SILOS CORDOBA

Storing rice to protect its quality

Recommendations for the storage of rice in a metal silo

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RECOMMENDATIONS FOR THE STORAGE OF RICE IN A METAL SILO

Rice is one of the most important human food crops in the world, directly feeding nearly half of world's population.

Adequately performed **rice post-harvest handling operations** contribute to **prevent food losses** and consequently to achieve **food security**.

The key to correct rice storage -> **To keep the grain clean, dry, healthy and without mechanical damage.**

How? -> **Keeping the grain "alive" with as little damage as possible. Storage technologies don't do anything by themselves. Proper management has to be done by the owner.**

FACTORS AFFECTING THE RICE STORAGE

Moisture content. Rice is usually harvested with a moisture content of ≈ 25%

Temperature. Growth of fungi and chemical changes such as oxidation are increased with temperature. Moreover, it is really important to consider the climate in the different regions of the world.

Storage period. The shorter the better. Cleaning the grain prior to storage will minimize the risk of spoilage and economic loss.

General condition of the rice and the amount of foreign materials. Broken seed during harvesting, surface and internal conditions, impurities in bulk paddy, etc. .

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POST-HARVEST HANDLING OF RICE AND ITS EFFECTS ON QUALITY

The processes involved in the post-harvest handling of rice are reception, cleaning, drying and storage. If all these processes are adequately performed, we will be able to maintain the highest quality.

RECEPTION PROCESS

Moisture content and heat are decisive factors in grain storage. They will condition the grain quality and, therefore, the final product quality.

In this initial step, we should consider:

Analyzing the rice upon arrival to the storage plant. Take samples for measuring the heat and moisture content and the percentage of foreign particles.

Insect control measures or mold activity. Currently there are high technological equipment able to do so without a high investment.

Aspiration system. It is highly recommendable to eliminate fines particles coming with paddy and allow a good ventilation during the storage period.

CLEANING PROCESS

Cleaning is the process of removing foreign particles from the bulk.

An integrated cleaning system adapted to the grain's needs should be installed.

Equipment necessary for the cleaning process:

Magnet separator. It is appropriate to get metal out from grains. This device will avoid damage or failures in the following processes.

Drum sieve. It separates coarse impurities such as pieces of straw, paper, pieces of wood... This device will avoid damage or failures in the following processes.

Grain precleaner. It removes dust and light particles from grain.

Grain cleaner. It includes a screen for incoming gross material such as sticks, leaves, straw, etc.

Buffer silos. They are installed after the cleaning process, because usually, the drying capacity of the storage plant is lower than cleaning system capacity. This way, paddy will be stored in the buffer silos while waiting to be dried.

- **Ventilation system:** Doing this kind of ventilation we can prevent or reduce also the "uniform drying".
- **Exhaust fans:** To prevent condensation.
- **Over-head cone:** This system allow a FIFO flow system, guaranteeing that all grain will be able remain inside the silo the same period.

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DRYING PROCESS

Drying is the process that reduces grain moisture content to a safe level for storage.

Important problems that will reduce the rice quality.

Discoloration/Yellowing is a result of heating in the paddy grain before drying.

Loss of germination: high respiration level will lead to reduction of grain viability for germination.

Loss of freshness/odor development: changes in chemical components like fatty acids, sugar reduction, kernel hardness, etc.

Breakage of the kernels.

Field drying or stacking.

Sun drying.

The dryer election will depend of your technical requirements, but here are some general recommendations:

- Clean before dry, since impurities in grain bulk reduce the air flow.
- Do not mix wet and dry paddy.
- Take samples to control the moisture content and temperature during the drying process.
- Experience in previous drying will lead to increased drying efficiency.
- Dry a maximum of 5% of the moisture content at a time and then leave the rice to rest for a minimum of 8–12 h.

Tempering silos

Tempering silos are used to cold down the grain and make the bulk grain uniform in terms of temperature and MC.

