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RESEARCH ARTICLE

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ABSTRACT

Once use of non fibrous material in paper making was considered to be cheating on the customers. This was so for many years. The effect of fillers on paper not only gives certain improved optical properties on paper but also reduce the dependency on fibre.

In the initial days filler mean invariably of soap stone powder (Talc) used in paper making. The limitation was imposed due to acid size during the period. The ash percentage on paper also could not be increased above 4 to 6 % on paper and this achieved at the reduced strength of paper.

With the advent of alkaline sizing, the usage of precipitated calcium carbonate and ground calcium carbonate ash on paper is increased paper to the tune of 18 to 20%. This increase in ash on paper without affecting the paper strength and at the same time increases the optical properties of paper.

The increase in optical properties of paper cannot be without some of draw backs in the form of fast wear out of forming fabric particularly wire.

INTRODUCTION

The different types of filler available are

Fillers are normally mined and naturally occurring material. Some changes in the filler are made with chemical process or simply ground to form fit to be used in paper making process.

Talcum

Talc is good filler for rotogravure printing paper. It is soft mineral flat like shape gives good smoothness for paper. Therefore it is good for paper and paper board printed in rotogravure. Talc used to absorb organophilic materials produced in the process like pitch. Talcum is hydrophobic in nature and it difficult to make water based dispersion on it. Talcum has tendency to foam during process.

Ground Calcium Carbonate (GCC)

In its natural state calcium carbonate occurs in the form of chalk, limestone and marble. The term GCC is referred in papermaking made of limestone or marble. Limestone and marble is used due to high brightness and less impurities along with chalk it gives high opacity level. The particle shape of GCC is rhombohedral, which creates porous surface on paper. GCC is also hydrophobic in nature and release water easily during the paper making. However, the rough particle shape of creates also challenge. The process of producing the GCC is grinding and filtering, the particle size could not be controlled effectively. Paper machine cloths especially wire wear more rapidly with GCC.

Precipitated Calcium Carbonate (PCC)

Precipitated Calcium Carbonate is a form of $CaCo_3$ which is chemically produced. Its structure is different from the structure of ground calcium carbonate. With the use of PCC the better opacity, bulk and gloss of paper is obtained. The PCC is produced primarily from $CaCo_3$.

Titanium Dioxide (TiO_2)

Titanium Dioxide is a pigment that has high optical efficiency. The small particle size of TiO_2 has high brightness value. It

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scatters light well as compared to other fillers. Titanium Dioxide is used such grade of paper which requires high opacity and like light weight high Opaque paper like offset paper or Bible paper. Show through is reduced by the use of TiO_2. High price and abrasive nature of TiO_2reduce its broader use in paper industry.

Filler is a non fibrous substance used in the paper making along with cellulosic fibre. Till the acid internal sizing programme was in trend, increased ash on paper could not be achieved due to many problems associated. The major filler used during the period of soap stone powder mined and the brightness of 85 to 90% was used. In the acidic media only soap stone powder remain as it is without reacting and fills the void volume in between fibre mats that is paper.

Abrasion characteristic of material is function of hardness, concentration and particle size.

Hardness is typically measured in Mohs scale, where diamond is 10 and Talc is 1. A high Mohs hardness will scratch or abrade a material with low Mohs. Calcium Carbonate is a soft material with Mohs of 3.

Mineral	Mohs Relative hardness	Scratch test	Vicker kg/mm2
Talc	1	Easily scratched by finger nail	2.4
Gypsum	2	Scratchable by finger nail	36
Calcium Carbonate	3	Easily Scratched by knife	109
Fluorite	4	Scratchable by knife	189
Apatite	5	Difficult to scratch by knife	536
Orthoclase	6	Scratchable with steel Fille	795
Quartz	7	Scratches window glass	1120
Topaz	8	Scratches Quartz	1427
Corundum	9	Scratches Topaz	2060
Diamond	10	Glass Cutter	10060

Particle size distribution is important parameter. Coarse grit sand paper is far more abrasive than fine grit-sand paper, even though grit consists of same material. So the median particle size and distribution of GCC is critical.

Till the end of December 2015 usage of high brightness talc (Soap stone powder) was used in the production of writing and printing paper. Usage of talcum as filler has its own limitation like, lower paper strength properties even at the ash level of 3 to 4 % on paper. More linting propensity of paper in machine and in the printing section. Linting of any gsm of paper plus 15 is acceptable, whereas for the talcum added paper, it used to go up 200 gram/km. (Fluff reading is made in paper machine pope reel with Emerson instrument, the grammage of fluff stick to the cloth is weighed and reported as fluff reading, this is only indicative reading).

This result in the blanket being cleaned very frequently in printing section, smudging on printing paper , in worst case blanket used to get damaged. To reduce the linting, dry strength resin is used. Dry strength resin in wet end helped in reducing the linting propensity of paper to very less points only.

