Section A-Research Paper
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ANALYSIS OF GSM DEVIATION ON WHITE-OPAQUE POLY & WHITE-SPECIAL OPAQUE POLY RAW MATERIALS

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Abstract

The objective of this research is to do a comparative analysis between the Gram Per-square Meter (GSM) variance between the incoming White-opaque and White- opaque Special Polyethylene (Poly) rolls from the standard values of GSM for the respective rolls. With the help of literature and industrial survey a complete comparative data is collected. Each individual roll film was diagnosed and different readings were taken with the help of certain set of equipment which later were analyzed in order to plot GSM deviation graph. In this research it was found that White-opaque special showed a lesser deviation in GSM from standard than White-opaque film.

Keywords: Blown Film Line, Gram Per-Square Meter, Polyethylene, Machine Direction, Transverse Direction, Quality Control.

Introduction

The production of films using biodegradable polymers is now being done through the blown film extrusion technique instead of using conventional polymers. White Opaque Multilayer Poly Film is a co-extruded type of film which is made from premium polyethylene raw materials. It serves as a thermoforming shield layer to shield the stored item from contamination and contaminants outside. It is widely utilized in a variety of businesses, including those that package cheese in the food industry, naphthalene balls in the pharmaceutical industry, and many more. Extremely resilient to pressure, weather, and punctures, this film. Additionally, White Opaque Multilayer Poly Film is cost-effectively offered in a variety of ranges.

The white opaque special Packaging Film is a three-layered extruded film that is produced in accordance with industry quality standards utilizing Food & Drug Administration (FDA)-approved raw materials and cutting-edge technology. Film for packaging food is frequently made using blown film coextrusion. At or very close to the die lips, the layers as much as to 11 are combined. One drawback is that not all polymer films and resins stick to one another. Many items have been created that are intended to offer bonding (Vlachopoulos &Sidiropoulos, 2001). This film is extruded under sanitary conditions and with the highest care. It has adequate stability and a leak-proof construction. It is frequently used in milk, curd, and other dairy product packaging due to its excellent durability and ideal strength. It has outstanding clarity and rigidity and is resistant to high pressures. Additionally, the white opaque special packaging film can be ordered in a variety of thicknesses, designs, printing, and sizes. But due to this growing polymer's manufacturing from the environmental perspective biodegradable polymers are being manufactured. As of late, biodegradable polymers have replaced conventional polymers in the blown film extrusion technique used to create films (Ashter, 2016).

Blown Film Line (B.F.L.)

Blown Film Line is the Department where the different Polyethylene films are made with the help of DGP WINDSOR machine designed by GERMANY and Manufactured by India. This Machine has a Feature of Producing a 3 Layer Poly (INNER, MIDDLE & OUTER Layer) with the help of Different Grades of resins (In the form of granules) manufactured by Different Companies like RELIANCE, ALAMCO etc. Grades are in terms of Low-Density Polythene, Low Linear Density Polyethylene, High Density Polyethylene. Blown film is another extrusion processes used to fabricate film products (McKeen, 2017). White Master Batch is used for producing the white Poly. Generally, TiO_2 (Titanium Di-Oxide) is used as an Additive which has good smoothness and Opacity feature. While the polymer is exiting the extruder it must have uniform melt-temperature and pressure while also being at the right temperature and pressure, operating a blown film line is comparable to operating other extrusion operations (Wagner et al, 2001). Since the film must be accessible from both sides for these systems to work, blown film extrusion does not allow for the measurement of film thickness using the techniques described for flat film extrusion. Because of this, blown film plants almost exclusively use capacitive thickness monitoring systems that rotate around the film tube. The change in relative permittivity in the field of a measuring capacitor, which is caused by thickness changes in the film, provides the foundation for capacitive thickness measurement. The measuring system must be calibrated before the measurement since the relative permittivity varies from one polymer to another (Michaeli & Hauck, 2001).

Why determining the material gram per square meter is important?

