Grain Drying Service Centre for Smallholder in China

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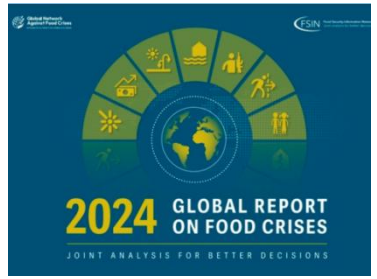
China's grain drying development policy and current situation of drying capacity building

Significance of food saving and loss reduction actions

- China has achieved a bumper harvest for consecutive twenty-one years, the total output of grain exceeded **706.5 million tons** in 2024, which is the highest level in history.

- According to **Chinese Academy of Agricultural Sciences** estimates, the annual grain losses through storage, transportation and processing is more than **35 million tons in China**, the total loss rate of the grain industry chain is about 12%.

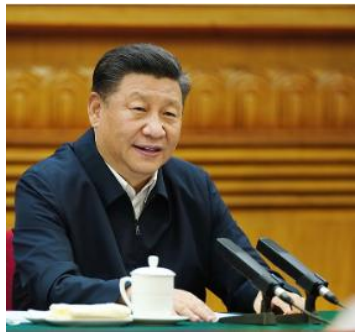


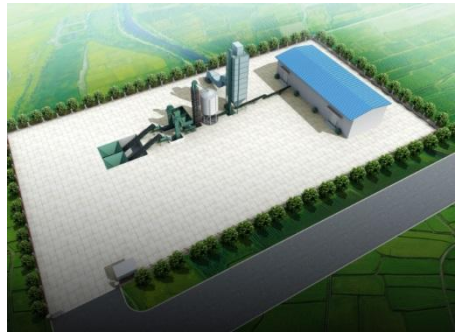
- In September 2021, the International Conference on Food Loss and waste was successfully held in Jinan City, Shandong Province, and the Action Plan for Grain Loss Reduction was launched, which explicitly states that "a wide range of **grain cleaning, drying, storage and other services** will be provided, and farmers will be actively promoted to store grain in a scientific manner".

Chinese Government has attached great importance to food conservation and loss reduction

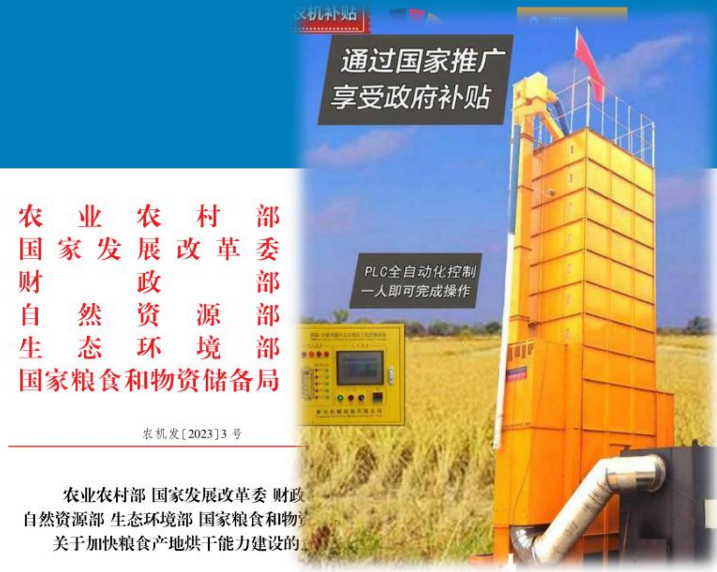
- The Programme of Action for Food Conservation issued by General Office of the CPC Central Committee and General Office of the State Council, PRC in 2021 and the Programme of Action for Food Conservation and Anti-Food Waste in 2024 made special arrangements for improving the conditions for post-harvest drying of grain.

Emphasized Grain drying facilities and equipment would be included in the pilot scope of new agricultural machinery subsidies and promote the purchase and use of grain drying equipment. And encouraged to popularize the application of environment-friendly drying facilities, and increased the promotion of green energy drying equipment in the major grain-producing counties.





Mechanized drying is the final link in the whole mechanization of grain production, and is also an important way to reduce grain loss

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农业农村部 国家发展改革委 财政
自然资源部 生态环境部 国家粮食和物
关于加快粮食产地烘干能力建设的

各省、自治区、直辖市农业农村(农牧)厅(局、委)、发展改革委、财政厅、自然资源厅、生态环境厅、粮食和物资储备局(粮食局)，新疆生产建设兵团农业农村局、发展改革委、财政局、自然资源局、生态环境局、粮食和物资储备局：

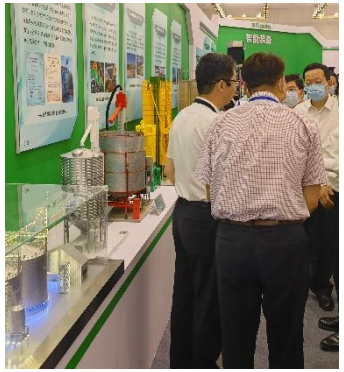
粮食产地烘干是保障粮食品质、减少粮食产后灾后损失、确保

— 1 —

- In 2006, grain dryers was listed in the catalog of national subsidies for the agricultural machinery purchase, effectively mobilized farmers' enthusiasm to buy drying machinery (farmer).
- In "the Thirteenth Five-Year Plan", the Ministry of Agriculture and Rural Affairs listed the capacity promotion of grain drying in the creation of national demonstration counties for the mechanization of the whole production process of major crops, and pushed the local government to strengthen the drying capacity building.
- The Guidelines of the Implementation of Agricultural Machinery Purchase Subsidies in 2021-2023 started pilot subsidies for complete sets of equipment of grain drying and storage.
- On May 9, 2023, the MARA, the NDRC, the MOF, the MNR, the MOE, and the SAGAR jointly formulated and issued the **Opinions on Accelerating the Construction of Grain Drying Capacity in Grain Producing Areas.**

Grain drying capacity building is given high priority

- The Plan of National Modern Facility Agriculture Construction (2023-2030) emphasized to strengthen modern facility agriculture construction including grain drying and storage



Overall situation of drying facilities and equipment in China

Currently actual grain dryers in use	128776 units/set
Total drying tonnage	5.08 million tons
Various Attached facilities and equipment	312515 units/set
the area of drying and storage centers	65.27 million m^2

