SILOBOLSA®

PLASTAR

DRY GRAIN AND SILAGE STORAGE
IN SILOBOLSA® PLASTAR

This manual is dedicated to all those persons who somehow provided their knowledge to the development of the system Silobolsa“, thus generating a new vision in grain commercialization, conservation of forage and by-products, as well as other uses as fertilizers.

The worldwide unprecedented research on storage in modified atmospheres, performed in our country, is the result of the knowledge of those unknown people who decided to change the ordinary use of Silobolsa“.

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Agricultural Scientist Felix Starszy, Plastar San Luis. www.silobolsa.com
Agricultural Scientist Alberto Stavisky, Plastar San Luis. www.silobolsa.com
Agricultural Scientist Marcelo Prono, Plastar San Luis. www.silobolsa.com
Agricultural Scientist Luis Rosemberg, Plastar San Luis. www.silobolsa.com
Agricultural Scientist Roberto Montoza, Plastar San Luis. www.silobolsa.com
Mr. Ricardo Knaupp, Plastar San Luis. www.silobolsa.com.ar
Agricultural Scientist Federico Castellano (Richiger). www.richiger.com.ar
Bachelor of Chemistry Liliana Pagliano, Plastar San Luis. www.silobolsa.com
Sworn Translator Virginia Moreira.

Technical team specialized in Silobolsa® Plastar

Agricultural Scientist Carlos Roldán. www.silobolsa.com
Agricultural Scientist Carlos Brambilla. www.silobolsa.com
Agricultural Scientist Daniel Bernardo. www.silobolsa.com

Institutions

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Index

Introduction

In the last years, the technology to produce and harvest in Argentina has advanced much faster than the infrastructure to transport and store grains. The poor infrastructure to store the surplus grains and the inadequate roads to transport them towards the few available storage plants and ports of exportation led us to develop different storage systems from the traditional low-cost ones and easy to adopt.

This technology of storage, conservation, identification and quality control on the farms began to be developed in Argentina due to the macroeconomic situation at the end of the nineties.

In Argentina, grain production varies between 60 and 75 million tons per year. In the last 10 years, grain production (cereals and oil seeds) grew by 60%.

On the other hand, the growth rate in the storage capacity increased 2 million tons per year due to the increase in the use of a storage system near the harvest place. On the farms, traditional facilities are used: such as metallic silos, farm bins, bins sites, and nowadays, another one, which is not traditional: Silobolsa“ PLASTAR.

Since 1995, Silobolsa“ PLASTAR for silage has been widely spread in the dairy farm areas, mainly because of the great job jointly undertaken by two firms: Sancor and Plastar, that spread the advantages of the preservation of food for cattle.

Nevertheless, it was not the use that increased most due to the current situation. Later, an unknown producer made a new use of it and turned it into a world innovation when changing its primary use of the preservation of food for cattle into storage and conservation of grain. Unprecedented research from public and private sectors and the higher capacity installed in our country promote the technique towards a development with Argentine personality.

In the campaign 2002-2003, 11.500.000 tons were stored in Silobolsa“ PLASTAR, 15% of grain production. The SAGPYA (Secretaría de Agricultura, Ganadería, Pesca y Alimentación – Secretariat of Agriculture and Livestock, Fishing and Food) estimates that 16.100.000 tons were stored in the campaign 2002-2003, 20% of the production. Nowadays, 17-20% of the crop is stored in Silobolsa“ PLASTAR in Argentina and a gradual growth is expected for the next years until reaching a plateau of 35%.

Simultaneously, the international food market has become more demanding, and producers are forced to respect the standard international quality regulations, what makes us foresee a more demanding market also regarding the process of grain and food production.

These demands will be focused on handling: from the very seeding of the vegetable until the moment when it leaves the countryside to be processed. The traceability, the exact identification of a certain batch of seeds or of a certain batch of food will be very important in the future to market normally.

This phenomenon is not exclusive to the developed countries but is a real transformation in all those countries having a clear and well-defined objective regarding the global food production, seriously and responsibly performed. Silobolsa“ PLASTAR is a good choice to classify and identify every batch produced, since it allows to preserve the commercial identity (for instance: lot of origin) and the quality of grains.

Through Silobolsa“ PLASTAR the storage capacity existing in the countryside could be rapidly multiplied. That situation had been unresolved for decades in Argentina; thus the beginning of the solution started in the last 10 years.
The excellent and latest generation production technology of the three factories operating in our country and the worldwide unprecedented research have permitted manufacturing levels in constant growth within MERCOSUR and increasing levels of exportation and utilization extra-MERCOSUR.

The scientific investigations carried out by the technical team of INTA Manfredi, Pergamino, Balcarce, Las Breñas, Concepción del Uruguay and Salta, the technicians of the group AACREA and AAPRESID, technicians of APROAGRO, all the Argentine technicians who promote the technique generate the best expectations and opportunities for the work growth and the Argentine intelligence in the world.

We strongly recommend this manual for all those persons who are somehow related to the agricultural and livestock production.

GRAIN STORAGE IN SILOBOLSA® PLASTAR

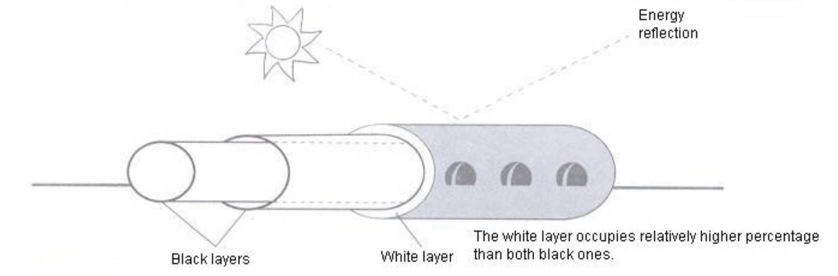
SILOBOLSA® PLASTAR

What is it?

It is a technology of storage, identification and conservation in a modified atmosphere.

How can we do it?

Through a polyethylene tube that may have several lengths and diameters. It has three layers with specific and independent functions.



What can you store and conserve?

You can store and conserve various products in bulk, especially the ones generated in agricultural and livestock production.

- Dry grains: Soybean, Corn, Sorghum, Wheat, Sunflower, Millet, Oats, Rice, and Barley, among others.
- Wet grains: Corn and Sorghum, among others.
- Silage: Corn, Sorghum and Alfalfa, among others.
- By-products: other by-products, from all the above mentioned ones.
- Hays: Wet and dry hays.
- Fertilizers: Solid ones.
- Others: Sand, soil, among others, used for whitewashing and for conducting walls (irrigation ditches) and/or retaining walls (floods).
- Reservoirs: temporary water reservoirs (for instance, fumigation).

ADVANTAGES OF THE STORAGE SYSTEM SILOBOLSA® PLASTAR

Storage in Silobolsa® PLASTAR is an increasingly used practice. The benefits this practice provides have allowed to solve a great part of the storage and logistics problems.

These problems may be summarized in the following aspects:

Logistics and Operation

Low cost storage capacity: storage depending on the magnitude of the farm.
Operating efficiency: right timing of the harvest.
Moisture: storage of the grain with a wider range of moisture than the traditional one.
Climate independence: to harvest with unlimited storage capacity. Independence of the state of the roads.
Capacity and operating efficiency: a better harvest undertaken in less time generates higher efficiency.
Efficiency of the cultivation: reduction in grain loss because of the delay in the harvest.
Storage of by-products: it allows the storage of by-products such as malt, bran, etc.
Production systems: adaptation to a variety of production systems from different regions of the country.
Traceability: it allows the differentiation between average quality from specialties and a better control on the part of the industry regarding the material to be acquired.
Ecological aspect: it allows the control of insects without insecticides that are harmful and/or residual for human health.
Barrier: Polyethylene is a barrier to the infestation sources of insects and plagues affecting the stored grains.

Economic and financial aspects

Cost: capacity for low cost grain storage on the farm.
Financial efficiency: independence of short distance transport for storage.
Saving: significant saving on transportation charges, storage and handling.
Out of season activity: use of transport and plant processes out of season.
Administration and planning: higher efficiency in delivery and trading of cereals.
Maintenance cost: It does not have maintenance cost, if we compare it to a traditional plant.
Low initial investment: the amortization monthly amount of a traditional plant is high compared to the cost of Silobolsa® PLASTAR.

What does the system consist in?

FUNDAMENTALS AND PHYSIOLOGY OF THE CONSERVATION

It is important to make a differentiation regarding the physiology of conservation:

I- Storage systems in a normal atmosphere (metallic silos, farm bins, bins sites, etc.)

II- Storage systems in a modified atmosphere (Silobolsa“ PLASTAR).

The difference between them lies in the type of atmosphere existing inside the silo during the storage period and the modifications produced during said storage.

Every product stored in Silobolsa“ PLASTAR modifies its own atmosphere and conservation, especially if it is a living organism such as seeds.

This modification of the internal atmosphere of Silobolsa® PLASTAR is caused by:

Physical factors:

1. Oxygen (O_2).
2. Carbon dioxide (CO_2).

3. Moisture.
4. Internal temperature (i tº).
5. External temperature (e tº).
6. Climatic damage of the grain.
7. Mechanical damage of the grain.
8. Cleaning of the grain.
9. Respiration.
10. Grain weight.
11. External climatic factors.

Handling factors:

1. Proper pressure.
2. Quality of Silobolsa".
3. Thickness of Silobolsa".

Biological factors:

1. Mites.
2. Small mammals.
3. Birds.
4. Fungi.
5. Bacteria.
6. Yeasts.
7. Insects.

"THE INITIAL CONDITIONS OF THE MATERIAL TO BE STORED DETERMINE HOW THE INTERNAL ATMOSPHERE WILL BE MODIFIED AND WHAT WILL HAPPEN WITH THE BIOLOGICAL AND PHYSICAL FACTORS IN SILOBOLSA® PLASTAR."

Common insects and fungi and the conditions predisposing their development are described below:

Organism	Range of Temperature for its development	
	Minimum	Ideal
Insects		
Sitophilus oryzae	17	27-31
Oryzaephilus surinamensis	21	31-34
Tribolium confusum	21	30-33
Tribolium castaneum	22	32-33
Cryptolestes pusilus	22	28-33
Rhyzoperta dominica	23	32-35
Fungi		
Aspergillus restrictus	5-10	30-35
Aspergillus candidus	10-15	45-50
Aspergillus flavus	10-15	40-45
Penicillium	0-5	20-25

What happens inside each Silobolsa® PLASTAR?

When filling in the Silobolsa“ PLASTAR, the internal air is expelled with a great quantity of oxygen in it. The remaining oxygen is consumed during the respiratory process, thus releasing carbon dioxide (CO2).

When the oxygen concentration (O2) decreases as the carbon dioxide concentration (CO2) increases, after a 4-5 day period, a decrease in grain respiration takes place, called “respiratory inhibition”; this is the main difference from the traditional storage system.

A self-modified atmosphere is created, decreasing the oxygen concentration (O2) and considerably increasing the carbon dioxide concentration (CO2).

Said oxygen decrease (O2) helps to decrease the grain respiration, thus stopping weight loss.

This situation is very different from the one occurring in the traditional storage, in which at least there is a minimum exchange of gases and moisture with the environment.

It happens due to the initial grain respiration and also to microorganisms and insects. That phenomenon, as time goes by, produces the natural control of insects due to the lack of oxygen (O2), The insect itself creates its own lethal atmosphere (eggs, larvae, adults and weevil pupas, woodworms) through its respiration along with seeds'.
Insect pupas are controlled when the carbon dioxide concentration (CO2) exceeds 15%. This process also inhibits the development of fungi and bacteria, that are responsible for internal temperature increase (i tº) at the beginning of the storage.

This system is based on the restriction of the free gas exchange with the environment; that is the basic and specific property of the system Silobolsa® PLASTAR.

Guidelines to store in Silobolsa® PLASTAR

The bad preservation of grains means a loss of their quantity and quality, as time goes by. The quality loss conveys a decrease in the metabolizable energy, changes in the chemical composition of the grains (oils, proteins, starch), decrease of the germinative power of the seeds and development of fungi with production of mycotoxins or other toxic substances.

Said loss may occur due to different factors:

Grain respiration:

Once harvested, the grain continues respiring. As a result of it, the oxygen produces the break of carbohydrates that compose sugars, thus releasing energy in the form of heat along with water and carbon dioxide (aerobic process).

The carbon dioxide increase (CO_2) reduces or inhibits grain respiration when it exceeds 12% of the concentration. Diminishing respiration during the conservation process implies keeping grain nutrients and quality.

