2016

RISK ASSESSMENT BULLETIN

"Engineering risk and damage assessment for claims department and underwriters"

CROP/GRAIN PROCESSING AND STORAGE FACILITIES

No: 2016/04

Ekol Loss Adjusting Co.
April 2017 Risk and Engineering Group Bulletin

Possible Risks in Insuring Crop Processing and Storing Businesses and the Assessment of the Risks

1. What is Crop/Grain?

The Crop/Grain are generally products harvested from graminae and is the name given to their seeds.

They are plants that are consumed as food and commonly found everywhere in the world. They are used in flour form to make bread and its products in everyday life. They are products used commonly. It is known that this family includes approximately 400 genus and 4500 types.

It is known that more than 614-million-hectar crops are processed. When their dispersion based on countries and regions is considered, it is seen that crop is common in Europe, North America and Near East while rice is common in South East.

Crops are seeds of plants such as wheat, barley, rice, corn, rye and oatmeal. The external part of the seed is used as bran. Its inner part is amylum. In the germinated part, proteins, oils and minerals are more.

The most important source of energy is grain seeds not only for people but also for all living creatures. Grains are consumed as seeds or as in their processed form like flour, amylum, oil, bran, sugar or as animal feed.

Grain Types	
Cool Climate Grains	**Hot Climate Grains**
Wheat	Maize
Barley	Wicker
Oatmeal	Corn
Rye	Rice

2. Grain Production in the World and in Turkey

The table below summarizes the world's grain production. Turkey is in the high levels in terms of the amount of production. (The data are based on monthly summary reports (06/25/2015 No:456) of International Grain Council(IGC).)

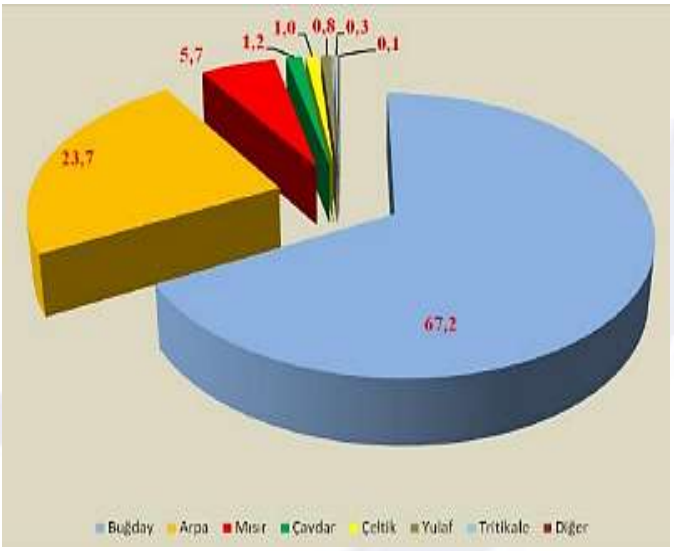
WORLD GRAIN PRODUCTION 82015/16 ESTIMATION, MILLION TONS

COUNTRY	WHEAT	BARLEY	MAIZE
EU-28	148,8	57,7	67,6
CHINA	127,0	1,9	220,0
INDIA	89,0	1,6	23,5
RUSSIA	55,0	16,0	12,0
USA	58,2	4,3	332,0
CANADA	30,0	8,0	12,4
AUSTRALIA	25,5	8,3	0,5
PAKISTAN	25,0	0,3	3,2
UKRAINE	22,0	6,3	25,0
TURKEY	18,0	6,5	5,8
KAZAKHSTAN	13,5	2,1	0,5
IRAN	13,8	3,2	2,5
ARGENTINA	12,5	3,6	28,0
THE WORLD	**711,3**	**136,2**	**962,7**

SOURCE: IGC JUNE 2015

Turkey is an advantageous country in terms of agricultural production due to its climate and ecological features for the growth of many products. The 24.6% of the total employment is in the agriculture sector.

The most remarkable increase in grain growth in Turkey was in 1951-60. This increase is a result of plow of pastures through tractor use in agriculture within the framework of Marshall Plan. The rise in 1950 in the grain production is due to the enlargement in plantation areas and the one in 1970 is due to the increase with productivity.



Turkey is one of the biggest flour exporters in the world. That is why, in addition to domestic production, the most important grain demand in Turkey is from flour factories. Also, forage industry and white meat sector that is a part of exportation demand grain too.

The 30% of Turkey's measure area (23.8 million hectares) is suitable for agriculture. The 65% of the agricultural areas (except for the fallowing areas) is allocated for field plants. In the 75% of these areas (11,5 million hectares) grains are planted. The 67.2%, 33.7%and 5.7% of the grain plantation area consists of wheat, barley and maize subsequently. These products are followed by rye, paddy and triticale.

3. The Relationship between Grain Processing and Storing and Insurance Sector:

As it is known, the number of grain processing and storing businesses in Turkey are in direct proportion to the policy production rate in the Insurance Sector.

Therefore, arranging the right policy by analyzing the existing dangers is a requirement for the assessment of sectoral dangers to minimize damage frequencies and protection of assets.

It is an ordinary situation that the investor needs an insurance policy covering all risks that s/he can be exposed to in the long run in the financing of all projects, especially the big ones with a high number of investments.

Generally, in crop processing and storing businesses, before machine-installation assembly delivery, (machine-equipments are generally imported from foreign countries. However, recently, with the development of Turkish machine manufacturers, the use of local machine and equipments has been increasing) the policy is made to differentiate business risks regarding assembly, process, storing and to guarantee the business with an appropriate policy by detecting the appropriate risks.

4. General Risks and Damage Types in Grain Processing and Storing Facilities:

The risk in grain processing and storing facilities starts with the installation period of the facility. Many different factors such as project field choice, machine-installation manufacturers, quality criteria and labor quality directly affect the risk factor. Following the installation of facilities, the risk factors naturally continue during the business. In this periods, maintenance conditions, qualified employees, process monitoring (automation check), fire measures are effective. Therefore, structural (construction/assembly) risks, storing risks and process risks are examined separately.

4.1. Structural Risks

Generally, in grain processing facilities, there are steel and/or reinforced concrete product storages and other additional buildings. The construction techniques of the structures in question are different from each other.