→ **Total Drying capacity of about 40%**

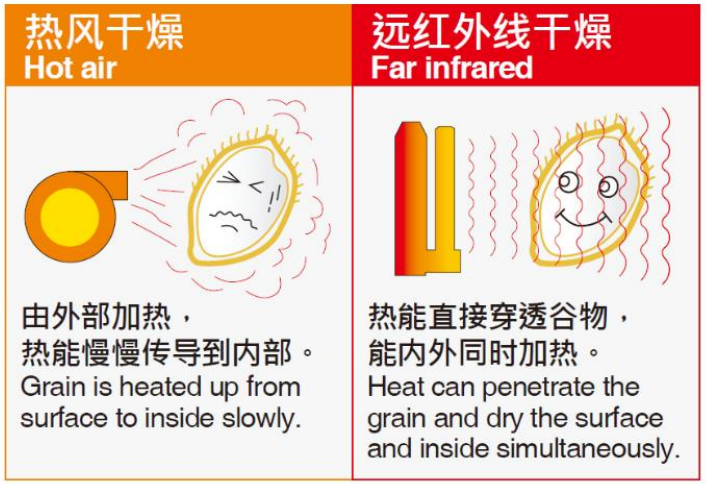


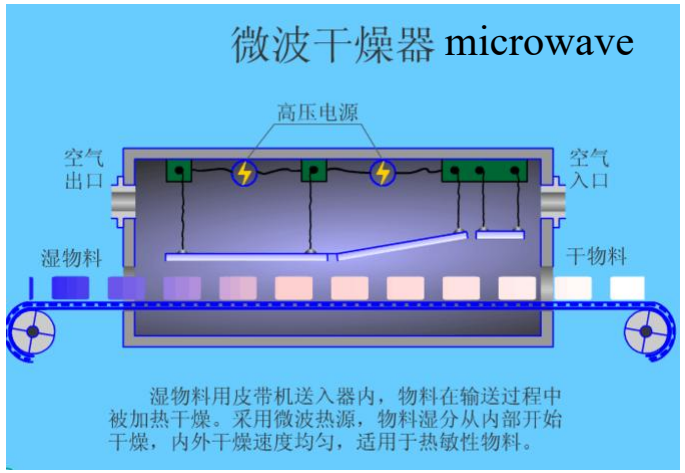


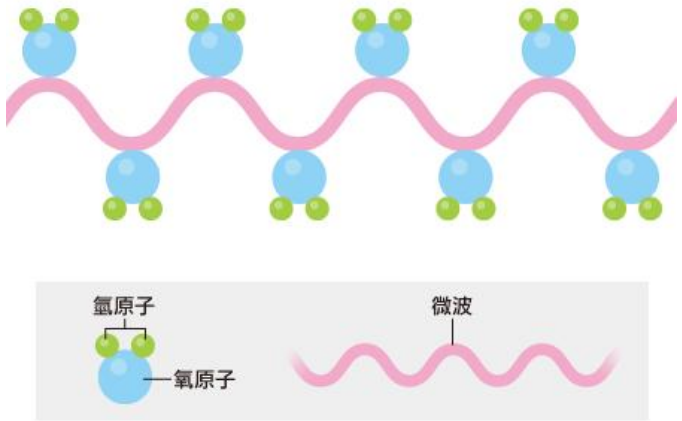
Common dryers in China

- **According to the way of heat mass transfer**

Grain drying technology		
	conductive	Fry drying, steam pipe heating, vacuum drying
	convective	**Hot air drying,** heat pump drying
	radial	Sun drying, infrared drying, microwave drying, radio frequency drying
	combinatorial	**Hot air + infrared (microwave, radio frequency, etc.)**







