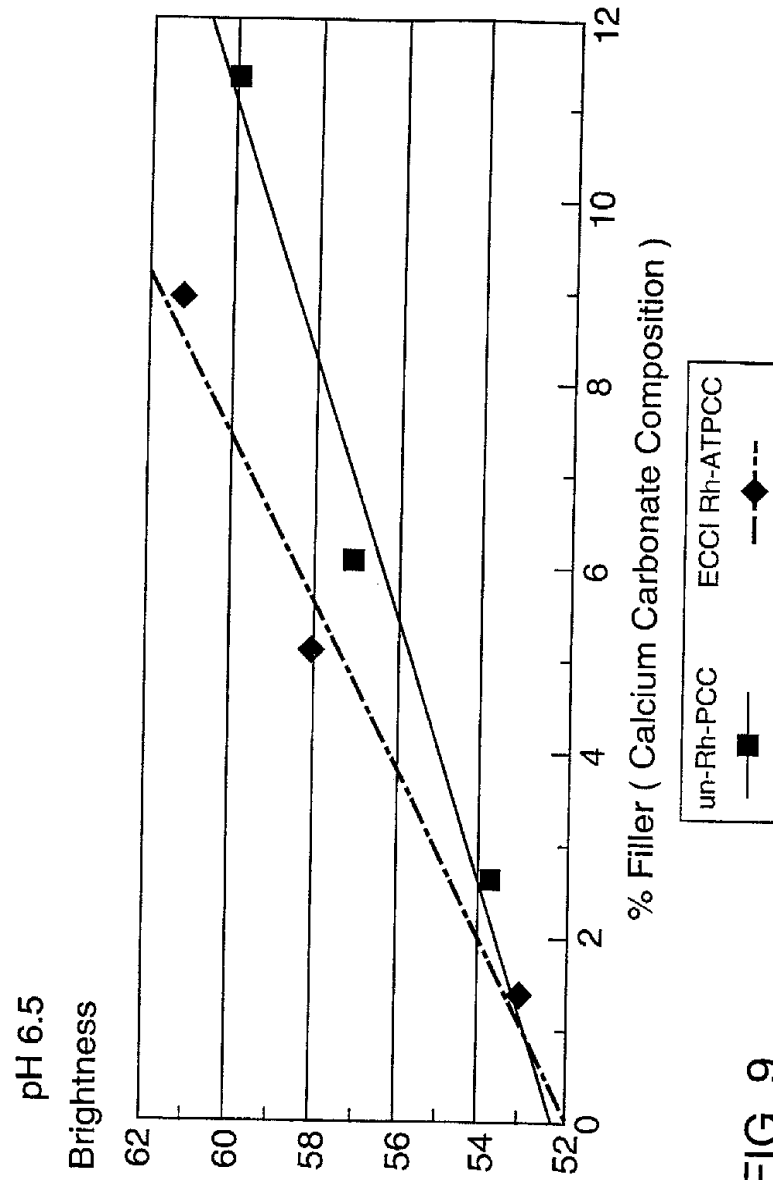


FIG. 9

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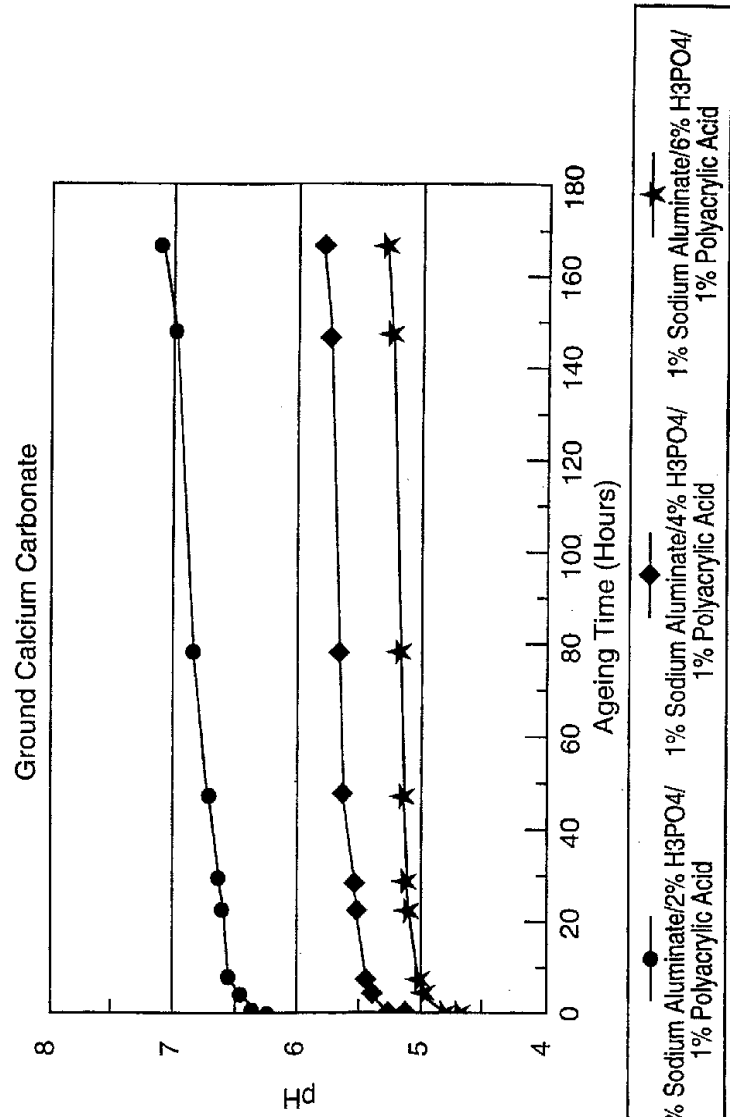