THE FASTER YOU MANAGE TO STABILISE THE INTERNAL ATMOSPHERE OF SILOBOLSA® PLASTAR, THE LOWER THE RISK OF SIGNIFICANT LOSS OF GRAIN NUTRIENTS.

Moisture

The fundamental condition regarding moisture is to store the grain following the specific commercial conditions for its normal trading. Although the system allows storage in a wider range, you should not store grains during a long period if the moisture concentration is high.

THE HIGHER THE MOISTURE CONCENTRATION IS, THE SHORTER THE CONSERVATION PERIOD IN SILOBOLSA® PLASTAR SHOULD BE.

THE HIGHER THE MOISTURE CONCENTRATION IS, THE GREATER THE RISK IN STORAGE ENVIRONMENT WILL BE.

The airtightness system does not allow the pass of external water nor internal moisture. Nevertheless, if we store wet grains in Silobolsa“ Plastar, we will be generating internal conditions favoring grain respiration and microorganisms (MO). The hydrolysis of the reserves takes place, and, as a result of it, energy is released in the form of heat (E), water (H_2O) and carbon dioxide (CO_2). This process continues as long as there is available oxygen (O_2) for respiration. Hence, preservation period decreases if the grain moisture percentage (% of M) increases.

During the storage process, grains should not exceed 16% of moisture as a maximum for soybean and corn, and 14% for sunflower and wheat.

Guide to store grains in Silobolsa®

Risk for grain moisture

Type of Grain	low*	low-medium	medium-high
Soybean – Corn - Wheat	up to 14%	14-16%	higher than 16%
Sunflower	up to 11%	11-14%	higher than 14%

** Seeds: this value should be 1-2% lower.*

Risk for storage period

Type of Grain	low	medium	high
Soybean – Corn – Wheat 14% Sunflower 11%	6 months	12 months	18 months
Soybean – Corn – Wheat 14-16% Sunflower 11-14%	2 months	6 months	12 months
Soybean – Corn – Wheat >16% Sunflower >14%	1 month	2 months	3 months

It is not advisable to store wheat with moisture exceeding 14% during a long period.

Under the abovementioned conditions there is no risk of microorganisms (MO) development. The higher the grain moisture percentage (% of M) is, the higher the risk will be and this risk will tend to increase even more in the summer season. At that time, the external temperature (tº) increase may cause an internal temperature increase and this process is deeper near the tropics since there are higher average temperatures (tº) than the ones in temperate areas.

Temperature (tº)

In Silobolsa® PLASTAR, the evolution of the inner temperature continues, thus generating a temperature decrease during the storage period. This evolution is influenced by the place where grains are in the Silobolsa® PLASTAR and by external temperature (tº). The grains situated in the upper part have a rapid temperature decrease, since heat is dissipated when the environment air is colder than grain temperature.

Grains situated in the lower part of Silobolsa® PLASTAR dissipate heat towards soil, but with a slower transference speed. Grains situated in the center of Silobolsa® PLASTAR take longer to decrease temperature (tº), since it depends on how the rest of the grains decrease their temperature (tº). As time passes by, temperature differences (tº) existing in the diverse places of Silobolsa® PLASTAR tend to be more homogeneous. The Silobolsa® PLASTAR containing high moisture concentration will have higher average temperature (tº) than the one with lower moisture concentrations.

If temperature (tº) exceeds 20º Celsius (Cº) the risk of development of microorganisms (MO) will be higher; the risk will be even higher if grains have high moisture.

Temperature increase provokes respiration increase, and therefore, of the degradation of the stored grain nutrients. At the beginning of the storage in Silobolsa® PLASTAR, the internal temperature increases due to the respiration of grains, of microorganisms (MO) and/or due to the external temperature increase. This process stabilizes when the remaining oxygen is consumed, thus stabilizing the internal atmosphere.

In the interior of Silobolsa® PLASTAR, convective air movements take place due to temperature differences (tº), accompanying the changes of the external temperature and are deeper in those regions where temperature variations between day and night are wide (huge temperature range). This phenomenon may generate spaces with high grain respiration, especially in those places where Silobolsa® PLASTAR has depressions (loose) because of moist air accumulation condensing over grains.

There is important interaction between temperature and moisture, which is reflected in the grain internal atmosphere and generated in the external atmosphere (environment where Silobolsa® PLASTAR was prepared).

ALL THE RISKS DRASTICALLY DECREASE IF THE STORED GRAINS ARE CLOSER TO COMMERCIAL CONDITIONS (CC).

See conditions for each type of grain – appendix I.

Temperature (tº) – Moisture Interaction

The combination of these two factors determines the safe storage conditions, modifying the development of the different pathogenic agents, chemical reactions in grains and alterations of the internal atmosphere.

It must be taken into account that the seasonal alterations provoked by temperature (tº) over moisture migration in the Silobolsa“ PLASTAR are related to the internal air migration of the system. This, in turn, is related to the uneven moisture concentration, which generates heat because of seeds respiration. This heat causes a convective internal air current which, due to its higher moisture concentration (because of its higher temperature (tº)), when reaching a colder place (upper part), condenses in little drops over the grains.

This situation takes place when we harvest grains with medium to high environmental temperature (e tº) and a certain degree of environmental moisture (e M) and grain moisture. Later, days start to shorten, average external temperatures (e tº) start to fall and the outer side of Silobolsa“ PLASTAR is cold. Nevertheless, the inner side is hotter and moisture concentration is a bit higher, too.

Again:

ALL THE RISKS DECREASE IF THE STORED GRAINS ARE CLOSER TO COMMERCIAL CONDITIONS (CC).

Conclusions regarding moisture and temperature (tº)

1. With moisture to commercial conditions there are not conservation problems.
2. With moisture to commercial conditions there is not deterioration in the Silobolsa“ PLASTAR system.
3. With moisture to commercial conditions there is not generation of heat of the system itself.
4. There is not moisture variation due to the Silobolsa“ PLASTAR system.
5. If, at the beginning, moisture concentration is higher than the one to commercial conditions, storage period shortens and there is probability of

deterioration that is inversely proportional to internal moisture concentration (i M).

6. Quality alterations are strongly related to breakages and their slow repair.

Fermentation

It is an anaerobic process (in the absence of oxygen (O_2)) by which carbohydrates are decomposed in ethyl alcohol, carbon dioxide (CO_2) and energy (E). It produces grain quality decrease due to hydrolysis of nutritional substances. This process deepens if the grain moisture concentration is higher than commercial conditions (CC).

Physical factors

During harvest as well as during post-harvest handling a mechanical damage may occur. Broken or cut grains expose their nutritional reserves, which can be easily decomposed by pathogenic agents and/or by oxidation if in contact with air oxygen, thus generating quality and weight loss. It is important to control the initial storage condition since quality and process success will depend on it.

Microorganisms: Fungi, bacteria, molds and yeasts

Microorganisms are one of the main factors that are responsible for grain temperature and moisture increase. Fungi act by starting a heating process over the stored grains that may increase up to 50º Celsius (Cº) due to energy release during respiration; at this temperature (tº) only bacteria may act. These bacteria may increase temperature even more and produce the material combustion, mainly if grains have a high oil content (Soybean, sunflower, flax, canola).

Fungi are aerobic, yeasts and bacteria, facultative (aerobic and/or anaerobic ones).

Fungi are the first stored grain colonizers because of their capacity to colonize relatively dry environments.

However, through their respiration they generate ideal moisture and temperature conditions for molds and yeasts to appear; these ones again recreate high moisture and temperature environmental conditions, favorable to bacterium proliferation.

The factors that favor microorganisms (MO) development during storage in Silobolsa“ PLASTAR are: high moisture, temperature and oxygen concentration.

Microorganisms (MO) generating mycotoxins

The control of microorganisms (MO) should be taken into account, especially due to mycotoxins that are of fungous origin and are toxic for cattle and human beings. They have the ability to act by themselves or jointly when generating diseases.
One type of mycotoxins, the aflatoxins, are produced by fungi of the Aspergilus sp. genus (A. Flavus, A. Parasiticus and A. Nomius). They affect the most important cereals (corn, wheat, rice and barley) and other species such as walnuts, peanuts, cotton, etc.
5 aflatoxins are known; they are called B1, B2, G1, G2 and M1. B1 has the greatest carcinogenic power for human beings.
Although the fungus Aspergillus sp. cannot survive within an atmosphere with high concentration of carbon dioxide (CO_2), since it acts as a fungistatic, the use of additives in Silobolsa“ PLASTAR may reduce the possible contamination with mycotoxins, thus avoiding the risk of economic penalization or reduction of the production potential because of its presence in the grain and/or forage.

The most economical method to reduce this risk is to harvest and store grains being dry, clean and in good commercial condition.

Rodents and insects

Rodents and insects break grains, thus diminishing their commercial quality. Likewise, many of them break Silobolsa® PLASTAR.

Therefore, it is very important to make frequent and systematic controls aimed at repairing potential damages.

Cereal bagging

During storage in Silobolsa® PLASTAR, it is advisable to reduce air and loose areas as much as possible; it is not advisable to exceed the stretching capacity.
Loose areas allow the presence of internal air, which contains moisture; it favors the respiration of nearby grains.
Once stuffing has been finished, the silage bag should be airtightly closed using the Silobolsa® PLASTAR Zip so as to ensure the airtight system.

Breakage in Silobolsa® PLASTAR

Because of climatic contingencies (hail, fall of branches, etc.), sometimes Silobolsa® PLASTAR may be damaged; in those cases it is advisable to repair the breakage as soon as possible with the sealing ribbon supplied with Silobolsa® PLASTAR, thus restoring the inner atmosphere.
Naturally, those Silobolsas® with higher thickness will be less damaged before climatic contingencies; therefore, if thickness is higher, the risk is lower.

Endosperm composition

It is important to consider grain composition regarding its protein percentage (for instance, hard grain – red corn) or its chemical composition (containing phenols or flavonoids – soybean), so as to be more resistant to potential deterioration.

CONCLUSION: GRAINS MUST BE DRY, UNSPOILT, WITH NO MECHANICAL DAMAGE AND CLEAN SO AS TO BE STORED, THUS ACHIEVING A SELF-MODIFIED ATMOSPHERE WITH LOW AIR CONCENTRATION (OXYGEN (O2)) AND HIGH CARBON DIOXIDE CONCENTRATION (CO2).

SILOBOLSAS® PLASTAR ARE THE MOST SUITABLE AND EFFICIENT SYSTEM SO AS TO GENERATE AND KEEP THESE IDEAL MODIFIED ATMOSPHERE CONDITIONS.

WORK METHODOLOGY FOR GRAIN STORAGE IN SILOBOLSA® PLASTAR

Location of Silobolsa® PLASTAR and pieces of advice

The location of Silobolsa® PLASTAR must make its bagging as well as its extraction easier.
1. Choose a place far from trees in order to reduce the risk of accidental breakage.
2. Place the silage bag on a flat, clean, compacted, high and well-drained place free of stubble. Keep the area free of weeds and waste.
3. A slight slope of 1-2% is advisable, but it must avoid to cross the Silobolsa® PLASTAR, since it would act as a retaining wall.
4. Before opening the Silobolsa® Plastar, as a precautionary measure so as to avoid the immediate aperture from side to side, it is advisable to make a transversal cut 3 mts. far from the opening at an angle of 45°. If with the time there is a spontaneous leak it is advisable to make a transversal cut, thus avoiding the crack extension in full length.
5. Avoid making the Silobolsa® PLASTAR on stubble lots, with fire hazard. It is advisable, first, to start a fire there (for instance, wheat stubble) if it is not possible to ensile the Silobolsa® PLASTAR on another lot.
6. You should choose an internal path in order to get firmness, a uniform Silobolsa® PLASTAR and easy to be bagged and extracted.
7. Place the silage bags in an easy-to-reach area and where it is easy to handle. The Silobolsa® PLASTAR must be placed where handling is easy in order to facilitate the rapid and safe extraction of the stored grain. The extractor and the truck must work comfortably. There must be enough space among the Silobolsas® PLASTAR to allow the passage of the vehicle for inspections and/or controls during the storage.
8. Protect them from domestic and wild animals by placing a little fence around.
9. Prevent children and adults from using them as a hillock for watching. Do not walk on the Silobolsa“ PLASTAR.
10. Keep the Silobolsas“ PLASTAR out of reach of poachers and cattle thieves.
11. The use of sulfur is not recommended to control rodents, since it may damage prematurely the silage bags.