Common Dryers

- **According to the heat source**

Coal-fired dryers

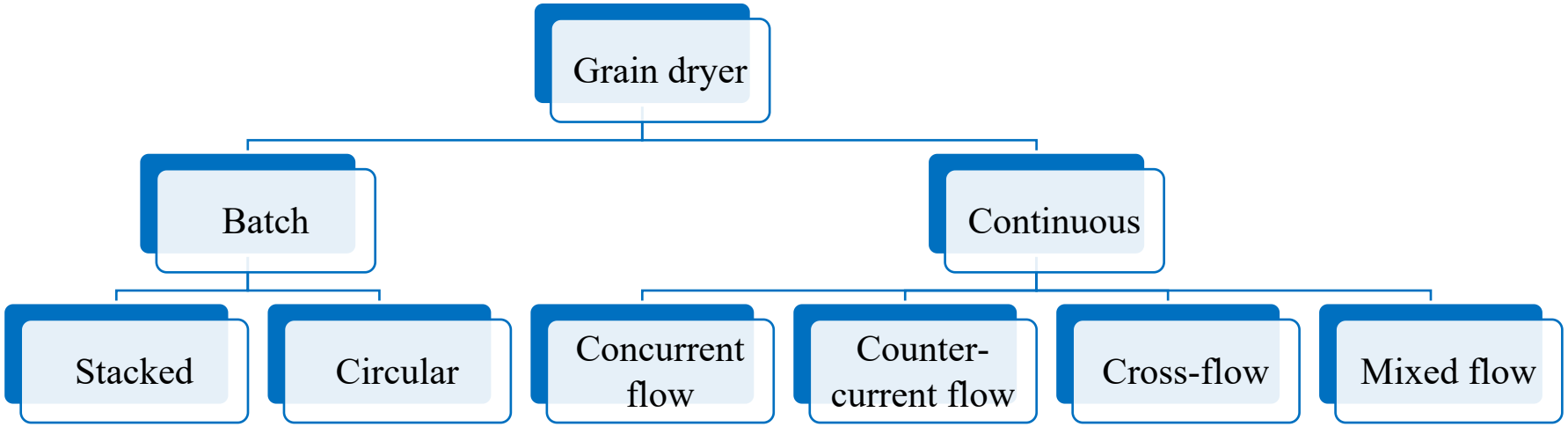
Fuel dryer

Biomass energy dryer

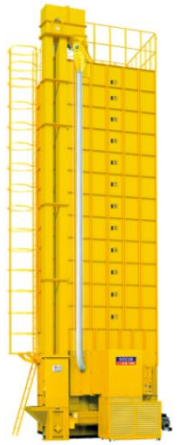
Heat pump dryers

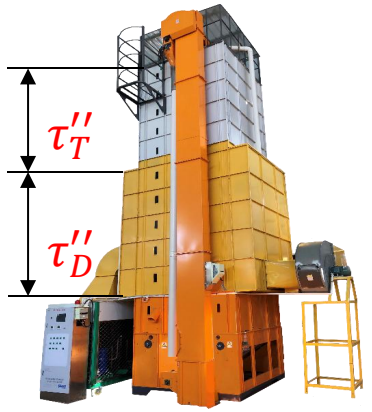
Common Dryers

➢ **According to the way of material movement**

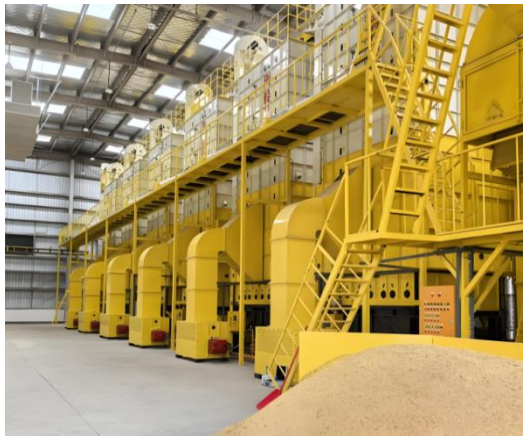


dryer.mp4





Traditional drying process → Modern drying technology



02

The mode and specification of grain drying center construction in China

1. History of the development and construction of grain drying centers in China

Pilot Demonstration Project on Drying of Grain at Producing Areas

MARA **firstly** proposed the concept of **grain drying centers**, relying on grass-roots agricultural machinery management service organizations to establish **small grain drying centers**

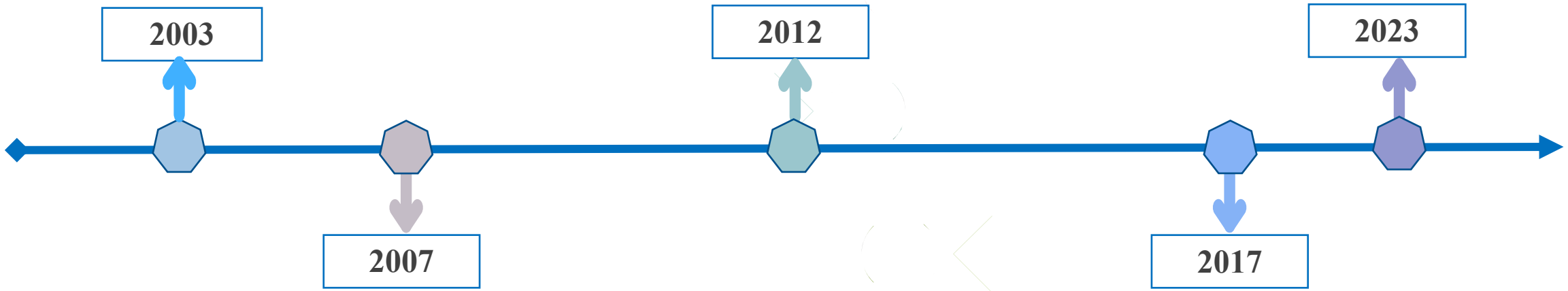
Agricultural Products Primary Processing Subsidy Policy

The former Processing Bureau of MARA conducted a "pilot test" for **subsidizing equipment for grain drying and storage centers**

Agricultural infrastructure development

Ministry of Agriculture and

Rural Affairs proposed to construct a grain drying system combining **drying points and drying centers**.



Pilot Support Project for Primary Processing of Agricultural Products

MARA carried out the **demonstration and promotion of corn drying technology** in Jilin and Henan provinces

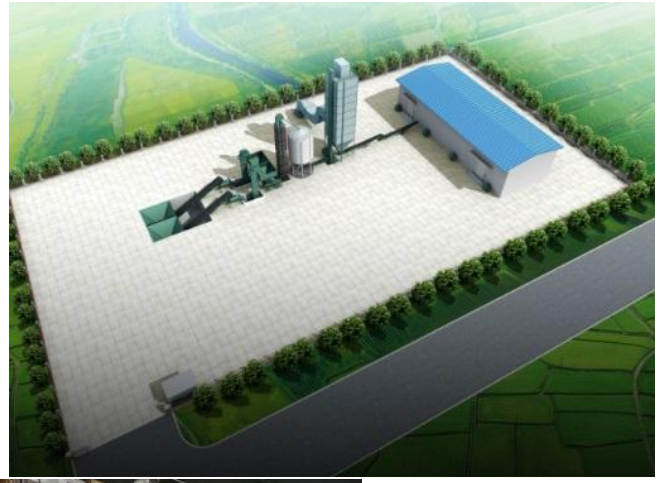
Quality Food Project

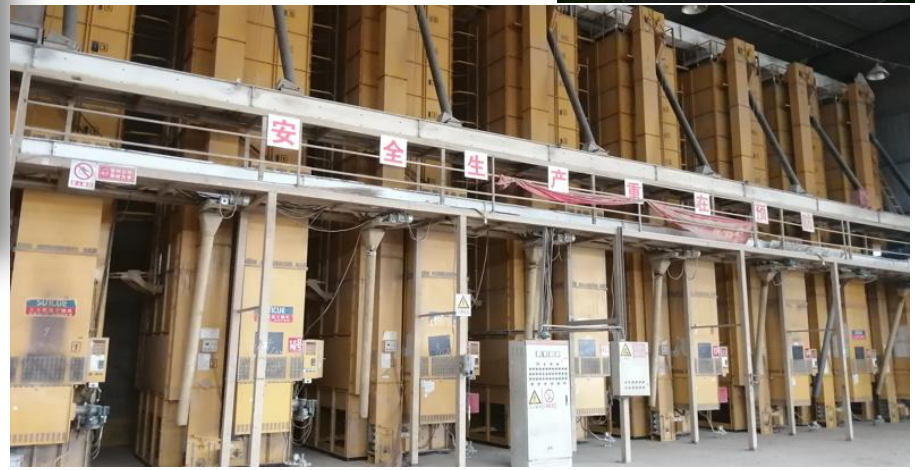
Supported by the National Food and Strategic Reserves Administration, To build 5,500 **post-harvest service centers** to provide grain farmers with "five kinds of service" including "cleaning, drying, storage, processing and marketing".

Specialized scientific grain storage for farmers

With the support of the National Development and Reform Commission, nearly 10 million sets of standardized small grain storage containers had been built for farmers nationwide, and grain storage losses of farmers who correctly used scientific grain storage equipment can be reduced from an average of 8 % to less than 2 %

1. History of the development and construction of grain drying centers in China





2. Grain harvest-storage technology models for “no landing during whole process”

- Focusing on the three major crops of corn in the Northeast, rice in the South, and wheat/corn in the Central Plains, research on grain harvest-storage technologies and construction patterns has been conducted for the specialized farmers' cooperative.

Specialized farmers' cooperative
• Higher moisture content of the grain obtained • Shorter grain storage time • Small storage scale, simple storage process, simple facilities and equipment • **Focus on “drying"**

2. Grain harvest-storage technology pattern for “no landing during whole process ”

- In order to improve the whole mechanization level of grain harvest-storage, reduce post-harvest loss of grain, safeguard the quality and economic rationality, it has constructed a grain harvest-storage technology models with the core content of application area, harvest-storage business entities, process technology route, facilities and equipment.