FIG. 10

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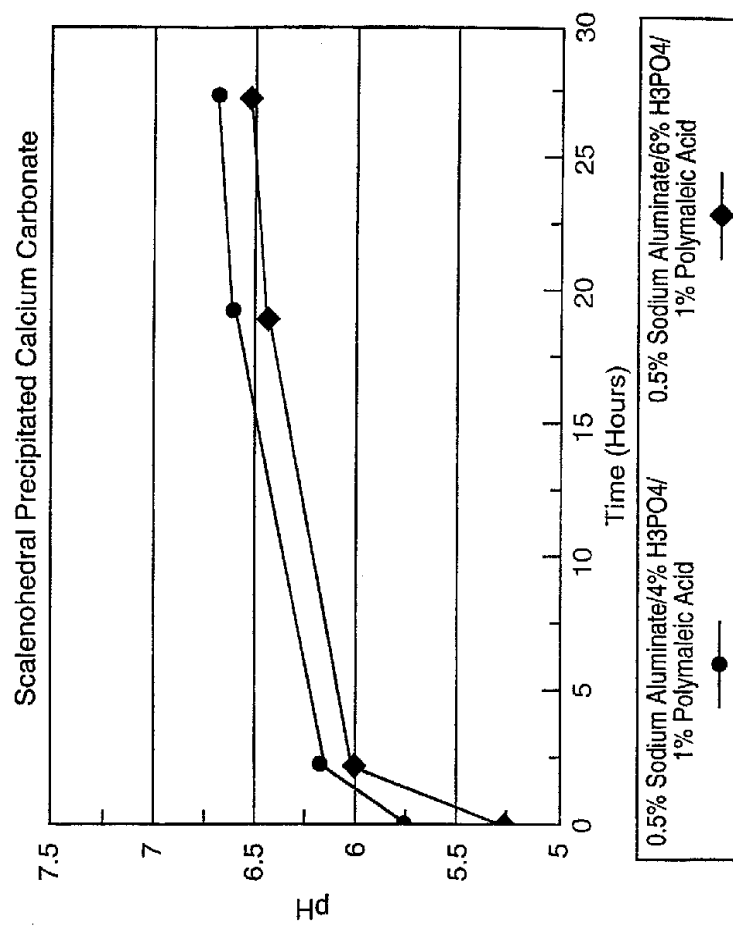


FIG. 11