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Change of Filler from Talc to Wet Ground Calcium Carbonate-A Noble Way to Reduce Fiber Consumption

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Abstract—*Mineral pigments are primarily used in printing and writing papers. Nevertheless, there are a few things which are very certain like changes happening at fast pace, customer expectations for better and cheaper products etc. Obviously, any manufacturing sector has to face this hard reality of high input cost, labor, manpower cost and depleting source etc.*

Paper Industry is no exception. It is expected that the per capita consumption of paper will go past double digit by 2020 in India. Competing against inflow of imports with its quality and cost is a big challenge for the industry in addition to the ever-changing demand of the customers for better quality but at least price.

Fillers in the year 2000 and beyond need to be ecologically safe, functional and available at reasonable cost. Further optimized products and application technologies as well as new paper machine concepts will allow filler levels to increase even further. This paper describes various measures taken up to stabilize this change over, machine productivity and up gradation of quality.

1. INTRODUCTION

Fillers are selected to provide distinct functions in papermaking. They have mark able influence on paper quality and in particular on paper production economics. Optical characteristics as well as particle shape, fineness (particle size distribution) and the chemical composition are the most important filler properties.

The importance of filler and coating pigments in the manufacturing of paper further growth in pigment consumption is expected. Uncoated papers like copy or magazine (SC) papers contain mainly primary (virgin) fillers. Coating base papers are loaded with secondary pigments ex-coated broke and, if paper quality demands, with some primary filler as a top up. Another source of pigment is represented by their used waste paper RCF. Newsprint produced in Europe, based on RCF for example, contains upto12% recycled filler and 88% recycled fiber.

2. FILLER

Filler is substance fills up the void spaces between the inter-fiber bonds in the paper. White mineral pigment fillers are used extensively by papermakers to improve a variety of paper properties (brightness, opacity, whiteness, gloss etc.) Fillers can also be used as fiber substitutes in order to lower furnish cost. Fillers are selected to provide distinct functions in papermaking. They give special properties for paper products that could not be achieved in any other way.

Table 1:-Filler Contents In Different Paper Grades

Example of Paper Product Filler Contents

Newsprint	0-15%
SC gravure paper	20-32%
LWC base paper	6-10%
Wallpaper	8-15%
Mechanical catalogue paper	5-10%
Wrapping base paper	5-20%
Woodfree printing paper	10-25%
Woodfree writing paper	10-25%
Coorugated board	2-10%
Wallpaper board	2-10%

The incorporation of pigments into the papermaking process adds positively to sheet formation. Replacing relatively hydrophilic fibres by (hydrophobic) pigments makes a more dimensionally stable paper. Finally, the incorporation of fillers in the papermaking process leads to dramatically lower furnish cost since the fiber cost (particularly chemical pulp). [1]

Organic fillers are only limited in use and if at all then for very specific reasons. The main (quantity) mineral fillers are Kaolin, natural ground $CaCO_3$, chemically precipitated $CaCO_3$and talc. Another inorganic filler of importance (not in quantity but in effect- and cost) is titanium dioxide, which at low dosage provides extra high opacity and brightness to the sheet. The amounts of fillers vary from none to at least 40% of the whole furnish.

Types of Fillers used in Paper Manufacturing:

(a) Clay
(b) Calcium Carbonate (Precipitated and Ground)
(c) Titanium Dioxide
(d) Talc

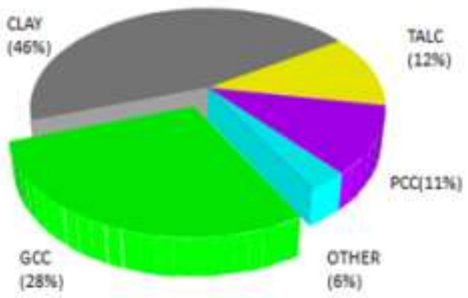
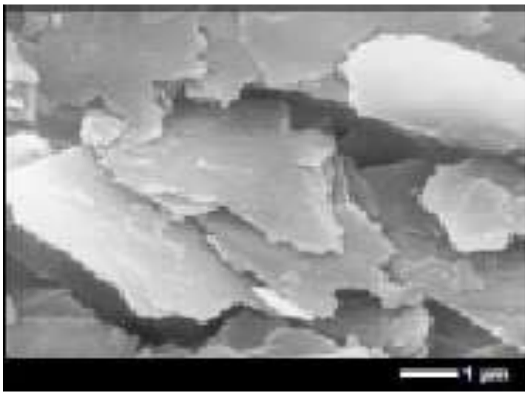


Figure 1: Worldwide Filler Consumption

Structure of Fillers

Talc is a natural hydrous magnesium silicate with the chemical formula of $3MgO.4SiO_4.H_2O$, which can be found almost everywhere throughout the globe. It is very soft and low-abrasive material with plate-like particles. Talc as a filler gives a good printability and brightness to paper, in addition to its positive economic impact.