Processing company

1. Northeast corn clean energy mechanized drying technology model
2. Green energy natural drying technology model of northern two-maturing area
3. Southern rice mechanized drying and classification storage technology model

模式名称	中原两熟区绿色能源自然干燥模式 . Green energy natural drying technology model of northern two-maturing area	东北玉米清洁能源机械干燥模式 Northeast corn clean energy mechanized drying technology model	南方稻谷机械化干燥分类收储模式 Southern rice mechanized drying and classification storage technology model
种植规模	400-2500 亩	1000-10000 亩	500-3000 亩
典型收储工艺	小麦机械收获—检斤—预清—通风储藏—干燥（备）—清选—装载—输送/玉米穗收-检斤-通风储藏-脱粒-清选-储藏-干燥（备）-装载—输送	粒收—检斤—清选—机械干燥（生物质）—通风储藏—清理—装载—输送	机械收获—检斤—预清—低温干燥—分类储藏（通风系统）—清理—装载（加工）—输送
关键技术	机械收获、干燥（备）、通风储藏	籽粒收获、清洁能源干燥、筒仓储藏	机械收获、低温干燥、分类储藏
收储设备设施配置	收获机、地磅、脱粒机（玉米）、清选机、果穗通风仓（玉米）、立筒仓（通风设施）、小型（移动式）干燥机、斗式提升机、皮带输送机	籽粒收获机、地磅、清选机、连续式干燥机（生物质）、立筒仓（通风系统）、斗式提升机、皮带输送机	稻谷收获机、地磅、预清机、机械通风仓、低温干燥机、立式分类储存仓、斗式提升机、皮带输送机
粮食品质保障	配置快速水分测定仪，容重仪	配备水分、容重、含杂、裂纹率等检验仪器	配备稻谷水分快速检测议、容重仪以及爆腰率、整精米率测定仪，规模较大从事加工的还需配备稻谷品质检测仪器
信息追溯	通过台账记录收储各环节的粮食信息	通过电子信息系统记录收储个环节的信息，并与田间作业信息系统与销售信息系统整合	通过电子信息系统记录收储各环节的信息，并与田间作业信息系统与销售信息系统整合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农业农村部 国家发展改革委 财政部
自然资源部 生态环境部 国家粮食和物资储备局
关于加快粮食产地烘干能力建设的意见

各省、自治区、直辖市农业农村(农牧)厅(局、委)、发展改革委、财政厅、自然资源厅、生态环境厅、粮食和物资储备局(粮食局)、新

● Technical models promoted by the Opinions on Accelerating the Construction of Grain Drying Capacity in Grain Producing Areas

Rgion	Northeast	Huanghuaihai area	The middle and lower reaches of the Yangtze River	Southwest	Northwest	South
Layout size	**Drying centers are the mainstay**. corn and soybean drying centers: 10,000 mu, 20,000 mu, and more than 50,000 mu; Rice drying center : 5000-8000 mu	The corn, wheat and soybean production areas are dominated by **drying centers:** 2000-3000 mu and more than 5000 mu; Rice and wheat :**drying points** of 300-500 mu , **drying centers** of 600-1000 mu and more than 2000 mu	**Drying points**: 300-500 mu; **Drying centers**: 1500-2000 mu and more than 5000 mu	**Drying points**: 100-200 mu, 300-500 mu; **Drying centers:** more than 1000 mu	**Drying centers**: 2000-3000 mu and more than 5000 mu	**Drying** points: 300-500 mu; **Drying** centers:1500-2000 mu and more than 5000 mu
Construction of drying facilities and equipment	Corn, wheat and soybeans focus on the promotion of continuous dryers; Rice is mainly based on continuous dryers, supplemented by circulating dryers, and **the integrated grain drying and storage silos** are moderately developed	Corn, wheat and soybean are mainly continuous dryers, supplemented by circulating dryers; Moderately develop **integrated grain drying and storage silos;** The wheat and rice rotation area focuses on the development of circulating dryers	Rice and wheat focus on the development of circulating dryers	Rice focuses on the development of circulating dryers; Wheat and corn are mainly used by circulating dryers, supplemented by continuous dryers; The development of small circulating dryers and multi-functional box dryers in hilly and mountainous areas	Wheat and corn are mainly continuous dryers; Encourage the development of **integrated grain drying and storage silos**	Rice focuses on the development of circulating dryers; The development of small circulating dryers and multi-functional box dryers in hilly and mountainous areas

3. Specifications for the construction of drying centers

- To guide scientific planning and standardized construction of drying centers
- To guide resionable use of relevant funds, and to carry out pilot subsidies for drying sets of facilities and equipment.
- To guide users to choose advanced and applicable, energy-saving and environmentally friendly, safe and reliable machines.

From 2021, the Department of Agricultural Mechanization of MARA carried out **the preparation of specifications for the construction of drying centers**:

- ✓ Technical specification for the construction of complete sets of equipment for rice drying centers in double-season rice areas
- ✓ Technical Specification for the construction of complete sets of equipment for grain drying centers in Jiangxi Province, Shandong Province, Jiangsu Province, Anhui Province, Inner Mongolia and Other Provinces