12. The Silobolsa® PLASTAR should be pointing North-South so as to facilitate the homogeneous heat in both sides. If it is pointed East-West, it will be exposed to North, thus causing greater heating and, as a result, there would be an increase of temperature in one area only.
13. Inspections and controls should be performed weekly as a minimum and after every weather contingency. After putting the Silobolsa® PLASTAR Zip, you should fold it downwards and put earth over it in order to avoid that the wind blow there, thus generating a risk of breaking the Silobolsa® PLASTAR.
14. Do not use elemental sulfur or any chemical means for rodent/pest control. Life expectancy of the polyethylene film is greatly reduced when exposed to chemicals (consult our Technical Department). Control the growth of weeds and grasses through mechanical means or through the use of the approved chemical Glifosato 48 %.

Filling in the Silobolsa® PLASTAR

A BADLY MADE SILOBOLSA“ PLASTAR HAS A HIGH RISK OF PREMATURE DETERIORATION DUE TO THE GREAT QUANTITY OF WEATHER AND BIOLOGICAL FACTORS INTERACTING WITH GRAINS. THE ONLY WAY OF REDUCING THIS RISK IS THROUGH AN EXCELLENT ENSILING.

Procedure to fill in the Silobolsa® PLASTAR

1. Verify the thickness of Silobolsa® by weighing it.
2. Check the ruler of stretching in order to expel as much air as possible.
3. Do not leave Silobolsa® loose.
4. Be careful about the maximum filling pressure of the bagging machine.
5. Stretching: depends on the type of Silobolsa® PLASTAR. **Use the ruler of stretching.**
6. Do not exceed the capacity of stretching.

Maximum stretching allowed for each type of Silobolsa® PLASTAR

	Size (Feet)	Maximum Stretching Allowed
Dry/Wet Grain	4, 5 and 6	17,5 cm. / 6.89 inches
Wet / Cut Grain	7 and 8	18 cm. / 7.08 inches
Forage	7 and 8	18 cm. / 7.08 inches
Corn / Sorghum / Pasture Silo	9 and 10	19 cm. / 7.48 inches
Dry Grain	9 and 10	19 cm. / 7.48 inches

Characteristics of each Silobolsa® PLASTAR

SILOBOLSA® PLASTAR

	Diameter	Width (mts / feet)	Thickness (m)	Weight (Kg./Pounds)	Length (feet/mts.)	Quantity (per pallet)	Volume (tons)
EXTENSIBLE							
SBEX32	1,20 mts./ 3,93 feet	1,90 / 6,23	120	25,30 / 55,77	200-60	24	35/40 rolls
SBEX42	1,30 mts. / 4,26 feet	2,05 / 6,72	120	27,30 / 60,18	200-60	24	35/40 rolls
WET GRAIN							
TMD 420	4 feet	2,15 / 7,05	150	35,70 / 78,70	200-60	12	45/50
TMD 520C	5 feet	2,40 / 7,87	150	39,90 / 87,96	200-60	12	55/60
TMD 620C	6 feet	2,82 / 9,25	180	56,10 / 123,67	200-60	10	90/100
FORAGE							
TGD 720	7 feet	3,30 / 10,82	216	78,90 /173,94	200-60	10	130/140
TGD 820	8 feet	4,00 / 13,12	216	95,60 /210,76	200-60	8	160/170
TGD 920E	9 feet	4,35 / 14,27	228	109,60 /241,62	200-60	8	200/210
TGD 925	9 feet	4,35 / 14,27	228	136,70 /301,37	250-75	6	250/260
TGD 1020	10 feet	4,85 / 15,91	228	122,50 /270,06	200-60	6	240/250
GRAIN							
CGS 520	5 feet	2,40 / 7,87	180	47,80 /105,38	200-60	12	55/60
CGS 620	6 feet	2,82 / 9,25	210	65,50 /144,40	200-60	10	90/100
CGD 920	9 feet	4,35 / 14,27	228	109,60 /241,62	200-60	8	200/210
CGS 920	9 feet	4,35 / 14,27	250	120,10 /264,77	200-60	8	200/210
CGD 925	9 feet	4,35 / 14,27	228	136,70 /301,37	250-75	6	250/260
CGS 925	9 feet	4,35 / 14,27	250	150,10 /330,91	250-75	6	250/260

Characteristics of the bagging machine of Silobolsa® PLASTAR

The quality of Silobolsa® PLASTAR ensilage depends on several factors, among which the quality of the bagging machine can be mentioned.
The principle of a good ensilage in Silobolsa® PLASTAR for dry grains is based on a proper polyethylene stretching, thus keeping a dynamic and uniform balance during the filling in.
It can be achieved by regulating the braking, that depends on the machine brake itself and on the ground surface conditions (with no sharp unevenness and/or irregularities).

Grains fall in the upper part of the tunnel formed by Silobolsa® PLASTAR and fit in because of gravity, so that the machine and tractor start pushing forward which only obstacle is the bagging machine brake.
This procedure allows the right stretching of Silobolsa® PLASTAR, filling it with minimum effort, and a great quantity of air is expelled.

A good bagging machine is designed so that the center of its hopper coincides with the center of the brake wheels axle. A high capacity hopper is required in those cases when you are working with big trailers in order to make bagging easier and increase the efficiency of the work in the harvest; it also favors constant supply and filling uniformity as well.

Braking system should allow to brake in an even way on both wheels, regardless of the different types of ground (mud, unevenness or moisture). Wheels having a grip surface, and good and constant contact with the ground are the most secure, therefore, the most advisable for undertaking this task. A system of regulation in the height of the wheels will favor the security with regard to the ground, especially if regulations are independent.

The filling auger must have a high diameter, with low revolutions, and parallel to the ground surface. This will allow to increase the loading capacity and avoid grain breakage.

The tray to hold the folds of Silobolsa® PLASTAR must have a width bigger than 60 cm. (the width of the fold of the Silobolsa® PLASTAR); it should be free of uneven or rough edges that may damage the Silobolsa® PLASTAR.

The bagging machine tunnel should have a very similar shape to the silage bag after it has been filled; the longer the tunnel is, the less effort will the Silobolsa® PLASTAR bear to the same stretching. The stretching will be more homogeneous and the silage bag will be easily unfolded.

The shaft of the equipment to the tractor must be easily adjusted, so as to be quickly adapted to the different tractors and their respective shafting heights.

Bagging machines are very risky, due to the nearness and the permanent movement of the machine operators while the engine is working. Hence, the following safety measures should be taken into account:

a. The transmission bar should be well protected.
b. Gears and chains must be covered.
c. Do not remove the protective elements placed by the manufacturer.

The bagging machine should have a beacon system with revolving warning lights to be visible while driving along the road. Besides, it should have a spare parts manual, a manual for efficient usage, post-sale maintenance instructions and the backing of a well-known manufacturer.

The best Silobolsa® PLASTAR is the result of a sum of factors, where the ability of the machine operator is fundamental.

Uniformity when ensiling Silobolsa® PLASTAR

The ideal practice consists in filling in the Silobolsa® PLASTAR continuously, without stopping. It is sometimes difficult to achieve this without interrupting the loading since bagging machines have such capacity of working that at least 3 to 4 simultaneous harvesters are required to fill in a Silobolsa® PLASTAR in an hour.

Because of this characteristic, interruptions during the filling of Silobolsa® PLASTAR are one of the main causes of lack of uniformity.
This inconvenient appears in every stop, with parts having less filling pressure which causes a bigger accumulation of air in that section thus condensing the moisture.

For that reason, it is important to brake properly during the filling and every time it is needed to stop, when waiting for the next unloading hopper. A good design of the bagging machine and a double-clutched tractor will make the constant work easier, reducing stops and allowing to minimize the problem, thus ensiling uniform Silobolsas® PLASTAR.

Steps to place the Silobolsa® PLASTAR

1. Place the box unopened following the direction suggested by the cover sticker.
2. Take off the Silobolsa® PLASTAR and place it (without unfolding it) on the ground, next to the bagging machine tunnel.
3. Check that the bagging machine should not have any sharpening edge that may damage the Silobolsa® PLASTAR. Inspect the area where the Silobolsa® PLASTAR will be placed and remove any strange element that could be accumulated. Be careful of the seam-edges that may tear the Silobolsa® PLASTAR.
4. Lower the tray until it almost reaches the ground surface.
5. Remove the rack backwards of the tunnel area and then lower it.
6. Place the Silobolsa®PLASTAR over the upper rack and bring it up yonder the upper part of the tunnel. Then place the Silobolsa® PLASTAR in the tunnel, in its entire perimeter and above the lower tray.
7. Be sure that the corners of the lower part of the Silobolsa® PLASTAR are not folded or twisted. The rest of the folds should remain as much forward as possible.
8. Remove the sealing straps that fasten the Silobolsa® PLASTAR.
9. Take the inner corner of the Silobolsa® PLASTAR and remove from it some 2,5 mts backwards. This section of the Silobolsa® PLASTAR will be used to seal its bottom.
10. Use the Silobolsa® PLASTAR Zip to seal the end of the Silobolsa® PLASTAR, thus achieving a safe, airtight and reusable sealing.
11. Once the Silobolsa® PLASTAR Zip has been placed, lift the lower tray without damaging the polyethylene.
12. Lift the upper rack until the Silobolsa® PLASTAR is stretched enough and covering the tunnel.
13. Place and straighten the elastic ropes well enough, one of them over the rack and the other backwards, near the tunnel end. An excessive tension

may break the Silobolsa® PLASTAR, while less tension may make the folds gush out, therefore you will not achieve a uniform Silobolsa® PLASTAR.
14. Start the filling of the Silobolsa® PLASTAR.
15. The brake must be regulated in both wheels. You should check that the regulations of the brakes were even before bagging the first Silobolsa® PLASTAR.
16. Ignite the tractor engine smoothly. The engine must be at less than 1.000 r.p.m.
17. SLOW DOWN THE SPEED SLOWLY when the mark indicating FIN DE Silobolsa® PLASTAR (END OF Silobolsa® PLASTAR) appears, so as to seal the end with the other Silobolsa® PLASTAR Zip.

The dry grain ensiling technology requires proper bagging of the Silobolsa® PLASTAR to expel as much air as possible; you should not leave the silage bag loose nor exceeding the capacity of stretching recommended by the manufacturer. You should not take into account the work pressure but the maximum stretching marks.

The speed of the work is very high. The power required by the bagging machine is 25 HP for non-stopping bagging of 180-220 tons/hour.
As a safety measure, it is important that the machine operator keep away from the transmission bar.

Periodic controls

Silobolsa® allows safe and airtight storage of grains, seeds and forage. Once the ensiling has been finished and is airtight it is important to undertake periodic controls aimed at assuring the optimum quality of the material. Controls performed during the storage period are an insurance policy that will avoid us a potential problem.

In some areas there is risk of breaks due to small mammals such as armadillos and mice. They can be kept away through suitable repellants with residual action of up to 90 days.

In every weekly control it is necessary to immediately repair potential breaks and to evaluate the application of a repellant to avoid any type of rodents.

It is advisable to apply the controls of the repair ribbon, thus immediately making the repair if necessary.
It is important to keep the area free of weeds; therefore, we recommend performing evaluations of the area to avoid their growth since they could provide refuge to rodents.
The use of fences is a very frequent and simple practice in some regions; hence, you should verify if they are in good state in every control.

They must be 5, 10 and 15 cm. high if the objective is to prevent armadillos from passing.
The use of sulfurs is not recommended for they cause premature deterioration of polyethylene.
The presence of foxes may be controlled through repellants; they should be placed on the upper part of the Silobolsa® PLASTAR, since these animals may climb and damage the upper part with their teeth and claws. This could increase the risk of tearing of the Silobolsa® PLASTAR in full length due to the chemical composition of the polyethylene molecules.
We recommend the use of electrical wire fence with good/high conductivity not less than 3 meters far from the Silobolsa® PLASTAR; thus, those animals attracted by the smell of the content of the Silobolsa® PLASTAR will not be able to break it.
Poultry must be kept away because they may peck the Silobolsa® PLASTAR and make holes. Turkeys are the most dangerous animals due to the great strength of their beak and claws.

Silobolsa® PLASTAR for fertilizers

When filling in the Silobolsa® PLASTAR with fertilizers there is no risk due to biological factors. Nevertheless, this little advantage in the decrease of risk factors that facilitates the product handling should not make us underestimate other handling and physical factors.

According to a private research performed in 2002, Argentine agricultural producers were asked about the use of fertilizers in bulk; below are their answers:

Why would you use Silobolsa® PLASTAR to store fertilizers?

