中国农产品初加工机械化发展与实践

Post-harvesting and processing mechanization of Agricultural Products in China

Reporter： Qizhen Xie， Professor

Academy of Agricultural Planning and Engineering, MARA

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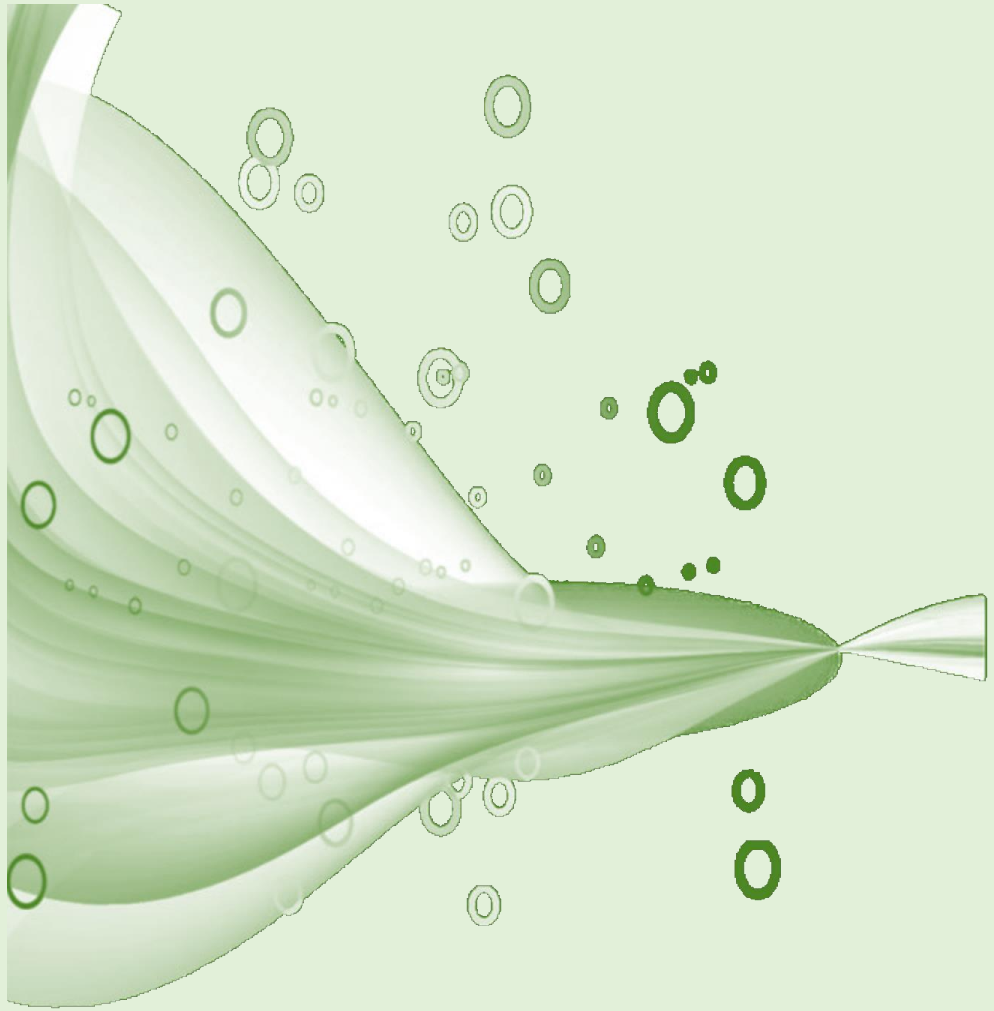


First Part

Aim of primary processing mechanization

1、Concept and scope of agricultural products

- Agricultural Products

  Refers to the primary products from planting, **forestry**, animal husbandry and fishery。

- Classification of Agricultural Products

Agricultural Products

1、**planting Products**
- **Grain** ， e.g. wheat, rice, corn, bean, potato
- **Oil seed**, e.g. rapeseed, peanut, oil sunflower, etc.
- **Fruit**, e.g. apple, orange, banana, pear, and etc
- **Vegetables**, including root, stem, flower, leaf and fruit vegetables
- **Characteristic products**, e.g. cotton, tea, cocoon, tobacco

2、**animal husbandry products**
- Meat
- Egg
- Milk

3、**fishery products**：Fish, shellfish, shrimp, algae, etc

2、 Primary processing machinery for agricultural products

The primary processing of agricultural products refers to the one-time processing of agricultural products that does not involve the change of the internal components of agricultural products,


ICS 65.060.01
B 90

NY

中华人民共和国农业行业标准

NY/T 1640—2021

代替 NY/T 1640—2015

agricultural Standard

农业机械分类

Agricultural machinery classification

Agricultural machinery classification

2021-05-07 发布　　2021-11-01 实施

中华人民共和国农业农村部 发布

One of five industries machinery

- **Planting machinery**
- **Animal husbandry and breeding machinery**
- **Fishery machinery**
- **Agricultural products primary processing machinery**
- **Agricultural power machinery**

8 major categories and 15 minor categories, It includes 89 items.

1. Seed processing machinery
2. Grain, Oilseed, sugar ma-
3. Cotton,hemp, silkworm ma-
4. Fruit, Vegetable, Tea ma-
5. Herbs, spices, tobacco ma-
6. natural rubber ma-
7. Animal husbandry and breeding machinery
8. Fishery machinery

3. Aim for developing agricultural products processing mechanization

（1）To reduce the postharvest losses of agricultural products can ensure the supply security.

In 2022, China produced

Grain	686	million ton
Oilseed	36	million ton

According to statistics, the losses among storage, process and transformation is 35 million ton, is 5% of total output。

（2）To promote farmers' income and rural economic development.

- **Reducing losses means increasing income.**

  e.g. reduce grain loss of 1 million tons, means 3 billion RMB Yuan.

- **Generate value-added income by storing off-peak sales**

  e.g. Extend storage time through modern storage facilities, and earn income by selling in off-season,

- **To produce high-value products by primary processing, can increase farmers income.**

e.g. prolongs processing chain and improves the commodity value.
Paddy-rice, wheat-flour

Aim for developing agricultural products processing mechanization

（3）Conducive to saving land and avoiding waste of resources

Corn loss
10 million tons → Corn cultivated land
2 million ha

Reducing losses means saving cultivated land.！！

（4）Reduce pollution and protect ecological environment.