Depending on the storage capacity, we can cool down the grain either using a tempering silo or in the final storage system.

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STORAGE PROCESS

Whilst the choice of grain storage methods is wide, the most popular ones are steel silos, concrete silos, storage warehouses and bag silos among others.

Features	Steel silos	Concrete silos	Warehouse	Silo bag
STORAGE	Bulk	Bulk	Bulk or bags	Bulk
RETRIEVAL	First-in, First-out	First-in, First-out	Last-in, First-out	Depending of the needs
SPACE REQUIREMENT	Vertical storage, less space	Vertical storage, less space	Horizontal storage, more space	Horizontal storage, more space
GRAIN QUALITY	Control by Temp. monitoring system , Aeration, PLC, etc.	Control by Temp. monitoring system , Aeration, PLC, etc.	Possible but not accurate	None
GRAIN LIFE	At 12% mc storage & low temperature. Long period	At 12% mc storage & low temperature. Long period	Here it will be much lesser	Un predictable
GRAIN HANDLING	Mechanized	Mechanized	Manual – Mechanized	Manual – Mechanized
DESIGN	Simple design, simple to erect	Complicate: rebar placement, concrete quality, longer commissioning	Simple	Simple
OPERATIONAL COST	Relatively less, (initial investment)	Relatively less, (initial investment)	Higher	Higher
FOUNDATION COST	Medium – high	High	Medium	None
WASTAGE	Less than 1%	Less than 1%	Could be up to 34 %	Could be up to 34 %
INFESTATION	Practically nil	Practically nil	Open to attack by birds, rodents, termites, pets, fungi, mold, fermentation, etc.	Fungi, mold, fermentation, insects, et.

Galvanised sheet metal silos are nowadays the best alternative for grain storage thanks to their versatility, easy assembly, hygienic handling and low storage cost.

At this point paddy is already clean and dry and we just need to manage the storage process properly to keep the maximum quality.

Recommendations

- Ventilation system including ventilation channels, ventilation grills, exhaust fans, centrifugal fans/chillers.
- Temperature monitoring system.
- Sweep augers for discharging flat bottom silos.
- Handling equipment that can transport grains without damage, such as belt conveyors.
- Insulation system.

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Rice storage plants by Silos Córdoba worldwide:

2002 | Arroz Cristal Venezuela

Plant conceived for the storage, cleaning and drying of rice.
The total capacity of the plant is 19.513 m³ for the storage of 15.000 T of cereal. The project includes:

- √6 silos mod. 6.11/7 of 283 m³ capacity each.
- √8 silos mod. 13.75/12 of 2.228 m³ each.
- √Filling up and emptying is done at 60 T/h.
- √This facility has a grain temperature monitoring system.

2003 | Unión Arrocera Spain

Plant focused on storage, cleaning and drying of rice.
The total capacity of the plant is 19.500 m³ for the storage of 14.600 T of cereal. The project includes:

- √6 silos model 14.51/16 with a total capacity of 19.500 m³.
- √ It has a ventilation system with 2 turbines per silo with a flow volume of 32.000 m³.
- √It includes as well a temperature monitoring system.

2004 | Arrosaires Deltra del Ebro Spain

Plant conceived for the storage of rice.
The total capacity of the plant is 91.000 m³ for the storage of 68.250 T of cereal. The project includes:

- √84 hopper silos 45° model 7.64/16 of 928 m³ capacity each.
- √The filling up capacity is 100 T/h.
- √It has a belt and protection tunnel, as well as a ventilation and cooling system.

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2006 | Calimboy Argentina

Plant conceived for the storage of paddy rice.
The total capacity of the plant is 33.000 m³ for the storage of 22.500 T of cereal. The project includes:

- √ 5 silos model 27.5 m of diameter.
- √ It includes temperature monitoring system and ventilation.
- √ It includes as well filling conveyors, sweepers, elevator and unloading conveyors.