Also due to its oleophilic character, talc absorbs resin particles and other organic compounds and agglomeration is prevented. In this way talc keeps the wet-end system of the paper machine clean. Talc also has a good retention and softness and extends the lifetime of the wire on the paper machine. However, its higher dusting tendency during printing compared to clay has slightly reduced its application. [2]

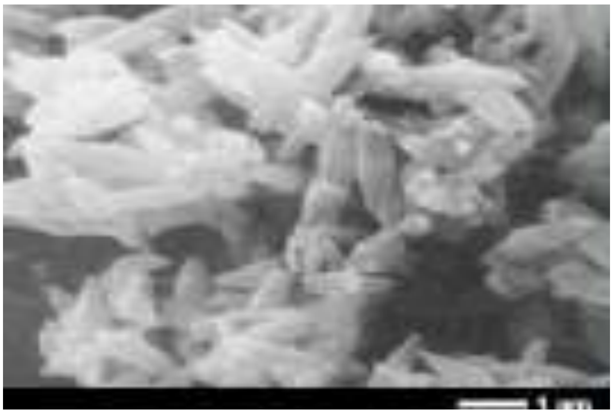


Shape:-Plate type
Abrasiveness:-3-5 mg/cm^2
Particle size (APS in microns):-1.5-10.0
Particle size (<2 microns):-1.5-10.0%
Brightness:-82%ISO
Specific Surface Area (m^2/g):-9-2
Figure 2:-Talc

Natural calcium carbonate contributes to sedimentary rocks and constitutes about 1% of the earth crust. Chalk, the softest type, is still formed in the oceans through reactions of calcium salts with carbon dioxide. It is then transformed into limestone and marble through geological modifications. [3]

Limestone may be calcinated at 800-900˚C to give CaO. The process is followed by the addition of water and carbonation to obtain precipitated calcium carbonate particles. The process affects the particle fineness and shape. PCC producing sites are usually located on the paper mills.

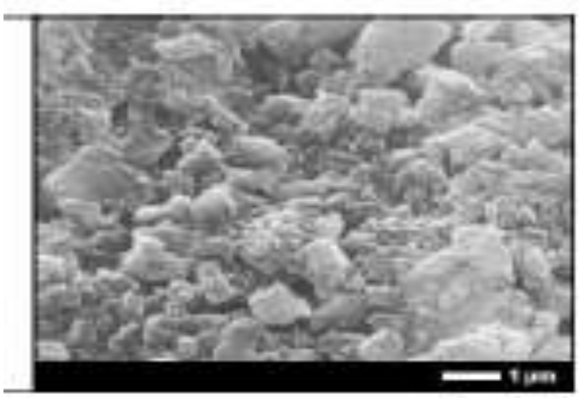
The comparative properties indicate that PCC is a better choice in view of brightness, possibility to go for higher percentage of loading, maintaining bulk of the paper etc due to its scalenohedral structure. Besides, it's low abrasiveness and controlled particle size distribution makes it a preferred choice over other fillers. However, issue still remains with its sustained availability at a competitive price in India. [4]



Shape:- Scalenohedral
Abrasiveness:-3-4 mg/cm^2
Particle size (APS in microns):-0.3-3.0
Particle size (<2 microns):- 45% (min)
Brightness:-94-95%ISO
Specific Surface Area (m^2/g):-3-25

Figure 3:-Precipitated Calcium Carbonate

On the other hand, GCC was readily available and easy to handle. More than 50 plants around the globe supplying GCC in slurry form for the paper industry, which makes it is very dominant filler. The WGCC has the advantage of high brightness and comparable with that of PCC. The fact that $CaCO_3$ is attacked by acids pushed papermaking processes to apply these types of fillers in neutral or slightly alkaline conditions.



Shape:- Rhombohedra
Abrasiveness:-6-8 mg/cm^2
Mohr Hardness:-3
Absolute Hardness:-9
Particle size (<2 microns):-45%
Brightness:-94-95%ISO

Figure 4:-Fine Grade WGCC Slurry

Their high brightness (90-95%) and with price the same as for clay motivated their vast application. Generally it is purchased from the supplier in paper industry at Rs. 2500/Metric Ton. The application of $CaCO_3$ as filler requires papermaking in neutral or slightly alkaline pH conditions. The benefits and particulars of alkaline papermaking with natural ground $CaCO_3$ are today experienced world-wide. [5]

Table 2:- Structure of fillers

Formula	Talc	PCC	GCC
Structure	$Mg_3SiO_{10}(OH)_2$	$CaCO_3$	$CaCO_3$
Density	2.8	2.7	2.7
Refractive Index	1.57	1.59	1.6
Hardness (Mohr's Scale)	1-1.5		3
Brightness (%)	78.2	79.3	80-90
Particle Size (<2 microns)	16	70	40
Specific Surface Area	6	2-10	1.6
Potential (mV)	-19	+5	-26
Abrasion(Bronze) gm/m^2	31	20	24

3. MANUFACTURING PROCESS OF WGCC

The raw materials are primarily crushed in jaw crusher followed by screening having open pit mine. Accepts from jaw crusher is sent to the centricleaner while rejects is treated as a waste. Centricleaner accepts is treated as a intermediate storage while rejects is sent to waste.

