Section A-Research Paper
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COMPARATIVE ANALYSIS OF GSM DEVIATION ON INCOMING RAW NATURAL & NATURAL-SPECIAL PLASTIC-BASED MATERIALS

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Abstract

The goal of this study is to compare the GSM deviation between the incoming Natural and Natural Special Poly rolls and the standard GSM values for the corresponding rolls. A thorough set of comparable data is gathered via literature and an industrial survey. With the aid of a certain set of tools, each individual roll of film was examined, and various readings were collected. These measurements were then analyzed to create the GSM deviation graph. According to this study, Natural Poly films displayed a lower GSM departure from the norm than Natural-special films.

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

Introduction

A thin plastic film commonly utilized for food storage and preservation is called Natural Poly Film, usually referred to as plastic wrap or cling wrap. In the blown-film method, a relatively thick tube is extruded and then expanded or blown to create a comparatively thin film by internal air pressure. The tube can be slit to create one or two single-layer film webs or collapsed to create double-layer flat film. Polyethylene (PE) films are frequently produced using the air-cooled blown-film method (Sina, 2015). It is constructed of low-density polyethylene (LDPE) or polyvinyl chloride (PVC), and due to its sticky and elastic nature, it may adhere to a variety of surfaces to form an airtight barrier. This film is frequently used for wrapping food items, cover containers as well, and block air exposure in homes, restaurants, and other settings where food is served. Blown film coextrusion is widely used to create film for food packaging. The layers as many as eleven are merged at or very near the die lips. Not every polymer film and resin adhere to one another, which is a downside. There are numerous objects that have been developed with the goal of providing bonding (Vlachopoulos & Sidiropoulos, 2001). To create packaging film, blown film extrusion is widely used. A large portion of this film is multilayered to increase mechanical, transport, and thermal properties as needed by the food or medical industries. To allow micro- and nanolayer coextrusion capabilities for blown film processing lines, research initiatives at The Dow Chemical Company and Sealed Air Corporation were carried out concurrently (Langhe & Ponting, 2016). This keeps food fresher for longer. It functions by sealing off the perimeter of food or container. Due to its static charge and stretchability, the film adheres to the

surface, blocking airflow and minimizing interaction with oxygen to help maintain the food's freshness. Extruding plastic through a die fashioned like a tube produces blown films, often referred to as tubular films, which are subsequently stretched and blown with air to produce incredibly thin-walled films. Blowing films are commonly produced using polyethylene resins as LDPE, LLDPE, and HDPE polymers (Becker, 2016).

For high-speed machine wrapping of huge palletized goods, special **Natural Special Film** is employed. With a stretchability of more than 300 percent and exceptional tear strength to prevent sharp corners, it works well on high-speed filling lines that operate at varied rates between 450 and 1000 BPM. The average GSM standard values for the natural special are generally greater than 130. They are used to convey items on pallets safely and securely.

A Blown Film Line machine is required to manufacture these films. The Department of Blown Film Line is where Natural Poly is produced using an India-made, German-designed machine called the DGP Windsor. This machine has the ability to produce a three-layer poly (inner, middle, and outer layers) using various resin grades. A significant processing method for creating a biaxial melt drawn film is blowing film. In this method, a higher haul-off roll speed is used to provide a machine direction draw while air pressure creates a transverse direction draw. This method processes several billion pounds of polymer annually, primarily polyethylene (Wagner, 2016). The quality of the manufacturing samples and the approved samples may occasionally differ somewhat. They are manufactured with the materials that are offered on the market, which is the reason. Unfortunately, it frequently happens that the production samples evaluated are of significantly lower quality than the approval samples. The buyer should specify the difference limit at the time of purchase confirmation, and the inspector should put it into practice when inspecting the product.

Having the correct materials for the project means getting a high-quality result. Specification in GSM helps everyone work more effectively by removing misunderstandings and mistakes from all trials. Blown film manufacturing facilities employ rotating capacitive thickness monitoring systems almost exclusively. Capacitive thickness measurement is based on the alteration in relative permittivity in the field of a measuring capacitor brought on by variations in film thickness. Since the relative permittivity varies from one polymer to another, the measuring system needs to be calibrated prior to the measurement (Michaeli & Hauck, 2001).

Research objective

Analysis of GSM values and the deviation these between Natural poly & Natural-special polyethylene.

