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STUDY OF VARIATION OF CORRUGATED BOARD PROPERTIES

Preeti Sharma[1], Mohit Kumar[2], Abhishek Saini[3]

[1]M.Tech. Student, Department of Printing Technology
[2]Assistant Professor, Department of Printing Technology
[3]Assistant Professor, Department of Printing Technology
Guru Jambherwar University Science and Technology, Hisar
Email: preetisharmag1995@gmail.com

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ABSTRACT: Corrugated Packages are designed to fulfill the need for product protection, material use efficiency and the material's impact on the environment. The purpose of this paper is to study the variation of corrugated board properties and then give solution to improve the properties of board. For this study, we found opportunities to solve the variation in corrugation board properties. This paper analyzed the various types of paper and paperboard having different – different GSM, thickness, bursting strength and cobb value. This type of board or corrugated board is light in weight and environmental protection etc. and this type of board is ideal material for packaging.

KEYWORDS: Types of paper or paperboard, corrugation board, board defects, board properties, testing value.

I. INTRODUCTION

Packaging is an art and science of safe delivery of the product to the end user and it also extend the shelf life of the product. The function of packaging is to protect, preserve, and it's also serves as a marketing tool so as to increase the sales of the products. Packaging is divided into three categories; 1 Primary packaging 2 Secondary packaging 3 Tertiary packaging. Corrugated board has many features. Corrugated board packages are designed to complete the need for the protection of product. [1]

Flutes are the geometric configurations formed by undulations (continuous rolling waves) of the corrugated medium in corrugated board. Flutes make the board stronger than paper or paperboard.

Corrugated board has five types of flutes of different varieties which are as under followed:

- A-flute- This type of flute is used for making heavy corrugated box which are used for packing of heavy products.
- B-flute- This flutes is mainly used for packaging of food products and cosmetic packaging. This flute has high tearing strength.
- C-flute- This flute is mainly used as cushioning purpose and it also has good printing quality.
- E-flute-This is of eco-friendly nature. And used more commonly than other flutes.
- F- flute-This flute is used for customized printed corrugated boxes and it is also of eco-friendly nature. This flute offer high printing quality. [2]

II. RESEARCH METHODOLOGY

This research/study was carried out in **Nugenic Pharma Pvt. Ltd.** Data was collected by taking samples from the manufacturing of corrugation boards and will be tested , namely cobb test, bursting strength test and thickness test and also gsm will be performed. The results so observed will help to find out the deviation of corrugated board properties.The quality of corrugation materials was verified by the researcher using various tools.

There are various types of Paper and paperboard used in this research having different – different GSM, thickness, bursting strength and cobb value.

Corrugated Board Machine

Corrugated board machinesare particularly designed for creasing work on paper, card board, corrugated board, fiber board, die cutting and PVC materials etc. With corrugated board making machine we achieve higher production and superior board quality. Some main features of corrugated board machine which is:

- Dwell timer

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- Adjustable chase
- Precise heating plate
- Gum circulation
- Variable speed control
- High strength production of corrugated board.
- Better compression strength.

Data collection and analysis

Data is collected by taking samples and find out the average value of tests is performed on day to day basis with the help of instrument. These are the following boards manufactured in Nugenic Pharma Pvt. Ltd.

Folding Box Board (FBB) -This board is formed by bleached chemical pulp and the mechanical pulp. The layers of mechanical pulp are sandwiched between the layers of bleached chemical pulp. The mechanical pulp at the centre makes the board stiffer.

Saffire - Saffire is a board with excellent attractive properties. It is manufactured by bleached chemical pulp and has a pure white shade. Saffire board is mainly used in the applications where the customer needs pure white shade.

White back –White back is of different qualities. It is manufactured by recycled fibers and bleached chemical pulp. The recycled fiber is sandwiched between the bleached chemical pulp or mechanical pulp.