Intermediate products are separated in dry and wet processes as required. During wet grinding process, the materials are sent to again to the centricleaner for impurities removal. The accepts from this is sent to wet autogenous mill while rejects are sent to the washing station for removal of undesirable particles from the stock and again mixed with the wet autogenous mill material. In wet autogenous mill, all the operations are carried out which can be done in ball mill along with some specific functions.

The mixed stock is then sent to the floatation cell where further impurities are removed present if any. The treated mixture is then sent to cyclone separator where desired size particles are processes for thickening while undesirable materials are sent to the ball mill for converting into desired size particles. Thickening as well as ball mill stock mixed in a storage vessel and to wet grinding slurry tank.

The final product is stored in various transportation device and sent to paper industry as per the requirement.

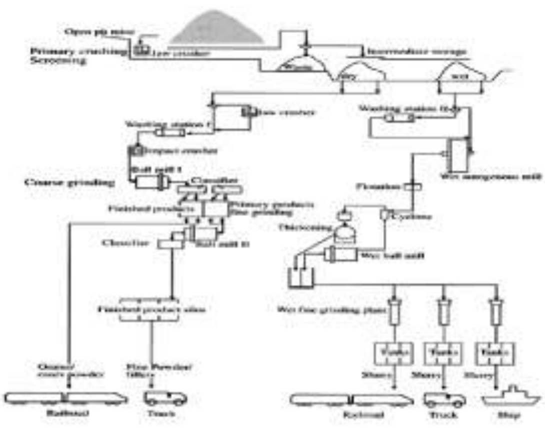


Figure 5-Manufacturing of WGCC

Fillers and Papermaking Chemistry

Particle size is the size of the ultimate particles into which filler can be dispersed. Higher the narrowness of the particle size distribution, narrower will be the distribution. Thus, if we increase particle size, filler retention will be increases.[6]

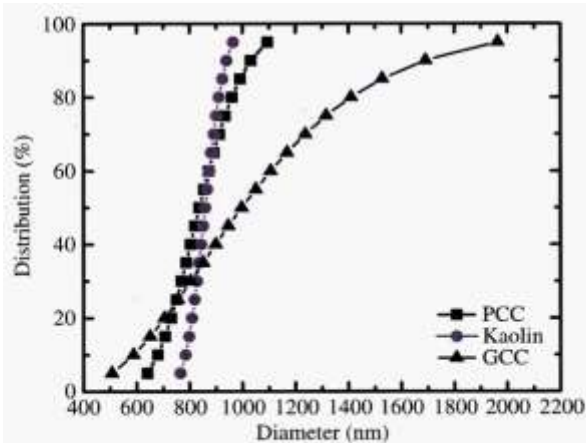


Figure 6:-Particle Size Distribution

Degree of Aggregation

If the filler is being utilized for purposes other than to gain opacity then it is important to aggregate filler particles to maximize first-pass filler retention. In doing the aggregation of filler decreases its light scattering capacity and thereby lowers its opacifying power. Therefore the papermaking chemistry is always adjusted to achieve the desired opacity at the highest first-pass retention and lowest filler level possible.[7]

Particle Shape

Particle shape is known to influence the light scattering performance of pigments as well as their response to calendaring and gloss development. Particle shape affects the extent to which filler decreases the air resistance and drying rate of paper. The shape of the particle size distribution has an impact on the performance of the filler.

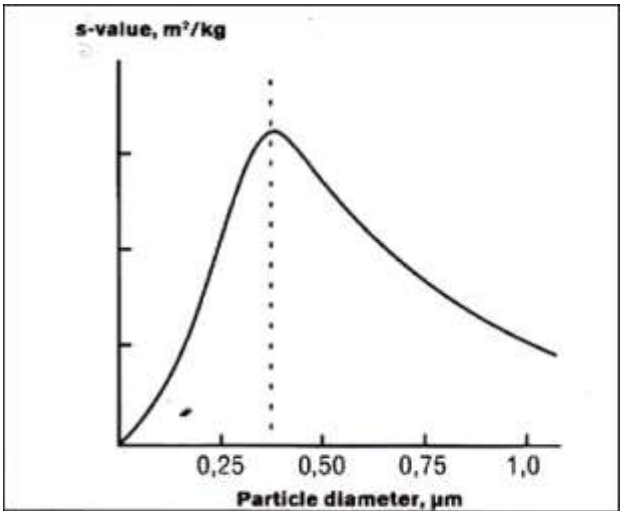


Figure 7:- Effect of particle diameter on light scattering (Turku 2010)