Rot and deteriorate, pollute the environment

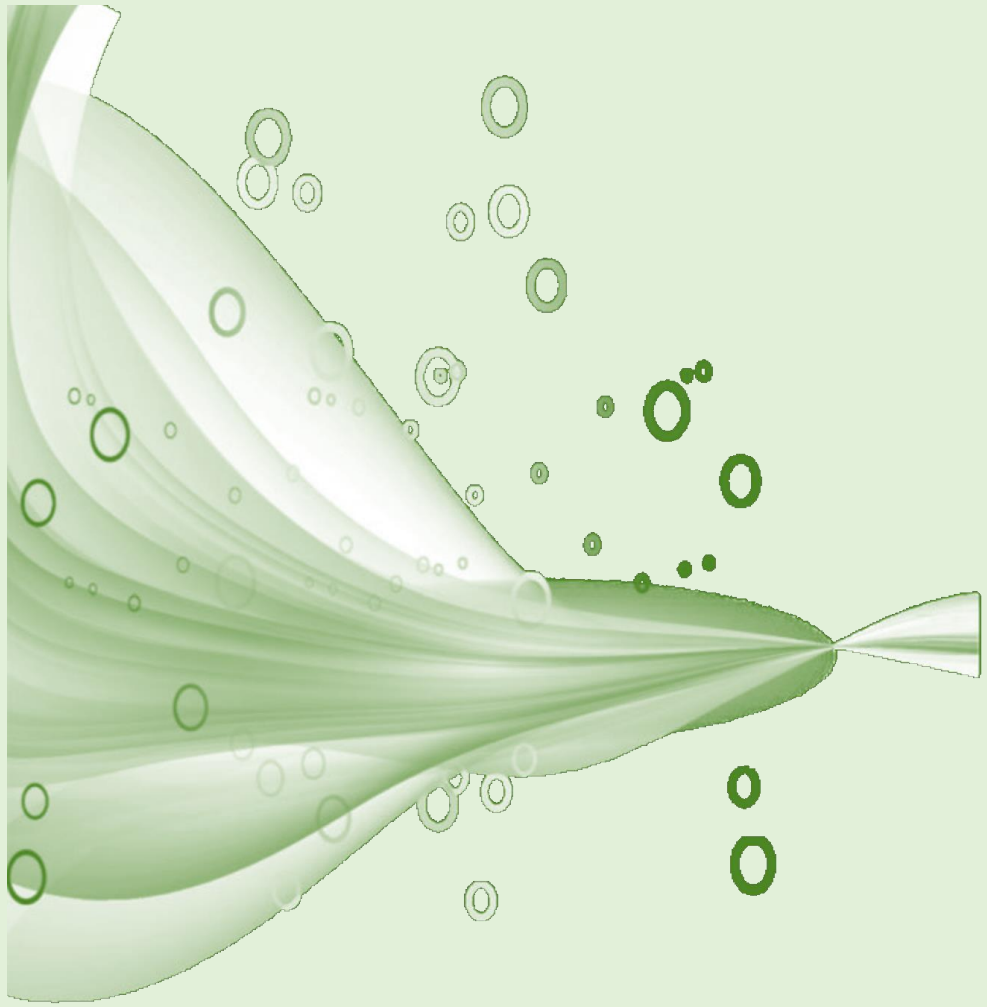
Increase the amount of domestic garbage

pollute the water source.

（5）Ensure the quality of agricultural products and eliminate potential food safety hazards.

- Corn is mildewed and produces aflatoxin.
- Accumulation of harmful microorganisms
- Mosquito and fly-borne diseases



The 2nd part

Present situation of mechanization of grain and oil primary processing in China

1.the overall situation of China's grain and oil primary processing mechanization development.

- Development level of mechanization of primary processing of grain and oil

$$A = 0.35A1 + 0.35A2 + 0.30A3$$

A——Mechanization rate of primary processing of grain and oil

A1——Mechanization rate of grain and oil threshing

A2——Mechanization rate of grain and oil cleaning

A3——Mechanization rate of grain and oil quality guarantee (drying+storage)

For grain	A=65.75%	A3=27.5%
For oilseed	A=57.73%	A3=26%

National Statistical Yearbook of Agricultural Mechanization

A1=X/Y ×100%
X—grain mass which is threshed by machinery.
Y--- total grain mass which is threshed by any ways.

- Ownership of grain and oil primary processing machinery

Grain primary processing machinery	12.51	million sets
drying equipment	145	thousands sets
Oil seed primary processing machinery	807.2	thousands sets

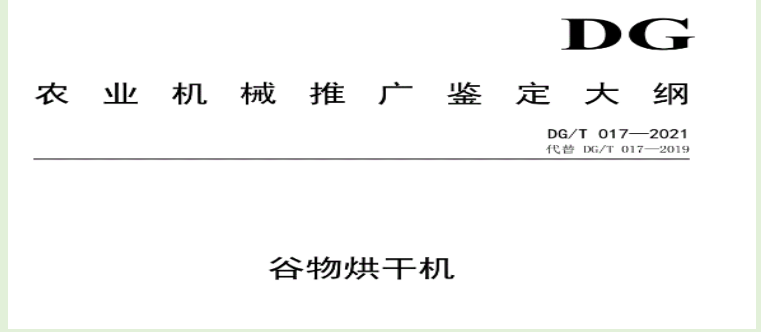
2、Equipment manufacturing popularizing evaluating

- **Manufacturing situation of grain drying equipment:**

There are more than 400 grain and oil processing machinery enterprises in China，and 205 grain dryer manufacturers.

- **Complete system for Equipment** performance testing, popularizing & evaluating
- **Complete standard system**
- **Complete Science & technology R&D system**

现行有效 GB/T 16714-2007 连续式粮食干燥机
现行有效 GB/T 6970-2007 粮食干燥机试验方法
现行有效 GB/T 21162-2007 顺流粮食干燥机单位耗热量与处理量折算规则
现行有效 GB/T 26550-2011 粮食干燥机同比热效率的测试与评价
现行有效 GB/T 30467-2013 横流粮食干燥机单位耗热量与处理量折算规则
现行有效 NY 1644-2008 粮食干燥机运行安全技术条件
现行有效 NY/T 463-2001 粮食干燥机质量评价规范
现行有效 LS/T 1222-2020 粮食干燥机系统工艺设计技术规范
现行有效 JB/T 13628-2020 循环式粮食干燥机
现行有效 GB/T 21399-2008 粮食干燥机自动控制系统评定规则