Table.1.1 Different GSM value of different boards

GSM of different Boards					
Sr. no.	**Saffire**	**Fbb**	**White back**	**Grey back**	**Cyber XL**
1	328	315	350	350	295
2	320	320	346	320	315
3	340	300	320	350	310
4	320	315	350	310	300
5	350	330	320	320	320
6	340	300	346	350	315
7	300	320	310	330	320
8	320	310	350	320	295
9	328	300	320	350	310
10	310	315	315	320	320
11	340	330	346	330	300
12	350	320	350	350	315
13	320	310	320	320	290
14	300	315	346	310	310
15	350	330	320	330	320
Avg.	327.73	315.33	333.93	330.66	309

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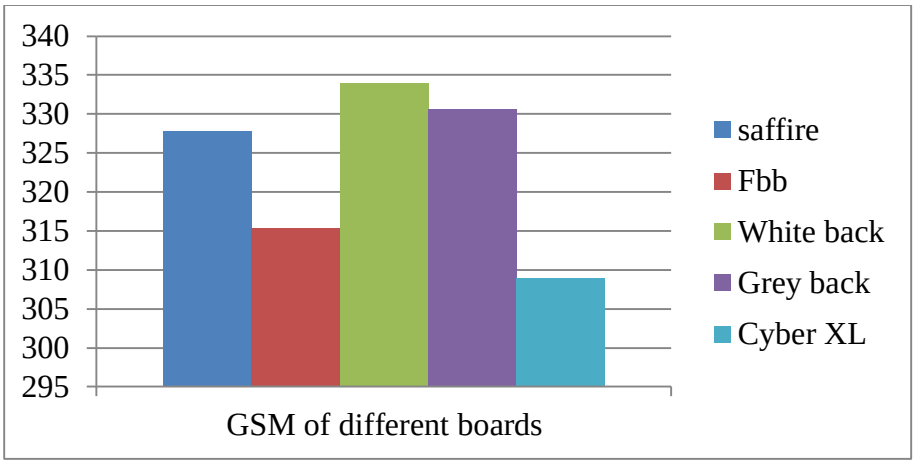

Chart1.1 Observed GSM value of different boards

Grey back - Grey back is widely used and manufactured board worldwide. It is also known as coated recycled board, grey back or duplex board. It comprises of 60-100% recycled fibres distributed across different layers. The middle plies, which are grey in colour, are made by recycled material. The layers between middle layer and top layer may comprise of bleached chemical pulp or mechanical pulp.

Cyber XL - In Cyber XL virgin fiber is used which gives the corrugated box a good strength and also look eye appealing. The first FBB made in India, Cyber XLPac has become synonymous with 'consistency' and continues to be the standard and the preferred choice for high quality packaging.

Table1.2. Different thickness value of different boards

	Thickness of different boards(mm)				
Sr.no	**Saffire**	**Fbb**	**White back**	**Grey back**	**Cyber XL**
1	.49	.32	.35	.43	.30
2	.31	.32	.34	.32	.31
3	.33	.30	.32	.43	.31
4	.31	.32	.35	.31	.29
5	.36	.34	.32	.32	.32
6	.33	.30	.34	.43	.31
7	.30	.32	.31	.34	.32
8	.32	.31	.35	.32	.30
9	.49	.30	.32	.43	.31
10	.30	.32	.32	.32	.32
11	.33	.34	.51	.34	.29
12	.36	.32	.35	.43	.31
13	.31	.31	.32	.32	.35
14	.30	.32	.34	.31	.31
15	.36	.34	.32	.34	.32
Average	.34	.31	.34	.35	.31