Ultrafine particles in the size distribution may not contribute to light scatter but may adsorb cationic starch or size increasing the consumption of these reagents or reduce the strength of the sheet. They are also more difficult to retain than coarser particles. Making steeper size distribution filler by preventing the generation of fines or removing them from the product results in more optically effective filler that has a less harmful effect on the strength of the sheet and helps to maintain Sheet Bulk. Particle shape is also important: platy pigments will give higher Gloss and lower Porosity than blocky pigments; blocky pigments will give good drainage, Light Scattering and Bulk.

Table 3:- Average Particle Size of Fillers

S. No.	**Pigment**	**Average Particle Size (µm)**	**Percent (0.2-0.8 µm)**
1	Clay	0.60	33
2	Precipitated Calcium Carbonate	0.80	43
3	Wet Ground Cal-cium Carbonate	0.95	33
4	Titanium Dioxide	0.37	85
5	Talc	1.2	27

Specific Surface Area

The surface area of any given pigment depends on its particle size and shape. Smaller the ultimate particle size, greater the surface area. Fine materials have a greater tendency to aggregate than coarse materials.Higher surface area materials will be more difficult to retain. The high relative specific surface area of fillers relative to fiber leads to greater sorption of wet end chemicals per unit weight of fillers than for fibres.

Table 4-: Specific Surface Area of Fillers

S. No.	Filler Type	Specific Surface Area(m^2/gm)
1	Clay	10-15
2	Precipitated Calcium Carbonate	2-10
3	Wet Ground Calcium Carbonate	2-12
4	Titanium Dioxide	8-10
5	Talc	9-20

Pigment Surface Charge

The charge on a filler particle suspended in water will usually be negative unless some other substance is added to reverse the sign of charge. The surface charge on filler particles can be altered by changing the pH of the suspending water. Addition of soluble inorganic salts (Alum, Calcium chloride).

Surface charges of different fillers were found as follows: talc (soap stone), -3; China clay, -10; GCC, +2; PCC, -6; TiO_2 (Anatase), -16; Retention decreased with increase in negative charge of filler.Addition of polymeric dispersing agents (Polyacrylates, Polyphosphates). Incorporation of charged groups in pigment surfaces when the pigment is manufactured. [8]

Filler Pigment Chemical Composition

Most common pigments are inert under normal papermaking conditions. A notable exception to this is calcium carbonate, which cannot be used in acidic conditions. Since in acidic medium in the presence of alum and $CaCO_3$, alum ionised to form sulphuric acid and $CaCO_3$ reduces to calcium oxide which affects the condition of raw stock and finished product. Fillers have an important function in the absorption of dyes, printing inks (oil, organic solvents and water), etc. Here, not only pigment surface chemistry, but also pore size and pore size distribution and the construction into the sheet and its surface comes into play.

Benefits of Alkaline Sizing

Recent developments in calcium carbonate filler products change the media of pH from acidic to alkaline paper making (pH :- 7-10). Among the benefits of so-called “alkaline papermaking” with $CaCO_3$ has been a marked reduction in the rate of deterioration of paper strength. Finally the solubility of a pigment in the papermaking environment needs to be considered. The dissolution of $CaCO_3$ under acid pH conditions was the cause for the revolutionary worldwide switch from acid to alkaline or slightly neutral papermaking.

In particular, there was growing concern regarding the embrittlement of paper products that were stored for long periods. Conservators noted a surprising phenomenon: the paper in certain books produced in the 1700s seemed to be in much better condition than typical books made during the late 1800s and 1900s (Barrett 1989). Barrett did a comparative study of such cases, extracting the paper with distilled water and measuring the pH. A strong correlation was found between the extract pH of the paper and its tendency to become brittle during storage.[9]

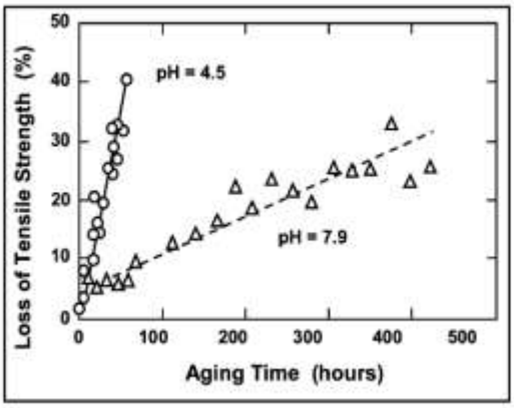


Figure 8:- Loss in tensile strength vs. time (newspaper sample)