In a normal situation, the approval samples quality could be slightly different from the production quality. The reason is that they are made with the material available on the market. Unfortunately, it is very common that the approval samples quality is much higher than the production samples inspected. The difference limit should be defined by the buyer at the time of the order confirmation and applied by the inspector during the product inspection. Knowing the right kind of material for your project means having a great output. Being specific on GSM eliminates the miscommunications, the errors on all the trials and make everyone efficient.

Problem & Solution of GSM Variation

There are multiple causes for the GSM variation. Firstly, there are equipment-related causes Sheet thickness variations can come from improper screw and/or die design, improper temperature profile, and worn extruder barrels and/or screws. Operators can tell from maintenance records if they have a worn screw or barrel, but they may not recognize it as the source of gauge variations. Screw-induced thickness variations, both Machine Direction (MD) and Transverse Direction (TD), are caused by surging and are easy to spot because they're repetitive. A melt pump can help remove variations induced by poor screw design or by wear. Next, there are material-related causes Gauge problems can result from inconsistent melt temperature going into the feed block and die and inconsistent feeding and blending.

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Keeping a consistent temperature in the melt stream is the most critical factor in maintaining sheet dimensions.

Melt temperature directly affects melt viscosity. Even small variations in viscosity will change the flow distribution in the die and thus alter the sheet profile. Here, again, an improperly set barrel-temperature profile is apt to be at fault. Variation in material composition can cause melt temperature and/or viscosity variations. When running blended materials, inconsistent blend ratios may be causing the problem. It makes sense to check that the blender is properly set and operating correctly. These are manufactured using BFL machines. White Opaque & White Special Opaque films both differ in GSM but are mostly used in packaging of dairy products like milk, cheese etc.

Research Objective

Analysis of GSM values of White poly & White special polys and their deviation from the standard and deviation from standard GSM when compared to one another.

Research Methodology

Machine used during the research is the DGP Windsor BFL which has a product specification of polyethene with thickness of manufacturing product up to 14 Micron. The temperature range during the manufacturing ranges from 180° to 205°C with the die temperature range of 180° to 215°C. the working line speed for the respective machine is approximately 15.3 meters/minute.

Apparatus required for calculating GSM

- GSM Cutter –It is a highly standardized and precise device which provides a circular sample cut from the material. The cutter comprises a circular disc and four blades that cuts the hardest samples easily and smoothly in no time with great precision. To use the cutter, a sample is placed on the flat surface and the knob of the cutter is slightly pressed and rotated in a clockwise direction. After rotating the knob release it to its normal position and you will get the circular size of the sample.
- GSM Cutting Pad– It is made of rubber. On top of this we put the sample and cut the sample with the help of GSM Cutter. It determines the GSM accurately because of its smooth surface.
- GSM Tester– It is a digital device which is used to check the grammage of all light weighed and a small piece of samples cut through the cutter. The balance is designed with sophisticated operating features and advanced software that help to operate the device easily.

Data Collection

- From the full width of poly take five samples from different positions of the poly using standardize round cutter.
- Weight all test samples with GSM tester.
- Note down the readings in the observation table.
- Calculate the average GSM reading and note down in the observation table.
- If the GSM reading will not as per the given standard or within the deviation given by the customer (usually it is ±5 percentage) then it is notified to the supervisor.

- After this the quality person holds the material and paste the Quality Control (QC) HOLD sticker on that particular roll.
- Further decision was taken by the management and it is notified to the PE supplier.