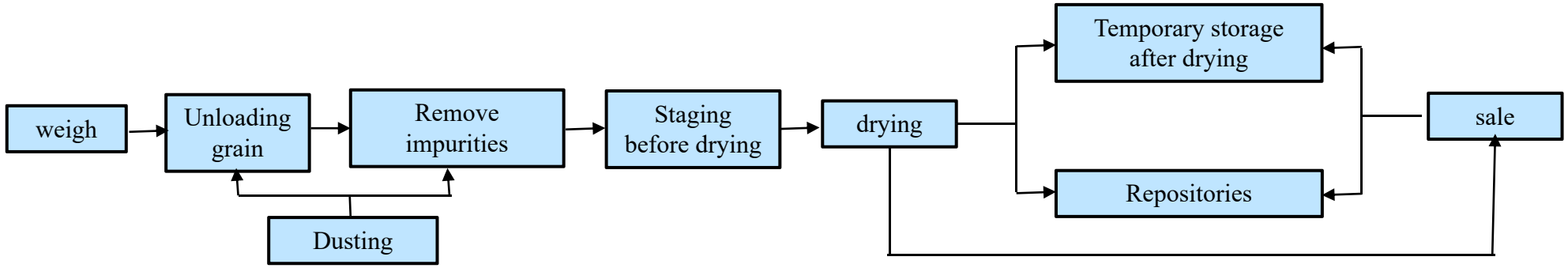
Construction Specification Outline

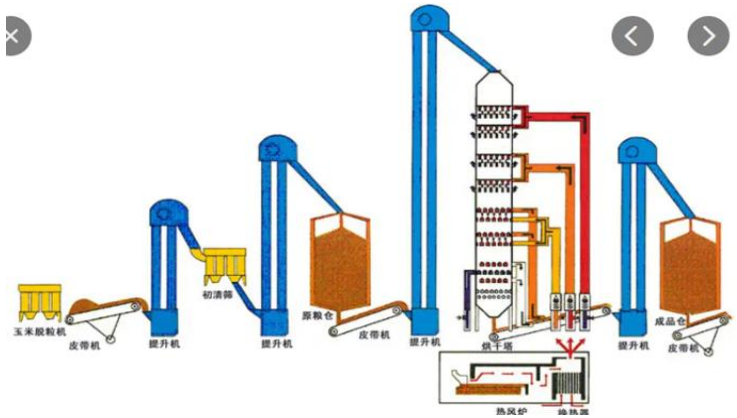
①Range	⑥Complete equipment configuration and investment estimation
②Normative references	⑦Safety and environmental protection
③Terms and Definitions	⑧Installation and commissioning
④Process	⑨Acceptance
⑤Construction requirements	⑩Schedules and drawings

3. Specifications for the construction of drying centers

➢ Construction content

- Drying center: with a certain scale, can complete the process of weighing, cleaning, drying, temporary storage and other operations of wet grain.
- Process:





3. Specifications for the construction of drying centers

➢ **Drying center set of facilities and equipment**

Weighbridge

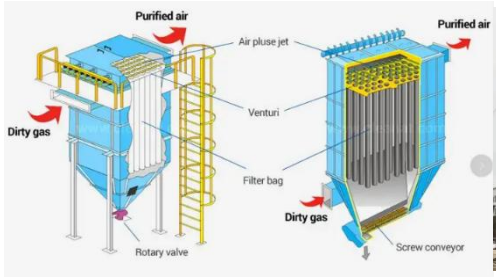
Horizontal belt conveyor

Tilt belt conveyor

Bucket elevator

- weighing system
- Raw Grain Pretreatment Systems
- Pre-drying storage systems
- Drying Systems

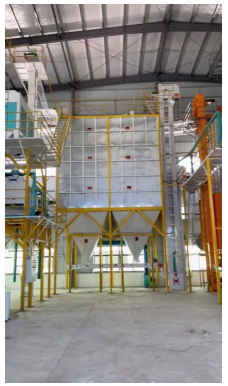
- Post-drying storage system
- Electrical control system
- Dust removal system
- Accessory facilities



Bag filter

Feeding

clean



temporary storage a

Dispensing + Drying + Packing

3. Specifications for the construction of drying centers

➢ **Technical and economic indicators**

Scale indicators for the construction of rice drying centers

No.	Scale metrics		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII
1	Throughput (ton/batch)		40	60	80	120	180	240	300
2	Drying center area (㎡)		720	738	787.2	922.5	1291.5	1476	1771.2
3	Dryer (tower) room area (㎡)		540	540	576	675	945	1080	1296
4	Dust chamber area (㎡)		39.6	59.4	79.2	118.8	178.2	231	277.2
5	Installed power (kW)	Biomass fuels	≤90	≤105	≤140	≤170	≤240	≤280	≤350
		Gas/Fuel Oil	≤85	≤100	≤128	≤152	≤220	≤255	≤320
6	Service area (mu)	Rice	3200~5600	4800~8400	6400~11200	9600~16800	14400~25200	19200~33600	24000~42000

The main technical performance indicators of the rice drying center

No.	The name of the metric		Metric content
1	Throughput (t/batch)		Meet the required size requirements
2	Unit heat consumption kJ/kg		Direct Heating ≤ 6800; Indirect heating ≤ 9520
3	Unit power consumption (electric heating) kJ/kg		≤ the explicit value of the enterprise
4	Drying unevenness %	Precipitation ≤5%	≤1.0
		Precipitation>5%	≤1.5
5	The temperature of the hot air fluctuates in the range of °C		≤±4
6	Waist burst rate increased %		≤2.0
7	Breakage rate increase %		≤0.3
8	Color, smell		normal
10	Increased value of benzo(a)pyrene (μg/kg)		≤5
11	Temperature of the grain out of the machine °C		≤8 (ambient temperature<0°C)
			≤ ambient temperature +8 (ambient temperature≥0°C)
12	Noise dB(A)		≤85
13	Dust concentration (mg/m3)		≤10

Investment Estimate Form

The name of the device		Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII
Weighing system		7.66	7.66	8.26	8.26	8.26	8.26	8.26
Raw grain pretreatment system		6.23	6.23)	6.98	6.98	6.98	6.98	6.98
Pre-baking staging system		12.9	14.32	16.35	18.24	32.36	34.4	49.95
Drying system	Biomass pellets	50.84	73.14	96.18	140.92	207.82	276.48	343.9
	Oil/gas	47.84	65.34	90.18	125.32	184.42	245.28	304.9
Post-baking staging system		12.9	14.32	16.35	18.24	32.24	34.4	48.62
Electrical control system		2.72	2.72	6.44	6.44	8.41	9.99	14.8
Dust removal system		9.3	9.423	14.8	15.56	18.99	23.49	27.85
Ancillary facilities		45.72	50.06	51.62	75.82	97.52	124.17	136.04
Drying center Total investments	Biomass pellets	**148.27 (153.0)**	**177.88 (182.61)**	**216.98 (223.02)**	**289.96 (296)**	**412.58 (418.62)**	**518.17 (524.21)**	**636.4 (642.44)**
	Oil/gas	**145.27 (150.0)**	**170.08 (174.81)**	**210.98 (217.02)**	**274.36 (280.4)**	**389.18 (395.22)**	**486.97 (493.01)**	**597.4 (603.44)**

4. The form in which the grain drying center serves farmers

➢ Direct service model

- **Leasing model**: Farmers pay according to the drying duration (e.g., charged by the day) or the drying volume (e.g., charged per ton), and operate the equipment themselves. **It is highly flexible and suitable for farmers with drying experience**.
- **Service charging model**: The drying center provides a full-process service (including labor and equipment), and farmers pay according to the weight (e.g., 0.2 - 0.3 yuan per pound) or volume of the agricultural products. **It saves labor costs and is suitable for small-scale farmers**. For instance, a small rice drying center attracts customers through its service quality.