In this experiment different samples of light-weight-coated (LWC) magazine papers were exposed to accelerated aging conditions of 90°C and 50% relative humidity. Two samples of paper manufactured under acidic conditions with alum (circles) were compared with two LWC samples prepared under alkaline conditions in the presence of $CaCO_3$ filler (triangles).[10]

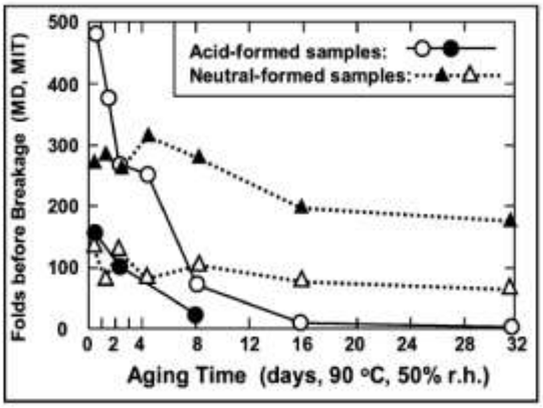


Figure 9:-Loss in folding endurance vs. time

Also the folding endurance of the acidic paper samples deteriorated to zero in less than 32 days of aging, whereas the alkaline papers lost only about 30%–40% of their folding endurance when subjected to the same conditions of storage. It is worth noting that one of the LWC samples prepared under acidic conditions started out with the highest strength. [11]

Properties of Fillers

There are several reasons why fillers are used in papermaking. The main reasons are their low cost compared to fibre and their ability to improve optical properties in the final product. Fillers can also improve surface properties of paper and by that have a positive effect on the printability of the final product. The price of bleached chemical fibre is roughly five to seven times as much as filler prices. Even recycled and deinked pulp (DIP) is more than twice as expensive as common fillers.

The great price advantage of filler easily makes a papermaker to think possibilities on how to use more filler instead of fibres. Fillers improve the optical properties of paper or paperboard in many ways. They improve such properties as opacity, brightness and colour. Opacity is increased because of filler particles scatter light well.

[1] Opacity

Amount of light scattering is dependent on

1. The size and shape of the filler particles,
2. The refraction index of filler
3. The amount of pigment-air interfaces present in the product.

Therefore very small and flat filler particles are optimal for obtaining opacity with the use of fillers brightness and colour of the final product can be controlled. The brightness and colour values of fillers typically beat the values of fibres as most of the fillers are almost 100% white or at least nearly white. [12]

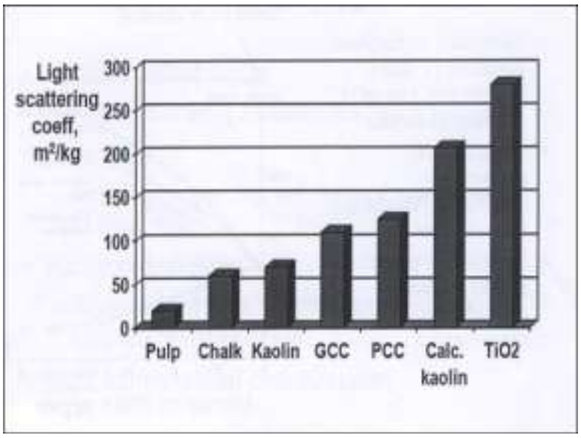


Figure 10:- Light scattering efficiency of fillers (Paltakari 2011)

High Opacity is achieved by pigments, which have high light Scattering and Light Absorption coefficients. Titanium Dioxide is the best opacifying coating pigment, Calcinated clays also perform well. Low Brightness clays and calcium carbonates, especially chalk, may be used to achieve Opacity, particularly in board pre coating applications.

[2] Smoothness

Fillers also have a smoothening effect on the paper surface. As small filler particles settle in between of fibres they together form a smooth paper surface. A smooth surface is required for example in rotogravure printing.

Although fillers are needed for a smooth surface and a good printing image, excessive amount of filler will compromise the paper surface strength. The loose particles and fibres will lint during converting and final quality will suffer.

[3] Print gloss

High gloss is achieved by minimising the micro-roughness of the surface. Fine platy clays are the most commonly used glossing pigments. The Rutile form of Titanium Dioxide gives some gloss and PCCs can be engineered to yield good gloss. The shape of GCC particles is not conducive to gloss, but this can be overcome to a large extent by grinding the particles to a very fine size. Good surface coverage can also contribute to paper gloss in single coating applications.

Good print gloss requires a combination of high paper gloss and good ink hold-out on the surface. The trend towards finer and finer pigments for glossing applications has resulted in coatings becoming more micro porous. Paper gloss has increased, but ink receptivity has also risen and ink hold-out has deteriorated.