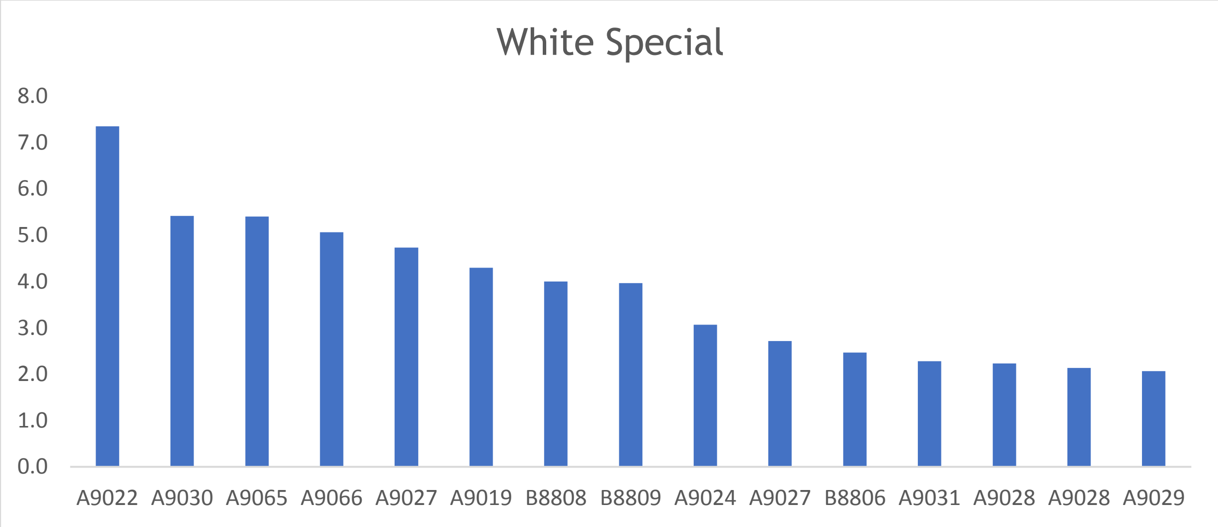
Data Analysis

The following table shows the white opaque special poly roll. The respective supplier for the rolls is "Suki-Creation Ltd". GSM was calculated and six different readings were taken based upon that and later averaged. Now this average and standard GSM values are used further to calculate the delta or the variance for these various roll samples.

Table 1.1 GSM Readings and Variations for various White Opaque-special Films

Specification	ROLL NO	Std. GSM	MIN	MAX	Av.GSM	R 1	R 2	R 3	R 4	R 5	R 6	Variance
915/160 W/O SPL SUP-334	A9022	154.8	147.06	162.54	162.2	155	163.2	162	159.7	164	169	7.3
915/160 W/O SPL SUP-334	A9030	154.8	147.06	162.54	160.2	149.7	155.1	164.8	168.3	160.9	162.5	5.4
915/160 W/O SPL SUP-334	A9065	154.8	147.06	162.54	160.2	163.1	156	163.2	161.1	157.4	160.4	5.4
915/160 W/O SPL SUP-334	A9066	154.8	147.06	162.54	159.9	160.2	155.3	159	163	161.7	160	5.1
915/160 W/O SPL SUP-334	A9027	154.8	147.06	162.54	159.5	164.5	147	155.7	168.4	158	163.6	4.7
915/160 W/O SPL SUP-334	A9019	154.8	147.06	162.54	159.1	162.3	157.1	156.2	161.7	159.9	157.4	4.3
915/140 W/O SPL SUP-334	B8808	134.4	127.68	141.12	138.4	142.2	137.6	138.2	138.1	135.8	138.5	4.0
915/140 W/O SPL SUP-334	B8809	134.4	127.68	141.12	138.4	138.8	136.2	139	138.6	134.8	142.8	4.0
915/160 W/O SPL SUP-334	A9024	154.8	147.06	162.54	157.9	156.2	157.3	158.8	156	156.5	162.4	3.1
915/160 W/O SPL SUP-334	A9027	154.8	147.06	162.54	157.5	157.8	157.1	157.9	154.5	160.2	157.6	2.7
915/140 W/O SPL SUP-334	B8806	134.4	127.68	141.12	136.9	138.4	139.7	138.3	134.7	134.6	135.5	2.5
915/160 W/O SPL SUP-334	A9031	154.8	147.06	162.54	157.1	157.3	157.6	159.5	158	157.3	152.8	2.3
915/160 W/O SPL SUP-334	A9028	154.8	147.06	162.54	157.0	151.7	158.9	160	159.5	158.5	153.6	2.2
915/160 W/O SPL SUP-334	A9028	154.8	147.06	162.54	156.9	158.2	157.7	152.9	161.2	157	154.6	2.1
915/160 W/O SPL SUP-334	A9029	154.8	147.06	162.54	156.9	159	159.7	152.6	150.8	160.2	158.9	2.1