2015 | Arrozúa Spain

Plant conceived for the storage of paddy rice and white rice.
The total capacity of the plant is 19.842 m³ for the storage of 14.600 T of rice. The project includes:

- √ 6 silos model 14.51/16 of 3.247 m³ capacity each.
- √ Chain conveyors and bucket elevators.
- √ Pre-cleaners.
- √ Towers, catwalks, support structure for elevators and precleaners.
- √ Loading and unloading is done at 100 T/h.

This project is an expansion of an existing 130,000 T plant.

2016 | CP18 Thailand

Storage plant for paddy rice in the Ubon Ratchathani Province.
The total capacity of the plant is 21.500 m³ for the storage of 16.125 T of paddy rice. The silos plant includes:

- √ 12 hopper silos model 10.70/15 with 45° cone of 1790 m3 capacity each.
- √ Matrix silo distribution of 3×4. Each silo is equipped with the following accessories:
  - √ Maximum and minimum sensors.
  - √ Aeration system made up by:
    - Aeration pipes and connections
    - Centrifugal fan
    - Exhaust fan on the roof
- √ Automatic Temperature Monitoring System.

Besides, the storage plant includes all necessary catwalks and supports for the loading handling equipment.

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2016 | SLK02 Sri Lanka

Plant conceived for the storage of rice.
The total capacity of the plant is 118.966 m³ for the storage of 89.500 T of rice. The project includes:

- √ 20 silos model 19.10/16 of 5.771 m³ capacity each.
- √ 3 hopper silos model 7.64/11 45° of 667 m³ capacity each.
- √ 3 hopper silos model 6.11/14 45° of 515 m³ capacity each.
- √ Bucket elevators and belt conveyors.
- √ Silos equipped with level detectors, ventilation system and thermometry.
- √ Catwalks and towers.
- √ Drying and cleaning systems.
- √ Electrical panel.

2019 | SLK14 Sri Lanka

Plant conceived for the storage of paddy rice.
The total capacity of the plant is 5.400 m³ for the storage of 4.000 T of cereals. The silos plant includes:

- √ 5 hopper silos model 10.70/08 45° of 1.073 m³ capacity each.
- √ Belt conveyors for loading and unloading.
- √ Insulation system.
- √ Aeration system: Centrifugal fans and grain cooler.
- √ Automatic temperature monitoring system.
- √ The complete project integration han been designed and supplied by Silos Cordoba.
- √

2020 | Vitam Hungary

Plant conceived for the storage of rice.
The total capacity of the plant is 2.511 m³ for the storage of 1.900 T of cereal. The project includes:

- √ 6 hopper silos model 5.35/14 45° for rice of 390 m³ capacity each.
- √ 1 hopper silo model 3.82/4 60° of 66.95 m³ of capacity.
- √ 1 hopper silos model 4.58/4 60° of 104 m³ of capacity.
- √ Catwalks and supports.
- √ Ventilation system and thermometry.

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Under construction | Bosand Bolivia

This plant is conceived for the reception, storage and expedition of soya bean and rice. The total capacity of the plant is 69.958 m³ for the storage of 52.500 T of cereals. The project includes:

- √ 8 silos model 22.92/15 of 7.990 m³ capacity each.
- √ 2 hopper silo model 7.64/11 45° of 667 m³ capacity each.
- √ 4 hopper silo model 6.88/6 45° of 322 m³ capacity each.
- √ 4 hopper silo model 9.17/6 45° of 762 m³ capacity each.
- √ 4 hopper silo model 5.58/2 60° of 66 m³ capacity each.
- √ 2 hopper silo model 3.50/4 60° of 52 m³ capacity each.
- √ Handling equipment capacity at 120 TPH using enclosed belt conveyors and standard belt conveyors.
- √ Catwalk with tunnel for belt conveyor with tripper for intermediate discharges.
- √ Cleaning, drying and continuous weighing system.
- √ Hopper Silo.
- √ Aspiration system.
- √ Electrical panel with SCADA and PLC.