The result is that the gloss differential between the print and the paper has declined. Fine pigments are used to generate paper gloss, but the particle size distribution may be modified so that a little paper gloss is sacrificed for better ink hold-out. Medium fine platy clay may also be used in matt coating applications where low paper gloss and a high gloss differential are important.

[4] Print density

High print densities are achieved by a combination of high ink receptivity and a large pore volume accessible to the ink. Micro porous coatings with simple pore structures and a high degree of connectivity give high print density values.

Combinations of very find GCCs and fine US clays give this sort of coating. Calcinated clays are micro porous and may be added to some pigment blends to increase the pore volume and ink receptivity of the coating.

[5] Fast Ink Absorption

Fine, relatively blocky pigments such as GCCs and fine US clays give fast ink absorption. Calcinated clays accelerate the ink absorption of coarse, platy pigments. Adding more find pigment particles will also increase the rate of ink absorption.

[6] Brightness

If we use talc then brightness will obtained 82% ISO which is very low as compare to wet ground calcium carbonate which gives brightness around 90-95 %.The effectiveness of the normally anionic oriented optical brighteners is intensified in the alkaline environment. The underlying reason for this is the absence of $Al_2(SO_4)_3$ under acidic conditions. Like all cationic additives, $Al_2(SO_4)_3$ impairs the effectiveness of anionic charged OBA's (Optical Brightness Agent).

OBA savings of up to 80 % over the acid system have been realized by alkaline paper mills, using high brightness natural ground $CaCO_3$ (marble) as filler. In light of present-day environmental awareness (AOX/ absorbable organic halogen, optical brighteners), interest in using high brightness natural ground $CaCO_3$ products for the manufacture of papers having a high natural brightness, is gaining ground.

High Light Scatter and Low Light Absorption by the pigment result in high Brightness. Ground Marble pigments are the most commonly used pigments when Brightness is critical. Precipitated Calcium Carbonates may be used in some coating applications. Fine, High Brightness clays may be added if high paper gloss is also a requirement.

Brightness can be improved a little if fines-deficient or steep particle size distribution pigments are used. Titanium Dioxide produces the highest Brightness, but it is very expensive so it is generally used as a minor component of a pigment blend. Calcinated clay may also be used, though they do not confer as much Brightness as Titanium Dioxide or Carbonate pigments. Both Calcinated Clay and Titanium Dioxide absorb UV radiation and neither is an "OBA efficient" pigment.

4. RETENTION

It depicts the amount of particles retained within a fibre network that is formed on the filter media from the suspension during filtration.

Since fibre suspensions include small, even colloidal-sized particles such as fillers whose mechanical entrapment is difficult due to their small size, attractive interactions, which promote particle deposition on different pulp fractions, play a significant role in particle retention. Influence of pulp fines fractions on filler particle retention is of particular interest, because fines contribute significantly to particle deposition in the stock due to their high external surface area and are in turn retained in the fibre network better than individual filler particles.

Coarse fillers, drainage aid are relatively easy to retain in the sheet, they give the sheet bulk and sheet strength is not unduly compromised. They also have some disadvantages; sheet Porosity is high, which may adversely affect printing properties, Light Scattering and Brightness may be low and the papers may be prone to dusting when printed on an offset press.

Fine fillers may give better sheet properties. They may scatter more light, giving better Brightness and Opacity. They may reduce Porosity and dusting; but their disadvantages are poor strength, low Bulk, poor drainage and filler retention. The problems associated with retention using fine fillers can be overcome to a great extent by the addition of flocculants to the furnish.

Interactions between the components of papermaking suspensions (e.g. fibres, fillers, fines and polymers) have a remarkable effect on various unit processes in papermaking. The filterability of fibre suspensions, which is a crucial property for example in paper sheet forming and solid recovery, is also known to be depended on particle interactions. However, due to the complex nature of the interactions, the role of these phenomena in fibre suspension filtration is still not fully understood. [13]

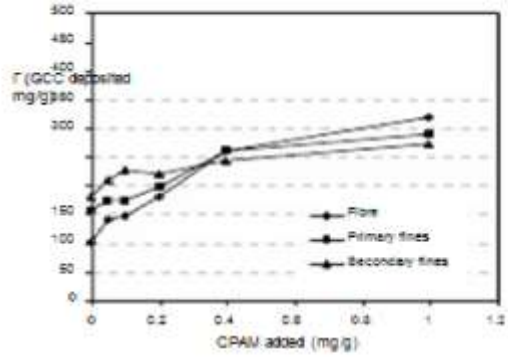


Figure 11:- Deposition of WGCC filler particle on fines and fibres fractions (filler dosage 600 mg/g of pulp)

The influence of fibre flocculation on dewatering is closely related to the structure of fibre floc. More importantly, the internal density of floc and factors that impacted the packing structure of filter cakes, such as floc size, played a crucial role in fibre suspension dewater ability. Dense floc with a low internal porosity particularly induces fast water flow by a mechanism termed as the “easiest path mechanism” through the large voids around the floc.