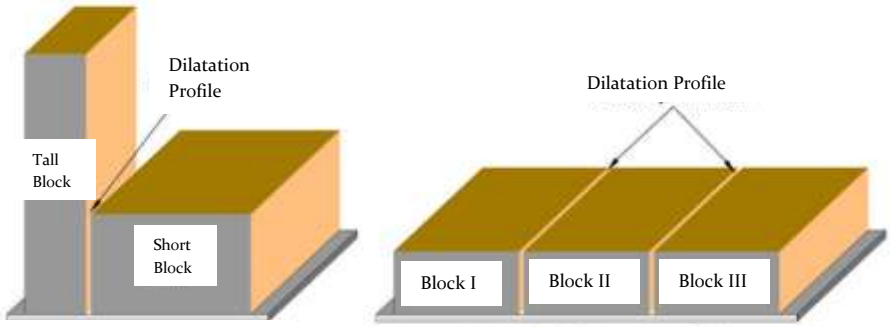
4.1.1. Grain Processing Buildings

During grain processing, especially in the factories with high capacity machines, there is a serious amount of vibration. It creates a risk factor for the structures if different machine facilities are deployed in different areas and if this case causes a different frequency during production. Therefore, the construction should be based on proper structure features by determining installation areas during the building design step. In these type of facilities, it is not proper to construct adjacent buildings with a different height and/or adjacent L-shaped buildings together.

Dilatation gaps should be left between buildings being based on construction techniques and building base should be designed in a way that it is tall.

Dilatation: To avoid the expansion, contraction and vibration movements in reinforced concrete or steel structures with a large settlement area or damages in structure elements because of the settlement on the ground, the carrier construction of the structure is designed as independent blocks. The gaps between these blocks are called as dilatation or expansion joint.

In tall structures, there should definitely be dilatation joint between high and low blocks. The places and widths of the joints should be determined by the companies designing the static project by considering the lateral and vertical movements.



Dilatation profile separates two builidngs with different heights

Tall structures are divided into blocks with dilatation profile

4.1.2. Vertical Steel Silos

a) Before Assembly;

Base

The structural strength and balance of a base depend on the weather conditions of the areas where the silo swill be constructed, flexible and/or plastic deformed, shearing deformations and installation. There might be many different problems due to wrong analysis of the ground features that are suitable to the geographical conditions, wrong planning of concrete base strengths in the steps of silo installation.

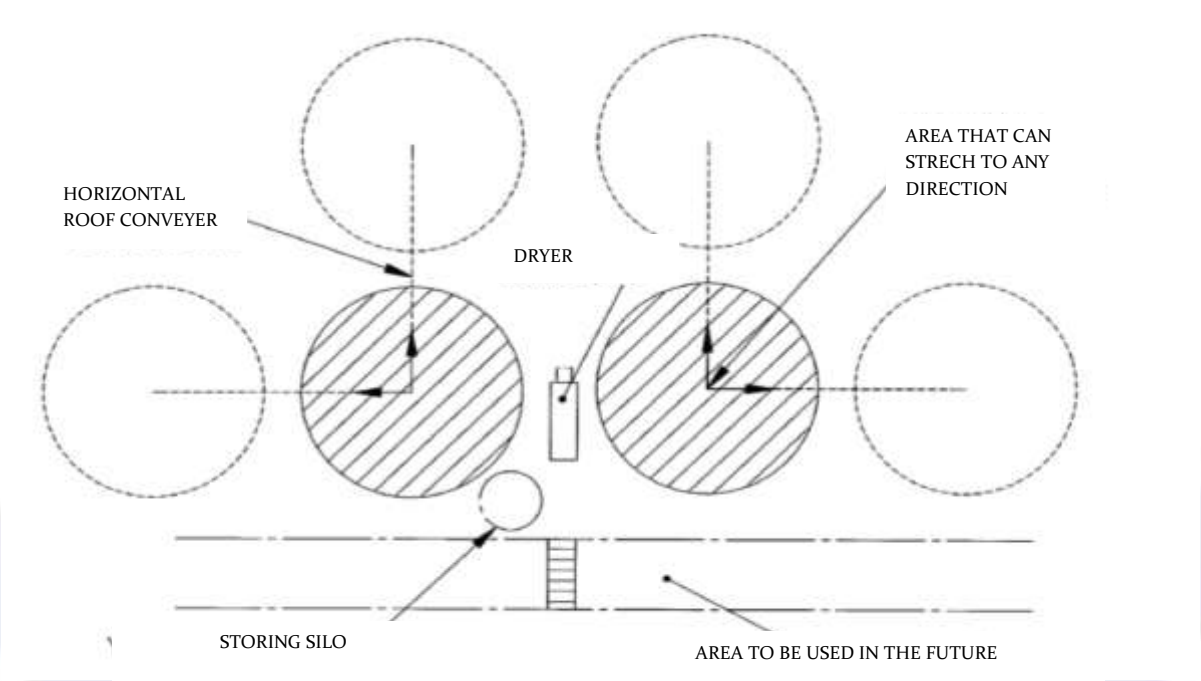
Manufacturers do not take the responsibility of the damages due to weak soil conditions, insufficient concrete quality and deficient application. Soil strength tests should be done by authorized and independent companies. Concrete base application should be done by a contractor company.

Before the assembly, the strength capacity of the area should definitely be determined. The examination done by people with a general soil knowledge for small silos but in order to decide on the soil suitability of big silos, the company should employ an authorized engineer.

Soil filling used in concrete base can be made with a mixture of clean pebbles or sand/stone chips. The filling material should be purified from weed, well-condensed and layered with a 15 cm height.

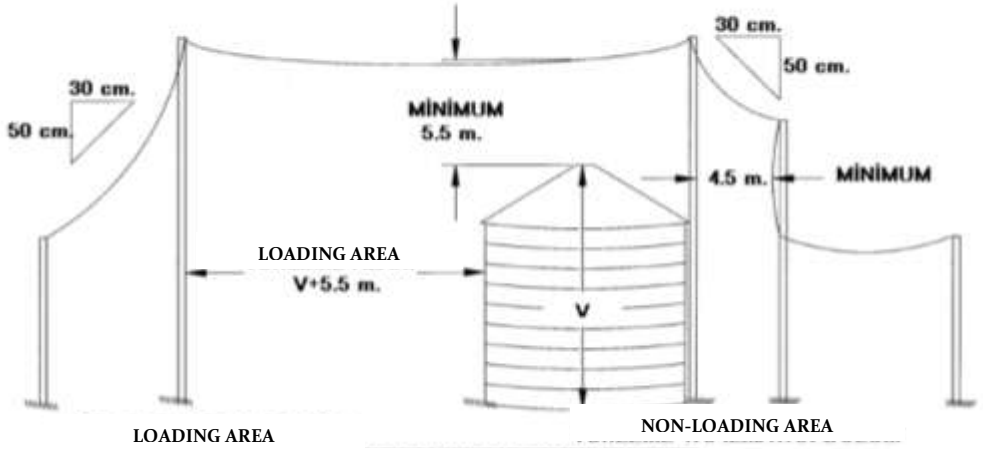
Choosing the Area

While choosing the areas for grain storing/carrying facility, many factors should be taken into consideration. The area should have the suitable access for filling and discharging and it should be considered that new equipment might be used in the future by increasing the capacity of the facility. Carrying equipment, fans, heaters, escalators and walkways, etc. should be pre-determined. Also, before starting foundation excavation, if there is any gas/water pipe, electric cable and the distance to electric poles should be considered carefully.



