

Основные виды дефектов полиэтиленовых рукавов для хранения сельскохозяйственной продукции и методы их устранения

The main defects of polyethylene sleeves for storing agricultural products and methods for their elimination

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Аннотация

Приведена актуальность проблемы хранения зерна в полимерных рукавах. Рассмотрено назначение полимерных сельскохозяйственных рукавов. Проанализированы дефекты пленки, возникающие в процессе производства. Произведена классификация дефектов пленки по внешнему виду, размерам, физико-механическим свойствам. Рассмотрены причины возникновения и предложены способы устранения дефектов.

Ключевые слова: сельскохозяйственные рукава, дефект, пленка, разнотолщинность, физико-механические показатели, внешний вид.

Abstract

The urgency of the problem of grain storage in polymer sleeves is given. The purpose of polymeric agricultural sleeves is considered. The film defects arising during the production process have been analyzed. The classification of film defects on appearance, size, physical and mechanical properties has been made. The reasons for the occurrence are considered and methods for eliminating defects are proposed.

This research has been funded by the Science Committee of the Ministry of Education and Science of the Republic of Kazakhstan (Grant No. AP08052553)

Keywords: agricultural sleeves, defect, film, thickness variation, physical and mechanical parameters, appearance.

This research has been funded by the Science Committee of the Ministry of Education and Science of the Republic of Kazakhstan (Grant No. AP08052553)

The reliable and long-term storage of millions of tons of grain is a laborious and costly business. Due to the biological nature of grain crops, in order to avoid spoilage and losses, the grown crop must be harvested in a short time and, depending on the state of grain and seeds, it is required to carry out post-harvest processing at a high rate. It should be noted that in Kazakhstan more than half of the grain harvest needs immediate processing, its main losses occur at the stages of harvesting and post-harvest processing. In some years, in many farms and regions, they reached 10% of the volume of the harvested crop [1,2].

The main task of any granary is to save money for the owner of an agricultural enterprise. Those who have their own grain storage in Kazakhstan do not need to spend money on renting premises for storing crops. Grain is a strategic product and its prices fluctuate depending on the season. It is no secret that grain is always more expensive in spring than in autumn; therefore, own grain storage facilities in Kazakhstan are a good tool for market competition.

Thus, if the entire volume of the harvest that has been harvested is sold, almost immediately after it has been harvested, a temporary grain storage will be enough. This type of granaries in Kazakhstan can allow storing grain for several months without loss of quality and quantity, but only on condition that the construction technologies were followed exactly during the construction of the granaries.

The main principle of the technology is to store grain in an airtight environment, by pressing the mass in a special polyethylene sleeve, which is tightly closed after filling it from both ends. This

stops oxygen access. In the respiratory process, the components that, along with the grain, get into the sleeve - insects and fungi, for example, - there is a decrease in the percentage of oxygen in the environment, and an increase in carbon dioxide. A new, optimal environment for storing grain automatically arises, in which the ability to live and develop is inactivated in insects and fungi. Depending on the moisture content, packed cereals in plastic sleeves can be stored for up to one and a half years [3,4].

Polymer agricultural sleeves are used not only for storing grain, but also for storing large quantities of corn, wheat, soybeans and sunflower seeds.

The effectiveness of this technology depends on several parameters, the most important of which is maintaining the microclimate in hermetically sealed sleeves. This can only be ensured by ensuring the overall integrity of the materials from which the sleeves are made.

We will analyze the arising film defects in the process of its production and propose methods for their elimination.

Let's conditionally divide all defects into 4 main groups.

1. In appearance:

- longitudinal stripes, risks (Figure 1);
- foreign inclusions (Figure 2);
- darkened surfaces (Figure 3);
- dull surface of the canvas (Figure 4);
- rough surface;
- sticking of the film sleeve (Figure 5);
- folds and wrinkles on the sleeve fabric (Figure 6);
- gel-like bubbles on the sleeve fabric (Figure 7);
- defects on the fabric of the "fisheye" type sleeve (Figure 8);
- transverse stripes on the surface of the sheet;
- warping of the canvas.