The effect of fibre suspension dispersing on dewater ability and particularly fines retention was found to be associated to the mechanism of action of the de-flocculation agent.

Carboxymethyl cellulose (CMC), had detrimental effects on the dewatering of a pulp suspension both when being adsorbed on fibre surfaces and when remained in the liquid phase. However, adsorbed CMC causes more plugging of the filter cake because it disperses the fines more profoundly. Thus the adsorbed CMC also reduces fines retention considerably more than CMC did in the liquid phase. Filler deposition and retention was found to be significantly higher on pulp fines fractions of mechanical and chemical pulp than on fibre fractions due to the higher external surface area of fines. The surface charge densities of pulp fractions also affected their ability to absorb fillers.

Cationic charges of filler particles was in turn observed to induce deposition of fillers on fibre surfaces which increased retention but also the dewater ability of a fibre suspension due to a decrease in total surface area of a suspension. The pigment morphology has an impact on the papermaking process and the final sheet quality.

A sheet filled with Natural Wet Ground Calcium Carbonate (WGCC) (rhombohedra shaped) drains faster than a clay (platy shaped) -loaded paper web. Precipitated Calcium Carbonate (PCC) of scalenohedral shape produces a more bulky paper web, which in consequence is more difficult to drain compared to a GCC loaded web. in order to have a good retention, high solid content suspensions, high sheet gram age, and high degree of beating also improve the filler retention.

Retention Aid

Calcium Carbonate in an acidic environment degrades, liberating Carbon Dioxide, unless steps are taken to protect the particles

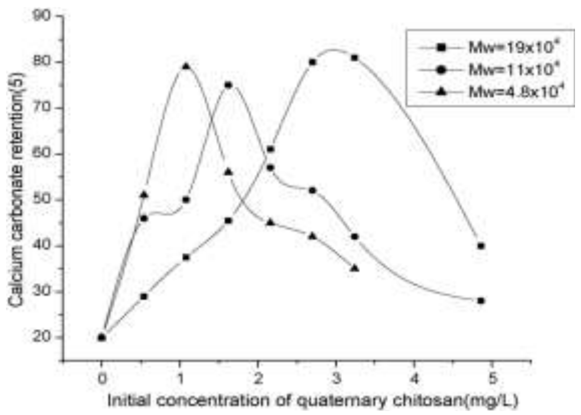


Figure 12:- Retention of calcium carbonate

The effect of quaternary chitosan with different molecular weight on the retention of CaCO3 fillers was plotted in. It was found that 20% of CaCO3 particles were retained in hand sheet as retention-aids were absent due to filtering of pulp fibres for the control group, but the addition of quaternary chitosan had a positive impact on the retention of CaCO3 particles. An increase and then a maximum in the retention were clearly observed. This trend was related to that of the flocculation experiments and zeta potential results [14]

As added at low dosage, quaternary chitosan were adsorbed onto the surfaces of CaCO3 particles via electrostatic attraction and induced CaCO3 suspension to associate or aggregate into the floc, which was retained easily in the paper sheet.

As the quaternary chitosan dosage increased, this aggregation was developed further, and the floc larger, and thus the retention of CaCO3 filler increased. When the aggregation became heaviest, the retention was in maximum, and the dosage of quaternary chitosan was called optimum retention dosage.

As showed the maximum retention reached the same level (the value was about 80%) regardless of the molecular weight of quaternary chitosan, but the optimum retention dosage was 3 mg/l, 1.7 mg/l and 1 mg/l for quaternary chitosan A, D, and E, respectively.

The adsorption of low-molecular-weight (4.8×104) sample (E) resulted in the most efficient retention, whereas the high-molecular -weight (19×104) quaternary chitosan (A) had a lower efficiency for the calcite fillers. The reason for this was that the flocculation mechanism of CaCO3 suspension by quaternary chitosan was charge patch. When the adsorbed amount (gram of quaternary chitosan/ gram of fibre) of quaternary chitosan was the same (mg/l), the positively charged patch sites formed by quaternary chitosan with low-molecular weight were much more than those formed by quaternary chitosan with high-molecular weight.

In this case, the interactions between the positively charged patch sites and negatively charged surface of CaCO3 fillers were stronger and the flocculation of $CaCO_3$ dispersion was easier to occur, thereby the optimum retention dosage of sample E was the lowest among samples A, D and E. However, at high dosages of quaternary chitosan, CaCO3 particles, just as Kaolin, were overcompensated and became re dispersion in the pulp suspension, and thus the retention of CaCO3 fillers was decreased.