Research Methodology

The machine specifications which were used throughout the research can be explained-starting with the name of the machine “DGP Windsor BFL”, a machine with a product specification of polyethene with a thickness of manufacturing product up to 14 Micron, was employed during the research. With the die temperature range of 180° to 215°C, the temperature range during manufacture is 180° to 205°C. The corresponding machine moves along its working line at a speed of about 15.3 meters per minute. There were two different cooling systems that were being used for the machine namely OBC that was the Outer

Bubble Cooling and the second one was IBC that can be abbreviated as the Inner Bubble Cooling.

Apparatus required for calculating GSM:

- GSM Cutter – It is a highly accurate and standardized tool that offers a circular sample of the substance. The cutter, which has four blades and a circular disc, quickly and accurately slices through even the toughest samples. The cutter is used by setting a sample on the flat surface, lightly pressing the knob, and rotating it in a clockwise direction. Once the knob has been rotated, return it to its default position to obtain the sample's circular size.
- GSM Tester–A little piece of samples is sliced via the cutter on a digital equipment that is used to examine the grammage of all light weights. The balance is made with complex operational features and cutting-edge software that make using the device simple.
- GSM Cutting Pad--It is constructed of rubber. We then placed the sample on top of that and cut it using the GSM Cutter. Due to its flat surface, it properly determines the GSM.

Data collection

The complete research was carried out Huhtamaki PPL Ltd. The required data was collected on a regular basis. Furthermore, these steps were followed in order to collect the data of the respective samples.

- Using a standardized circular cutter, take five samples from the poly at various locations across its whole width.
- Use a GSM tester to weigh all test samples.
- The readings should be noted in the observation table.
- Determine the typical GSM reading and record it in the observation table.
- The GSM reading is reported to the supervisor if it does not match the standard or falls outside of the customer-provided variation (typically, this is 5%).
- The quality inspector then holds the material and applies the QC HOLD sticker to that specific roll.
- The management made a further decision and informed the PE supplier about it.

Data Analysis

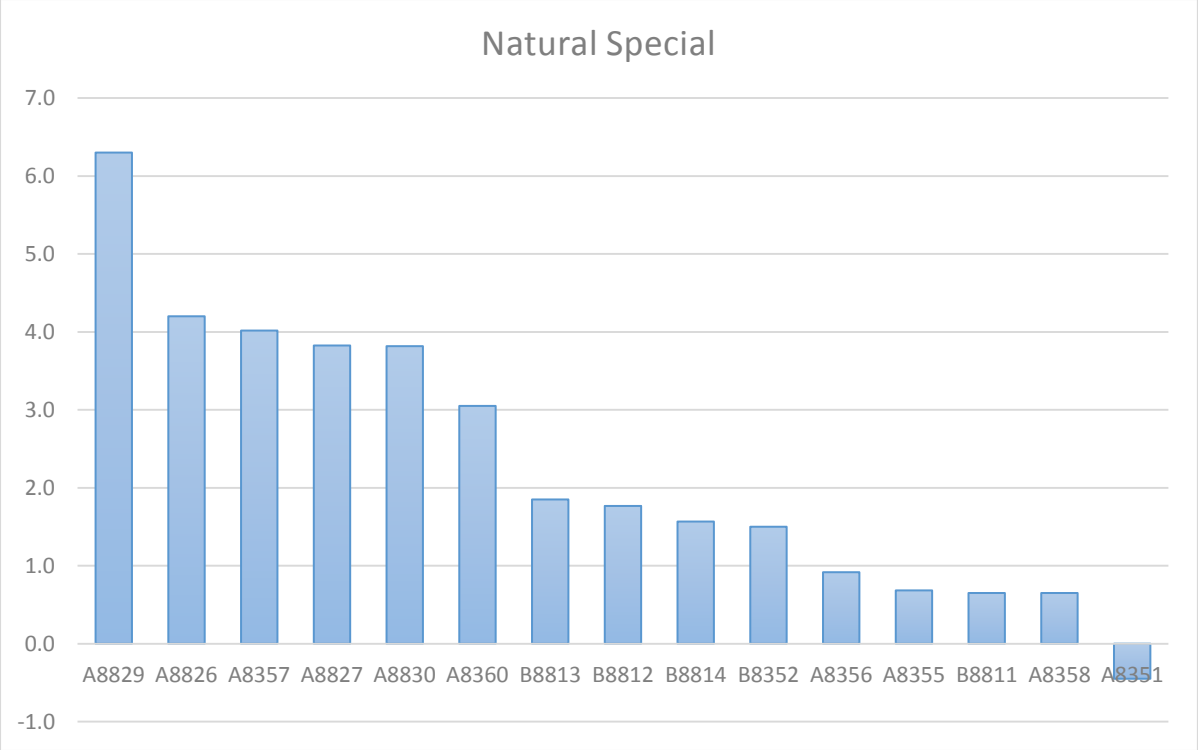
The natural special poly roll is displayed in the following table. "Suki-Creation Ltd" is the appropriate provider for the rolls. Six readings were taken based on the GSM calculation, which was then averaged. The delta or variance for these multiple roll samples is now calculated using the average and standard GSM values.