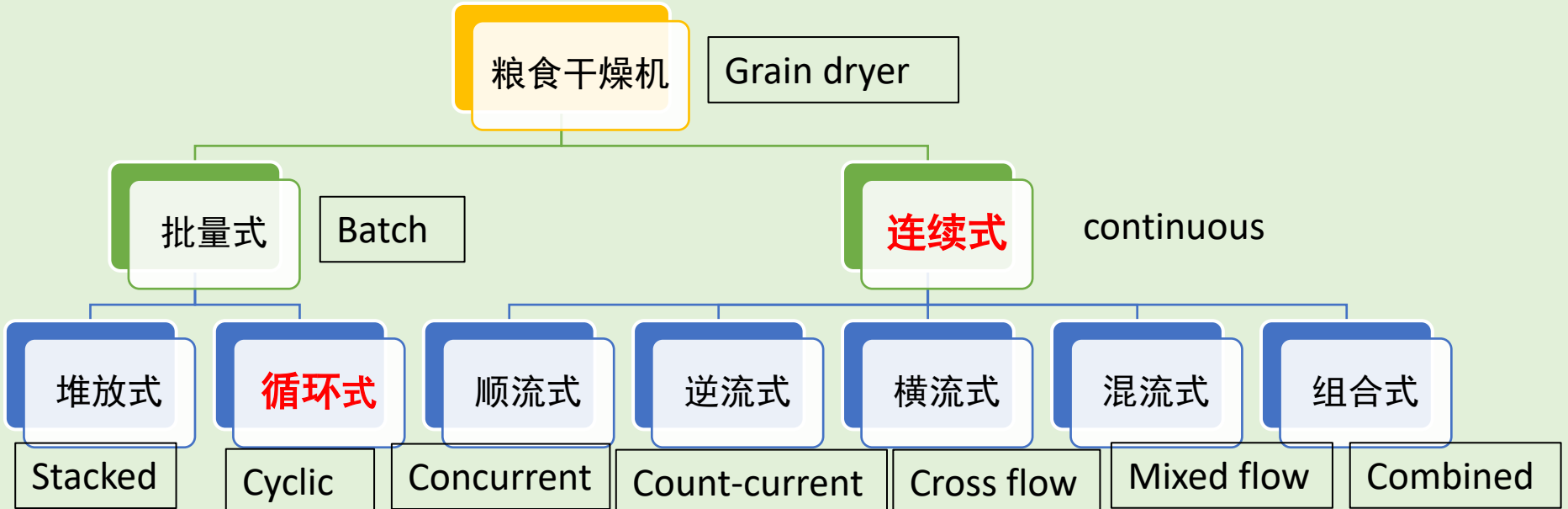

DG
农 业 机 械 推 广 鉴 定 大 纲
DG/T 017—2021
代替 DG/T 017—2019
谷物烘干机

3、 Application of grain and oil primary processing machinery

Main section of grain and oil primary processing

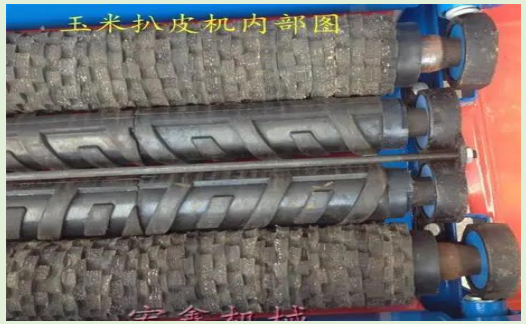
grain	Peeling, threshing, cleaning, grading, drying, storage, pulverizing and milling.
Oilseed	Shelling, cleaning, grading, drying, storage and squeezing.

Drying section of grain and oil are the weakest section



3、 Application of grain and oil primary processing machinery

Peeling machinery-for corn



Threshing machinery

simple thresher

compound thresher

Cleaning machinery

Double-cylinder cleaner

Combined cleaner

Vibrating Cleaner

3、 Application of grain and oil primary processing machinery

- **Corn drying in the sun**

drying in the sun
and ventilation with natural air

3、 Application of grain and oil primary processing machinery

- **Wheat /Rice**

- **Pennut /rapeseed**

(2) Batch type grain dryer

☐ Stacked Batch type grain dryer

Features：

- **Simple structure，Low price。**
- **Wide application ，** all kinds of agri. Products
- **Lower capacity,** low efficiency**,** Loading and discharging by hand

Multi- beds batch dryer

Single bed batch dryer

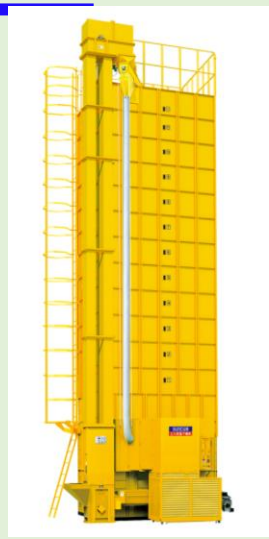
Stacked corn ear drying chamber with slopping bed

3、 Application of grain and oil primary processing machinery

（2） Batch type grain dryer

☐ Cyclical dryer

The largest amount dryer, about 85% in all dryers
The largest amount of manufacturers



Features：

- Specific for paddy，also dry wheat and corn (maize)
- Low drying temp. cyclical drying technology, drying and tempering Alternately，good ≤quality，lower drying rate, 0.5%-1.0%/h。
- Capacity ≤ 30t/batch
- Good flexibility for different capacity， Tandem arrangement or Parallel arrangement

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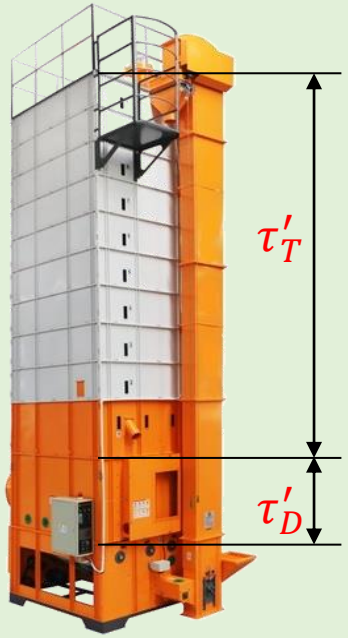
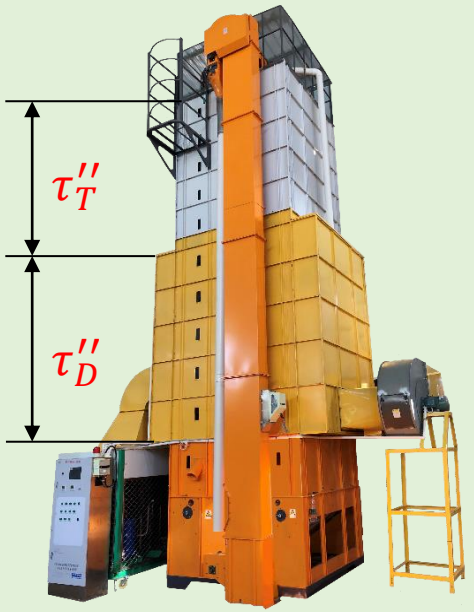
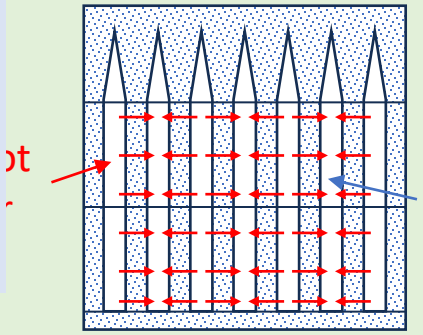


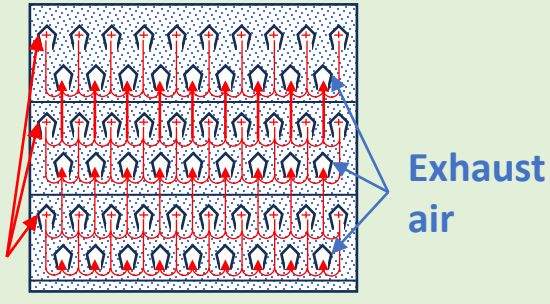
Cyclical dryer with
Cross- flow drying tech.



Cyclical dryer with
Mix- flow drying tech.

提高干燥效率和物料适应性，可烘干小颗粒粮食油料





（3）Continuous grain dryer

Features：

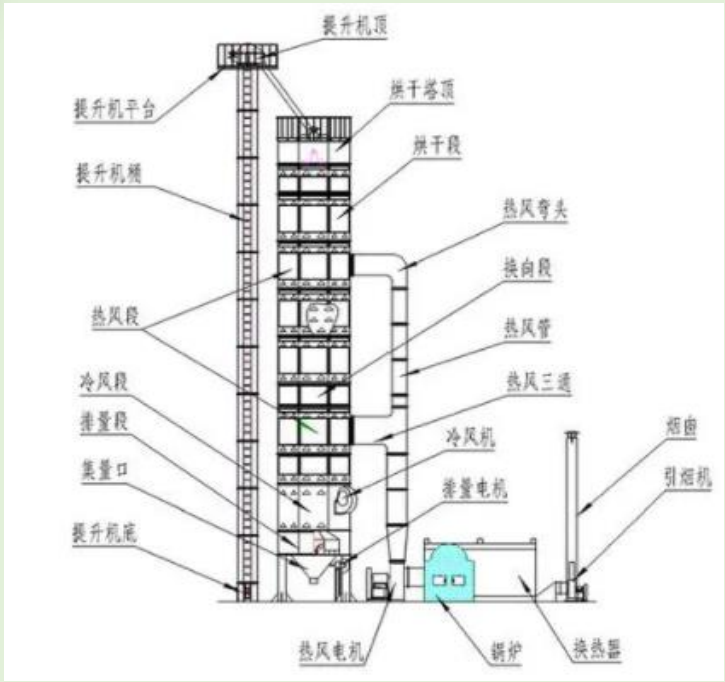
a. Continuous drying, no cyclical operation ；