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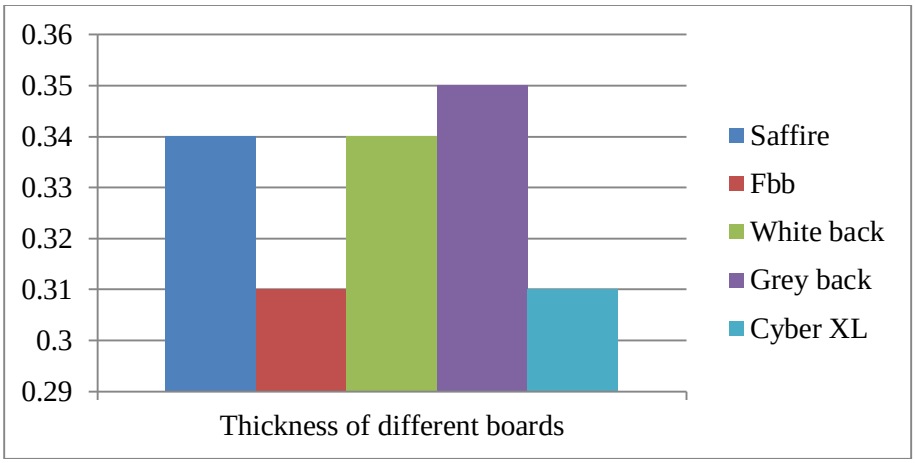

Chart1.2. Observed thickness of different boards

Table1.3. Different Bursting strength value of different boards

Bursting strength of different types of board (Kg/cm2)					
Sr.no.	**Saffire**	**Fbb**	**White back**	**Grey back**	**Cyber XL**
1	5.2	5.1	5.6	4.7	4.8
2	4.5	5.2	5.3	4.5	5.2
3	5.6	5.0	4.9	4.7	4.8
4	4.5	5.1	5.6	4.4	4.6
5	6.1	5.3	4.9	4.5	5.2
6	5.6	5.0	5.3	4.7	5.1
7	4.3	5.1	4.8	4.6	5.2
8	4.5	5.0	5.6	4.5	4.8
9	5.2	5.0	4.9	4.6	4.9
10	4.2	5.2	4.8	4.5	5.2
11	5.6	5.3	5.3	4.6	4.6
12	6.1	5.1	5.3	4.7	5.2
13	4.5	5.0	4.9	4.5	4.7
14	4.3	5.2	5.3	4.4	4.9
15	6.1	5.3	4.9	4.6	5.2
Average	5.08	5.1	5.16	4.5	4.96

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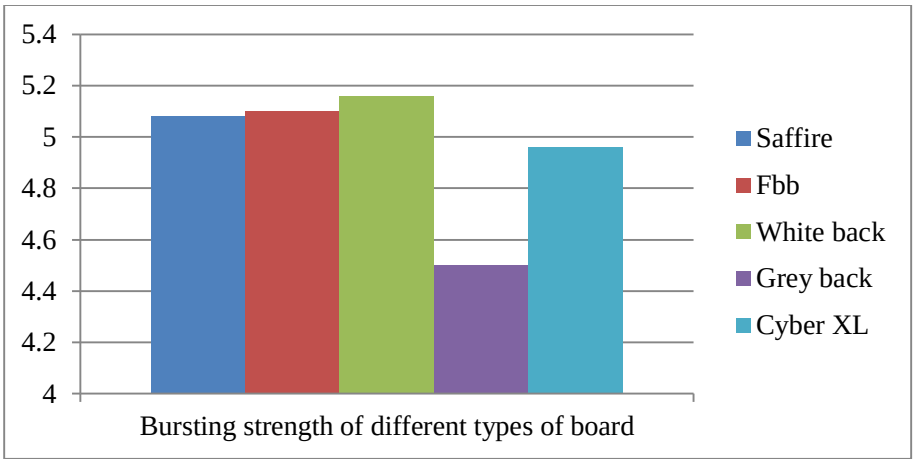

Chart.1.3.description:- This chart shows the observed bursting strength of boards

Table1.4. Different Cobb value of different boards

Cobb value of different types of board					
Sr.no.	**Saffire**	**Fbb**	**White back**	**Grey back**	**Cyber XL**
1	35	35	40	35	32
2	32	32	35	40	35
3	40	38	36	32	40
4	37	35	42	30	38
5	41	40	40	38	30
6	39	35	38	35	35
7	32	32	35	30	40
8	38	35	42	32	32
9	35	38	38	40	30
10	34	40	30	35	35
11	37	35	35	36	37
12	41	31	44	30	32
13	32	30	36	35	35
14	38	32	45	38	40
15	45	35	32	40	36
Average	37.06	34.86	37.86	35.06	35.13