Table 1.1 GSM Readings and Variations for various Natural-special Films

Specification	ROLL NO	Std. GSM	MIN	MAX	Av.GSM	R 1	R 2	R 3	R 4	R 5	R 6	Variance
910/150 Nat	A8829	138	131.10	144.9	144.3	145.9	145.9	143.7	146.4	142.7	141.2	6.3
910/150 Nat	A8826	138	131.10	144.9	142.2	136.1	143.2	142.9	144.1	142.2	144.7	4.2
910/150Nat	A8357	138	131.10	144.9	142.0	145	140.3	142.9	143.8	137.7	142.4	4.0
910/150 Nat	A8827	138	131.10	144.9	141.8	142.3	142.2	144.7	140.9	142.5	140.2	3.8
910/150 Nat	A8830	138	131.10	144.9	141.8	143.8	136.2	139.1	140.4	143.3	148.1	3.8
910/150Nat	A8360	138	131.10	144.9	141.1	136.4	143.8	142	142.3	142.7	139.1	3.1
910/150 NAT SUP FLX	B8813	137.7	130.82	144.585	139.6	139.5	141.5	141.5	137.5	139.6	137.7	1.8
910/150 NAT SUP FLX	B8812	137.7	130.82	144.585	139.5	139.4	137.9	137.6	138.3	141.2	142.4	1.8
910/150 NAT SUP FLX	B8814	137.7	130.82	144.585	139.3	138.6	137.8	138.6	139.7	140.8	140.1	1.6
910/150Nat	B8352	138	131.10	144.9	139.5	139.2	140.6	139	136.5	143.2	138.5	1.5
910/150Nat	A8356	138	131.10	144.9	138.9	141.5	140.9	134.8	135.8	139.4	141.1	0.9
910/150Nat	A8355	138	131.10	144.9	138.7	131.4	142.2	139.1	141.4	141.5	136.5	0.7
910/150 NAT SUP FLX	B8811	137.7	130.82	144.585	138.4	139	137.9	137	141.8	136	138.4	0.7
910/150Nat	A8358	138	131.10	144.90	138.7	137.5	141.5	136.8	137.3	139.8	139	0.7
910/150Nat	A8351	138	131.10	144.9	137.6	140.8	136.6	135.1	135.1	137.1	140.6	-0.4

The Table 1.1 illustrates the various Natural-special rolls. The next column shows the supplier for these specific rolls used. These rolls are distinguished on the basis of the roll's no. being provided. The standard GSM column describes the adequate-level values that is provided by company for these different rolls. The next two columns show the minimum and the maximum values that are being found out while taking multiple readings of that same roll respectively. The next column of average GSM is basically calculated using the previous calculated values of Minimum and Maximum GSM. The next six columns comprise the six different readings that are taken from portion of each roll respectively.

To obtain precise variance or deviation data for the Natural-Special Poly, six separate readings are taken. Readings with a significant value of variation from the standard are the one which are marked in red. The Natural-special poly, however, exhibits a bigger value of deviation from the standard and a greater number of highlighted values when compared to the Natural-poly. This shows that there are more deviations from the norm in it. The average of the six readings is obtained after collecting them for each roll. The minimum and maximum values are likewise derived from the six readings that were obtained. The average values and standard values are now used to determine the variance. To determine the variance or value of deviation, the standard values are subtracted from the average values. The resulting values in the variance column are both positive and negative, suggesting that the positive values are all greater than the needed standard while the negative ones are lower.



Graph 1.1 Values of GSM Variations for various Natural-special Rolls

The variation for Natural-Special Films is here now represented using a bar graph, with values ranging from highest to lowest for variance.