b. Mainly for corn and wheat，need to modify structure for paddy

c. High drying efficiency，capacity，1000t/day, 1500 t/day,

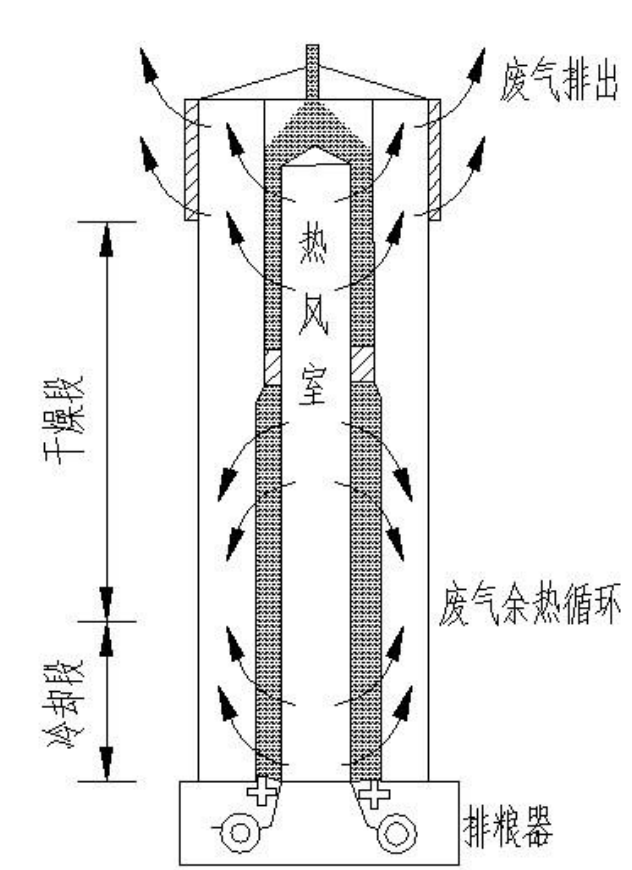
Mixed flow grain dryer

Concurrent flow grain dryer



（3）Continuous grain dryer

☐ Crossflow dryer



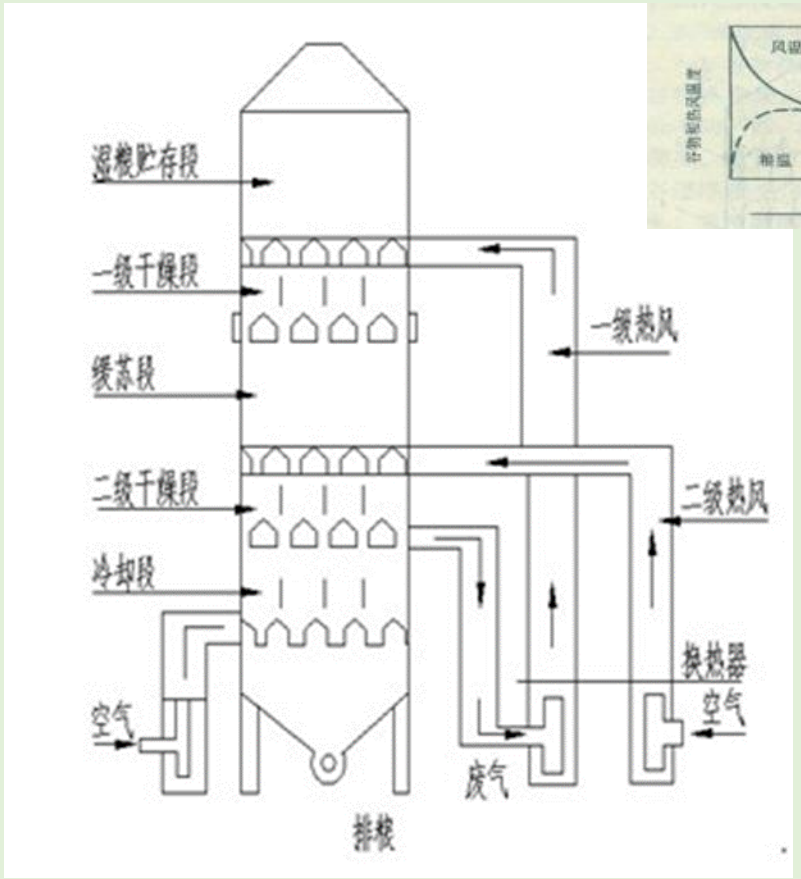
Features：

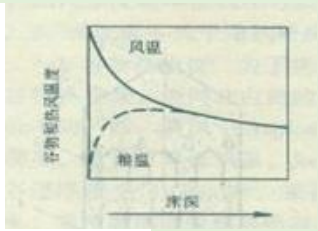
- ◆ simple structure, convenient manufacture and low cost.
- ◆ grain flow direction is perpendicular to the hot air flow direction.
- ◆ Shortcomings

Uneven drying, on the inlet side the grain too dry, on the exhaust side grain is not dry enough, energy consumption is high

（3）Continuous grain dryer

☐ Concurrent flow dryer





Features:

- ◆ hot air flows in the same direction as grain;
- ◆ Fast drying speed

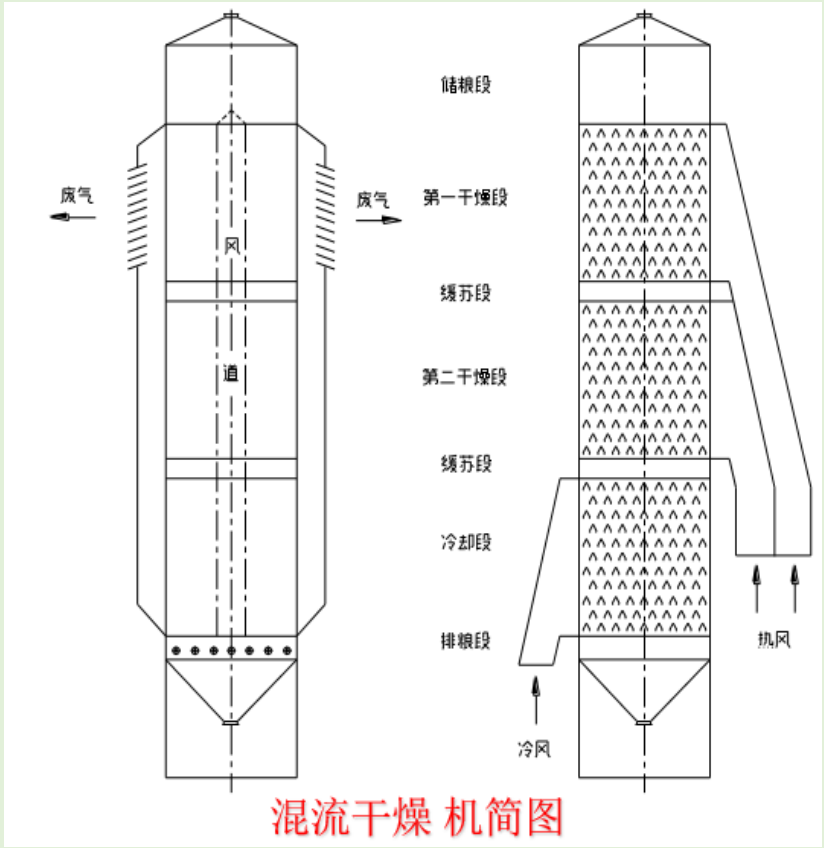
Use higher hot air temp., such as 200 ~ 285℃, grain temp. not too high,

- ◆ low energy consumption ,and high efficiency .
- ◆ uniform drying and good grain quality;
- ◆ Thicker grain layer, larger resistance of grain to airflow, and larger fan power
- ◆ Suitable for drying high moisture grain.