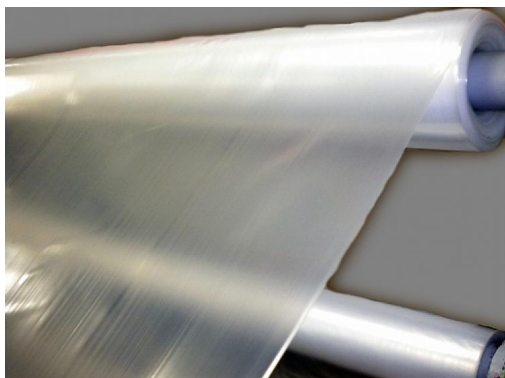


Figure 1 – Longitudinal stripes on the sleeve



Figure 2 - Foreign inclusions



Figure 3 – Dark spots



Figure 4 - Dull canvas surface on the sleeve



Figure 5 - Sticking of the film sleeve



Figure 6 – Folds in the canvas



Figure 7 - Gel bubbles



Figure 8 - Defects on the canvas
fisheye type

2. By size:

- the average value of the thickness is greater (or less) than the specified one;
- thickness variation in the transverse direction;
- thickness variation in the longitudinal direction;
- thickness variation of the inflated sleeve (asymmetry);
- local thickenings on the bobbin during winding;
- instability of sleeve inflation, uneven width or thickness, variability of diameter;
- reducing the width of the film sleeve.

3. According to physical and mechanical indicators:

- low mechanical strength;
- rupture of the inflated sleeve at the site of defects.

Having analyzed the defects arising in the process of extrusion of film for sleeves, it is necessary to identify the causes of their occurrence and ways to eliminate them.

Table 1 shows the reasons and methods for eliminating defects in appearance, physical and mechanical properties and dimensions of the film for agricultural hoses.

Table 1 - Reasons and remedies for defects in film for agricultural hoses

Film defect	Cause of occurrence	Way to eliminate
In appearance		
Longitudinal stripes, scratches	1. The presence of defects on the working surface of the forming tool. 2. Pollution by polymer burns.	1. Clean, grind the working surface of the forming tool.
Foreign inclusions	1. Insufficiently dense filter mesh package. 2. Rush of nets. 3. Contaminated raw materials.	1. Increase the number of filter nets 2. Notice the mesh. 3. Replace the batch of raw materials.

Continuation of the table 1

Film defect	Cause of occurrence	Way to eliminate
Blackout on film	1. Decomposition of the polymer due to overheating of the melt	1. Clean the extruder and the forming tool and adjust the temperature regime: reduce the temperature in the cylinder zones or increase the worm rotation frequency.
Dull surface	1. Poorly polished working surfaces of the forming tool. 2. Poor mixing of the melt. 3. Rapid cooling of the extrudate.	1. Grind the working surfaces of the forming tool. 2. Increase the pressure in the head - lower the temperature in the cylinder zones, install additional filter nets, cool the worm, reduce its rotational speed. 3. Change the cooling mode of the extrudate after leaving the forming head
Rough surface	1. Contaminated or wet raw materials. 2. Low melt temperature. 3. Contamination of the working surfaces of the tool. 4. Interruptions in the flow due to interruption in the supply, due to a high rate of extrusion of the melt or due to a decrease in the forming gap.	1. Replace the batch of raw materials or dry them. 2. Increase the temperature of the forming head. 3. Grind the working surfaces of the head. 4. Observe continuous power supply, adjust the temperature regime, reduce the rotational speed of the worm and the speed of the product retraction, change the gap or replace the head.
Sticking of the film sleeve	1. Insufficient distance between the forming head and the pulling rolls.	1. Increase the distance with the forming head and the pull rolls.
Pleats and wrinkles on the sleeve	1. Large variation in film thickness. 2. The spreading angle of the folding panels does not correspond to the diameter of the film sleeve. 3. Wrong shape of the film sleeve	1. Adjust the film thickness. 2. Adjust the spreading angle of the panels. 3. Adjust the cooling of the film sleeve
Gel bubbles on the sleeve fabric	1. Poor homogenization of the melt. 2. Burst of filter nets. 3. Insufficient uniformity of raw materials.	1. Decrease the temperature of the melt, decrease the rotation frequency of the worm. 2. Replace the filter screens. 3. Replace the batch of raw materials