The X-axis of the graph depicts the various Rolls as represented in the table which were used throughout the entire process for GSM computation, while the Y-axis of the graph displays the variance value which was calculated in the Table 1.1 using the difference of the average calculated using the six different readings for each different roll and the standard values of GSM respectively. Fifteen different rolls for each type that is for Natural-special and the Natural-poly were used throughout the research and thus the graph shows fifteen different types of rolls plotted over the X-axis in both the graphs. The rolls ranging from A8829 to A8351 are the different rolls but each belongs to the Natural-special type of polyethylene. The roll A8829 here shown the greatest value of deviation or variation with value for variation greater than 6. The roll A8351 is the only roll that showed a negative deviation or variance with a value of -0.4 illustrating that it had a lower value for GSM when compared to the standard.

The GSM readings for Natural-poly rolls from the same provider are displayed in **Table 1.2**. For every single roll, six separate readings were also taken. The standard and average values were also used to calculate variance values with the same procedures as were followed in the case of Natural-special poly films.

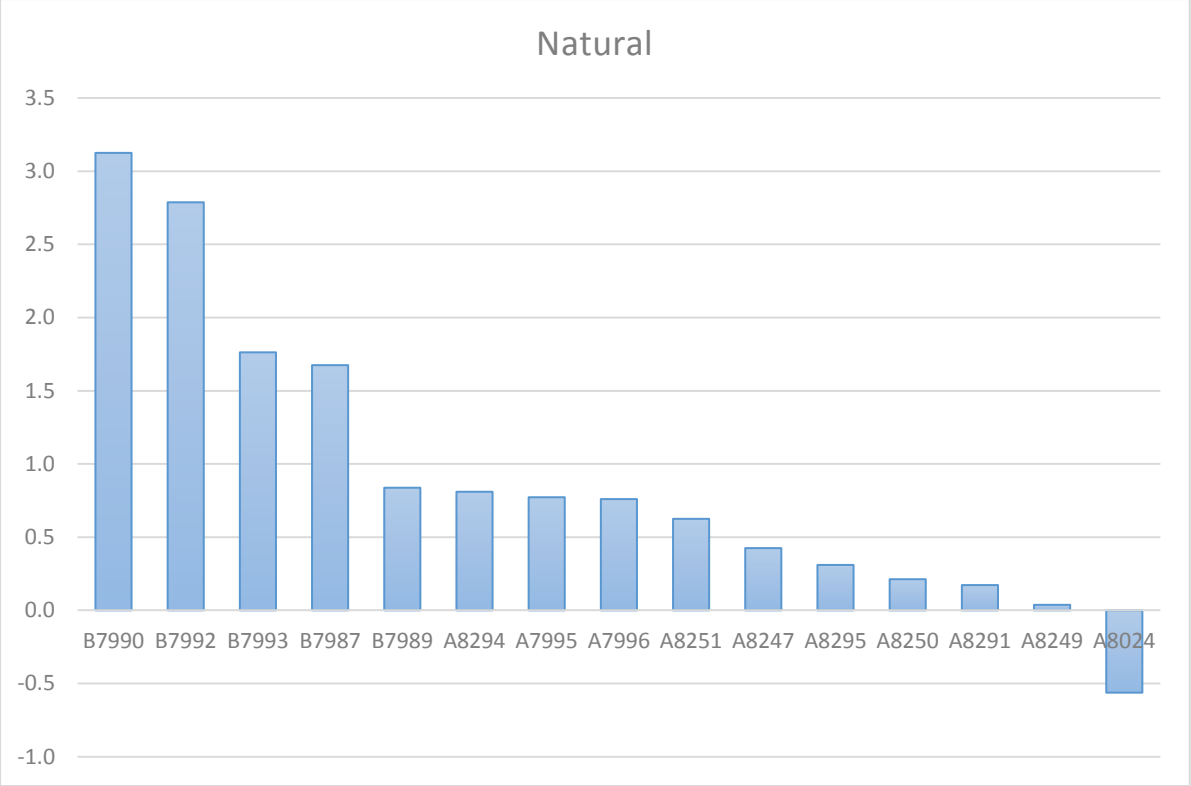
Table 1.2 GSM Readings and Variations for various Natural Films