I do not have unavailable fertilizers in bulk in my area	2%
Our supplier only sells XX Kg. bags	2%
Because of cost reduction	5%
I just use liquids	7%
I have storage problems	10%
The XX Kg. bag is convenient	16%
I have logistics problems	58%

Silobolsa® PLASTAR is intended to solve operative and storage limitations of fertilizers, not only for agricultural producers but also for fertilizer distribution chains.

In that work, it was concluded that, after 66 days of storage, urea conservation was acceptable, taking into account two parameters: fluidity and moisture.

Moisture and fluidity of the system were under the risky limits.

Plastar San Luis has developed Silobolsa® PLASTAR for fertilizers, specially designed for this type of storage with no risk during a period of 8 months, which usually exceeds the agricultural producer's storage need.

Advantages of Silobolsa® PLASTAR for fertilizers

Agricultural producer

• More efficient amortization of bagging and extracting machinery.
• Learning process already done in the grain forage system.
• Easily applicable.
• Storage in the lot to be used.
• Specific identification depending on what you need to use in the lot.
• Independence of the logistics of the "carts" concentrated at the moment of greater use.
• Access to fertilizers in bulk when the plant of distribution is located over a 35 km. radius.

• Anticipated coordination of the plant-lot logistics.
• Effective cost reduction due to the independence of short distance transports.
• Disappearance of freight cost due to a higher volume of transport.
• Availability of fertilizers “just before it rains”.
• Timing at the right moment of use.
• Increase of economic-financial efficiency, as the anticipated purchase.

Advantages for distributors

• To extend the logistics period.
• Anticipated delivery to big clients.
• To extend the logistics area of operations.
• Cost reduction due to more frequent use of transport units for larger quantities.
• Storage capacity increase in plant.
• Identification of special mixing destined to specific lots.
• To deposit the fertilizer in the lot where producer will use it.
• Better customer service.
• A customized service regarding mixing.
• Anticipated sale.

Advantages for the industry

• To extend the logistics period.
• To deposit the fertilizer in the lot where producer will use it.
• Better customer service.
• Availability of additional capacity at low cost.
• Identification for specific batches.

Conclusions on Silobolsa® PLASTAR for fertilizers

The highly functional aspect of Silobolsa® PLASTAR is assured from the viewpoint of conservation as well as its operative and economic qualities.
In accordance with the results obtained in producer fields, distributor plants and scientific tests, the fertilizer-producing industry concludes that Silobolsa® PLASTAR is suitable for fertilizer storage during average periods.

Grain extraction

The Silobolsa® PLASTAR must not be opened through horizontal and/or vertical cuts. The cut should not be done on the upper side either.
The right procedure is to make an oblique and elliptical cut in the less stretched area, that is to say, on its base.
When making cuts in the less stretched areas, you will avoid their extension several meters long.
The same precautionary measures are recommended when you perforate the Silobolsa® PLASTAR to take samples.

Grain extraction may be undertaken in different ways:

1. Auger: It is the less advisable method because the labor is high and the task is slow. Approximately 4 hours are required to load a truck.
2. Sweeping Auger: This system speeds up the task, since it demands half the time required by the abovementioned method. It is cheaper due to the saving in the labor required. The inconvenient of the auger system is that you must move the gains along the silage bag while being unloaded.
3. Pneumatic extractors: The technique is based on sucking the grain through a hose by producing vacuum inside a cleaning turbine. In this compartment, the grain is separated from the air and falls at the bottom; then it is extracted by propelling the same air generated in sucking. In this case, the same pump generates vacuum (grain sucking) and pressure (grain pushing), thus grains are taken from one place (Silobolsa® PLASTAR) to another (truck) without mechanical tools that may damage them.
4. Palou®-type extractors.

Characteristics of extractors

The objective is to undertake a task without waste and to leave the place tidy.
Extractors usually have a work capacity of 100 tons/hour, which is high. They should be built so that the process does not damage the grain. The general good finish of the machine is very important for this purpose.
A big auger without uneven edges and with the less inclination as possible; it should also work at low revolutions.

There are mechanical and pneumatic machines to empty the Silobolsa® PLASTAR. Although the pneumatic ones are more versatile, they require a higher power of the tractor and of the "operator", since it is a very hard work to extract several Silobolsa® PLASTAR in one day with this kind of machine. Said machines do not pick up (they roll up the Silobolsa® PLASTAR). If they have so much power, the grains bounce and may break.

The mechanical machines pick up the Silobolsa® PLASTAR rolling it up, as it is emptied. They pick up all the cereal, they do not need the double-clutched tractor, because it operates with the same Silobolsa® PLASTAR's traction.

SILAGE IN SILOBOLSA® PLASTAR

INTRODUCTION

Ensilage is not a new process. It has been carried out since biblical times in different ways. For those who do not know about it, “it is something that smells putrid and very unpleasant, although for our animals it smells French roses and stimulates the appetite”. For professional nutritionists, it is like feeding with “a transformation step less for rumen microbes. We go a step ahead and save them work”, and this is fully capitalized by the animal (greater production).

The ensiling process, which arose from the necessity of increasing the productivity of livestock establishments in a constant and sustainable way, has encouraged livestock and dairy producers to consider this type of reserves for the last 10 years.

According to data by INTA PROPEFO, in the campaign 96/97, 270,000 hectares of crops of sorghum and corn were ensiled. Different ensiling systems were used: 30 % of that surface was ensiled using a bunker system; 20 % was ensiled in silos; the remaining 50 % was ensiled in Silobolsa® PLASTAR.
The 95 % of the ensiling process was performed with finely chopped forage and 50 % of the finely chopped silage was made with Silobolsa® PLASTAR.

According to the INTA PROPEFO project of the Instituto Nacional de Tecnología Agropecuaria (INTA) the evolution of the ensiling surface is expressed in the following table:

Evaluation of the ensiling surface (thousands of hectares)

	94/95	95/96	96/97	97/98	00/01
Corn	76	154	200	250	450
Sorghum	4	17	70	100	250
Pasture	3	15	35	60	200
Wet Grain Corn+Sorghum	1	30	50	75	150
Totals	84	216	355	485	1050

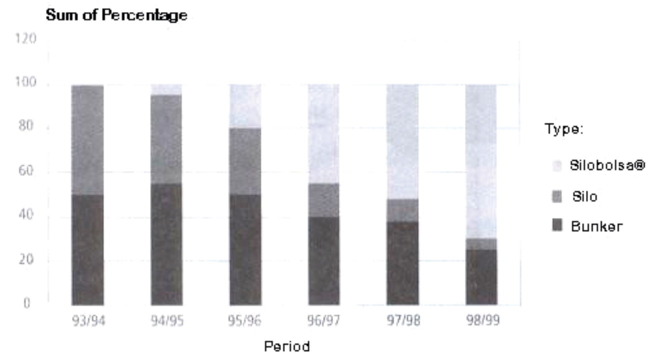
The use of this process was spread mainly because of its low unitary cost, high probability of obtaining a high nutritional food, easy conservation, certainty of obtaining a high quality food, similar to the original forage, a constant diet and increase in the average load of the establishment.
The crops that are preferred for their composition were Corn and Sorghum. They were utilized according to the following ensiling systems:

Evolution of Corn and Sorghum silage

	Hectares	Type of chopping	Percentage	Type of storage	Percentage
				Silo	50
93/94	80000	Thick	90	Bunker	50
		Fine	10	Silobolsa®	0
				Silo	40
94/95	120000	Thick	40	Bunker	55
		Fine	60	Silobolsa®	5
				Silo	30
95/96	170000	Thick	15	Bunker	50
		Fine	85	Silobolsa®	20
				Silo	15
96/97	270000	Thick	5	Bunker	40
		Fine	95	Silobolsa®	45
				Silo	10
97/98	350000	Thick	2	Bunker	38
		Fine	98	Silobolsa®	52
				Silo	5
98/99	700000	Fine	100	Bunker	25
				Silobolsa®	70

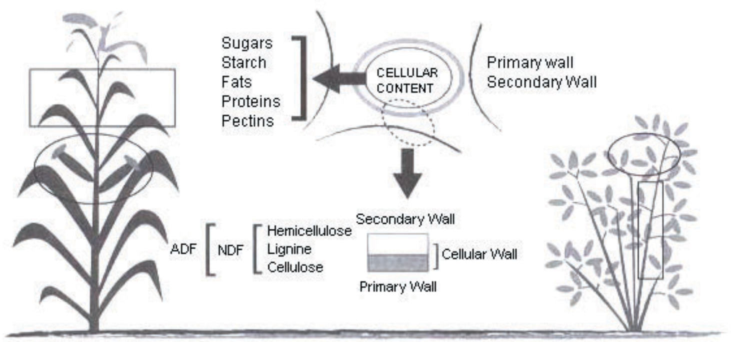
We can see that producers began using Silobolsa® PLASTAR massively because of its easy making, low cost and mainly its “high stability in the achieved quality”.

Below, we describe some basic guidelines for making good ensilage.

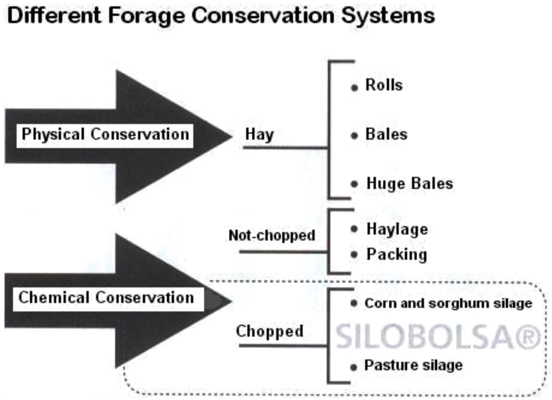


What is "ensilage"?

Green forage ensilage is a conservation technique of vegetable nutritional properties. It is based on chemical and biological processes generated in anaerobiosis, produced in vegetable tissues when they contain a sufficient amount of fermentable carbohydrates. The conservation process is carried out in a wet environment and, because of the formation of acids acting as preservative agents, it is possible to obtain a succulent food with a higher nutritional value compared to cut and dried forage and similar to original forage.



Forage Classification



Process Fundamentals

The practice of good silage will be ideally composed of several factors that favor high nutritional food.

1. Low pH.
2. Rapid exclusion of the remaining oxygen (O2).
3. Maintenance of oxygen exclusion.
4. Maximum concentration of Soluble Carbohydrates (SCH).
5. Minimization of proteins degradation.
6. Proper concentration of lactic acid-forming bacteria.
7. Minimization of aerobic activity at the moment of supplying.

Advantages of ensiling Whole Plants

• The end product, if produced with an adequate conservation process, has minimum nutritional differences with green forage.
• This process is quite independent of climatic factors. This means that the producer has greater possibilities of accumulating forage reserves in problematic zones.
• It allows to balance the inequality among forage offer throughout the year and frequent animal requirements.

• It allows to balance the ration composition against deficient pastures regarding some components of the ration.
• It allows to supply food for stabled and/or semi-stabled cattle, thus improving the soil for a prairie or plain with excessive soil moisture.
• It allows to preserve forages difficult to cut and dry, such as corn and sorghum.
• It is the conservation system which best adapts to weedy crops.
• It does not pose fire risks.
• After pastures, it is the forage with a lower cost, quite below stored grains.

Ensiling Process

The forage that is to be stored wet is harvested by machines especially designed on that purpose. Those machines cut and chop the forage, which is then transported and accumulated on the ground, on special facilities or are stuffed in Silobolsa® PLASTAR.
In this green mass, a series of chemical changes soon begins during four or five weeks, generating silage, ensilage, ensiling, etc.

The process is divided into two basic and essential phases:

1. Aerobic Phase (in the presence of oxygen (O2)):

Stage when Soluble Carbohydrates (SCH) are generated

On making a silo, it is impossible to eliminate completely the inter-material air containing oxygen (O2); the remaining air is consumed by cells of the tissues of living plants together with aerobic bacteria.

THIS IS THE PHASE IN WHICH THE MOST IMPORTANT CHANGES OCCUR IN THE ENSILED MASS

It is important to limit this phase as much as possible, since soluble sugars are consumed due to respiration, and water, carbonic anhydride and energy are generated in the form of heat, in accordance with the following reaction:

Glucose + O_2 _ CO_2 + H_2O + Energy (tº)

As long as there is oxygen (O_2) this reaction occurs and the resulting energy raises the silage temperature (tº); for that reason it is important to expel the air (containing oxygen (O_2)) from the ensiled mass. However, as this reaction is produced the released carbon dioxide (CO_2) displaces the oxygen (O_2)) in the mass.