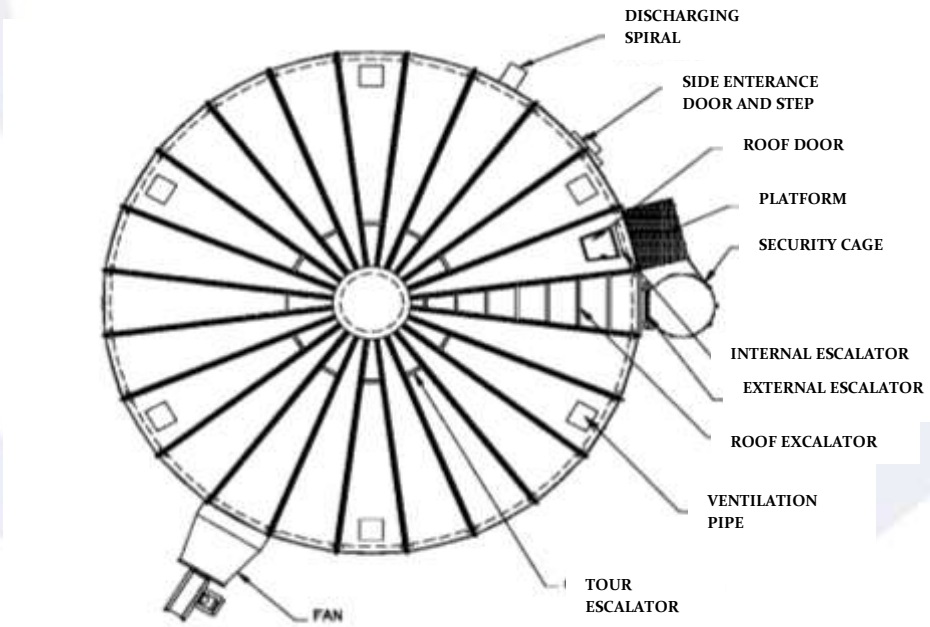
While choosing an area for grain storing and carrying facility or project enlargement, there should be a secure distance to electricity and gas sources and electricity power sources. In American Standards Institute ANSI C7 1997, there is security advice for grain silos. The diagram below indicates the suggested distances between electric cables and grain storing silos and carrying equipment surrounding them.

THE DISTANCES AROUND SILOS FILLED WITH PORTABLE SPIRALS, CONCEYERS AND ELEVATORS



V= THE HIGHEST LOADING POINT OF THE

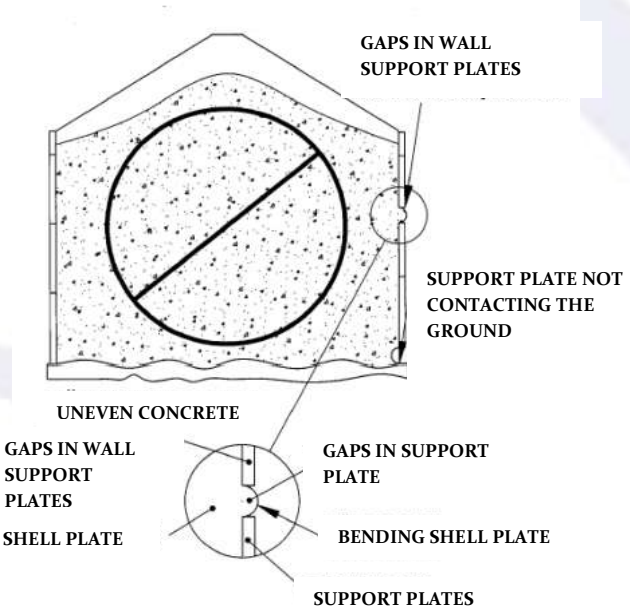
In order to maximize the efficiency in grain silo, all equipment should be deployed properly. The main part of this should be done in the concrete step. The places of side entrance door, body and roof escalators, fans/heaters, discharging spiral, cornice platform, walkway and ventilation pipes should be determined carefully. In the figure below, there is a suggested example. Fan should be placed right across the spiral.



Note: In conical based silos, there might no be side enterance door, fan and discharging spiral

Errors Made during Silo Assembly

- Gaps in wall support plate– There should be gaps in wall support plates.
- Bending in shell plate – Shell plate shouldn't bend.
- Wall support plates out of ground contact – All wall support plates should contact the ground.
- Uneven base (concrete) – The level of concrete base should be even everywhere.
- Metal corrosion before assembly – Plates should be stored in a way to avoid rust before (by not decreasing strength) assembly.

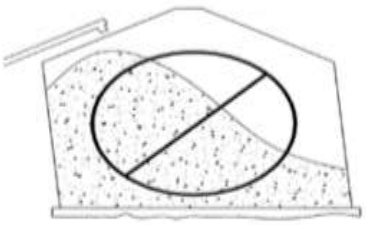


b) Errors Made during Operation:

The main damages due to operational errors in silos:

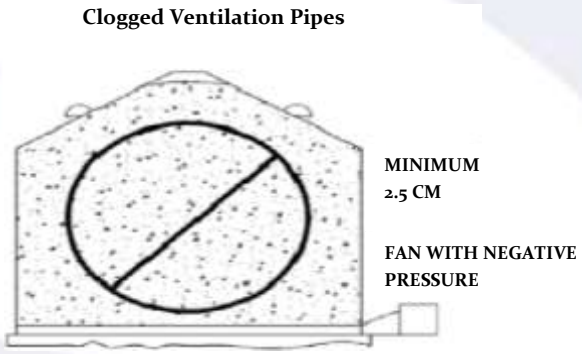
1. Offset filling and discharge from the center
2. Non-proper silo maintenance
3. Malfixation of roof leaking
4. Rusted shell plates
5. Improper use and assembly of side discharge
6. Malfixation of damaged pieces
7. Design changes during assembly