Specification	ROLL NO	Std. GSM	MIN	MAX	Av.GSM	R 1	R 2	R 3	R 4	R 5	R 6	Variance
1230/75 Nat	B7990	69	65.55	72.45	72.1	74.5	72	71.4	72.7	72.7	70.7	3.1
1230/75 Nat	B7992	69	65.55	72.45	71.8	73.3	69.9	73.1	71.6	73.1	70.3	2.8
1230/75 Nat	B7993	69	65.55	72.45	70.8	70.6	71.6	70	69.3	71.1	69	1.8
1230/75 Nat	B7987	69	65.55	72.45	70.7	70.2	70.4	70	70.7	72.4	71.2	1.7
1230/75 Nat	B7989	69	65.55	72.45	69.8	68	69.3	70.9	69.7	71.3	70.7	0.8
1145/32 Nat	A8294	29.44	27.97	30.91	30.3	30.7	31.5	29.6	30	29.9	29.9	0.8
1230/57Nat	A7995	52.44	49.82	55.06	53.2	54	53.3	53.6	52.6	53.4	52.7	0.8
1230/57Nat	A7996	52.44	49.82	55.06	53.2	53.9	52.2	53.3	52.9	54	53.7	0.8
1045/29NAT	A8251	26	24.70	27.3	26.6	25.8	25.7	25.7	26.4	27.7	26.8	0.6
1045/29NAT	A8247	26	24.70	27.3	26.4	25.6	27.8	26.4	26.2	26.8	27.3	0.4
1145/32 Nat	A8295	29.44	27.97	30.91	29.8	29.1	30.1	30.4	29	29	29.7	0.3
1045/29NAT	A8250	26	24.70	27.3	26.2	26.2	26.7	26.6	25.6	26.1	26.1	0.2
1145/32 Nat	A8291	29.44	27.97	30.91	29.6	29.8	29.4	29.3	29.7	30.6	29.2	0.2
1045/29NAT	A8249	26	24.70	27.3	26.0	26.4	27.2	25.1	25.2	24.7	26.4	0.0
1045/29 Nat	A8024	26	24.70	27.3	25.4	26	24.4	24.2	26.5	26	24.9	-0.6

The Table 1.2 illustrates the various Natural rolls. The column of roll no. basically illustrates the various unique rolls that are tested during the research. Even the material for these rolls is same but each different roll is allotted with a different roll no. in order to distinguish each one while collecting the data. The standard GSM values are preset by the company itself. These standard values are unique for each different roll respectively.

Similarly, as the natural special, six different readings were taken for the natural poly in order to get a precise data of variance or deviation. The readings highlighted with red are basically the readings with high value of variance from the standard. But when compared to the Natural-special poly the Natural-poly shown a lesser number of highlighted values thus means that it has lesser number of high variances from the standard.

After collecting the six different readings average of them is taken for each different roll. Minimum and the maximum values are also taken from those six collected readings. Now the variance is calculated using the average values and the standard values. The standard values are subtracted from the average values in order to find out the variance or the value of deviation. The resulting values in the variance column are both in positive and negative illustrating all the positive as higher when compared to standard while those in negative showing lesser than the standard required.



Graph 1.1 Values of GSM Variations for various Natural-special Rolls

The data from Table 1.2 was also used to create a bar graph, which shows the GSM variation from highest to lowest, with variance values shown over the X-axis and various rolls on the Y-axis. Similarly, to that Roll no. A8351 of Special natural poly the Roll A8024 also had a smaller value for the average GSM than that of Standard GSM resulting in negative value for delta or variance.

Results And Discussion

The Table 1.1 shows the data related to the Natural-special polyethylene films. Here, the specifications column shows all the different rolls of Natural-special poly that are being used in the research. These rolls may have same specification numbers but vary in terms of GSM b and is distinguished on the basis of roll's no. Six different readings of every roll were taken in order to have a precise average reading. Now these readings are compared to the defined standard values and delta or variance for that specific roll is calculated. The graph 1.1 is plotted using the data derived from Table 1.1 and different rolls are plotted against the variance.

The Table 1.2 is also made following the similar steps of calculating GSM values for different roll films. The major difference is that it is calculated for the Natural polyethylene film rolls. A similar graph is plotted using the Table 1.2 data.

These graphs shows that Natural-poly shows a lesser deviation than that of Natural- special poly films. Moreover, Natural films only show an average of 0.9 value for the variance.

Conclusion

In this study, we discovered that both of these poly sheets exhibit a GSM variation when measured against the norm. The Natural-Special's average value for variance came out to be 2.3, while Natural Poly's average variance came out to be 0.9. This demonstrates that **Special Natural Poly** films deviate from the GSM standards more than **Natural Poly** films do.

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