This is achieved in three ways according to the container that is being used:

1. Compaction
2. Vacuum pumps
3. Silobolsa® PLASTAR sealing process with Silobolsa® PLASTAR Zip.

The sooner the oxygen is expelled (O_2) and greater the concentration of Soluble Carbohydrates (SCH), the lower the production of heat and less the time for achieving the desirable conditions for the development of anaerobic microorganisms.

Enzymatic action begins during this phase and it is important because it initiates hydrolysis and the degradation of certain substances contained in plants, such as sugars, starch and proteins.

Molds, yeasts and aerobic bacteria are present in this phase; their activity is limited to the initial period and, until the oxygen has not been excluded from the ensiled mass, they consume simple sugars such as fructose and glucose, generating volatile fatty acids.

Molds + Yeasts + Bacteria _ Fructose + Glucose = VFA + Gases + Organic Compounds

If for any reason, it is not properly compacted, sealed, or vacuum is not produced, the nutritional quality of silage drastically decreases.

Basic conditions for good ensilage practices:

1. Chopping crops with proper moisture percentage
2. Adequate compaction.
3. Long chopping.
4. Rapid filling.
5. Covering (if appropriate).
6. Use of accelerating additives (if appropriate).

If the abovementioned processes are not properly performed, they can cause important losses in sugars (used in respiration). As a result, their nutritional quality will be rather low for “food”.

When the silo is well closed and/or sealed, that is, it prevents air from entering, this phase is brief, excluding the activity performed by bacteria, yeasts and molds on sugars, which result from the starch hydrolysis.

Simultaneously, the growth of molds and yeasts (white color of material), which are responsible for a low palatability and some animals’ health disorders, is avoided. (e.g. aflatoxins caused by Aspergillus flavus).

Cells respiration during silage may be rapidly stopped by using accelerating additives.

As a consequence of oxygen exclusion, vegetable cells die, their structure is broken and cellular juice is released, making the silo temperature start decreasing.

In this phase, a high concentration of Soluble Carbohydrates (SCH) should be achieved for the next phase in which microorganisms (M.O.), especially lactic bacteria, allow silage stabilization with the lactic acid they generate.

What are the Soluble Carbohydrates (SCH) produced in this phase used for?

2. Anaerobic Phase (in the absence of oxygen (O2))

Who uses the Soluble Carbohydrates (SCH) produced in the previous phase?

During the process, a phase, quite different to the previous one, can be identified. Once the air has been excluded and oxygen (O2) is used up and there is not gas exchange with the outside (notice the difference between bunker and silo vs. Silobolsa® PLASTAR), the second phase starts. Intense lactic fermentation should predominate in order to efficiently preserve the ensiled green forage. Some of the bacteria involved in the different processes that may occur in the ensiled mass are on the surface of the vegetable being chopped and are placed in the silo next to the chopped plant. It is shown here that it is important to reduce the length of this activity in order to accomplish a better process of forage conservation.

During the fermentation process, a new group of microorganisms starts growing actively such as saprophytic bacteria, present in the forage. These bacteria grow in the absence of oxygen (O2) and become stable and may make us anticipate events.

Enterobacter (related to the one that causes gastrointestinal disorders in human beings) ferments the Soluble Carbohydrates (SCH) to acetic acid, which initiates the fermentation process. Here, a succession of four types of lactic acid bacteria begins, such as:

1. Lactococci (previously called streptococci) and Leuconostocs.
2. Lactobacilli
3. Pediococcus

The bacteria present during this phase include three different groups:

1. Acetic acid-producing bacteria: facultative (aerobic/anaerobic bacteria). They utilize sugars, alcohol and carbon dioxide (CO2) and work with a pH higher than 4.5 in wet environments.
2. Lactic acid-producing bacteria: they grow at 20-37 degrees Celsius (Cº). A high pH generates a greater concentration of acetic acid (vinegar odor) and as it decreases, the concentration of lactic acid increases. It should be

noted that the concentration of sugars should be the minimum required to provide energy for microorganisms (M.O.). Lactic acid bacteria can be divided into the following three sub-groups:

I. Homofermentative Bacteria: such as Lactococci and Pediococci, which ferment sugars in the lactic acid (exclusively).

II. Heterofermentative Bacteria: such as Leuconostocs, which generate acetic acid, lactic acid and alcohol.

III. Hetero- and Homofermentative Bacteria: such as Lactobacilli.

Importance of lactic fermentation:

1. It ensures the concentration of lactic acid, a natural preservative, which is digested by animals without forming polluting byproducts.

2. Low temperatures generated during lactic fermentation ensure maximum conservation of nutrients.

3. Losses due to respiration are minimum.

4. Under normal conditions, lactic bacteria are present and in adequate number in the cut (harvested) forage.

5. A silage accepted by the animal is obtained (acceptable animal palatability).

6. It causes no adverse or harmful side effects on animals and it does not modify the taste and aspect of milk, butter or cheese, either.

7. It generates improper conditions for undesirable microorganisms.

3. Butyric acid-producing bacteria: these bacteria, such as Clostridium, have their habitat in the grass and ground. They are responsible for butyric fermentation by using glucose and lactic acid as energy sources.

I. Clostridium tyrobutyricum: uses the lactates, producing carbon dioxide (CO_2) and hydrogen (H_2).

II. Clostridium sacharobutyricum: uses the lactates and ferments sugars.

III. Clostridium saporogens: is also present in spring forages.

" MICROORGANISMS (M.O.) BELONGING TO THE GROUP OF BUTYRIC ACID-PRODUCING BACTERIA ALSO USE PROTEINS AND AMINO ACIDS (AA) AS ENERGY SOURCES. AS A RESULT, AMINES INTERFERING IN THE ACCOMPLISHMENT OF AN ADEQUATE ENVIRONMENT ARE PRODUCED."

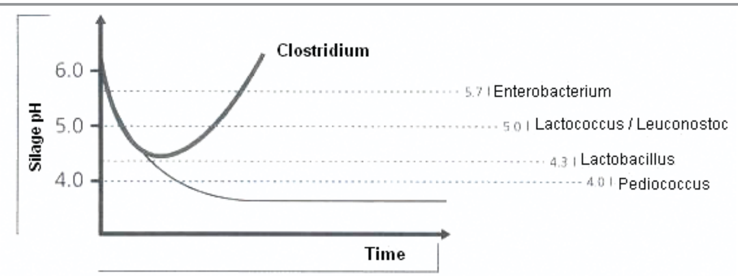
All the microorganisms (M.O.) are favored by the spread of cellular juice, easily fermentable sugars, which are used as energy source. The most important role of these microbes is to act on soluble carbohydrates contained in the ensiled mass and change them into other simpler substances that generate a conservation medium for the same forage. The main products involved in this bacterial activity are organic acids (lactic and acetic + butyric), which naturally acidify the wet medium till the concentration reaches an appropriate level for forage conservation.

We can give some examples and consider the concentrations in relation to the most important chemical components as it is shown below:

_____________[Lactic Acid]___________
[Acetic Acid + Butyric Acid + Ammonia]

According to this calculation it is reasonable to assume that physical and chemical conditions (t°, moisture, material size, inoculum of bacteria from original crop, etc.) are not constant.
This causes populations of bacteria, yeasts and molds (BYM) to vary depending on changes in these conditions, and acids derived from anaerobic fermentation.

The process could be described in the following graphic.



The time necessary to reach the best values of acidity will depend, among other variables, on three basic ones, which are the most relatively important:

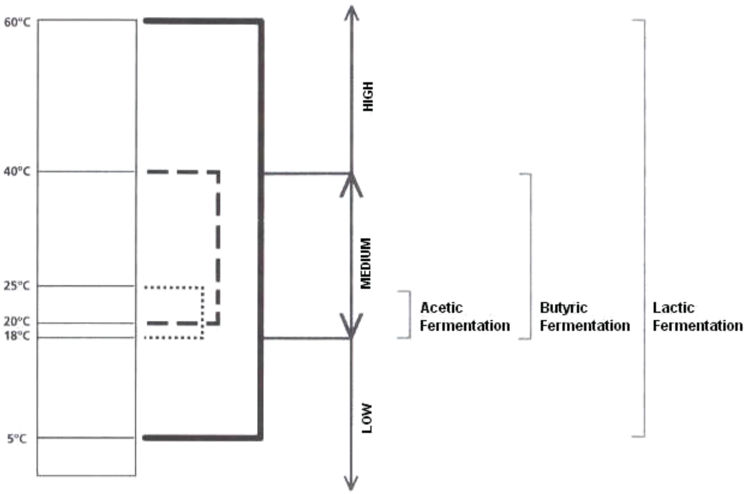
• Amount of air present in chopped forage: the less oxygen (O2) is present, the more rapidly anaerobic microorganisms (M.O.) grow.

• Concentration of sugars of the harvested crop: the greater the concentration of sugars is, the more rapidly anaerobic microorganisms (M.O.) will grow.
• Airtight sealing of the silo: airtight sealing means that there is no gas exchange with the environment in the whole structure, especially in the front part.

Types of fermentation and fermentation temperatures

During the ensiling process different types of fermentation may be produced: lactic, acetic, butyric fermentation, etc. The food will have a high or low nutritional value depending on the type of fermentation produced. Each fermentation is favored by an optimum temperature range:

Graphic of temperature ranges of each fermentation type



We can consider two types of fermentation regarding their temperatures:

High-temperature Fermentation: it occurs in a silo/ bunker-silo. The material is deposited in layers and temperature rises up to a range of 40° - 50° degrees Celsius (C°).
A brown color is obtained as well as a caramel taste that is very palatable

for animals though with a low nutritional value. The reason is that there is no optimum environment for lactic acid bacteria.
There is high utilization of sugars and important losses of material by the dragging action of cellular juice.

Low-temperature Fermentation: temperature is kept below 20º degrees Celsius (Cº), it is of yellowish green color and it is palatable for animals. It is slightly acid and it has a high nutritional value.

GENERAL CONSIDERATIONS ABOUT THE ENSILING PROCESS

Carbohydrates content in plants

When crops are to be ensiled certain qualities should be taken into account:

1. High yield of dry matter per surface unit: each forage species has its optimum harvest to achieve the best amount of green material per hectare and its corresponding yield in dry matter. Dry matter increases along with the starch and fiber content. Simultaneously, the relative content of proteins is reduced. In most used crops, such as corn and grain sorghum, the cut time is near their physiological maturity. In the case of alfalfa, we can find a proportion sugars/proteins equivalent to 0.5 (10 % of sugars and 20 % of proteins). Although this property makes conservation more difficult, there are some specific handling guidelines that can be followed for these crops to be ensiled.
2. Importance of soluble sugars content: four basic points are recommended to obtain a high concentration of sugars.

I. Soluble sugars concentration depends on the vegetable species being considered: high concentration of sugars plus its supremacy on proteins content. The proportion sugars/ proteins should be increased so as to prevent the formation of toxic products and/or neutralization of lactic acid due to the excess of nitrogen produced in the degradation processes. Leguminous plants (e.g. alfalfa) have a low proportion sugars/ proteins, and therefore their conservation is rather complex with this technique, since it requires previous processes and special facilities that diminish the risk of material rotting.

Concentration of soluble sugars and proteins in forage crops

Crop	Soluble sugars	Proteins	Proportion Sugar/protein	Ensilage capacity
Corn sorghum	Very high	Very low	High	High
Gramineous pastures	High	Medium	Medium	Medium
Mixed pastures	Medium	High	Regular/ medium	Regular
Alfalfa	Low	Very high	Low	Complex

The values shown in the table correspond to the optimum time for ensiling.

II. Maturity state of crops at the time of chopping: as species grow, their organs (morphologic and chemical composition) generate changes in relation to the proportion sugars/proteins.

III. Climatic conditions: higher radiations on growing crops induce a greater concentration of carbohydrates. High temperatures between 20º-25º degrees Celsius (Cº) are disfavorable for the ensiling process, since the material is stored in the silo with high temperatures. Crops have a greater concentration of sugars at the end of spring and at the beginning of summer. Optimum conditions for warm regions such as the "Pampa húmeda" (a humid flat green plain) are in spring.

IV. Types of material cutting: this is very important to achieve the rapid contact between bacteria and internal cellular components.

3. Control of the ensiling temperature: temperature raises due to:

I. Cell respiration, using sugars. Aerobic phase.
II. The relation between the absolute amount of bacteria and the absolute magnitude of respiration by each of them.
III. Degree of airtight sealing of the silo.
IV. Specific heat of the ensiled material and temperature during silo filling.