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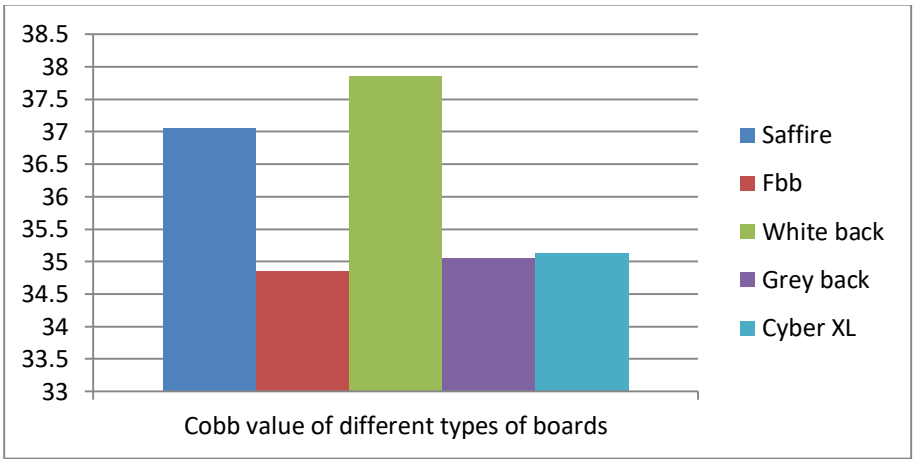

Chart.1.4.description:- This chart shows the observed Cobb value of different boards

Table2.1. Virgin Kraft Paper testing value

Sr no.	GSM Std.GSM 180.0	Bursting factor Std.B.F 25.0	Bursting strength	Cobb (g/m2)
1	176.0	25.6	4.5	46
2	184.0	24.6	4.5	40
3	179.0	25.0	4.4	44
4	175.0	25.4	4.4	40
5	181.0	24.4	4.4	44
6	180.0	25.0	4.5	33
7	174.0	26.0	4.5	47
8	184.0	24.5	4.5	41
9	185.0	25.1	4.6	45
10	180.0	24.0	4.3	33
11	183.0	25.4	4.6	44
12	177.0	25.0	4.4	49
13	184.0	24.6	4.5	41
14	181.0	25.1	4.5	44
15	173.0	24.6	4.2	41
16	179.0	25.0	4.4	46
17	175.0	25.4	4.4	40
18	179.0	25.0	4.4	44
19	176.0	25.6	4.5	46
20	184.0	24.6	4.5	40

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Average	179.45	24.99	4.45	42.4