Continuation of the table 1

Film defect	Cause of occurrence	Way to eliminate
Transverse stripes on the surface of the sheet	1. Adhesion of the extrudate to the surface of the calibrating rolls of the calender.	1. Reduce roll temperature and apply air cooling
Sheet warping	1. Low temperature of the calibrating rolls of the calender.	2. Increase the temperature of the middle roll; adjust the degree of extraction
Fisheye sleeve defects	1. Contaminated or wet raw materials.	1. Replace or dry raw materials, stop the supply of secondary raw materials.
By size		
The average thickness is greater (or less) than the specified value.	1. Inconsistency between the rates of extrusion of the melt and removal of the product. 2. Inaccurate calibration of the forming gap. 3. Increased swelling of the extrudate due to the inconsistency of temperature and speed parameters of extrusion.	1. Decrease (increase) the rotation frequency of the worm or increase (decrease) the speed of the product retraction. 2. Calibrate the forming gap. 3. To adjust the temperature and speed parameters of the process in accordance with the rheological parameters of the raw material.
Thickness difference in the transverse direction.	1. Displacement of the forming gap. 2. Uneven temperature distribution	1. Adjust the forming gap. 2. Adjust the temperature in the head.
Thickness difference in longitudinal direction	1. Heating of the worm and cylinder due to the increasing rotational speed of the screw. 2. Increase in head temperature.	1. Adjust the cooling of the worm (with pulsations of the extruded melt) and the temperature in all zones of the cylinder, change the rotation speed of the worm. 2. Reduce the temperature in the head, install additional screens. If the resistance of the forming head is low, reduce the screw speed.
Instability of sleeve inflation, uneven width or thickness, non-constant diameter.	1. Leakage of the air supply system to the sleeve: 2. The presence of movement of ambient air, pulsation of material in the extruder: reduce the extrusion speed, control the level of raw materials in the hopper.	1. Repair leaks in pipes and valves. 2. Isolate the unit from external air flows.
Reducing the width of the film sleeve.	1. Possible air leakage from the air supply system to the hose.	1. Adjust the pressure of the take-off (take-up) shafts.

Continuation of the table 1

Film defect	Cause of occurrence	Way to eliminate
Asymmetry of the swollen sleeve	<ol style="list-style-type: none"> Poor design of the head. Head and / or cooling ring need adjustment. Adhesion of oxidized materials or contaminants to the walls of the forming channels. 	<ol style="list-style-type: none"> Change the design of the head. Adjust the size of the forming gap around the perimeter, check the uniform heating of the head. Clean the extrusion head of adhered oxidized material or contaminants.
Local thickenings on the bobbin during winding (different thickness)	<ol style="list-style-type: none"> The gap in the head is not adjusted. Creasing of the film (formation of wrinkles) during the passage of the sleeve between the pulling, intermediate rollers. 	<ol style="list-style-type: none"> Adjust the size of the forming gap around the perimeter, check the uniform heating of the head and blowing Adjust the alignment of the rolls, the tension of the film on the winding, the position of the folding cheeks
According to physical and mechanical indicators		
Low mechanical strength	<ol style="list-style-type: none"> Poor mixing (heterogeneity) of the melt. The temperature regime is not adjusted. 	<ol style="list-style-type: none"> Increase the resistance in the head by installing additional meshes. Adjust the temperature regime.
Rupture of the inflated sleeve at the site of defects.	<ol style="list-style-type: none"> Presence of foreign impurities in the hopper 	<ol style="list-style-type: none"> Clean the head.

It should also be noted that there are a number of manufacturing defects that generally affect the quality of the film and depend on the operation of the equipment. They are presented in Table 2.

Table 2 - Manufactured defects of the films

Defect	Cause of occurrence	Way to eliminate
Dust accumulation on the surface of the film (the film attracts dust)	<ol style="list-style-type: none"> Excess static electricity on the installation surface. 	<ol style="list-style-type: none"> Add an antistatic agent to the raw material, ground the installation to remove electrostatic charge, increase the air humidity
Unstable yield after extruder starts	<ol style="list-style-type: none"> Overheating of the material in the cylinder. The surface of the die is too cold (long cold air pre-blast time). The temperature is too low when starting the extruder. Temperature instability of the barrel or die head. Looseness or slippage of the drive belt. Blockage of meshes. 	<ol style="list-style-type: none"> Unload the overheated melt from the cylinder, stabilize the melt temperature. Check if the polymer has melted in the die. Check the temperature of the barrel, adapter and extrusion head for the specified values. Check if the heating elements are working properly. Check the temperature