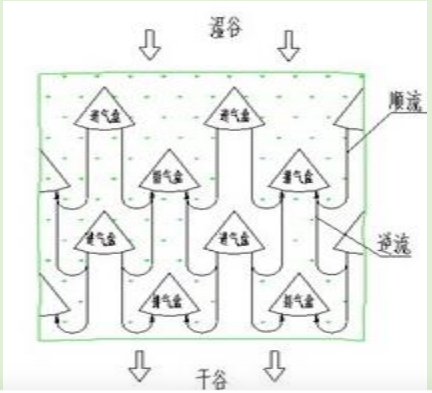
3、 Application of grain and oil primary processing machinery

（3）Continuous grain dryer

☐ Mixed flow dryer



混流干燥 机简图



Features:

- **Mixed-flow drying technology alternately arranged the inlet and exhaust air ducts , and grain flow downwards according to the S-shaped trail, and alternately contact high-temp. and low-temp. airflow, more high air temperature than cross-flow dryer.**
- **dry small grain and oilseed, such as rapeseed**
- **Lower power than concurrent flow dryer.**
- **High efficiency and capacity**
- **better grain quality, lower crack rate and thermal damage**

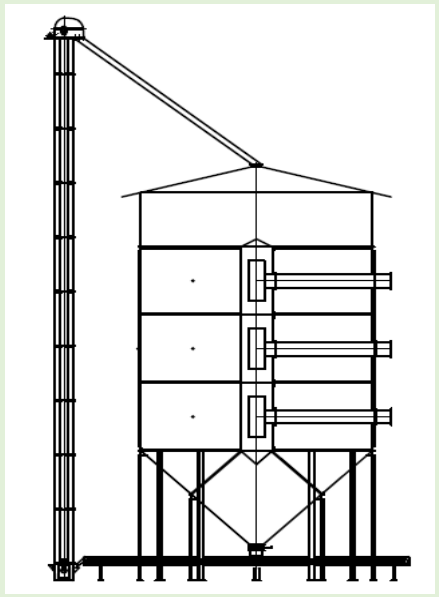
（4）Heat Pump Grain Dryer

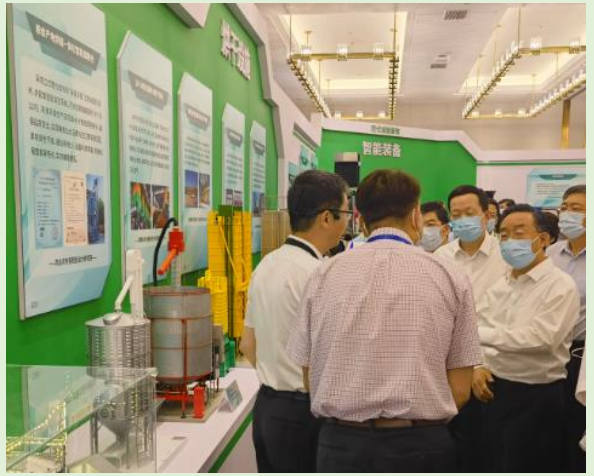
High quality	• Less circulation times than traditional dryers, drying temp. is below 55 ℃ • Fit for seed drying
High efficient	• In Guangdong province, 16h for drying early rice and 20h for late rice • Drying time is less 30% than other dryers
Energy-saving, clean energy	• Drying cost 40RMB/t wet paddy，lower 40% than biomass fuel, lower 70% than diesel. • no carbon dioxide emissions
Cost-effective	• Profit can be achieved in the drying process. • The investment return period is 7 years.

（5）Self-circulating intelligent drying and storage integrated silo

- Intelligent grain storage facility combining natural ventilation with mechanical ventilation

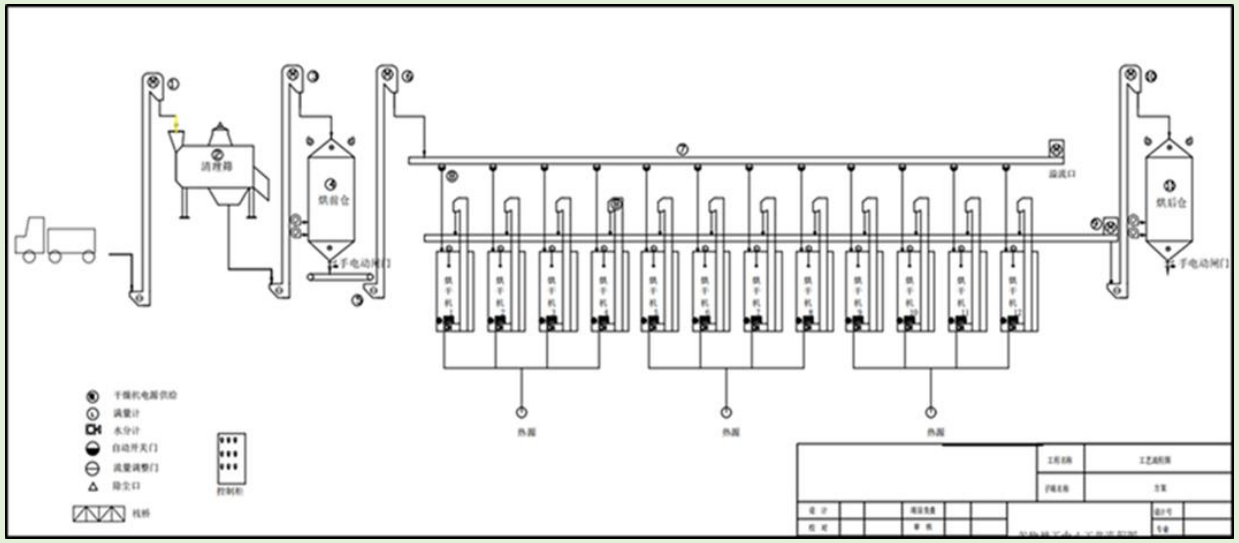
  Capacity 100t-300t , fit for smaller famers with 20-30ha. Carry out integration of grain drying and storage.；
- Smaller area to built , longer operation time, and farmers can get bonus by storage；
- Low drying cost and good grain quality.