In view of the above and to satisfy the requirement of customers, precipitated calcium carbonate and wet ground calcium carbonate were tried. In the initial stage, Precipitated calcium carbonate along with Talcum in the ration of 1: 1 is tried, there is marked improvement in the reduction of linting propensity of paper, but still it is not accepted to customers. However 1.5 to 2 % increases in ash paper could be achieved with reduced fluff reading on paper. The optical paper properties also increased drastically and paper shade is well accepted by customers. Paper bulk also increased considerably. The wire life started decreasing from the targeted production of fabric to 4000 MT less.

The encouraging result of PCC in combination of talcum usage in 50 :50 ratio, it was decided to try WGCC (Wet grounded calcium Carbonate) in machine with PCC and WGCC in the ratio of 50:50. The soap stone powder (talcum) was totally stopped. The usage of PCC and WGCC in equal proportion in machine helped in acceptable shade of paper, increased the ash percentage of paper to the tune of 3 to 4 % from the initial stage. The ash percentage could be increased on paper up to 8 to 10 % without reduction in the paper strength properties at the same time good optical properties of paper, good bulk, good depth of shade, drastic reduction in fluff (linting) in paper without the usage of dry strength resin for the increased ash percentage on paper.

With all the above mentioned benefits of using WGCC and PCC on paper optical properties, increased ash on paper and thus reduced the dependence of costly fibre, at the same maintain the paper strength. The main disadvantage of using the WGCC and PCC faster wear out of forming fabric particularly wire due high abrasiveness of carbonate. In WGCC, controlling of particle size is very difficult and it is purchased in slurry form. In Mysore Paper Mills it was purchased from outside and the travel time for the slurry to reach the mill site is 14 hours after the preparation of slurry. Since the slurry got the tendency to settle, the travelling time due to tanker movement, the settlement of slurry to certain extent can be avoided. Once it is transferred to storage tank and before dosing to the system, settling and property change could not be ascertained. The tank was provided with the agitator to avoid rapid settling.

Fabric life with soap stone powder as Filler

Sl.No	Year	No.of fabric	Fabric Supplier	Fabric No.	Date On	Date Off	Number of Days run	Production achieved MT	Remarks
1	2013-14	1	SWILL	19219	06-13-13	09-11-13	90	14816	Normal
		2	W&F (STL)	26735	09-11-13	12-30-13	110	16857	Trial wire
		3	SWIL (DL)	19180	12-30-13	04-02-14	93	15602	Normal
2	2014-15	1	SWILL(2.5)	21222	04-02-14	07-04-14	93	15662	Normal
		2	W&F (STL)	30243	07-04-14	10-01-14	89	15589	Trial
		3	SWILL – SSB	23722	10-01-14	23-02-15	145	7707	Damaged
		4	SWILL(2.5)	21207	23-02-15	23-06-15	120	12594	PCC & SSP in equal proportion

Fabric life with PCC & SSP and PCC& WGCC in equal proportion

Sl No	Year	No of Fabric	Fabric Supplier	Fabric No	Date on	Date Off	No of Days	Production Achieved MT	Remarks
1	2015-16	1	SWILL(2.5)	23661	23-06-15	16-08-15	54	8318	GCC Trial Taken
		2	SWIL(TL-SUP-AT)	23730	16-08-15	17-09-15	32	5375	PCC & WGCC are being used in 1:1 ratio
		3	SWIL(TL-SUP-AT)	24394	17-09-15	24-10-15	37	5239	
		4	SWIL(TL-SUP-AT)	24395	24-10-15	22-11-15	28	3640	

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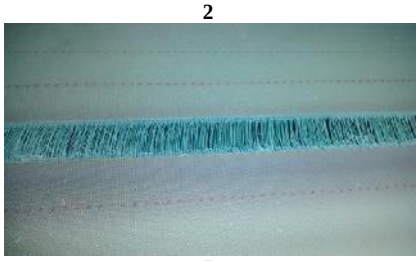

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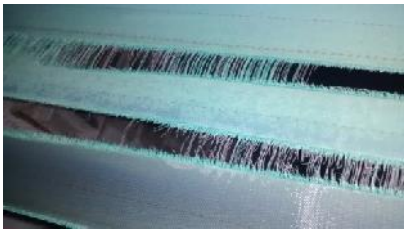