	<p>7. Back pressure too low.</p> <p>8. Uneven speed of rolls rotation.</p> <p>9. Excessive content of waste (crushed) added to the raw material composition.</p>	<p>sensitivity. controller and carry out the necessary settings</p> <p>5. Replace the worn out belt. To prevent loosening or slipping, make it easier to adjust the belt tension by applying oil to it or using a tension pulley.</p> <p>6. Replace the mesh.</p> <p>7. Increase back pressure.</p> <p>8. Check the roll alignment and the possibility of belt wear, looseness or slippage. If the pressure of the rolls is too low (which could lead to sliding), adjust the piston or spring to increase the pressure.</p> <p>9. Reduce the amount of waste in the feedstock. When using secondary raw materials, it is preferable that it be in granules.</p>
Decreased line performance due to insufficient sleeve cooling.	1. Insufficient film cooling.	1. Increase the air supply to the cooling unit, raise the carriage.
<u>Wobble</u>	<p>1. The crystallization line is too high or too low.</p> <p>2. The melt temperature is too high or too low.</p> <p>3. Film removal is too slow.</p> <p>4. Vibration of the extruder.</p> <p>5. Incorrect adjustment of the air flow from the blower ring.</p> <p>6. Too close position of take-up rolls.</p>	<p>1. Adjust the operation of the blower ring.</p> <p>2. Correct the temperature of the melt in the head.</p> <p>3. Check the speed of the take-off rolls.</p> <p>4. Strengthen the extruder frame.</p> <p>5. Check the geometry (all gaps), dirt, design features of the blower ring.</p> <p>6. Raise the carriage</p>

Thus, the quality control of the film at all stages of the production process of its production and extrusion, as well as the timely elimination of detected defects is the most important factor for obtaining high-quality domestic products.

References

1. Starodubtseva A.I. Grain storage workshop. / Starodubtseva A.I., Panshina N.I. - M.: Kolos, 1976. - 256 p.
2. Yukish A.E. Grain storage technique and technology / A.E. Yukish, O.A. Ilyin. - M.: DeLi print, 2009. - 718 p.
3. Dikhanova M.B. Storage of grain under a film. / Dikhanova M.B. // Materials of the Republican scientific-theoretical conference "Seifullin readings - 11: Youth and science". - 2015. P. 17-18

4. Stankevich G.N. A modern approach to the study of the intensity of respiration of grain / Stankevich G.N., Babkov A.V. // *Almaty tekhnologii universityinin khabarshysy*. 2014. No. 2. P. 45-51.
5. Myrzabekova A.M. Review of modern systems for storing grain crops // VI Scientific-practical conference "Information-measuring equipment and technologies". 2015. P.123-125
6. URL: <http://ussrforever.ru/raskaz/207dihanie.html>. (date of treatment 08/05/2020).

Литература

1. *Стародубцева А.И.* Практикум по хранению зерна. / Стародубцева А.И., Паньшина Н.И. – Москва: Колос, 1976. – 256 с.
2. *Юкиш А.Е.* Техника и технология хранения зерна / А.Е. Юкиш, О.А. Ильина. - Москва: ДеЛи принт, 2009. – 718 с.
3. *Диханова М.Б.* Хранение зерна под пленкой. / Диханова М.Б. // Материалы Республиканской научно-теоретической конференции «Сейфуллинские чтения - 11: Молодежь и наука». – 2015. – С. 17-18
4. *Станкевич Г.Н.* Современный подход к изучению интенсивности дыхания зерна /Станкевич Г.Н., Бабков А.В.// Алматы технологиялық университетінің хабаршысы. – 2014. – №2. – С. 45–51.
5. *Мырзабекова А.М.* Обзор современных систем для хранения зерновых культур/ //VI Научно-практическая конференция «Информационно-измерительная техника и технологии». – 2015. – С. 123-125.
6. URL: <http://ussrforever.ru/raskaz/207dihanie.html>. (дата обращения 05.08.2020).