4. The form in which the grain drying center serves farmers

➢ Cooperative linkage model

- **Win-win cooperation**:Cooperatives raise funds or lease drying centers, provide services to members at preferential prices or free of charge, and sell dried agricultural products in a unified manner. Improve bargaining power through scale advantages.
- **Return of profits**:Cooperatives dry and sell agricultural products in a unified manner and return profits according to the proportion of farmers' deliveries at the end of the year (such as returning 30% of the total profits), directly increasing farmers' income.
- **Driven by the village collective economy:** Adopting the model of “village party branch + cooperative + farmer”, the village collective builds and operates the drying center.

4. The form in which the grain drying center serves farmers

➢ Enterprise-led model

- **Made-to-order production**:Enterprises sign orders with farmers, provide drying services and purchase agricultural products, and lock in farmers' profits.
- **Brand appreciation**:The company integrates the production resources of small farmers, creates a unified brand (such as "Shimen rice"), achieves high quality and high price (the selling price is 30% higher than the market), and ensures the dividends of farmers through the "land transfer rice ticket" mechanism, driving more than 8,000 households to increase their income.

04

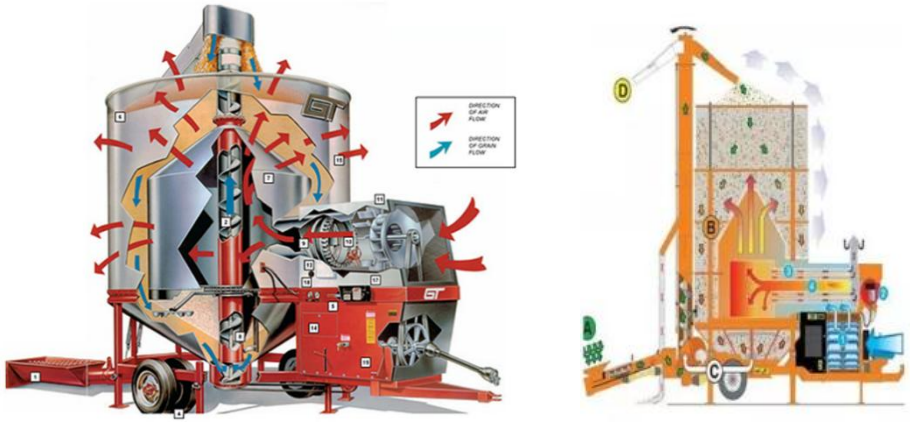
Typical drying technology recommended for smallholders

1. Mobile Dryer

价格

The mobile grain dryer has been used in China since the 1990s and is primarily categorized into three types

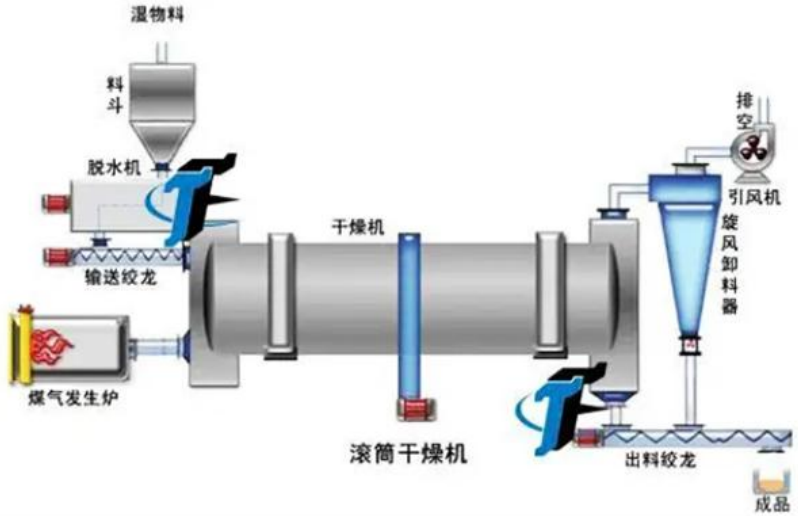
(1) Cross-Flow Mobile Dryer



- Originated from Europe and other countries, mainly Italy, England, France, etc.
- **Main features:** Cross-flow drying process; Double-cylinder structure, hot air enters from inner cylinder, crosses the material layer and discharges from outer cylinder.
- **The way of grain circulation**: internal circulation, external circulation.
- **Typical enterprises**: Jiangxi Hongxing Machinery Co., Ltd., Shandong Wopu Agricultural Equipment Technology Co., Ltd.
- **Capacity**: 6.2m³,18m³,25m³,31m³,38m³,40 m³, 75m³

1. Mobile Dryer

(2) Rotary dryer



- **Main features：** Drum-type horizontal structure and is a universal type of dryer, suitable for drying various grains and oilseeds; The manufacturing process is simple.

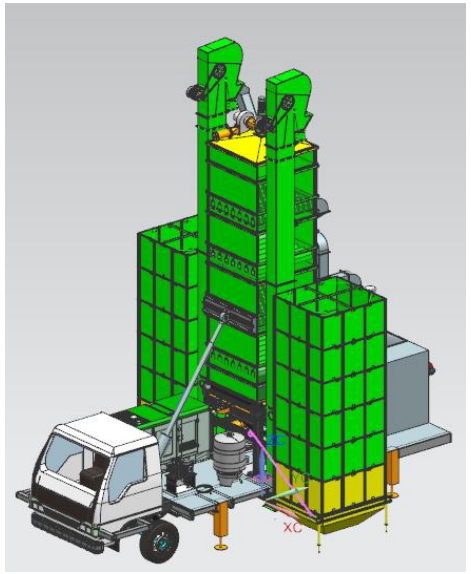
- **Typical enterprises:** Shaanxi Qintuo Machinery Equipment Co., Ltd., Henan Gongyi Jinhua Machinery Machinery Co., Ltd.

- **Main technical parameters :**

Model	Treatment capacity(t/h)	Drying range(%)	Coal consumption(kg/t)	Power（kW）	Weight(kg)
HZG1800	2-3	7-13	10-20	14.1	9540
HZG2200	4-5	7-13	20-40	18.2	13360

1. Mobile Dryer

(3) Mixed Flow Circulating Dryer



- **Main features:** mixed-flow drying process, suitable for drying various grains and rapeseed, etc;
- **Typical enterprises:** Hunan Nongyou Machinery Group Co, Ltd., Academy of Agricultural Planning and Engineering, Ministry of Agriculture and Rural Affairs
- **Capacity**: 2-10 m^3

1. Mobile Dryer

(4) Application scenario

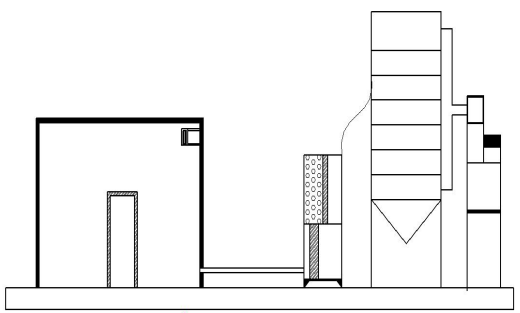
- **Suitable for drying by small-scale farmers**: The batch processing capacity is generally from several tons to over ten tons, and the coverage of the planting scale can reach several tens of acres.
- **Suitable for short-distance mobile operations**: Because the mobile dryer itself has poor mobility, and the ground clearance of the base is small. In addition, due to the limitations of rural roads, it is suitable for small-scale mobility.
- **Suitable for emergency disaster relief drying in disaster weather**: It can reach the disaster area by mobile means, and there is no need for special site installation. It is flexible and convenient to use.