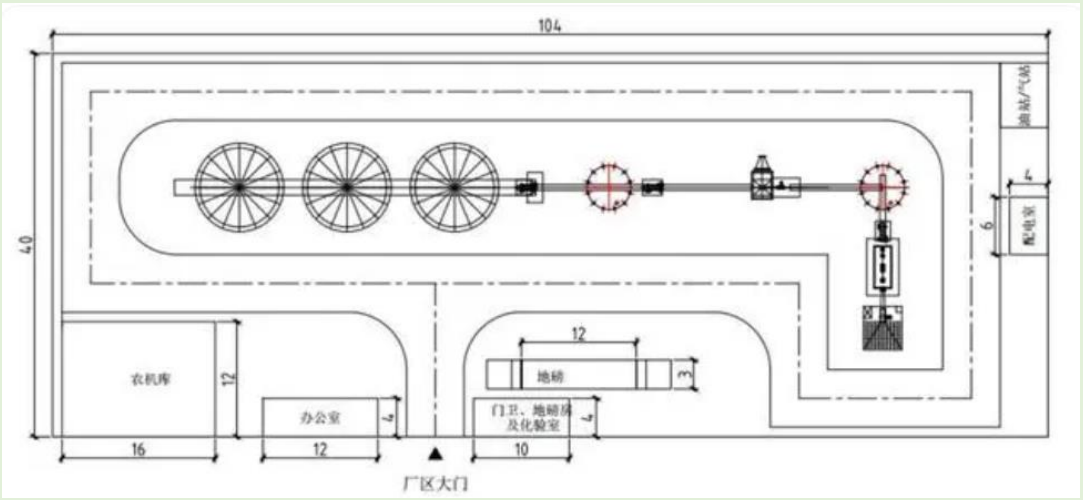


（6）Complete sets of Grain Drying

The main facilities and auxiliary facilities and equipment for wet grain weighing, cleaning, drying and temporary storage. Generally, it includes complete sets of equipment such as weighing, cleaning, temporary storage and drying.



Flow diagram for Grain drying



Layout plan for Grain drying

3、 Application of grain and oil primary processing machinery

Auxiliary equipment of complete grain drying equipment

motor truck scale

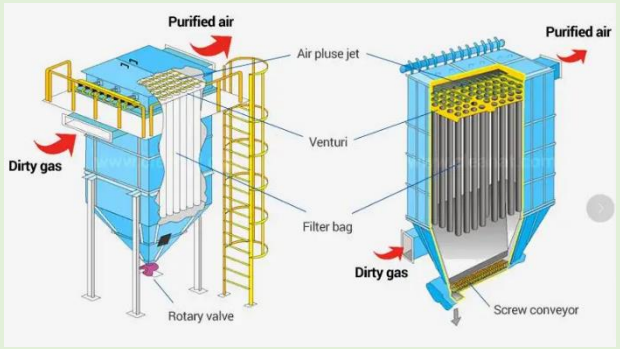
motor truck scale

Grain cleaner

bucket elevator

Horizontal belt conveyor

Inclined belt conveyor



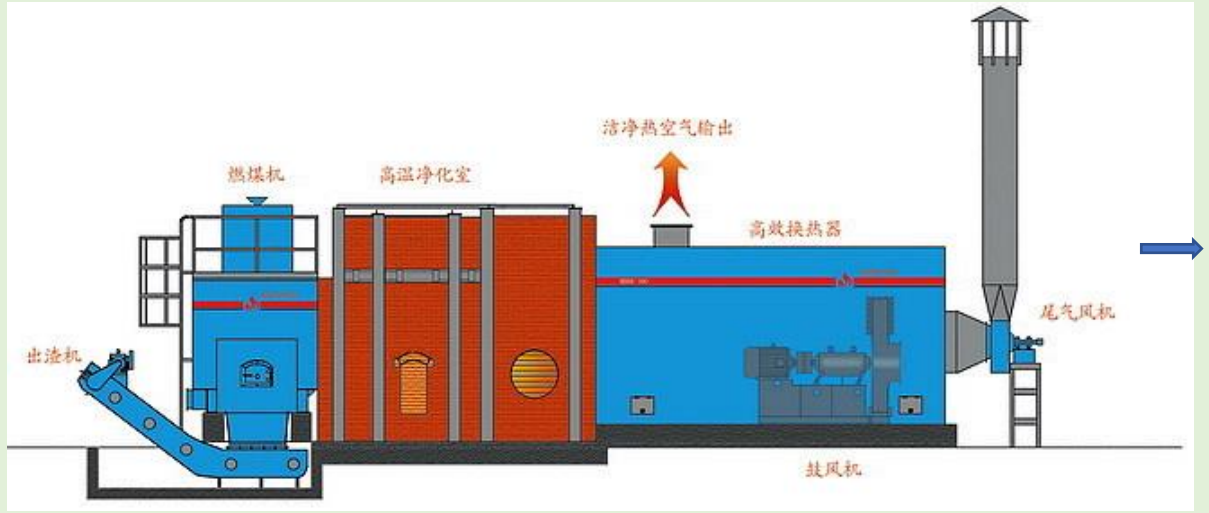
bag-type dust remover

Temporary storage silo before and after drying

（5）Mobile grain dryer

3、 Application of grain and oil primary processing machinery

- **Heat source is used for grain drying.**



Coal-fired hot air furnace

Biomass bullet hot air furnace

Diesel /natural gas-fired hot air furnace

Heat pump

4、Development status of grain storage facilities

（1）Classification of grain storage facilities

- According to the shape of the warehouse
- According to grain stacking mode

  Bulk bin, packaging bin

  House warehouse, silo, building warehouse
- According to the warehouse building conditions and equipment configuration

  Simple granary, general granary, mechanized granary and assembled granary
- According to the location of granary construction

  Above-ground , underground and semi-underground
- According to the grain storage performance

  Controlled atmosphere, low temperature ,

  quasi-low temperature and normal temperature





4、Development status of grain storage facilities

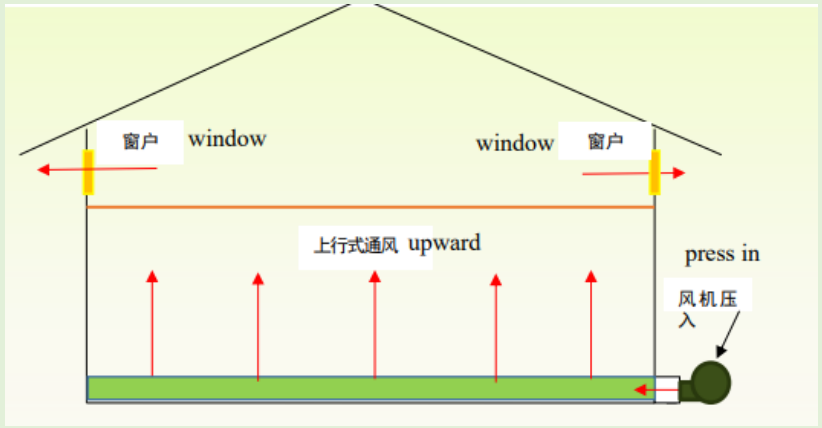
（2）Steel Silo

（3）High flat warehouse

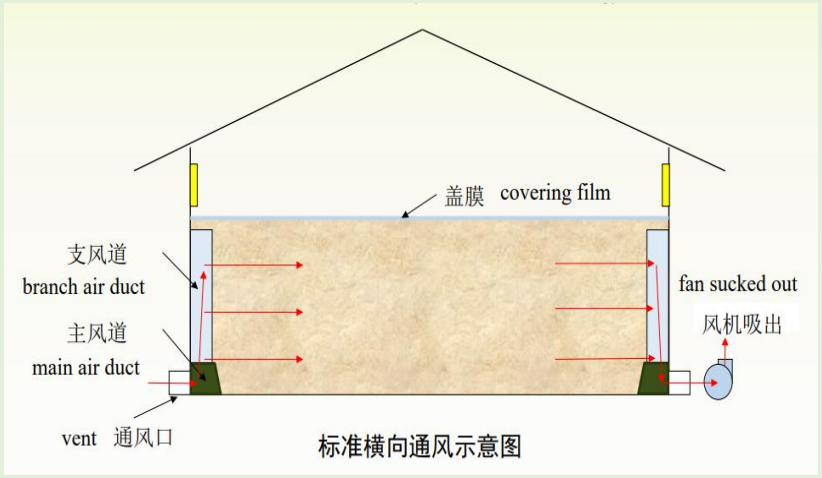
4、Development status of grain storage facilities