Table 1.1 shows the GSM readings for White Opaque poly rolls of the same supplier. Similarly, six different readings ranging from R1 to R6 for each single roll were taken. Likewise, variance values were too calculated using the standard and the average values. The readings highlighted in red are the readings that shown a very high value of deviation when compared to the standard GSM and were further marked and rejected. As these have a highlighted readings have a high difference from the standard their deviation value is very high as compared to those with non-highlighted ones. The maximum value for the variance here is 7.3 for the Roll-A9022 whereas the minimum value of 2.1 for the Roll-A9029.



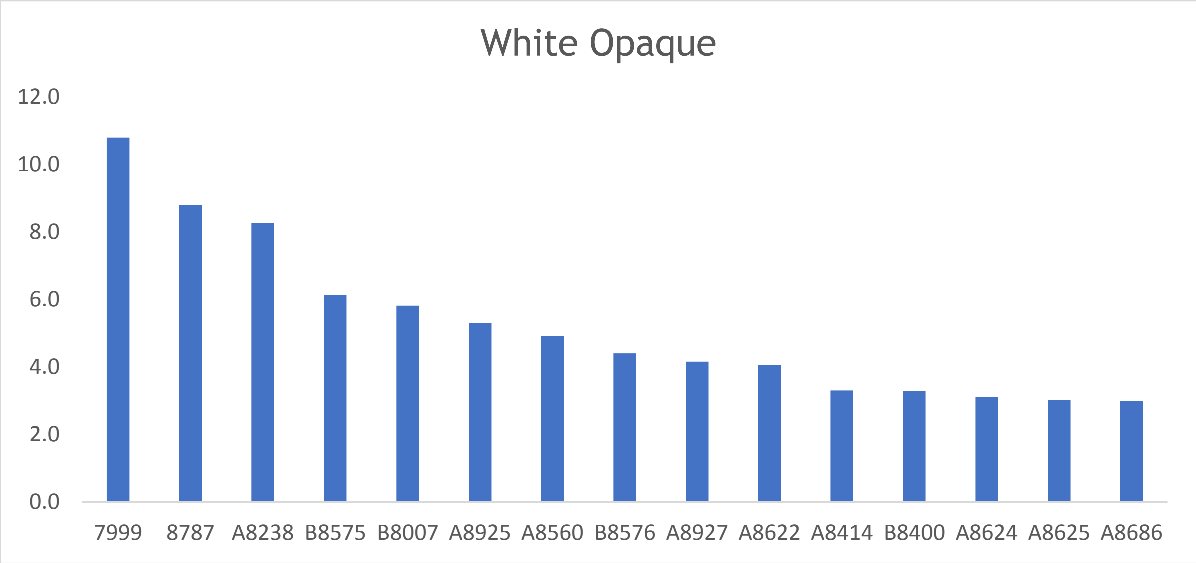
Graph 1.1 Values of GSM Variations for various White-opaque Special Rolls

Now, this variance is plotted using a bar graph showing greatest to the smallest variance values for white opaque special sheets taken from Table 1.1. The X-axis of the graph represents the value for variance while the Y-axis represents the different Rolls being used during the entire process for GSM calculations.