Rapid and efficient expelling of air

Rapid and efficient expelling of air depends on the following factors:

1. Maturity: variations in the cellulose content depending on the physiological state of the plant, induce to less efficiency in relation to the exclusion of air during the ensiling process. That occurs because of fibers, which expand and let the air enter the silo.

2. Moisture content: in forages with low moisture content, the exclusion of air is more difficult, especially in those with an advanced physiological maturity.

3. Cut length: if forage is cut or chopped, it will be easier to fill interstitial spaces; it can be better arranged and thus the internal air will be expelled.

4. Forced exclusion of air (mechanical exclusion): the greater the exclusion of air is, the greater the nutritional quality of the resulting food will be.

5. Type of silo: its shape, size and relation with the soil will determine its relation and exchange with the environment.

6. Speed of filling: there is a basic rule regarding this point that is "fill the silo as soon as possible", whatever type and shape of the silo.

7. Uniform distribution: the surface should be uniform and homogenous.

8. Silo covering: if a silo is not covered it is not a silo but a lot of low nutritional food. To prevent the air with oxygen (O2) from entering and preserve the internal atmosphere, it is necessary to cover the silo with a polyethylene cover.

4. Moisture content in plants: The ensiling process and compaction is easier when the moisture content in the plant is above 80 %. However, if it surpasses 35 %, the following problems may occur:

- Nutrient losses due to the drainage of cellular juices.
- An environment suitable for the growth of Clostridium tyro butyricum is generated.

Finally, the desirable moisture content for making silage is a range between 30-35%.

Losses during the ensiling process

Losses during the ensiling process can be divided into two big groups:

1. Losses that can be avoided:

I. Losses from drainage (7-8 %): liquid cellular juices drag essential nutrients, lactic acid and additives that are necessary to obtain food with a high nutritional value.

II. Losses from air: if the ensiled material is exposed to air, its temperature raises. As a result, chemical reactions are accelerated, generating more heat and thus reproducing its cycle successively. As it occurs, essential nutrients are lost due to their oxidation.

2. Losses that cannot be avoided:

I. Gaseous losses (3-5 %): they occur because of the fermentation process and the oxidation, which turns solid products into gases.

II. Additional losses of dry matter during the ensiling process (15-30 %): if silage is not airtightly sealed, losses can reach 50 %.

" ACHILLES' HEEL OF THE ENSILING PROCESS IS EXPELLING OF AIR AND AIRTIGHT SEALING"

The worst enemy of the ensiling process is oxygen (O_2); a simple exposure to circulating air that acts on food does not favor retention of nutrients. On the contrary, it makes nutrients oxidize. Processes begin at the time of cutting (respiration).

A brief summary of losses and their magnitude is described below:

Source	Net energy loss (% equivalent of starch)	Factor generating the loss
Respiration	1-2	Enzymes present in plant
Lactic Fermentation	4	Heterofermentative lactic acid bacteria
Secondary Fermentation	0-5	Clostridium
Effluents	2-7	Low dry matter Continuous respiration
Wastes from exposed surface	0-10	Aerobic microorganisms

Equivalent starch: *energy unit expressing the energy of the fat produced per unit of food weight, in relation to the fat energy produced per unit of pure starch weight.*

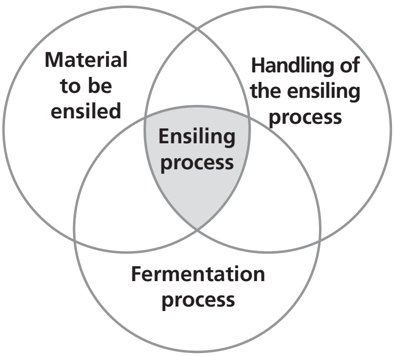
We can notice that those generated by the influence of oxygen (O2) are potentially greater. Oxygen (O2) is responsible for losses produced due to respiration of recently cut forages, and later in those that were not well compacted and in unsealed or badly sealed silos.

If compaction is not properly performed, it rises by the action of fibers and the entering of the circulating air generates the oxidation of the material. The time of oxygen (O2) decrease or depletion may be from 15 minutes to 90 hours depending on compaction.

Modern recommendations and techniques to reduce losses are listed below:

1. "Utilize sharp block cutters, designed to remove the ensiled material", leaving a smooth and well-compacted face which reduces the entering of air.
2. "Do not expose more than the necessary surface/open face to circulating air".
3. "Utilize narrow and long silos which favor rapid movement with a small exposed surface".
4. "Utilize only the necessary material, trying to avoid quality losses caused by nutrients oxidation of food not consumed by animals".
5. "Reduce the exposure to air during all the phases of the process".

To summarize, fermentation is an extremely important part in making an ensilage of a high nutritional value. A good result depends on the characteristics of the crops to be ensiled, handling of the ensiling process (silage making, airtight storage and supply) and the fermentation process. The three factors that interact are shown in the following graphic:



The most important factor is the handling of the ensiling process since it must be carried out by a qualified person with deep knowledge of the internal ensiling process and its subsequent handling on supplying. The technology used in Silobolsa® PLASTAR has all the characteristics that allow to optimize the making processes, compaction, isolation, storage and extraction, better than any other system since it favors every phase in the process.

Since its implementation in the '90s, a revolution of methods regarding wet forages conservation occurred. What years before had been considered a highly risky technique, was assumed as a routine, and attention was focused on the optimization of crops and cattle management, since the correct conservation process was guaranteed.

Which phases are favored by the utilization of Silobolsa® PLASTAR?

1. Lactic fermentation.
2. Acetic fermentation.
3. Low exposure to circulating air.
4. Narrow and long silo.
5. Utilization of the necessary material and airtight sealing with "Silobolsa® PLASTAR Zip".
6. Reduction of air exposure during all phases.
7. It favors the reduction of both avoidable or non-avoidable loss factors.

Utilization of additives in the ensiling process

" THE PURPOSE OF USING ADDITIVES IS TO STABILIZE THE SILAGE AND/OR RESTORE A LACKING ELEMENT".

The utilization of additives is desirable when there is a component in such a concentration that put the conservation of nutritional properties or the correct evolution of the process at risk.

This situation occurs more often than it is known by experience but remains masked because in Argentina, constant analysis to predict a situation is not common; what a person has experienced is used as a guide during the process until achieving a good "silage".

Additives do not have to be necessarily analyzed as a "corrective measure" of silage properties, but it is reasonable to analyze them, considering palatability and consequent increase of consumption by animals.

Additives for:

1. **Inoculation of lactic bacteria:** A number of lactic bacteria is introduced in an amount sufficient for a successful ensiling process. Among them, we can mention Lactobacillus plantarum, lactobacillus brevis and lactobacillus buchneri. They begin acting with below pH 6. In Argentina, natural lactic bacteria in crops are usually enough to obtain a minimum population.
2. **Increasing the Soluble Carbohydrates proportion (SCH):** In this group we add molasses (30 kg/tn), dry milk serum (25 kg/tn), grains, potatoes (300 kg/tn), sugar beet (270 kg/tn) and residues from industrial processes in fruit. This would induce rapid utilization of lactic bacteria producing lactic acid.
3. **Absorbing the excess of moisture in forages:** It can be accomplished with grains, dry hay and any food with a high content of dry matter.
4. **Preventing microorganisms (M.O.) from growing:** This action is really art, because we have to make our efforts to avoid damaging lactic bacteria. The metabolites that play this role are sodium metabolites and the mixture of calcium formate and sodium nitrate.
5. **Artificial acidification:** This is achieved as the material is being bagged in Silobolsa® PLASTAR or silo, by using propionic acid and mixtures with acetic acid.
6. **Enhanced nutritional value and/or palatability:** It is obtained by adding urea, sodium chloride and molasses, ground cereal grain, etc.
7. **Bacteria produced through biotechnology:** Mixtures of lactic acid bacteria and different enzymes were developed through biotechnology and were called carbohydrases.
8. **Enzymes**: They reduce the fiber content by degradation of cellular walls and Carbohydrates (SCH). Among these are: cellulases, hemicellulases, pectinases and amylases.

Guidelines for the correct filling of Silobolsa® PLASTAR

The material to be bagged should be loaded constantly and regularly, especially the first three meters. Caution should be taken regarding brake regulation until Silobolsa® PLASTAR reaches the size of the tunnel and the

wheels begin moving. This shows that Silobolsa® PLASTAR is uniform and with no wrinkles in polyethylene.
Then, and as the tractor goes ahead, it is recommended that the stretching marks are checked systematically and the brake is regulated in accordance with the stretching of Silobolsa® PLASTAR.

The conditions of crops, uniformity of chopping, time of work, etc. may cause changes in the working pressure. On average, forage in Silobolsa® PLASTAR may reach values of 50 to 88 kg/m_, depending on the degree of compaction and moisture content.
Silobolsa® PLASTAR will have a differential stretching according to the pertinent place: in the upper part, sides and the lower part, in contact with soil.

The stretching ruler printed on the sides of Silobolsa® PLASTAR is 17 cm long. You should not surpass stretching for more than 10%. The situation for field work is quite different and it is usually stretched more than the recommended size.

If complicated materials such as alfalfa are to be bagged, it is advisable to utilize a forage wagon with rear unloading system, equipped with dumps on the ground as they pack forage in a uniform way to the bagging machine tray. There are machines that allow uniform chopped forage filling because they have a mill on the upper side and above the rotor. This allows a constant supply to the bagging machine and the homogeneous and uniform conformation of Silobolsas® PLASTAR.

Each Silobolsa® PLASTAR has strips of tape printed with the legend "Fin de Silobolsa® PLASTAR" (End of Silobolsa® PLASTAR") indicating that at 2,5/3 m of it, it will end. To close Silobolsa® PLASTAR airtightly, use Silobolsa® PLASTAR Zip, which is easy to use, practical (it is closed by hand), reusable and provided with all models of Silobolsa® PLASTAR.

The first days, after the Silobolsa® PLASTAR has been made, and depending on the fermentation type produced, vapors from gases are released. The amount of vapors depends on the type of bacteria, material, moisture, compaction level, etc.

These gases will generate an internal pressure if they do not have where to circulate. Therefore, an exhaust system should be provided.
At the end of the Silobolsa® PLASTAR, in an intermediate place between the sector without pressure and the place where it is full, a V or X cut, 4-5 cm long, can be performed.
Said cut will remain with the windows to the outside (open flower) when the internal pressure is positive.

When gases are allowed to get out from the inside, external and internal pressures are balanced; the cut will be closed and at that moment the silo should be sealed so as to get an airtightly sealed silo.

Bagging of high moisture material

The final shape of Silobolsa® PLASTAR is directly related to the type of material and the moisture it has. The greater the moisture content of the material is, the flatter the shape it will have. If materials have a low dry matter content, it is possible that water accumulates in the rotor plate. We can suppose that after bagging it, the mixture of vegetable juices will go to the lower part of the Silobolsa® PLASTAR. These juices have soluble sugars that are very important for the fermentation process and animal nutrition; their loss will be very important when reaching values above 100 lts/ton of wet forage, and losses up to 15 % of dry matter. Under these conditions it is advisable to increase the chopping size and reduce the brake pressure.
The shape of Silobolsa® PLASTAR should be respected because if it does not reach the tunnel height, the folds may overlap or liquids may be deposited in its lower part. Under these circumstances the best option is to stop, pre-ventilate the material before chopping it and postpone the harvest till it reaches the optimum moisture content.
At the same time, high moisture materials favor undesirable fermentations (Clostridium sp.) and proteins decomposition. In the case of corn, when moisture levels at the time of chopping are above 70%, in Silobolsa® PLASTAR the material is rearranged, which settles and compacts post-confection in a flatter shape.

This makes the stretching of the sides increase, and as a result, it increases in the upper part. Therefore, caution should be taken while stretching.

Stretching should be controlled and the limit recommended by the manufacturer should not be exceeded, especially when we are working in periods of high temperature, since they may collapse 6-9 months after their confection.

Confection during a period of high temperature

Both corn and sorghum are usually harvested in periods of diurnal maximum temperatures, up to 35-40° Celsius (C) and nocturnal temperatures of 22-25° Celsius (C).

Consequently, forage as well as Silobolsa® PLASTAR may reach similar temperatures. This characteristic may cause some problems.

Polyethylene reduces its resistance to stretching and on rare occasions, it could increase its permeability to gases and vapors due to an excessive stretching that could make the film become thinner. This is the main reason why a Silobolsa® PLASTAR with more microns is recommended in order to diminish risks.