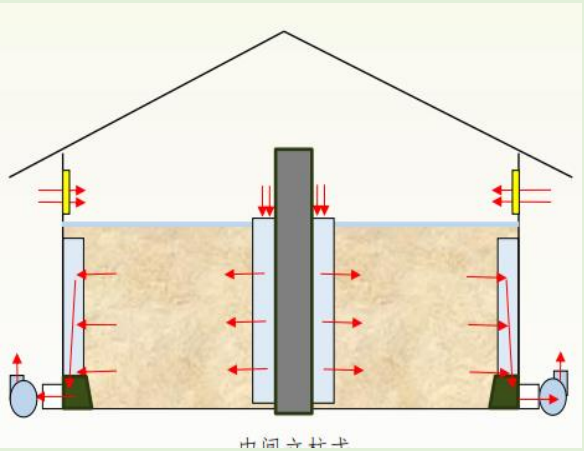
3、Typical grain storage technology

Vertical ventilation system



Horizontal ventilation system





4、Development status of grain storage facilities

3、Typical grain storage technology —— Low temperature grain storage technology

分类

Low temperature grain storage means that the average grain temperature is kept at 15℃ and below all the year round, and the local maximum grain temperature does not exceed 20℃。
Quasi-low temperature grain storage means that the average grain temperature is kept at 20℃ and below all the year round, and the local maximum grain temperature does not exceed 25℃.

功能

Insecticidal and bacteriostatic, inhibit grain respiration, reduce grain dry matter loss, reduce the use of chemical agents, delay grain aging, and ensure grain edible quality and nutritional quality.

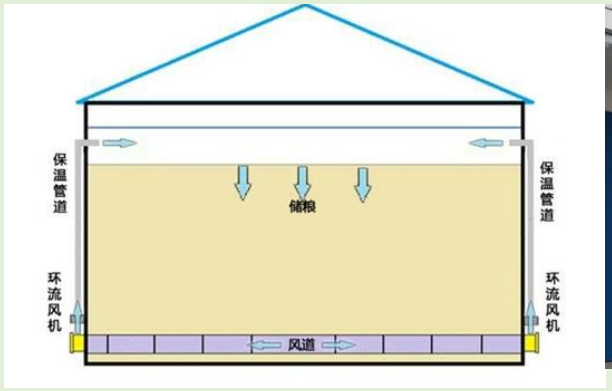
实现

- Air conditioner control technology

controls and adjusts the warehouse temperature, grain temperature and humidity，suitable for high temperature and high humidity areas in the south.

- Internal circulation temperature control

In winter, uses the ventilation equipment installed in the warehouse to cool the grain pile temperature，and suitable for the northern region。



4、Development status of grain storage facilities

3、Typical grain storage technology　　Modified atmosphere grain storage technology

artificially modifies the gas composition or proportion in the grain pile to a certain concentration , and maintain it for a certain time, so as to achieve the purpose of killing insects, inhibiting mold and delaying the change of grain quality.

Nitrogen storage: Using nitrogen concentration above 95% can effectively delay the change of grain quality.

function

1. Reduce or eliminate pests
2. Prevent mildew: make the oxygen concentration lower than that required for mold metabolism.
3. Prolong grain storage time: slow down the metabolic activity of stored grain cells and reduce volatilization and oxidation reactions
4. Preserve grain nutrients effectively
5. Save Energy Consumption

5、 Production Lion of grain and oil primary processing

(1)Corn processing production line

System composition diagram

5t/d production line

20-30t/d production line

100-120t/d production line

5、 Production Lion of grain and oil primary processing

(2) Rice processing production line ——From Paddy to Rice

15t/d complete sets of rice milling

50-80t/d complete sets of rice milling

120-150t/d complete sets of rice milling

200t/d complete sets of rice milling

5、 Production Lion of grain and oil primary processing

(3) wheat processing production line

200t/d wheat milling complete set

0-1t/d wheat milling complete set

30t/d wheat milling complete set

80-100t/d wheat milling complete set

5、 Production Lion of grain and oil primary processing

(4) Oilseed processing equipment ＆production line



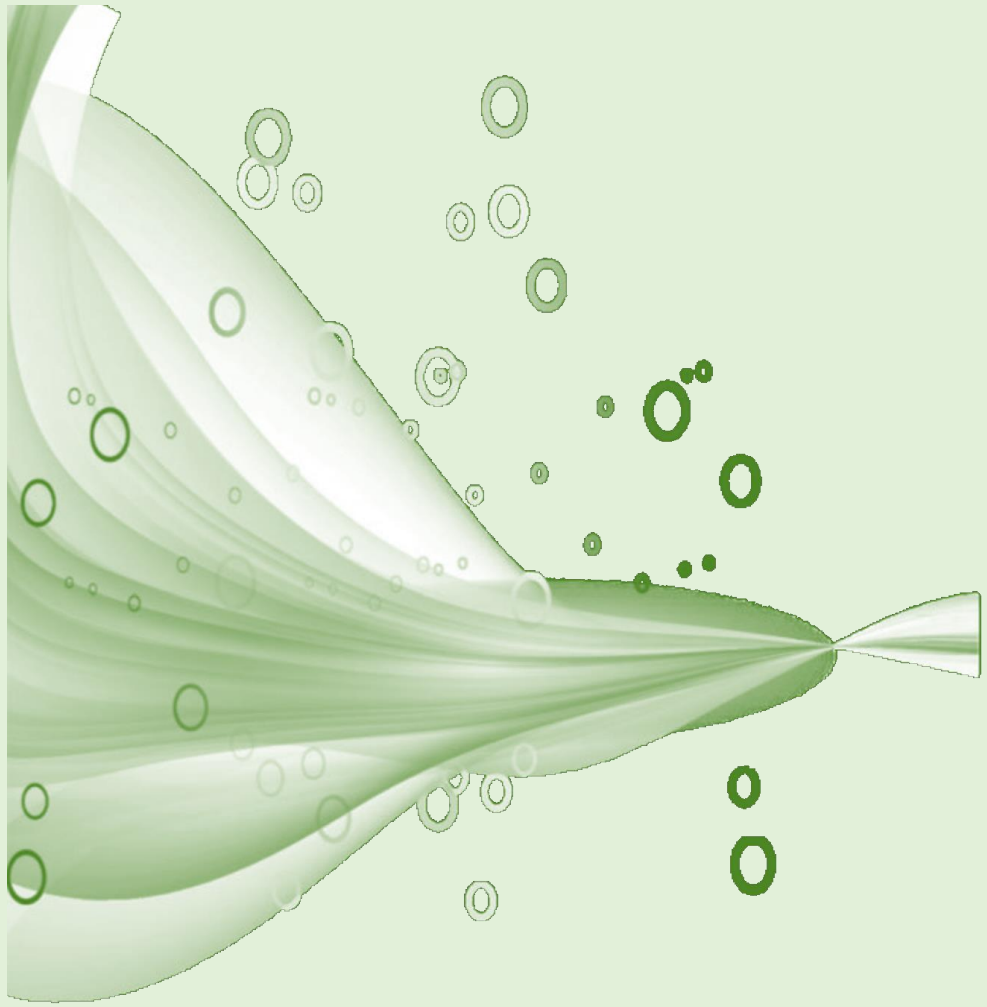

Cleaning → shelling → crushing → steaming and frying → squeezing → filtering → squeezing oil.