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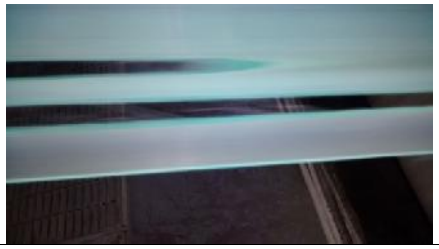
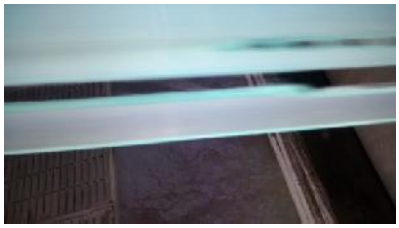
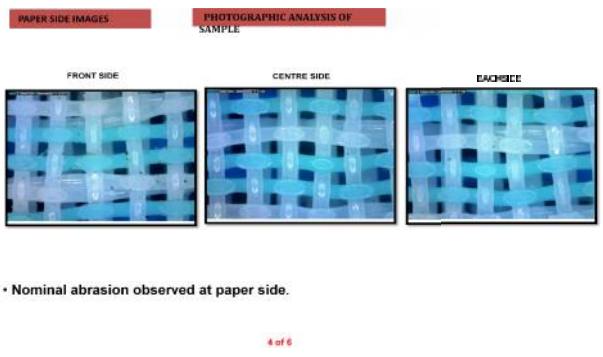
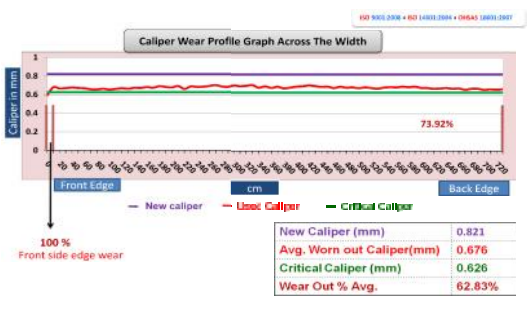




Fabric Wear Pattern On The Machine After Use Of Wgcc & Pcc



Caliper Distribution Of Fabric After The Use Of Pcc & Gcc As Filler After Wire Has Given 5000 Mt Of Production



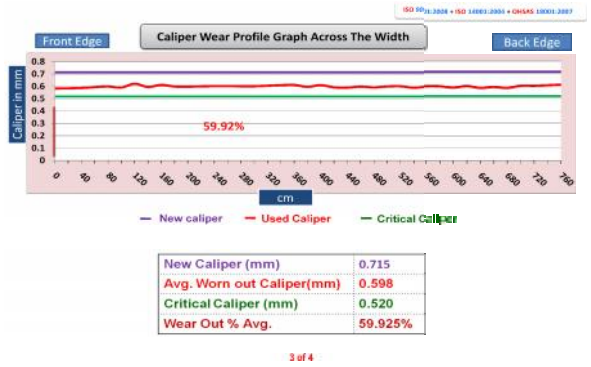
Forming fabric life (wire) during the usage of talcum powder as filler in paper and PCC &SSP and WGCC & PCC in equal proportion are listed in below tables

The fabric damage pattern also of similar in nature, both edges of fabric is weak and develop hole. Once the hole developed it propagate very fast. Some of picture listed below of the fabric damage in progress

All the wire damage is of similar in nature in all wire and over all wear out of the fabric also very fast and drastic.

Caliper distribution of fabric across width of the machine during the use of the soap stone powder as filler and PCC & WGCC as filler is given in the below.

Caliper Distribution During The Use Of Soap Stone Powder As Filler After The Wire Has Given The Life Of 15000 Mt



New Caliper (mm)	0.715
Avg. Worn out Caliper(mm)	0.598
Critical Caliper (mm)	0.520
Wear Out % Avg.	59.925%

CONCLUSION

The case study for the twin wire former producing writing and printing paper gsm range from 47 to 80 gsm. Machine speed varies from 480 mpm to 540 mpm.

From the above graphs it is very evident the WGCC and PCC combination have gave rise to more wear pattern of fabric than with soap stone powder as filler. The fabric life has reduced drastically.

In consultation with fabric supplier correction in fabric design and other parameters are thought of. The following points and changes in machine are suggested by the experts and fabric manufacture to get the maximum benefit of usage of WGCC and PCC as filler.

1. Forming section drainage element present aluminium oxide material to silicon carbide or silicon nitrate material,
2. Increase the First pass ash retention and overall first pass retention.
3. Restricting the usage of ash to 10 % till all the problems are sorted out in machine and improved fabric life.
4. Putting satellite WGCC plant near by mill site so that effective control of particle size of WGCC can be achieved.

It is also pertinent to mention here the cost of filler to fibre if it is not 1:5, the cost benefit will not be there. However, keeping in line with the optical properties achieved by the usage of WGCC and PCC combination, like reduced fluff, bulk and surface properties improvement cannot be achieved with SSP powder. Further trial and experimentation with new ideas are warranted to stabilize the WGCC and PCC combination in paper machine at the sustained usage.

Acknowledgement

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