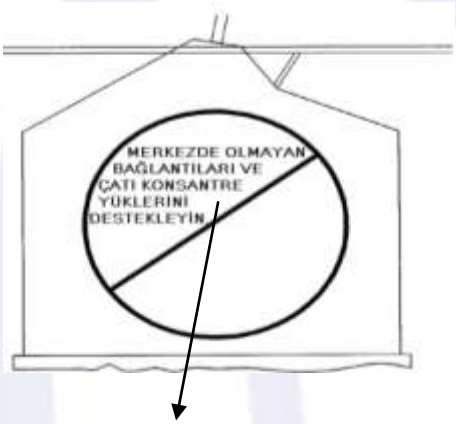
OUT-OF-CENTER FILLING

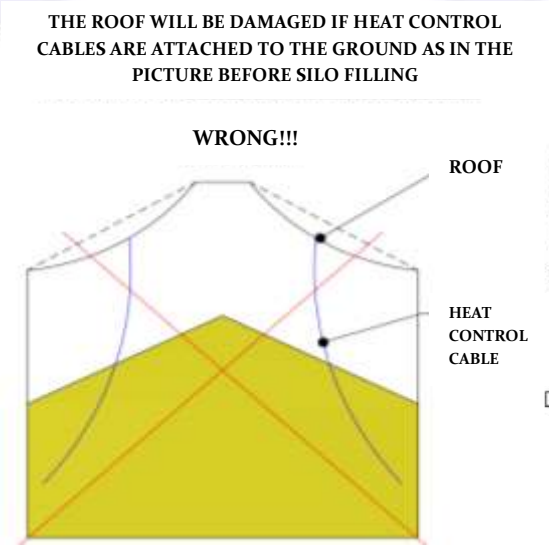


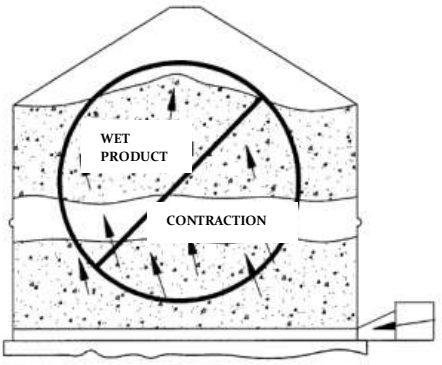
Out-of-center filling may cause turnover or bending and stiffener bendings. Also it may cause turnover momentum in shell plates.

8. Spirals added to roof lid/ Flow pipes
9. Discharging and filling at the same time
10. Wrong assembly of shell plates and support plates
11. Clogged ventilation pipes
12. Installation of heat control cable
13. Fast grain move (discharging)
14. Dumping wet grain on dry grain
15. Not considering the filling height









4.2. Process Risks

4.2.1. Grain Processing Process

SUPPORT THE OUT-OF-CENTER CONNECTIONS AND ROOF CONCENTRATION LOADS

In grain processing factories, products such as flour, semolina, bran and razmol (flour with big) are made as a result of grain processed under different processes. In such facilities, generally, e as subsidiary product and pasta as valuable product are made as well. In order to understand ss risks better, process steps are briefly mentioned.

Grinding is the process done to separate endosperm and bran and making flour out of endosperm. In other words, it is a process to make flour or semolina out of wheat. Flour is the product made by cleaning wheat form impurities and grinding it between fast gear cylinders called as vals and screening in griddles. Flour is an accumulation of 212-micron particles.

The process starting with wheat in mill until the end product can be examined under 5 steps:

- Intake and storing
- Purifying wheat
- Adding water to wheat
- Grinding wheat
- Screening

A. Intake and Storing

Acceptance of Raw Material to Processing: Except for some special cases, wheat is carried by trucks, trains or boats in piles, bulks. Wheat intake consists of analysis, discharging, storing, carrying to silos an determining the amount of the product to be processed.

Product Analysis before Processing: The physical and chemical features of the wheat in mills are analyzed.

This analysis is necessary for:

- Deciding whether the wheat will be processed or not
- Determining the price
- Categorizing the wheat and putting them in different silos

Tonnage Weighing: The amount of wheat is found as truck tonnage – truck tare.

Discharging: Wheat discharging is generally done to areas called as conical based discharging pool. In the discharging pool rocks, branch pieces, big stems and dung in wheat are separated. It is the point where the first and rough cleaning is done. It is important that machines are not damaged because of these. The cleaning done in this step is called as pre-cleaning. Through pre-cleaning, rocks, stems, metal, plastic pieces and dust in wheat are separated. In this way, possible congestions in the carrying system and damages to the machines due to hard pieces are avoided. The most ideal case is to separate foreign substances form wheat before storing the wheat. In this way, damages due to foreign substances during storing are avoided. There might be rubbish lifts, magnets, air canals between the machines used in pre-cleaning.

The second step of the process is storing. However, as they are seen as risky by the grain processing and storing businesses, it will be explained in detail in **Storing (Chapter 4.3)** part.

B. Cleaning Wheat

Wheat generally contains foreign substances that are different from its characteristic features. The main criteria during the cleaning process to separate foreign substances are listed below.

a) Magnetic features

Here magnets are used. Separating metal pieces are for different priorities in various steps of the process. That is, the priority of the magnets in the first step is to avoid damage to the machines while the last magnets' priority is to present uncontaminated flour to the costumer. Magnet choice (Gauss value) and the points they are installed in the process are very important. Also, there should be periodical Gauss measurements.

b) Size

It is the most used separation criterion in mills. For this, separators (diameter lifts) are used. Sieves can be made of metal plates with holes or wire nettings. Generally circular sieves are used for the separation process. Also, diagonal separators can be used. There are two important criteria to separate wheat from foreign substances effectively. These are the size of wheat and the amount sent to separators. For the first cleaning steps, sieves with bigger holes are used while towards the cylinders sieves with smaller holes are used to ensure a deeper cleaning.

c) Shape

Separation in mills can be done by two different machines functioning with the same principles. These are Vertical Separators and Trieurs.

d) Density

The density difference principle is used for non-separable wheat and substances with the same size as wheat in machines functioning based on size differences. These machines functioning based on these principles are dry rock separators and cleaning machines for hard pieces (rock, glass, etc.), air canals for light pieces (empty wheat kernels, fragmented wheat that cannot be separated during these processes, wheat husk, etc.). Empty wheat kernels separated through air canals are generally used as forage.

e) Other Cleaning Machines/ Peeler

The aim of peelers is to separate the external layer of wheat. In this way, microbial and chemical activity especially in the external part of wheat do not mix in semolina during the grinding process. Peelers should be used after water adding process. Otherwise, knives turning in high speed may crush dry wheat with sound kernels and may remove them from the line for the next processes. Another well known method is color differences method. It is a more recent separation system compared to the others.

C. Annealing

Wheat should have a specific amount of humidity in addition to cleaning before being ground in mills. Annealing process consists of steps like watering wheat for humidity, watering wheat in a way that water equally covers all wheat kernels and keeping wheat in water until water reaches wheat kernels' middle part.

D. Grinding

It is the gradual separation of endosperm from wheat bran. It is ensured through a quite complex system with cylinders, sieves, lifts and other machines. The aim of wheat grinding is to separate the kernel's endosperm part from the shell and germ and to turn the separated endosperm into flour or semolina. Grinding consists of:

- The process of crushing during which kernels' shell roughly separates from endosperm
- The processes of reduction during which the endosperm is reduced to flour.