Forage can be bagged in Silobolsa® PLASTAR at very high temperature (tº) but it would be disfavorable for the ensiling/ conservation process. To solve this problem, it is advisable to avoid working during hours of high temperatures, especially in those zones close to the tropics; otherwise, polyethylene especially formulated for those purposes should be used.

In the case of polyethylene materials which are to be exposed to extreme weather conditions, the basic indication “more microns (μ), more safety” should be followed, using those of the greatest thickness, as it is the best option for reducing the risk of accidents.

Nutritional quality of the end-product

Chemical methods, such as the determination of lactic acid content, butyric acid, ammonia nitrogen, etc., can be used to determine the quality of the material obtained after a 3-8 week fermentation. The acid level reached by the mass of forage after the conservation process is an excellent indicator of the end-product quality. Values close to pH 3.5 are desirable for both forage and grain corn and sorghum. In the case of alfalfa, those acid levels cannot be reached due to the proportion sugars/ proteins.

The following table shows the average values of the most representative compounds with respect to quality of silage:

Crop	pH	% of volatile fatty acids of the Green Matter			Ammonia N as % of Total N	Quality
		Lactic	Acetic	Butyric		
Corn	3.6	1.7	0.6	0.1	5.9	Quite good
Sorghum	4.0	1.8	0.6	0.2	7.1	Quite good
Alfalfa	5.7	0.0	1.1	1.9	39.6	Bad
Ventilated Alfalfa	4.6	1.4	0.7	0.5	9.7	Quite good

Organoleptic characteristics of different end products of silage

Lactic silage (well-fermented)

Color: Greenish-yellow, to greenish-brown. Dark green, in the case of alfalfa and light brown, in the case of corn and sorghum.
Odor: Pleasant, harsh and pungent.
Texture: Very firm. Its segregation is difficult.
Acid Level: pH 3.3 – 4.0
Acceptance: Good.
Nutritional Value: Similar to that of the green forage.

Butyric silage

Color: Brown or Olive green.
Odor: Unpleasant, rancid odor. It is not pungent.
Texture: Soft, of viscous consistency.
Acid level: pH above 4.5 in the case of corn and sorghum, and above 5.5 in the case of alfalfa.

Acceptance: Very low, some animals can tolerate it.
Nutritional Value: Regular due to proteins decomposition.

Moldy silage

Color: White cotton spots, on a grayish-brown base.
Odor: Rancid, not pungent.
Texture: Loose, sometimes gelatinous.
Acid level: pH above 5.
Acceptance: Very bad. It is not accepted by cattle.
Nutritional Value: Very low and occasionally toxic.

Rotten silage

Color: Dark green, grayish or black.
Odor: Repelling odor, because of the ammonia and typical amines in decomposing tissues.
Texture: Gelatinous and soft.
Acid level: pH above 5.
Acceptance: Very bad.
Nutritional value: Very bad and usually toxic for cattle.

Overheated silage

Texture: Rather loose. Its segregation is easy.
Acid level: Very variable.
Acceptance: Very good (caramelization sugars)
Nutritional value: Regular to low.
Color: Brown.
Odor: Caramel with a slight tobacco odor.

Fungi and mycotoxins in ensiled materials

In ensiled materials it is possible to find diverse fungi that produce certain types of toxins. These are similar to a type of crop and ensiled material.

Fungi	Toxin	Crop	Affections
Fusarium sp	Trichothecenes	Low quality corn, gramineous and hay silage	Food rejection and vomiting
Fusarium sp	Zerealenone	Corn and sorghum silage	It affects fertility and reproduction
Aspergillus sp	Aflatoxin	Corn and sorghum silage	Hepatic disorders and tumors
Penicillium roqueforti	Penicillium roqueforti toxin	Corn and sorghum silage	Neurotoxic
Penicillium sp Byssochamys nivea	Patulin	Corn and sorghum silage	It affects lungs
Claviceps purpurea	Ergotin	Gramineous silage	It produces ergoalkaloids and abortions
Claviceps paspali	Claviceps paspali toxin	Gramineous silage	It causes tremors in animals.
Fusarium moniliforme	Fumaricin	Corn silage	It is carcinogen. It affects pigs and horses
Aspergillus sp Penicillium sp	Fumitremorginis	Corn and sorghum silage	It affects the nervous system

" THE KEY TO MINIMIZE FUNGI AND THEIR MYCOTOXINS IN ENSILED MATERIAL IS TO ELIMINATE AIR AS SOON AS POSSIBLE"

WET GRAIN SILAGE

What is wet grain silage?

Wet grain silage consists in storing harvested grain with mean moisture levels of approximately 30 % in grain weight. Another method is to cut and/or press the grain in order to accelerate the action of bacteria on cellular juices.

Advantages of storing grain in Silobolsa® PLASTAR

The alternative of ensiling grain with high moisture content in Silobolsa® PLASTAR has the following advantages:

1. Operating simplicity.
2. Relatively low investment.
3. Good conservation conditions.
4. High energy supply.
5. High level of utilization in relation with dry grain.
6. It saves cost of single/return freight to centers of dry grain storing (if you do not utilize Silobolsa® PLASTAR for dry grain).
7. Fewer losses of grains in harvest.
8. Storage in the supplying place.
9. Anticipated release of lot.

Recommendations for high nutritional quality

1. The moisture range is between 25 and 35 % of moisture range.
2. Break/press the grains, thus avoiding its germination, increasing the efficiency at a ruminal level (greater exposure to starches) and interrupting the respiratory process of the seed.
3. Utilize storage structure that do not leave a big front part exposed and that restore the internal environment if possible.
4. Systematically check the moisture of the grain in very dry seasons.
5. Logistics planning to achieve grains with similar moisture content in the entire harvest.
6. Moisture in grains should not be higher than 35%, as it makes the work

of the harvester inefficient. The final result is a decrease of the surface per hour harvested, higher operating cost and less nutrients per unit of weight.
7. Utilize machinery that break and bag simultaneously, reducing the confection time and generating greater total efficiency (technical and physiological one).

Wet grain ensiling process

Minimum changes to the harvester allow to process the grain with an optimum moisture range for ensiling 25-30%, such as:

1. Increased cylinder rotation speed.
2. Cylinder lining.
3. Reduction of concave cylinder separation.
4. Increase of the sieve holes or even their extraction.
5. Increase of the wind speed.

In our sector, the bagging of wet grain is made by specific bagging machines, equipped with all the hoppers and breaking hammers. These machines make a good job with grains.
The diverse bagging machine trademarks have different tunnel perimeters, defining the size of Silobolsa® PLASTAR to be used. The ensiling machine cuts the grain and also bags and compacts the grain with the help of a auger in Silobolsa® PLASTAR. Compaction is regulated according to the degree of drainage of the ensiling machine and tractor:

The greater the brake, the greater the compaction and the utilization of Silobolsa® PLASTAR (more tons/linear meter) up to the maximum stretching permitted for each Silobolsa® PLASTAR.

The ensiling machines are different depending on their manufacturer:

1. Design of the hopper (whether self-loading or not).
2. Breaking rolls (whether parallel or helicoidal).
3. Rolls teeth (whether parallel or helicoidal).

The average performance of the ensiling machines is of approximately 20 tons/hour of effective work on a wet base. Such a value is limited by grain moisture and calibration of the breaking.

Animal consumption

When the process develops in a proper way, it is well-accepted by animals, both in dairy and wintering animals. On the contrary, deficiencies in conservation techniques (lack of anaerobiosis, water filtration) and/or inadequate supply (silage with too much air exposure time) generates firm rejections.

Sorghum grain is less preferred to corn by animals. Rations should be properly handled to avoid their selection, through a mixer or similar equipment. Therefore, habituation and the design of the infrastructure of forage supplying play an important role. This technique, if well implemented, perfectly adapts to the production conditions ruling our country with excellent productive results.

For that reason, the optimization of the process will mean a greater and more efficient utilization of the capital assigned to its production.

Silobolsa® Plastar Zip

Silobolsa® Plastar Zip is the only one with a liquid proof joint, 100% effective.
It is ideal for closing the ends of Silobolsa® PLASTAR with chopped grain or forage, water handling and projects concerning contamination control.

Utilization of Silobolsa® Plastar Zip

Silobolsa® PLASTAR Zip is the most efficient, effective and economical system for closing Silobolsa® PLASTAR. Following these basic instructions, you will discover a simple means of satisfying your sealing needs.

Unwind the appropriate length of Silobolsa® Plastar Zip required to seal the ends of silage Silobolsa® Plastar. Leave additional 5/7 cm. in each end to facilitate its opening and closing.

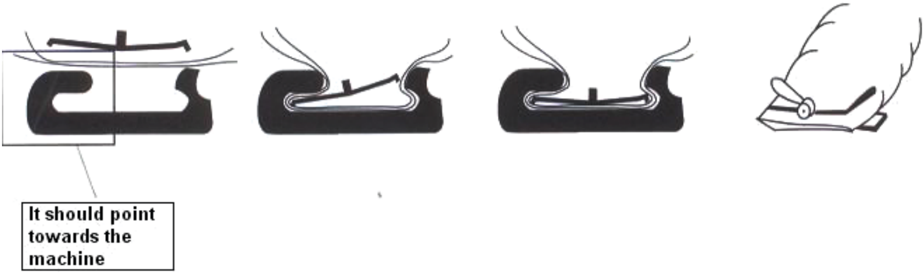
Sealing of the ends of Silobolsa® Plastar.

Select a wood board, longer than the width of Silobolsa® PLASTAR.

Take out the insertion strip from the channel of Silobolsa® Plastar Zip.
Fasten the channel to the board at both ends.

Extend the end of Silobolsa® PLASTAR 15-30 cm. plus Silobolsa ® Plastar Zip.

The wide curb of the channel is the side of fastening and therefore it should be opposite the filled end of Silobolsa® PLASTAR to increase safety against slipping.



Place the insertion strip on the upper part of Silobolsa® PLASTAR.

1. Take an end of the insertion strip.
2. Force it down in the channel with the end of Silobolsa® PLASTAR in between.
3. Take the roll, put it on the external edge of the insertion strip, pushing downward in the central channel.
4. Move the roll to reach the end.
5. Repeat the same procedure to seal the other end.

Utilization and reutilization of Silobolsa® PLASTAR Zip

1. Reusable
2. No chemical products are required for sealing.
3. Heat is not necessary for sealing.
4. Storage deposits of dry grains.
5. Sheds for animals.
6. Holes covering of soil filler.
7. Deposit holes covering of residual substances.
8. Water conduction through irrigation channels.

The Silobolsa ® PLASTAR Zip is:

1. Airtightly closed to air
2. Airtightly closed to water
3. Reusable
4. Multifunction

GRAIN STORAGE IN SILOBOLSA® PLASTAR

STORAGE OF GRAINS IN SILOBOLSA® PLASTAR

The basic principle is to keep dry grains in a controlled atmosphere, with low oxygen (O2) and high concentration of carbon dioxide (CO2). Thus you will succeed in controlling fungi and insects which are the main factor in the increase of grain temperature (tº).

Steps to consider:

• **The start of filling:** the task to fill in the Silobolsa“ Plastar will be different depending on its content.
• **Damage and cleaning:** it is very important that grains were unspoiled, with no mechanical damage and clean so as to keep the best quality during the storage.
• **Moisture:** it must be lower or the same as the base moisture allowed in commercialization. The lower the moisture of the grain is, the better its conservation will be.
• **Control:** The quality of the Silobolsa“ Plastar must be verified daily. Seal any torn piece immediately with sealing ribbon Plastar San Luis, thus restoring the inner atmosphere of the silo.
• **Location of the Silobolsa® Plastar:** Place the bag in a high well-drained slightly sloping place, on a solid and smooth ground far from trees. It should be pointing N-S or S-N in order to avoid excessive heat.
• **Domestic animals:** Keep all sort of domestic animals (dogs, poultry, cattle, birds, etc.) as well as rodents far from the Silobolsa“ Plastar, thus avoiding its damage.
• **To open the Silobolsa® Plastar:** Before opening the Silobolsa“ Plastar, as a precautionary measure so as to avoid the immediate aperture from side to side, it is advisable to make a transversal cut 3 mts. far from the opening at an angle of 45º. If with the time there is a spontaneous leak it is advisable to make a transversal cut, thus avoiding the crack extension in full length.