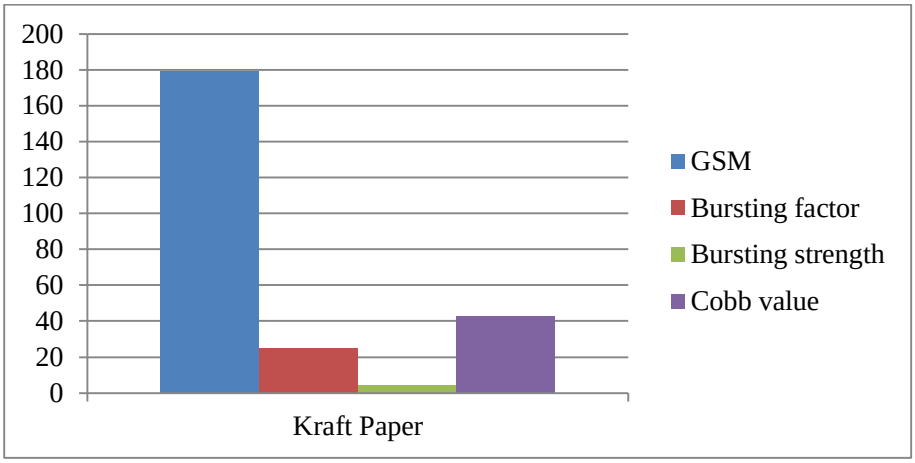

Chart2.1.description:- This chart shows the observed Virgin kraft paper value

Table2.2. Semi Kraft Paper Testing value

Sr.no.	GSM Std.GSM 140	Bursting factor Std.B.F 18.0	Bursting strength	Cobb (g/m2)
1	142	18.3	2.5	42
2	138	18.0	2.4	40
3	140	18.2	2.5	41
4	137	18.1	2.4	40
5	141	18.1	2.5	43
6	143	18.0	2.5	42
7	139	18.2	2.4	40
8	142	18.3	2.5	45
9	144	18.1	2.6	43
10	138	18.0	2.4	41
11	136	18.2	2.4	43
12	139	18.1	2.5	44
13	141	18.0	2.5	45
14	140	18.4	2.5	42
15	142	18.3	2.5	40
16	140	18.1	2.5	42
17	138	18.0	2.4	41
18	140	18.4	2.5	42
19	139	18.1	2.5	44

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20	136	18.2	2.4	43
Average	139.7	18.15	2.47	42.15

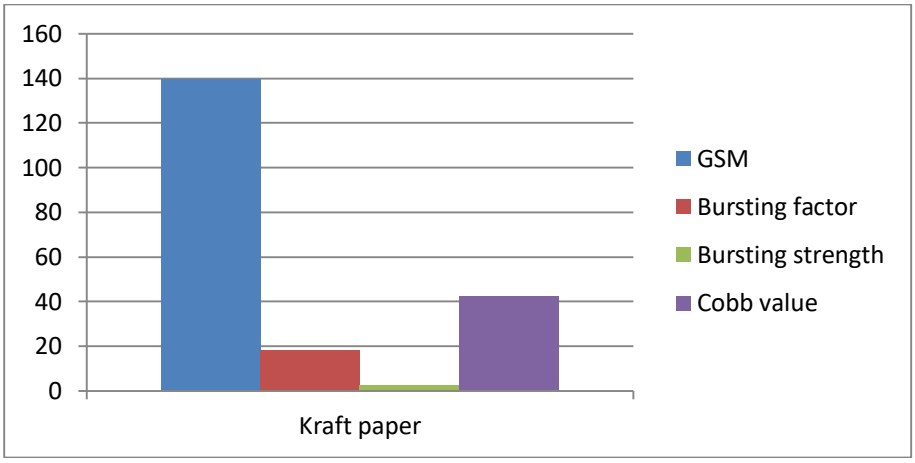

Chart 2.2.description: This chart shows the final observed Semi Kraft paper value

In corrugation board manufacturing process some defects are also occur these defects are normal in corrugation. These defects are describe below and also its remedy.

High and low Flutes:-

- Improper setting of adaptor.
- Quality and characteristics of paper.
- Paper reel not in perfect circle.

Remedies:-

- Proper setting of adaptor.
- Proper reel winding.

Cracking of Flutes:-

- Paper is brittle.
- Excess pressure on flute roll.
- Excess tension on paper reel due to brake being tight.

Remedies:-

- Reduce pressure.
- Reduce tension

Delamination:-

- Inferior Quality of gum.
- Insufficient heat.
- Low pressure of pressure roll.
- Application of gum not uniform from one end to the other.
- Insufficient quantity of gum applied.

Remedies:-

- Controlled heat.
- Proper quantity of gum is applied.
- Increase pressure of pressure roll.

Blisters:-

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- Thin streak in liner.
- Loose corrugation.
- Spotty glue application at fingers

Remedies:-

- Change liner.
- Adjust Fingers.
- Check Medium Moisture.

Wrinkles:-

- Adhesive application too heavy.
- Too much heat.

Remedies:-

- Reduce Adhesive
- Run at faster speeds or bypass pre-heaters with minimum possible glue line.

Leaning:-

- Corrugating rolls not parallel.
- Wet medium.
- Uneven pressure on corrugating rolls.