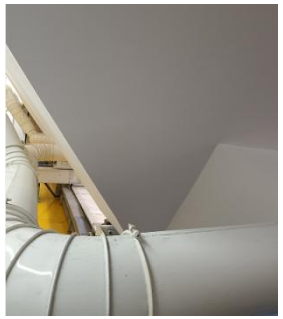
2. Integrated drying-storage system

- **Integrated drying-storage technology** includes integrated drying and storage (heat source) and ventilated drying and storage (No heat source).

- **Integrated of drying and storage**: with heat pump as the heat source, heat and cold can be generated at the same time when working, realizing synchronous operation of drying and preservation of freshness, and more efficient use of energy.

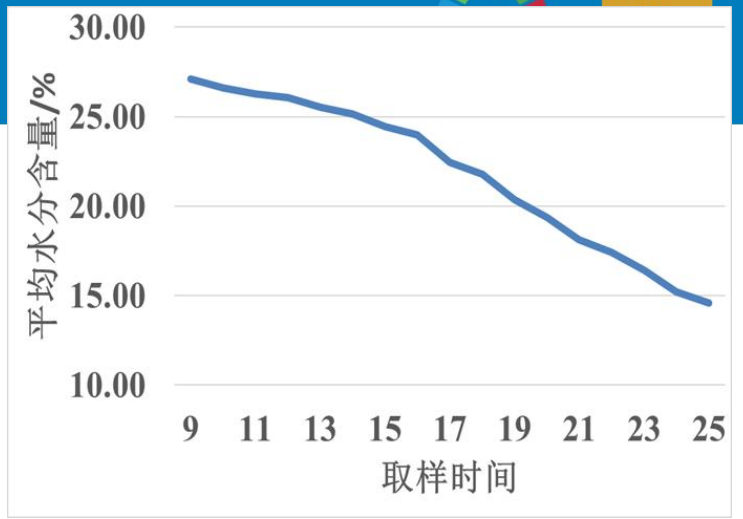
- **Ventilation drying and storage**: natural ventilation and mechanical ventilation.





2. Integrated drying-storage system

(1) Rotating ventilation grain natural drying silo

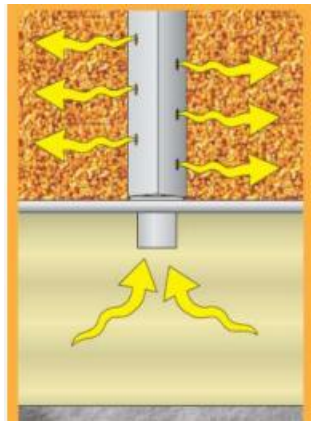


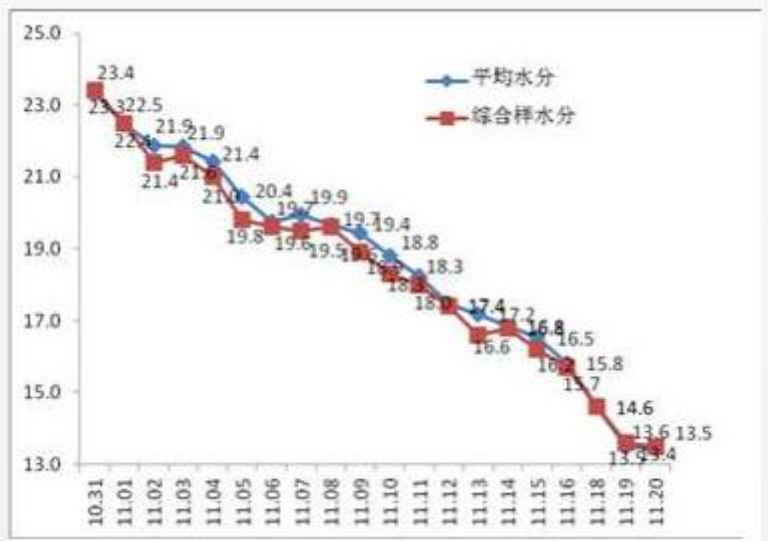
- **Test location**: Faku Grain Depot in Shenyang
- **Test period**: March 9, 2018 - March 26, 2018
- **Total time:** 18 days
- **Rotation:** 104 hours
- **ventilation**: 100 hours
- **Corn moisture content**: 27.12% →14.60%.
- **Moisture decreased**： by 12.52%
- **Daily precipitation**: 0.70%
- **Dlectricity consumption**:198 kW·h
- **Initial tons of grain**: 10.8t

Each ton of corn with 1 % moisture is consuming about 1.46 kW.h, which is in line with the requirements of energy consumption per unit of ventilation for maize water reduction as stipulated in S/T 1202-2002 Technical regulations of aeration for grain Storage (Ew ≤ 2.0 kW.h/(1 % moisture.t)).

2. Integrated drying-storage system

（2）High-moisture corn/rice dry and shelf-stable storage silo

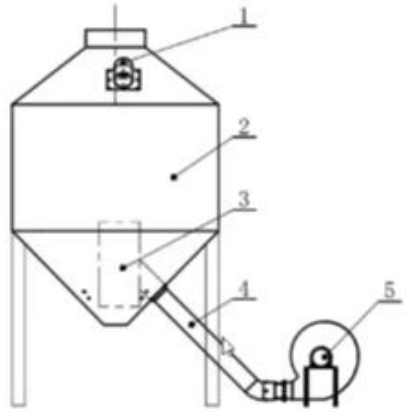




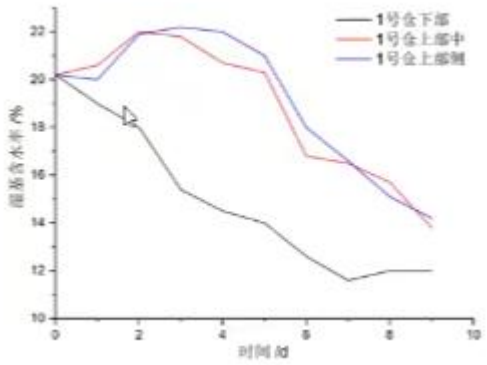
No.	index	Time		
		2017.11.02	2017.11.10	2017.11.27
1	Roughness(%)	74.0	75.2	77.2
2	whole semolina rate(%)	37.7	33.6	61.1
3	gelatin consistency(mm)	100	99	67
4	imperfect grain(%)	12.4	10.5	7.4
5	yellow grain rice(%)	0.3	0.3	0.3
6	impurity(%)	0.7	0.7	0.9
7	Moisture(%)	23.3	19.9	13.5
8	color and odor	Nomal	Nomal	Nomal
9	fatty acid value(KOH, mg/100g)	18.7	13.9	17.9
10	mildewed grain(%)	1.2	0.6	0.6
11	tasting score(score)	69	70	78