Table 1.2 GSM Readings and Variations for various White Opaque Films

Specification	ROLL NO	Std GSM	MIN	MAX	Av.GSM	R 1	R 2	R 3	R 4	R 5	R 6	Variance
1045/40W/OP	7999	38.8	36.86	40.74	49.6	39.4	97.3	40.1	39.9	40.4	40.5	10.8
915/160 W/O	8787	154.8	147.06	162.54	163.6	165.7	161.1	160.1	164.7	165.3	164.7	8.8
915/140 W/o	A8238	134.4	127.68	141.12	142.7	141.7	143.9	144	141.3	141.9	143.2	8.3
675/75 W/O	B8575	71.2	67.64	74.76	77.3	77.8	77.9	74.3	76.6	78.7	78.7	6.1
830/120W/OP	B8007	114	108.3	119.7	119.8	111.8	110.2	112.3	117.4	153.3	113.9	5.8
915/140 W/O	A8925	127.68	121.30	134.064	133.0	133.9	131.7	134.2	133.2	128.8	136.1	5.3
915/160 W/O	A8560	154.8	147.06	162.54	159.7	157.2	158.5	160	159.5	160.8	162.3	4.9
675/75 W/O	B8576	71.2	67.64	74.76	75.6	74.5	74.9	75.7	76.8	75.6	76.1	4.4
915/140 W/O	A8927	127.68	121.30	134.064	131.8	133.3	132.2	130.9	130.8	133.4	130.4	4.2
915/140 W/o	A8622	134.4	127.68	141.12	138.5	137.9	137.6	140.4	137.6	138.3	138.9	4.0
1035/70 W/O	A8414	67.2	63.84	70.56	70.5	65.2	70.9	72.1	72.9	73	68.9	3.3
1125/58 W/O	B8400	56.5	53.68	59.33	59.8	60.5	59.9	61	59.4	59.5	58.4	3.3
915/140 W/o	A8624	134.4	127.68	141.12	137.5	135.5	135.2	139.6	140.8	136.9	137	3.1
915/140 W/o	A8625	134.4	127.68	141.12	137.4	136.9	138.3	139.4	136.2	136.3	137.4	3.0
1175/45 W/O	A8686	45	42.75	47.25	48.0	47.6	49	47	48.2	48	48.1	3.0

The **Table 1.2** shows the white-opaque sheets' GSM values. Similarly, to Table 1.1 the Table 1.2 also consists of six different readings for the GSM tested for each different roll. The highlighted values in the red are the values of GSM which have a high difference from the standard values for the respective rolls. Thus, those values shown the highest deviation in GSM with highest value for variance of 10.8 for Roll-7999 and the least value for variance of 3.0 for the Roll-8686.



Graph 1.2 Values of GSM Variations for various White-opaque Rolls.

Similarly, a bar graph was plotted using the data from the table 1.3 and GSM variation is plotted from highest to the lowest with variance values plotted over the X-axis and different rolls on the Y-axis.

Results And Discussion

The data for the White Opaque-Special Polyethylene Films are shown in Table 1.1. The many rolls of White Opaque-Special poly that are being utilized in the study are displayed in this row's specifications column. The rolls of the same specification are identified by their roll numbers which is unique. The standard GSM values of rolls with different specification numbers vary. In order to obtain an accurate average reading, six separate readings of each roll were taken. Now, the delta or variance for that particular roll is derived by comparing these readings to the established standard values. The data from table 1.1 are used to produce the graph 1.1, and several rolls are plotted against the variance.

The same procedures used to get GSM values for various roll films are used to create Table 1.2. The main distinction is that it is figured for the rolls of white-opaque polyethylene film. Using the information in Table 1.2, a comparable graph is drawn.

These figures demonstrate that compared to White-opaque poly films, White Opaque-special exhibits a smaller divergence. Additionally, White Opaque-special films only have an average variance value of 3.8.

Conclusion

In this research we found that both these poly sheets show a GSM variation when compared to the standard. The average of variance for the **White-Special Opaque** came out to be 3.8 whereas the average value of variance for **White Opaque** came out to be 5.2. This shows that Special white Opaque poly sheets shows less deviation from the standard values for GSM than the White Opaque one's.

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