III. RESULT & DISCUSSION

Properties of corrugated board manufactured by the company -: Actual average values of different boards measured during this research work are: Gsm of saffire = 327.73 gm/m^2, Gsm of fbb= 315.33 gm/m^2, Gsm of grey back = 330.66 gm/m^2, Gsm of white back= 333.93 gm/m^2, Gsm of cyber xl= 309 gm/m^2 as shown in table 1 and Chart1-1. Thickness of saffire = 0.34mM, Thickness of fbb= 0.31MM, Thickness of grey back = 0.35MM, Thickness of white back= 0.34MM, Thickness of cyber xl= 0.31 as shown in table 2 and Chart1-2. Brusting strength of saffire = 5.08Kg/cm^2, Brusting strength of fbb= 5.1Kg/cm^2, Brusting strength of grey back = 4.5Kg/cm^2, Brusting strength of white back= 5.16Kg/cm^2, Brusting strength of cyber xl= 4.96Kg/cm^2 as shown in table 3 and Chart1-3 and cobb value of saffire = 37.06, cobb value of fbb= 34.86, cobb value of grey back = 35.06, cobb value of white back= 37.86, cobb value of cyber xl= 35.13 as shown in table 4 and Chart1-4. By analyzing the data of table 2 and Chart1-1, it is quite evident that white back has more gsm i.e., 360.86 gm/m^2 among saffire, fbb, grey back, white back and cyber XL boards. White back has more thickness i.e., 0.40MM among saffire, fbb, grey back, white back and cyber XL boards. White back has more brusting strength i.e., 5.78Kg/cm^2among saffire, fbb, grey back, white back and cyber XL boards. The results show that white back exist more qualities and characteristic features like strength, density etc.

Virgin kraft paper and Semi kraft paper: Kraft paper is of two types one is virginnkraft paper and another is semi kraft paper. Virgin kraft paper is better than semi kraft paper because GSM of virgin kraft paper is higher than semi kraft paper. Standard GSM of version kraft paper is 180gsm and standard gsm for semi kraft paper is 140 gsm. The Actual average values of virgin kraft paper measured during this research work are: Gsm of Virgin kraft paper is 179.45, brusting strength of Virgin kraft paper is 4.45, brusting factor of Virgin kraft paper is 24.99,cobb value of Virgin kraft paper is 42.40. Whereas, the actual average values of semi kraft paper measured during this research work are:gsm of Semi kraft paper is 139.75, brusting strength of Semi kraft paper is 2.47, brusting factor of Semi kraft paper is 18.15, cobb value of Semi kraft paper is 42.15

Defect Analysis: By analyzing the data of this research work it is quite evident that these are the most frequent occurring defects which is seen during the board manufacturing process.

Variation in board is normal in corrugation process and this variation in board is occurred because of some defects. These defects are normal in during board manufacturing process. Mainly some defects are seen which is wrinkles, leaned flute, blister, cracking of flute, delamination etc.We also use some remedy to remove this defects which is important to decrease the variation in board.

IV. CONCLUSION

- The results showed that the virgin kraft paper is better than semi kraft paper because GSM of version Kraft paper is higher than semi kraft paper. Standard GSM of version kraft paper is 180gsm and average gsm

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which is calculated by the company is 179.45gsm and the standard bursting factor of virgin kraft paper is 25.0 and average b.f which is calculated by the company is 24.99 b.f. And the standard gsm for semi kraft paper is 140 gsm and the average gsm which is calculated by the company is 139.75 and the standard brusting factor of semi-kraft paper is 18.0 b.f and average b,f for semi kraft paper is18.15b.f. The deviations of gsm and brusting factor of virgin kraft and semi kraft paper from their standard values are within the tolerance limit.

- Variation in board also happened during some defects, with this defects properties of board is fully changed so remove this defects properly with the use of proper remedy.Most common defects in board is like wrinkles, delamination, blister etc. We can remove all these defects with proper solution, which is also used in company.

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