E. Sieving

Sieving is the process of separating different sized particles from each other in the milled material. In mills, sieving is done to classify the material obtained after each grinding operation for the next grinding or purification stage or to separate the flour in the material.

The hazards that occur during the product manufacturing process and the precautions to be taken are summarized as follows:

Purchase of Raw Material: The characteristics of raw material directly affect the risks existing during the process and storage processes. In particular, the amount of moisture contained in the product is the main factor in the realization of the danger of so-called evaporation during storage, and the microorganisms carried on the product may also cause the complete loss of the merchandise. For this reason, laboratory measurements made during product purchase should be done with care and standards should be adhered to during sample collection.

Removal of Foreign Substances: Cleaning is carried out to prevent foreign substances (stone, metal, etc.) from being included in the process. It is inevitable that foreign matter that cannot be extracted during the cleaning stage damages the machine installations. Another risk factor is that foreign substances are involved in the product. For this reason, proper maintenance of the machine elements used for maintenance and cleaning and cleaning must be ensured.

Vibration: Grinding, sieving, etc. Vibrating machines are used in process stages. Vibration, which occurs when the dimensions of the machines are considered according to the production capacities, causes the machine elements to tend to loosen constantly. Although the design phase takes account of the fact, the factory maintenance and repair team must be in constant control. Otherwise, it is obvious that the frequency of damage will be higher. Also, it should not be forgotten that the vibrations occurring create danger for the building. For this reason, while designing buildings dilatation applications, etc. should be taken into account.

Corrosive Effect: Water is used during annealing. Moisture, temperature and amount of wheat are measured in the first parts of annealing machines. In the second part, the water required to arrive at the desired final moisture is given to the wheat and distributed to the wheat at all points. Only the necessary amount of water is added to the wheat. Thus, the enzymatic and microbial activity in the wheat will be increased more rapidly than normal, and the corrosion effect will be prevented which will cause excessive water to the machine parts. Possible discontinuity at this stage may cause corrosive effect and machine damage. For this reason, automation controls must be continuously monitored.

Dust: Grain dust, which accumulates intensively in production buildings, creates a risk factor. Spreading dust particles accumulate over time. Especially the grain dust that accumulates in the electrical and control panels causes damage to the electrical installations. For this reason, the electrical installation panels inside the facility should be sealed with suitable gaskets and kept closed continuously. In addition, mechanical ventilation systems should be installed if appropriate ventilation conditions cannot be provided by natural means in order to prevent dust accumulation. Based on the experience, it is known that most of the grain production factories use electric heaters to meet the need for heating in the winter months. After the amount of dust reaches a certain density in the medium, dust explosion with hot surface contact can be realized. For this reason, the use of such heaters in dusty environments and the potential ignition sources of electric motors, lighting and so on. installations should be installed by selecting the exproof feature.

4.3. Storing

As it is known, the necessity of using the products obtained during the harvest season throughout the year and the production and consumption amounts changing over the years make the necessity of storing the grain.

Pre-cleaned and weighed grain are sent to silos. The silos can be reinforced concrete or steel. Today's modern grain warehouses are mostly vertical buildings with circular sections and conical bases. These warehouses are arranged side by side. The amount and capacity of the mill vary according to the crushing capacity. In the layout of the warehouses, beside the installation of each unit, filling and unloading systems, drying, dust control systems and other equipment are carefully planned. These plans should be made so that they can transfer, dry, ventilate from one silo to another. Thus, it is possible to adjust the humidity and temperature during storage, to protect the quality and to prevent possible damages.

It is not desirable that the grain to be stored is too dry, which will cause damage to the grain during transportation. In this case the product can be passed on to humidifiers. But it is much more dangerous if the humidity is too high. For this reason, it is necessary to dry high moisture grains. Modern storage systems are used for this purpose. After the wheat moisture coming from one of the silos is lowered to 14-14.5%, any desired silo is sent. Dust control is performed with negative air in storage systems. The negative air creates a vacuum effect in all the silos and carrying elements, reducing the ambient dust to a minimum and eliminating the dust explosion risk. Dust explosion is a matter that should be given much importance in milling.

Optimum conditions can be achieved during the storage of the grains by applying the correct storage methods. Grain storage silos are generally divided into two types: over ground silos and subsoil silos. However, since the grain storage enterprises usually store on the ground silos, soil silos have been the subject of examination. The top silos are divided into two main groups; horizontal and cylindrical (vertical, tower type) silos. These groups can be subdivided into permanent and temporary silos.

a) Horizontal Silos

Horizontal silos are usually reinforced concrete. Warehouse walls and floors should be non-porous and smooth to avoid insect formation. Intake from warehouses is carried out by machines such as conveyor screw, belt conveyor, buffing machines.

An important factor in storage is the application of first-in first-out principle in silos. The application of this system in vertical silo is easy with different output systems. But it is much more difficult for the first entry to get out first from sloped silos and storage. During the discharge, the wheat scattered on the sides of the silos can wait until the reservoir is completely emptied. This triggers the factors that accelerate the degradation (heat, humidity, enzymatic effects). In addition, there are problems in the horizontal silos, such as high operating costs and disadvantage of volumetric space in the covered area. However, horizontal silos are much less risky than vertical silos in terms of hazards such as overheating and dust explosion. Sloped silos usually have large doors. For this reason, ventilation is provided naturally and dust accumulation is limited.

Another risk factor that is important for horizontal silos is that the stored grain is easy to come into contact with water due to the rain and snow waters that leak from the openings in the building and floods. The stored grain is stored directly as a stack on the ground. The contact of grains with water usually results in a loss (in some applications, grain products and products that come into contact with water can be put into recycling processes). For this reason, when building sloping concrete silos, building design should be done so that it can be constructed higher than the ground level, and protection should be provided by suitable water collecting piles around the building.

b) Vertical Silos

Vertical silos can be constructed in steel or reinforced concrete. However, steel silos are the most suitable options for storage needs, as long as they can retain the grain for a long time. For this reason, steel silos are the most preferred method of grain storage.

Steel grain silos can be designed and produced for all kinds of grain (wheat, corn, rice, soy, barley, canola, sunflower, etc.)

Important points to consider when choosing the silo model are as follows:

- The type of product to be stored,

- The place where steel silos will be installed,

- The purpose of use of the plant (plant type, fill and discharge type).

Steel silo models are two types, flat-bottomed and taper-bottomed, depending on the intended use. Factors important for both types of steel silos are metal sheet, bolt and sheet metal coating qualities used in silo manufacturing. Silos are generally manufactured from galvanized sheets to remove corrosive effects that directly affect their durability. Coating thicknesses vary according to manufacturers. Likewise, the selection of the connecting bolts, which vary from manufacturer to manufacturer, directly affects the quality, durability and reliability of the silo.