Ensilage of forage in Silobolsa® PLASTAR:

Ensilage in the Silobolsa“ Plastar is the most effective method to store and preserve the nutrient values of your forage crop. Based on anaerobic fermentation (without oxygen (O2)), ensilage is a whole science, similar to the fermentation of a good wine; it betters the taste of the forage and the process of digestion in the first stomach of the cattle. It is as if the cattle ate green forage all the year round.

Steps to consider: the same as with grains.
You should take into account that forage produces gases during the first hours after being stored. Therefore it is advisable to air Silobolsa“ Plastar once those gases have been produced. The procedure should be the following:

Procedure to fill in the Silobolsa® PLASTAR:

1. Dry grain: Begin with the outer fold upwards.
2. Forage: Begin with the inner fold downwards.
3. Control: Be sure that the greatest quantity of air is expelled.
4. Don’t leave the silage bag loose.
5. Don’t exceed the capacity of stretching.
6. Be careful about the pressure of the filling.
7. Stretching: control the ruler of stretching printed in the Silobolsa“ Plastar.

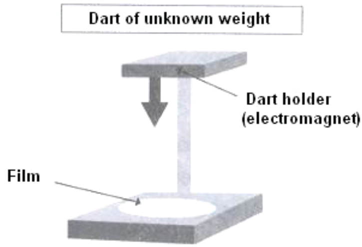
A Silobolsa® Plastar endures two seasons in regions of high temperature. In colder regions it may endure more than three seasons.

Quality of Silobolsa® PLASTAR

In the process of grains conservation, the airtightness of Silobolsa® PLASTAR plays such an important role that it is necessary to begin the process from the polyethylene own properties.
Some basic properties of polyethylene are described below:

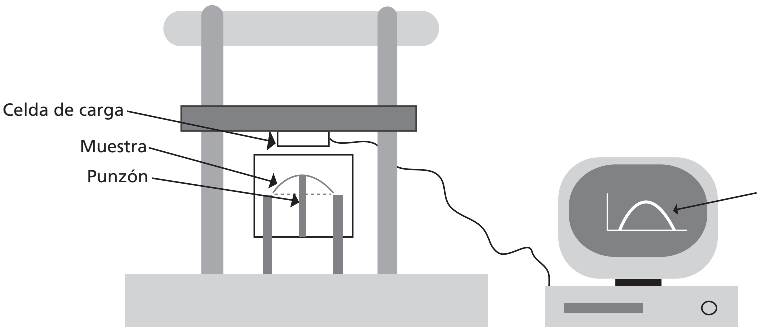
Dart Impact (ASTM D 1709)

It is a method for determining the weight required (in grams) to break the film under conditions of a free falling dart from a standardized height. The result is the weight of the dart when 50 % of the tested film specimens fail.



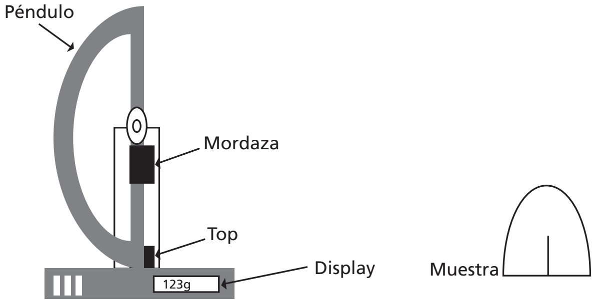
Puncture Resistance (ASTM D 5748)

This method measures the total energy required to puncture a film softly. Taken to everyday life, it represents the property of a film to resist the puncture of irregular-shaped objects such as branches falling on Silobolsa® PLASTAR, birds or mammals' claws, etc. The specimen is fixed with two rings supported by the base of universal testing device. The puncher is fixed to a load cell, which is elevated. The puncher perforates the film at 500 mm/min until the film is broken. The curve force vs. deformation is recorded. The area under the curve is the energy of punching. The result can be expressed in energy per unit of volume (area of specimen x thickness).



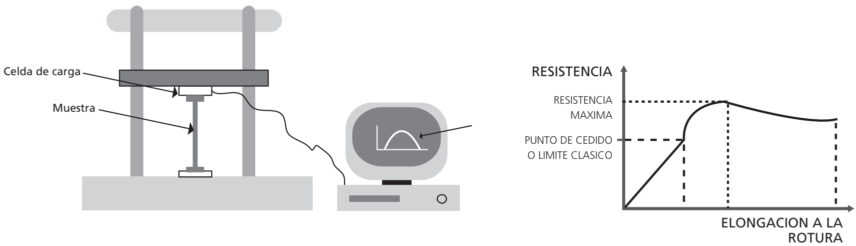
Test Method for Propagation of Tear Resistance (Elmendorf tearing) (ASTM D 1922)

This method determines the average force in grams, necessary to propagate tearing after it has started. As films generally have different tearing values according to the test direction, it is necessary to evaluate the tearing in a longitudinal and transversal direction.



Test Method for Tensile Properties (ASTM D 882)

The samples consist in 1 inch-wide strips that are fixed to two separate holders at a defined distance. Tension is applied at constant speed (500 mm/min). A Tension or Resistance vs. Strain curve is recorded. The final test finishes when the specimen breaks.



Silobolsa® PLASTAR is composed of polyethylene, a material with the necessary conditions for making good ensilage.
Silobolsa® PLASTAR is made of a material manufactured through co-extrusion system of simultaneous multilayers (3 layers, each one with different and specific properties). These layers are melted, thus producing a single uniform film, inseparable and with great resistance.
The polyethylene used is 100 % virgin resin, provided by Dow-Polisur for all the products manufactured by Plastar.

Additives such as titanium dioxide and stabilizers UV are added to the white (external) layer and high concentration of carbon black is added to the black (internal) layer.

The external white layer reflexes great part of the incident solar radiation. This allows to diminish the internal temperature.

Among the desirable properties in a Silobolsa® PLASTAR of excellent quality we can mention the most important ones:

1. Mechanical resistance: e.g. Perforation resistance.
2. Thermal resistance
3. Good stretching
4. Internal temperature stability.
5. Impermeability
6. Reflection of solar rays.
7. Filtration of ultraviolet rays
8. Durability
9. Flexibility
10. Softness
11. Internal opacity

COMMERCIAL CONDITIONS FOR THE ARGENTINE REPUBLIC (SOYBEAN)

Item	Basis	Tolerance	Reductions	Remarks
Foreign material	1 %	3 %	For values higher to the basis (1 %) up to tolerance (3 %) at a rate of 1% per % or proportional fraction.	They are those grains or pieces of grains, other than soybean or any other inert matter, including the loose soybean shell.
Including earth	0.50 %	0.50 %		
Black grains		10 %		They are those soybean grains with a shell of normal internal color and texture.
Cut or broken grains		30 %	For values higher than 20 % and to 25 % at a rate of 0.25 % per % or proportional fraction. For values higher than 25 % to 30 % at a rate of 0.5 % per % or proportional fraction.	They are those pieces of soybean grains, whatever size.
Damaged grains, including grains		5 % 2.50 %	For values higher than 2.5 % at a rate of 1 % per % or proportional fraction. For values higher than 2.5 % at a rate of 1 % per % or proportional fraction.	They are those soybean grains or pieces of grains with a substantial alteration in their normal color, internal and external shape and/or texture.
Moisture		13.5	When the goods exceed the tolerance for moisture levels (13,5%) the corresponding decrease will be discounted in accordance with the Junta Nacional de Granos (National Grain Committee) and the drying process fees.	This is the water content, in %, obtained from a sample through the methods used by the JNG or the ones with equivalent results.
Chamico Seeds (Datura Ferox)		2 per 100 grams	For goods exceeding tolerance levels (2 seeds per 100 grams)	

Resolution "JNG" (NGC) Nº 23882 (4-3-83)
Free of live insectsArbitration: For items having these conditions: "dirty grain", "commercially objectionable odors" and "moldy grains", an arbitration is established of 0.5 % to 2 % according to intensity.

The hard type will admit a maximum of 5 % of semi hard varieties												
		Maximum tolerance per grade										
			Damaged grains									
Grade	Minimum hectolíter weight Kg	Foreign material %	Burnt and heat damaged grains %	Total damaged %	Ball smut infected grains %	Grains with excess of starch %	Splits (1) %	Insect damaged grains	Sweet clover (Melilotus indicus L) Seeds per 100 grams	Moisture %	Live insects	Arbitration discounts on prices (depending on intensity)
1	78	0.75	0.5	1	0.1	15	1.5					
2	76	1.5	1	2	0.2	25	3	0.5	8	14	Free	Commercially objectionable
3	73	3	1.5	3	0.3	40	5					
Proportional discount to be applied per each lacking in pH or on the proportional surplus	2	1	1.5	1	5	0.5	2	2% decrease and expenses of sieving process	Decrease and expenses of drying process	fumigation expenses		odors from 0.5. to 2% Dirty grain from 0.5 to 2%. Ball smut infected grains from 1 to 6%.

(1) They are all the grains or pieces of Wheat Bread grains that pass through a sieve of grooved 1.6 mm x 9.5 mm-long holes, excluding damaged wheat Bread grains or pieces of grains.
Note: Furasium is included in “Total damaged”. For instance, if there is only Fusarium as damaged grains, the maximum tolerance is 3 %.
The prices on the board refer to “grade 2” and correspond to a discount of 1 % if said goods are “grade 1”. A discount of 1.5% will apply if goods are “grade 3”.
Discount per proteins: up to 11% is considered to be neutral, that is, there is no discount or reduction.
The discount will be above 11 % in a proportion of 2 % per 100 or proportional fraction.
The discount will be under 11 % in a proportion of 2 % per 100 or proportional fraction.

COMMERCIAL CONDITIONS FOR THE ARGENTINE REPUBLIC (CORN)

Type: Hard – Dent – Semident Color: Red – Yellow - White		Tolerance for each grain							
Grade	Hectoliter weight	Damaged grains %	Broken grains % (1)	Foreign material %	Type % (2)	Color %	Grains %	Moisture %	
1	75	3	2	1					Out of standard: Goods exceeding the established tolerance levels, presenting commercially objectionable odors or moldy grains, goods treated with products that alter their natural condition or that for any other cause were of inferior quality, will be considered out of standard.
2	72	5	3	1.5	3	3	3	14.5	
3	69	8	5	2					
Discount for surplus		1	0.25	1	0.25	0.25	1	Agreed fee and decrease of drying and handling	Discount on price. Objectionable odors (depending on intensity) from 0.5 to 2 %. Moldy grains (depending on intensity) from 0.5 to 2 %. Chamico: 1.3 % of reduced weight and expenses of sieving process.

Resolution "JNG" Nº 22678 (22.12.81 d/m/y)
Effective as from 1-1-82
Free of live insects.
Tolerance of chamico seeds (Datura Ferox): 2 per 100 grams
(1) They are pieces of corn grain that pass through a sieve with circular holes of 4.76 mm of diameter (0.013mm), excluding pieces of damaged corn grains.
(2) Hard and dent corn will admit a tolerance of 3 % of a type in the other type.

COMMERCIAL CONDITIONS FOR THE ARGENTINE REPUBLIC (SUNFLOWER)

Classification Rules for Sunflower

Item	Basis	Tolerance de recibo	Reductions	Discounts	Remarks
Fat Content S.S.S. and L. **(1)**	42 %	_	For values higher than 42 % in a proportion of 2 % per % or proportional fraction	For values lower than 43 % in a proportion of 2 % per proportional fraction	_
Acidity of fat content	1.5 **(2)**	It does not correspond	For values higher than 1.5 % in a proportion of 2 % or proportional fraction		_
	2 % **(3)**	It does not correspond	For values higher than 2 % in a proportion of 2.5 % per % or proportional fraction		
Foreign Material		3 %	It does not correspond	Tolerance up to 3 % in a proportion of 1 % per % or proportional fraction	For values higher than 3 % , a discount of 1.5% will be made per % or proportional fraction
Moisture	11 %	14 %	It does not correspond	**(4)**	
Chamico	Free	0.25 %	A discount will be made in a proportion of 0.1 % per seed in 100 grams **(5)**	_	This scale will apply for goods exceeding tolerance levels

Resolution "JNG" N° 23.525 (20-10-82)
Effective as from 1-11-82 (day-month-year)
(1) Over substance dry and clean.
(2) Since the beginning of harvest until August 31st
(3) Since September 1st.
(4) When goods exceed the moisture basis (11%) the corresponding decrease will be discounted according to the tables established by this Junta Nacional de Granos and the arranged fee for drying process.
(5) Prior to manual homogenization of the faulty sample, separate, through a homogenization machine and divisor of representative fraction, samples of 50g each. The Chamico seeds and foreign material will be determined, by manual separation of said failures.