100T/D rapeseed oil pressing equipment

100T/D tea seed Oil pressing equipment

100T/D peanut oil pressing equipment

100T/D soybean 0il pressing equipment



第三部分

Support policy for mechanization industry of grain and oil primary processing

3、 Subsidy policy agricultural machinery

Subsidy policy for purchasing agricultural machinery in China

---by Ministry of Agri. ＆Rural Afair

In 2004, in order to support the development of agricultural mechanization, Chinese government began to implement the policy of subsidizing the purchase of agricultural machinery.
At the beginning, and subsidized agricultural machinery focused in tractors and planting machinery,
Now it has gradually formed a complete organization and management measures, farmers and cooperatives could apply and get financial support, subsidy ratio is around 30%.

In 2014, primary processing machinery was listed in items of subsidized machinery.
From 2021, complete sets of primary processing machinery was listed in items of subsidized machinery.

By the end of 2022, total subsidy fund was about 270 billion RMB, arroud 40 billion US dollors.

The National Science and Technology Project for High Grain Yield

---by 3 Ministries

The Projects started in 2004. In view of the grim reality of China's grain production, the Ministry of Science and Technology, the Ministry of Agriculture, the Ministry of Finance and the State Grain Administration joined forces with 12 major grain-producing provinces, based on the three major plains of Northeast China, North China and the middle and lower reaches of the Yangtze River, and started the implementation of the National Science and Technology Project for High Grain Yield around the goals of high yield and high efficiency of rice, wheat and corn.

From 2005-2015 State Grain Reserve Bureau implement a subsidy project for small grain silo suitable for smallholders.

850 ~ 1200kg

rice, wheat

3t ~ 5t

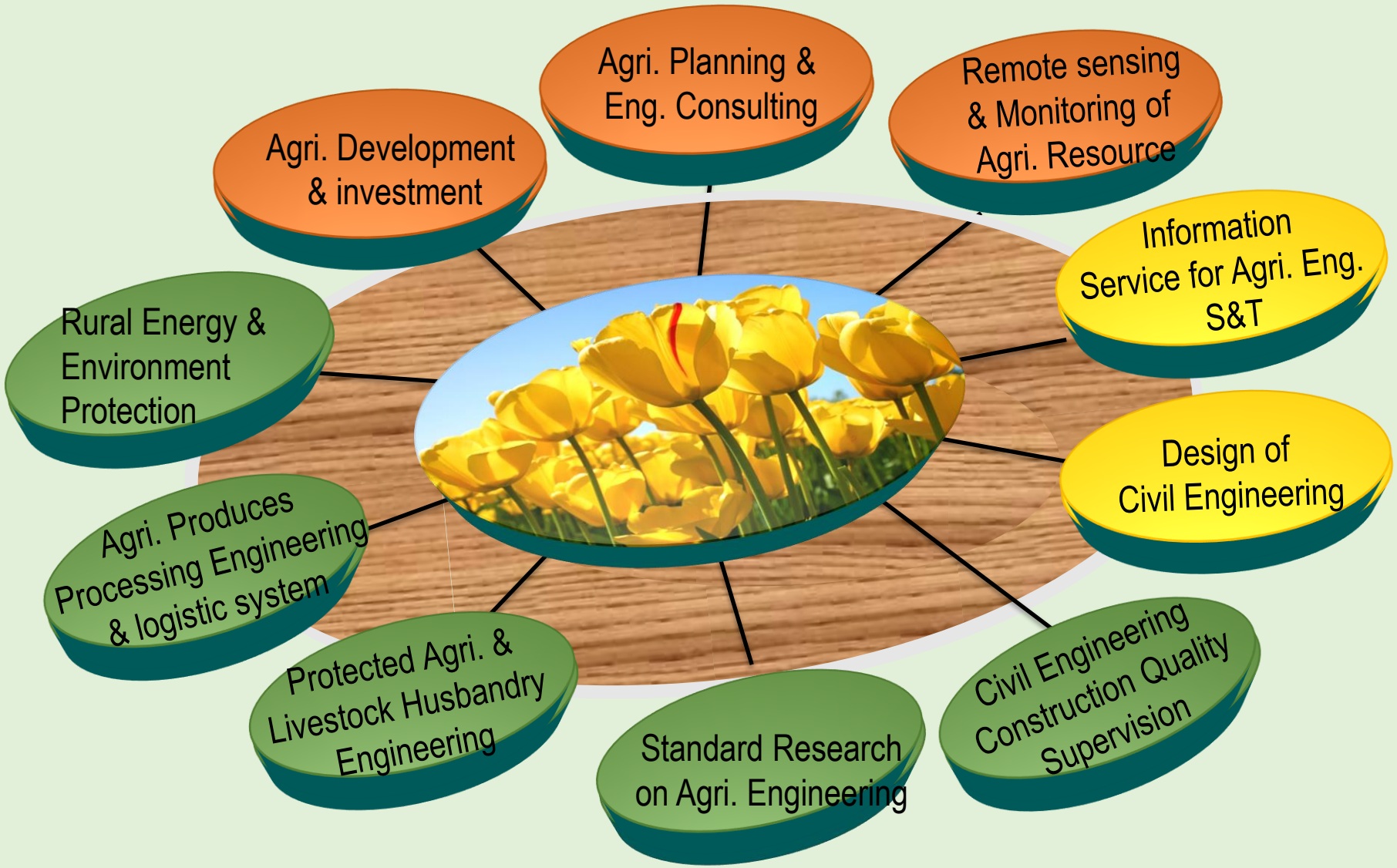
Ear corn

12t ~ 15t

Brief introduction

- Founded in 1979, named as Chinese Academy of Agricultural Engineering, is a public institute of MOA, Serve China's Agriculture.
- Growing up with Chinese Reform and Opening to Outside World
- In 1992, changed name as "Academy of Planning, Design and Research of MOA.
- In 2018, changed name again as "Academy Agricultural Planning and Engineering. MARA.

Key Interests



Staff

- Totally > 600 Staff

- PHD 57
- Master Degree 68

- Professor 45
- Senior Engineer 88

人员质、量、结构继续改善

Scientific Condition

Address of Headquarters:

NO.41 Maizidian Street ,

Chaoyang District,

Beijing, China

- Research Centre of Biomass Engineering ,MOA
- Key Lab of Energy Utilization of Rural Waste, MOA
- Remote Sensing Application Centre, MOA
- R&D Sub-division of National Agro-food Processing Equipment
- Key Lab. of Agri. Produce Postharvest Processing, MOA
- Key Lab. of Facility and Construction Engineering, MOA

END

MANY THANKS FOR YOU ALL

If you have any questions, please ask us any time at your convenience

Tel：0086-1059197326 Moble：008615701525357
Email：xqizhen@sina.com