Flat-bottomed Silos: Flat-bottomed silos provide low cost storage with minimal installation costs, ease of installation and high efficiency. Bottom scrapers are used to collect the remaining grains around the discharge mouth during discharge.

Tapered Silos: The cost of tapered silos is more expensive than that of flat-bottomed silos of the same capacity. However, this cost meets the cost difference over the operating period when operation and labor costs are taken into account. There is no bottom scraper or sweeping job as there is no product (due to inclination) during discharge. They generally prefer low-capacity and many types of product processing businesses.

Moisture and temperature control in the silos must be carried out on a continuous basis or periodically. Due to the vital importance of temperature and humidity controls for silos, temperature and humidity measurement systems are installed and continuous controls are provided. These systems are connected with PLC controls and automatic protection is provided. It is not expected to be left to fate in case of increase of humidity and temperature. It is very important to have drying and ventilation systems in the silo to reduce the temperature and humidity to acceptable levels. These systems can be in special silos or during transfer.

Danger may occur due to temperature and humidity controls of the silos, such as improper construction of the silo, lack of ventilation ducts, and so on. These hazards are the highest risk factors that can occur during silo storage. For this reason, it will be explained in detail.

4.3.1. Effective Conditions in Storing

1. The amount of humidity

2. Temperature

3. Oxygen

4. The amount of foreign substance

5. Other causes

4.3.1.1. The amount of humidity

It is the most important factor in storing. If only the storage dampness can be kept under control, the grain can last for several years even if other conditions are not suitable. This is the case because humidity is the most important factor for the control of microorganism and enzyme if the continuation of the vitality of the grain is necessary.

Tannin breathing rate is an important factor in tank life and these values are directly related to moisture. For example; In cereals stored at 14 ° C under 14% humidity, the respiration rate is very slow. But when the humidity is slightly above this limit, the respiration accelerates suddenly. The humidity limit required to store the cereal without deterioration is around 13.5-14%. This is called the critical humidity value. If the storage period is longer than 5 years then the critical humidity limit is reduced by 2% from the upper value. (11.5-12%).

Storage should not be used in the sense that a product is kept in a place for a certain period of time. Storage; refers to maintaining the product for a certain period of time by minimizing changes in the characteristics and quality of a product.

The aim of storing is:

- to control the storage conditions in order to reduce the quality of the initial qualification as much as possible and to reduce the most negatively affected changes in quality.

- to be able to maintain the biological activity of tannin's nutritional value, commercial and technological value for the longest time with hygienic conditions with minimum dry matter loss.

If these storage conditions are well controlled, the shelf life can be extended for several years if the grain quality is maintained for a few years without any change.

The critical humidity limit depends on the type of grain, where it is, on its growth condition, or on other storage conditions. However, in general, reducing the humidity by 1% increases the warehouse life by 1.5 times.

Critical humidity limit of some grain seeds;

Flax seeds: 11%

Maize: 13.8%

Soybean: 14%

Grain: 14%

Critical humidity, for example; When it reaches 14.1%, the damage increases suddenly.

4.3.1.1.1. The Effect of Environmental Humidity to Storing

The stored food is affected by the humidity of the surrounding atmosphere. In other words, the food substance absorbs the humidity of the air or gives its own humidity to the atmosphere. This exchange continues until there is a balance between the relative humidity of the air and the humidity of the food itself.

The ability of food to absorb the relative humidity of the air is called as hygroscopicity. Food that is prone to get relative humidity from the air are called hygroscopic food. Each material has a hygroscopic humidity that corresponds to the relative humidity of the atmosphere at a given temperature. Moisture taken from the atmosphere is called hygroscopic equilibrium point where the given rupture is equal. This hygroscopic equilibrium point depends on:

• Food's own humidity,

• Atmospheric humidity,

• The characteristics of foodstuffs,

• Ambient temperature.

For example; the hygroscopic equilibrium point is 14.5 in a 75% relative humidity of wheat with a moisture content of 8%. However, it reaches this point in 8 days.

Moisture absorbed by the material drops depending on the temperature drop. In the same way, the rate of humidity that can be kept in the atmosphere decreases with decreasing temperature. For example; the moisture absorbed by wheat is 3 times more than the temperature of 10 ° C at 300 ° C.

Relative humidity of the atmosphere is important for microorganism and enzyme activity. Although respiration varies according to the type of grain, it accelerates after 75% relative humidity. The relative humidity in grains that are hygroscopically balanced is more important than the moisture absorbed by the grain.

Osmotic molds and some Aspergillus types, Osmophilic spots can also grow under 75% humidity. However, bacteria rarely develop under 90% relative humidity.

That is why;

• When the temperature is high,

• When the amount of foreign matter is excessive,

• When there are more cracked, diseased or insect-eaten grains,

• If the granary is to be stored for a long time (more than 2 years), it is important that the relative humidity does not exceed 65%.

Humidity Transfer:

Grain placed in a closed warehouse may deteriorate due to excessive moisture even if the humidity is within normal limits and homogeneously dispersed. This happens with moisture transfer.

Reason: Temperature Differences

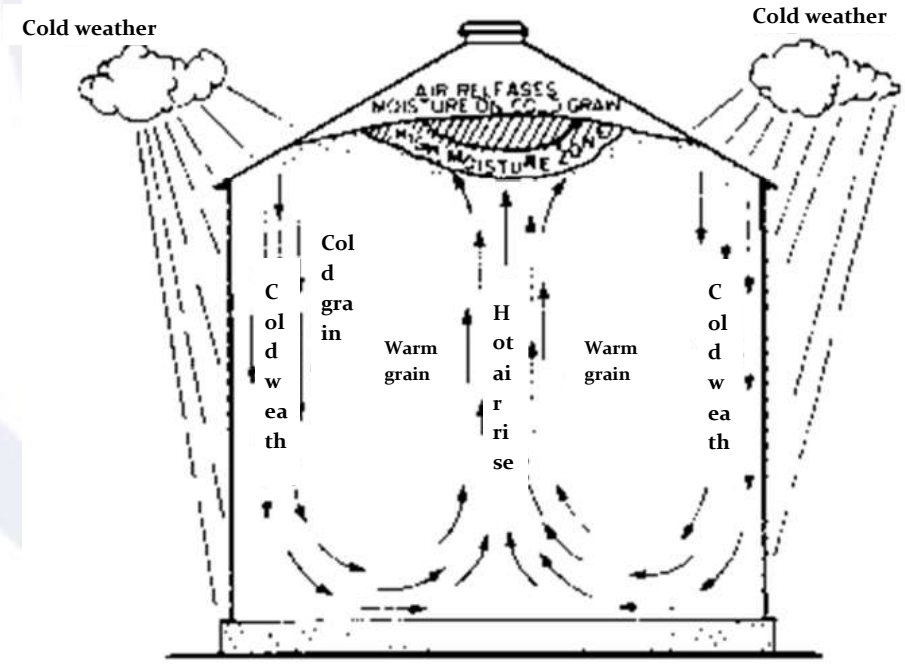
• At any level of moisture, the volume of water vapor that a certain volume of air will hold increases as the temperature rises.