It was also found that quaternary chitosan had a sharp retention maximum as a function of added amount shown. For the low-molecular-weight of quaternary chitosan, the phenomenon was more pronounced. Swerinetal Also found the same phenomenon when they studied the flocculation of cellulosic pulp by cationic polyacrylamide.

Table No. 5:- Process Conditions

Sr. No.	Particulars	Unit	ASA+ TALC	ASA+W GCC
1	Machine Speed	Mpm	290	290
2	Rate Of Production	Tpd	4.8	4.8
3	Coagulant	Gm/Ton	50	Not Used
4	Cobb Value Before Size Press	GSM	45-50	45-50
5	System pH		6.2-6.8	7.2-7.4
6	ASA Dosing	Gm/Ton	1.0-1.1	1.0-1.1

Table 6:- Paper Properties

Sr. No.	Par-ticulars	Unit	ASA+ TALC	ASA+ WGC C	Remark
1	Bright-ness	%ISO	93.5	94.2-94.8	
2	Cobb	GSM	23-30	25-30	Sizing Rever-sion Ten-dency reduced t large extent
3	Ash Content	%	11-12	12-13	Ash% Increases

Table 7:-Retention Figures

S. No	Par-ticular s	Unit	ASA+ Talc	ASA+ WGC C	Remarks
1	FPR	%	83-85	83-85	Retention im-proved.
2	FPAR	%	55-60	50-55	
3	Over All Filler Reten-tion	%	78-82	78-82	

5. OBSERVATIONS

With the use of surface sizing agent ASA dosing could be brought Down to 1.0-1.1 Kg/ Ton of paper. This reduction of ASA by almost 30% helped to avoid sizing reversion issue.

- Overall filler retention increased to 75-80% and also FPR& FPAR could be increased to 84-85% & 53-55% respectively.
- Paper ash% could be maintained around14 -15 % without any major impact on machine run ability or final quality of paper.

6. COST IMPACT

After running paper machine with WGCC as filler in ASA sizing for almost 3 to 4 months, a detailed cost comparison done to evaluate cost benefits considering all the pro and cons of the change of filler from Talcum to Wet Ground Calcium Carbonate.

Overall there is a saving of Rs.144/-per MT of paper which is over and above the additional cost incurred due to increase in wear and tear of machine clothing, use of new chemicals like cationic starch, surface sizing aid, Wet ground Calcium carbonate and usage of extra flocculent.

Table No. 8:- Cost sheet

Sr. No	Particulars	Unit	Normal (Talc)Ash-11.5%(A)	Trial (WGCC) Ash-14.0(B)	Remarks
1	Fiber cost	Rs/Ton	25490	24899	Fiber cost reduced due in increase in Ash%
2	Filler cost	Rs/Ton	879	1088	Increased due higher usage of maintaining high ash%
3	Optical whitening agent cost	Rs/Ton	600	445	Reduced due to use of high bright WGCC as filler
4	Surface sizing cost	Rs/Ton	1264	1264	No change
5	Internal sizing cost	Rs/Ton	380	490	Increased due to additional use of flocculent and surface sizing chemical **(Surface sizing aid cost included)**
6	Cationic starch cost	Rs/Ton	0	136	Additional cost
7	Biocide cost	Rs/Ton	35	58	Increased
8	Felt conditioning cost	Rs/Ton	45	60	Increased
9	Additional cost due to increase in machine clothing consumption	Rs/Ton		110	Increase due reduction of wire life from 90 days to 45 days in comparison to blank
10	Total	Rs/Ton	**28692**	**28548**	
11	Saving in comparison to Blank (10.B-10.A)	**Rs/Ton**		**144**	

7. CONCLUSION

- Wet Ground Calcium Carbonate can replace conventional soap stone powder as filler with ASA sizing. However following care needs to be taken.
- Retention on wire should be sufficient to handle the fine graded WGCC so as to keep ASA demand as low as possible i. e. a suitable retention program & Surface sizing program is required.
- Combination of suitable retention aid (flocculants) along with wet end starch will give desired results in retention and ASA demand.
- Use of effective surface sizing aid & Micro particle retention system (bentonite) to control the requirement of ASA chemical for imparting required sizing to the paper.

Proper optimization of felt and wire conditioning as well as slime control programs.

(a) Loading of Filler can be increased by almost 20-30% in comparison to the existing loading keeping the paper quality same or better than before.

(b) Paper Brightness can be improved further by 2.0% ISO with high bright WGCC with considerable saving in OWA to get the same brightness level.

(c) Due to increase in loading an equal amount of fiber can be saved which gives the overall cost benefit with an upgraded quality.

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