2. Integrated drying-storage system

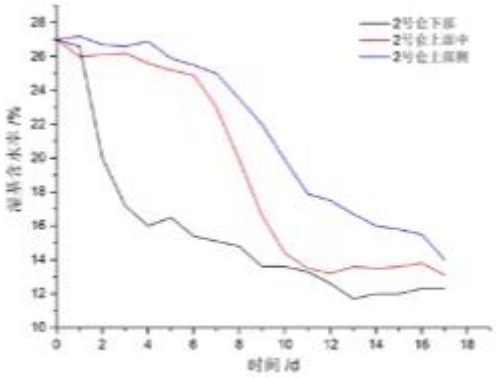
(3) Moderate high moisture corn kernel storage technology



1、出风口 2、仓体 3、通风装置
4、进风管路 5、中压风机



Initial moisture:20%



Initial moisture:27%

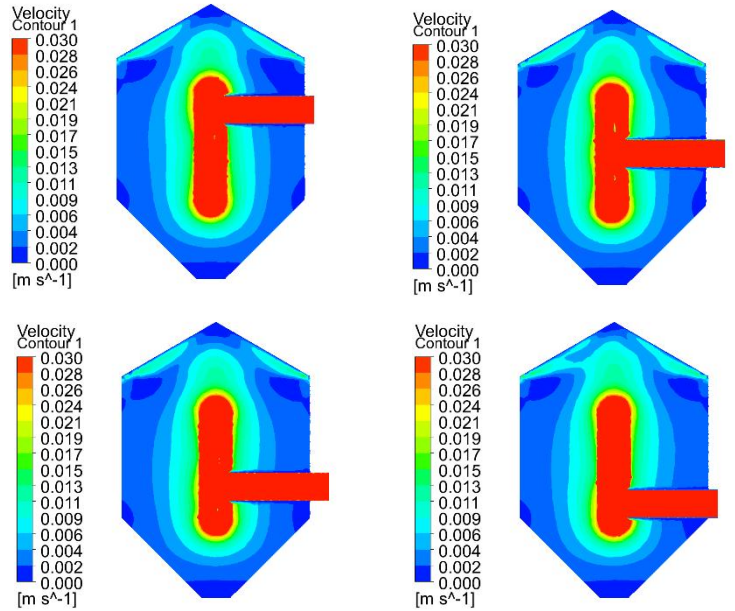
- The drying time is 9 days and 16 days when the moisture declined from 20% to 12% and from 27 to12%,respectively;
- The drying quality of grain is good, and the energy consumption is significantly lower than that of hot air drying.
- The one-time investment is small, suitable for smallholder and large-scale management organization.

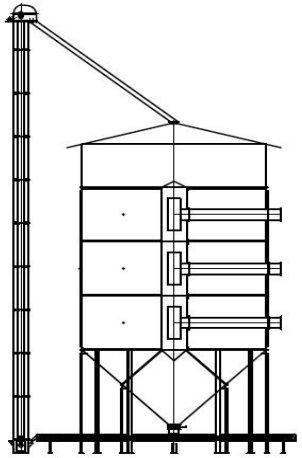
No.	Energy consumption(kW.h)	Unit heat consumption (kJ/(kgH2O)
1(20%)	155	2800
2(27%)	320	2520

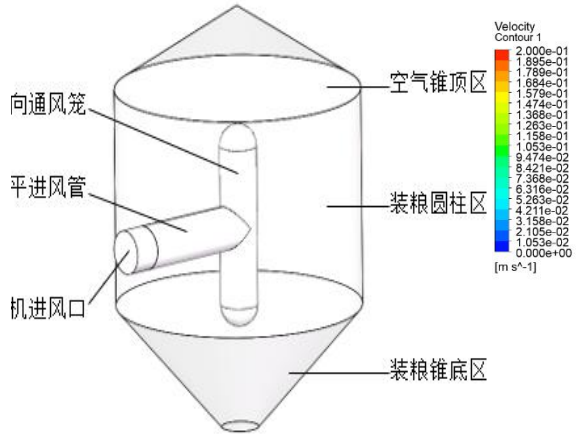
2. Integrated drying-storage system

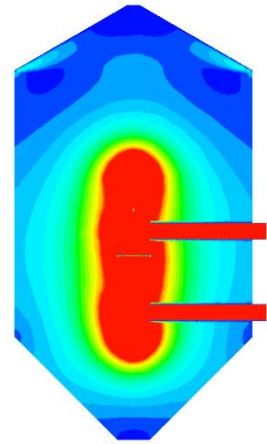
（4）Integrated silo of mechanical ventilation drying and storage of grain

- **Capacity**: 5-300 m^3;
- innovates the technology of “mechanical ventilation + grain circulation”, and obtains optimized ventilation process parameters;
- adopts the “multi-layer and multi-segment” cross-flow ventilation (commutation) drying technology, the ladder drying process and the supporting intelligent regulation and control technology;
- heat source (solar energy, gas, heat pumps, etc);
- achieves green and efficient drying in the grain production area and short-term (within 6 months) quality preservation storage.









2. Integrated drying-storage system

- After nearly 12 d of ventilation drying, the moisture content of corn was reduced from the initial 0.337±0.043 g/g to 0.152±0.045 g/g
- The acid value of corn increased from the initial 19.85 mg/100g to 25.44 mg/100g, but the value is still far less than 65 mg/100g, which meets the requirements of GB/T 20570-2015 for suitable storage.
- The energy consumption is 209 kW.h, the specific energy consumption is about 1115.24 kJ/kg.H_2O, and the drying cost is 33.23-47.47 yuan/t, which is a remarkable energy-saving effect.

WFP World Food Programme

2 ZERO HUNGER

Thank You

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