• The air in the tank is in diffused and convective motion.

• If the temperature rises somewhere in the reservoir, this movement is accelerated.

• The warmth takes the moisture of the grain around the rising air and moves to the cold part of the tank. When it comes to cold division, the water inside it cannot hold the steam and gives the hubs around because the temperature drops.

• In this way, the humidity of the grain in certain regions rises and the transfer of moisture from the warm part of the reservoir to the cold part occurs.



Heating and temperature difference of the grain can be due to various reasons. The main reasons are:

• The tank is not well insulated. Because of temperature difference, heat changes are seen.

• During harvesting, if the harvest time is different and the harvested products are put in the same warehouse at these different times, the temperature difference (change) is seen in the warehouse.

• If there is insect repellency anywhere, insects raise the temperature of the atmosphere around them.

Drying: If the temperature rises, drying is done.

Important points in drying are as follows:

The higher the humidity of the tannin, the lower the temperature to dry. Grain dry temperature increases. This is because when the moisture is high, if the temperature is high, the stored grain is damaged because the wet heat penetration is high. Due to this evaporation, the surface temperature of the tannin is lower than the surrounding air temperature, since initially a small amount of water flows from the grain surface (because of evaporation). Towards the end of the dryer, the amount of water flowing from the grain surface decreases, so the surface heat of the grain approximates the heat of the surrounding air. But it will not be equal. Equality occurs when evaporation stops, when it is completely dry.

The temperature to be applied for the drying of grains to be used as seeds or for malting should be lower. Because the effect of temperature on the germination of the grain, its technological quality are more than the effect of chemical reactions.

Therefore;

If used as seeds, the drying temperature should not exceed 43 ° C if the grain moisture is above 24%. If the humidity is below 24%, the drying temperature is 45 ° C.

If wheat is to be used in grinding rather than seed, germination ability is not so important. The temperature can then be increased to 60 ° C. However, it is necessary to keep this temperature as low as possible. Otherwise gluten structure will be damaged.

If it is used for forage, it can be removed at a much higher rate. This (unless kept too far) does not significantly affect the forage value.

The inside of the grain is still damp when the top surface is dry because the moisture from the inside of the tannin is very slow to flow out. For this reason, it is necessary to give time for drying the moisture in the inner parts of the grain during drying. For this reason, in practice, it is left to rest from time to time.

The air should be as low as possible during drying. However, the temperature difference between grain temperature and air temperature must not exceed 6-7 ° C. However, this is more of a case of cooling than heating. The grain temperature should be lower than the temperature of the given air. Drying is not done by hot air. Cold weather can be given as well.

4.3.1.2. Temperature

A reason for the long shelf life of stored grain is temperature. The respiration rate of the grain in the warehouse increases with the storage temperature. Keeping the storage temperature below 18 ° C prevents or completely stops the activity of many insects. The drop in storage temperature every 5 ° C doubles the storage period.

Heat (Spontaneous Heat)

The second significant event after the transfer of moisture is heat. The grain in the closed tanks breathes because it is alive even if all conditions are appropriate. This gives some heat to the respiratory result and the water becomes clear. The heat from the field encourages the repetition of insects. It helps to keep mold out of the water. The initial heat and humidity initiate insect activity, and the respiratory heat rapidly increases in molds.

Glucose + 6O2 ----------> 6CO2 + 6H2O + 38ATP

The maximum temperature at which stored heat will rise depends on the source of heat. That is, at the end of germination, the temperature is at most 43 ° C. The germinated seed will die on this level, so breathing stops. It remains at 43 ° C at the maximum temperature caused by the insects. If the storage temperature rises above this level, the insects will go to cooler places and there will be no further heat rise where the temperature rises. If the proper conditions are the reasons for mold growth, the temperature due to the molds is raised by 54-55 ° C, which causes considerable damage to the grain.

In bacterial activity, the temperature rises to 80-82 ° C, which means that the product is out of the way. If there is enough oxygen in the medium if the bacterial activity progresses, the chemical reaction starts and then the grain burns.

Measures taken to prevent the heat:

The most important measure to avoid the heat is to frequently ventilate the product.

The stored grain may be air-permeable if it is in a porous structure. If enough air is passed, the accumulated heat and humidity can be discharged. However, ventilation should be used at low temperature and low relative humidity.

If any heat is generated, 800-1000 m3 of air is needed to normalize the heat of 1m3 crop.

For this reason, continuous temperature and humidity measurements in silos have vital importance. Necessary measures must be taken immediately when temperature or humidity increase is detected.

Emergency response plans should be determined by providing the necessary information to the authorities in case of heat. In case of a possible heat, it is necessary to cut out the appropriate section of the silo body and immediately remove the stocks. The maximum temperature to be formed in the silo is about 450 - 500 ° C, and it is a matter of loss of the structure of the silo due to thermal stresses. At such a temperature increase, deformations due to thermal expansion in the silo outer shell will occur. If repairs are not carried out properly after such an incident, water and moisture entering the silo with rainfall from deformation surfaces may cause a new flash. (Heat clause can be taken into consideration within the light of this information).

4.3.1.3. Oxygen

Like all living organisms, stored grains and macro and microorganisms that disturb it require oxygen. If there is an insect in a closed depot, it quickly consumes the air in the tank and drowns.

• The presence of bacteria, yeast, and many insects and molds in stored grain is important.

• Tannin breathing is very slow compared to the molds.

• Factors affecting the solubility of particles and microorganisms are as follows:

- Moisture

- Temperature

4.3.1.4. The Amount of Foreign Substance

The amount of foreign substance, crushed pieces or flour waste in the stored grain affects the storage quality of the grain.

The importance of foreign substances:

a) Live foreign substance in kernels is important in terms of storage stability. Others, especially cracked grains and flour dishes, are particularly the first places where larvae of insects and insects grow

b) They reduce the effectiveness of fumigation (if depot is sprayed).

Because these detractors absorb foreign substances and some drugs, they decrease the effectiveness of the drug and prevent the penetration of the drug deep into the depot. When the amount of foreign matter is more than 6%, the effect of fumigation decreases considerably.

4.3.1.5. OTHER FACTORS

Also the factors below are effective on the storing durability of the stored grain:

a) Growth conditions of cereals, growth and maturity status,

b) Grain type,

c) Other processes applied to seed,

d) The maturity of grain at harvest,

e) Variety differences

f) Harvesting methods etc.

4.3.2. Dust Explosion

As it is made in the storage warehouses, dust explosion is one of the biggest risk factors known by the experts working in the sector. Granular raw materials are stored in the vertical silos used for storing. There is a possibility of explosion and condensation in a rapid manner, triggered by a spark or activator, after the density of the dust particles released during the storage of these raw materials has increased to a certain limit. This is very dangerous in the presence of flammable dust particles.

The dust explosion is a rapid bursting and condensation of dust particles when a density of airborne dust particles increases to a certain limit (1m3 / 50gr dust), triggered by a spark or activator.

They can be found in explosive atmospheres according to the materials they carry. For example, grain elevators in grain silos are buried completely within the explosive dust environment. Generally, such elevators are completely closed and explosive dust is formed in their inner parts. For this reason, it is sufficient to take precautions against sources of ignition such as friction which may occur in the inner parts of such elevators.

Normally there are no electric tools in the elevator. Drive motors and starting devices are kept away from explosive dust. If there are sensors near the dust zone, it is sufficient to select them as certified, i.e suitable to explosive environment. The control buttons that operate the elevators are kept away from the dust environment. These distances are included in the ZON distinction. It depends on the working environment and the material to be transported.

The manufacturer of the elevator or user must perform a risk assessment according to the operating conditions of the elevator (risk assessment). Necessary measures should be taken according to this evaluation. If the elevator is completely closed from the outside, a dangerous environment can occur only inside. These are the issues that put the friction of elevator parts and other factors in danger. Generally, there are no electric tools in the elevator. Paying attention to such simple matters is sufficient.

There is usually no need for a compliant compliance test and certification for the elevator. If, however, any elevator is in an intensive explosive environment, of course EC testing and certification may be needed. In short, it is enough to take measures against the elevator. There are no definite lines in this regard. Everything depends on the risk analysis that the owner has it done. It is not a job for every specialist to dare to report such as "no risk" in an elevator working in a heavy dust environment. Owners should also consider his/her own property. The dust explosion is far more dangerous and destructive than the gas explosion.

4.4. Planning of Maintenance - Repair and Intervention Methods

It is of great importance to determine planned maintenance works and intervention plans in order to minimize the frequency of damage and to limit the damage in case of damages, especially in silo storage facilities.

The silos must be kept under constant observation. For example, in the case of rusting of the silos, the structural strength may decrease. The reason for the holes on them for any reason may be that rainy weather can increase the humidity in the silo and cause the escalators to come to the rally. Calibrations of in-silo measuring instruments, which provide data to automation systems in the same way, are important to ensure that discontinuities are recognized at the right time.

Knowing how to intervene in a possible incident is very important to limit the amount of damage. For example, when the escalator arrives, it is necessary to evacuate the warehouse without delay. Otherwise, there may be cases where the silo and the inside of the warehouse are completely lost. In this context, the problem tracking tables that silo manufacturers have published should be examined carefully.

Problem Tracking Table

Problem Observed	Possible Reason	Suggested Action
Rotten or molded grain smell	Accumulation of hot humid in the area	Turn on the ventilators to make the area cold.
Hard layer or rotten grain	Grain without air circulation, with a high level of moist	Turn on the ventilation Discharge the rotten grain.
Warm grain under upper layer	High level of moist	Turn on the ventilation regardless of the outside temperature.
Sticky, wet or frozen grain on surface	The first symptoms of moist movement	Turn on the ventilation until outside and inside temperature are equal.
Hard surface, shelled and dusty product, limited air flow	High moist on the upper layer	Remove the rotten surface. Wear a dust mask for the molded area. Turn on the ventilators.
Density in the under layers of roof	Warm grain stored in cold weather, high circulation and moist	Turn on the ventilation until grain temperature and outside temperature are equal.
Wet or rotten grain on the surface of center point or right under the silo intake lid	Roof lid, flow pipe or bolt hole with weak impermeability	Check the relevant elements. Check grain temperature to see if there is any water accumulations at nights.
Ventilators do not provide air flow.	Shelled grain limiting air flow is possibly on the ventilation canal or surface.	Determine the location of the rotten part. Discharge he stored grain and refill the area with good grain.
Cooling is later than usual.	Increased foreign substance rate limiting air flow	Activate the ventilators more than usual till the grain gets back to its normal temperature. Clean the grain.
The temperature in the center of the silo is higher than the one outside.	Accumulation of foreign substance limiting air flow	Regardless of the outside temperature, activate the ventilators until the center of the grain reaches the sufficient coolness.
Unknown grain conditions in the center of the silo	It is too high to do any measurements. Silo is too full to get into. There is no heat control cable.	Discharge an amount of grain from the silo. Check the grain in hand and do the necessary measurements in the silo.

The problem tracking table published by a silo manufacturer

5. Result and Assessment:

The information and findings related to Grain Processing and Silage Operations were compiled from intensive surveys, meetings with producers and local markets and data collected as a result of our damage experience.

Damage and dust based damages and structural damages that are the first common main reasons in Grain Processing and Storage Enterprises should be considered as the highest possible damages and should be emphasized in policy premium balance and exemption applications.

Damage to the site, especially structural damages, should be carefully examined in terms of manufacturer and installation defects,. In the same way, the intervention process should be questioned and examined from the retrospective data records whether insured enterprises take the warning about heat incidents into account.

This country has entered into a period of significant restructuring and change within the last 5 years. Soil Products Office (TMO) has emerged from being a monopoly throughout the country and continues to be a market maker. As the private sector initiatives have become widespread, the technology co-ordinated to world markets has begun to take place in our country. When the sector is examined as a whole, it is in the process of change and development with every aspect. Whether the plant and equipment producers are interacting in parallel with agriculture, it is seen that the new structure has been adapted to the needs of the times. A change of risk and damage management model should be devised from the beginning of the sector as there is a change in almost all of the structures and equipment. Detailed research will always yield very different results as risk and cost management have very variable consequences.

Turkey, which allows the product to be grown in many climates and ecological characteristics, is advantageous in terms of agricultural production, the 24.6% of total employment is located in the agricultural sector. Therefore, policy production for the sector is also in direct proportion to the number of enterprises. For this reason, our bulletin is designed to provide an understanding of the risks frequently encountered in the insurance of such businesses and to ensure high efficiency in policy designs. It is clear that the insurance sector should show a new approach to this study area, which is at the beginning of the new structuring period. (This area is designed as a general approach since the bulletin area is limited, with too much data and information to explain.)

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1- http://www.akademik.adu.edu.tr/myo/cine/webfolders/File/ders%20notlari
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*** *This bulletin was prepared based on the information from various resources about the issue and includes our own views based on our experience in the domain of claims and risk.*