China's solution on rice Post-harvest loss reduction

中国产后稻米减损技术

Prof. XIE Jian 谢健 教授

China Grain Wuhan Sci. Res. & Design Insti.

国粮武汉科学研究设计院

2022.09.13

1. Potential losses & causes
2. Solutions for 3 main sections

1. Potential losses & causes in sections

type of loss	causes	drying	store	milling
quantity loss	exceed grain content in impurities / by-products/reject or due to leakage	√ √ √	√	√ √ √
quality loss	heat damage due to exceed temp	√ √ √	√ √ √	√ √
quantity loss & quality loss (nutrition loss)	damaged by rats，bird，insect，moldy	√	√ √	√
	ultra low moisture due to exceed drying	√ √ √	√	√
	high broken kernel rate due to exceed pressure / impact /stress variation/ temp.	√ √ √	√	√ √ √
	high crack kernel rate due to exceed pressure / impact /stress variation/ temp.	√ √ √	√	√ √ √
	over milling due to exceed milling degree			√ √ √

2. Solutions for 3 main sections

2.1 Solutions for drying

2.2 Solutions for store

2.3 Solutions for milling

2.1 Solutions for drying

2.1.1 low temperature drying

(air / paddy temperature)

2.1.2 low speed drying

(rate of moisture reduction)

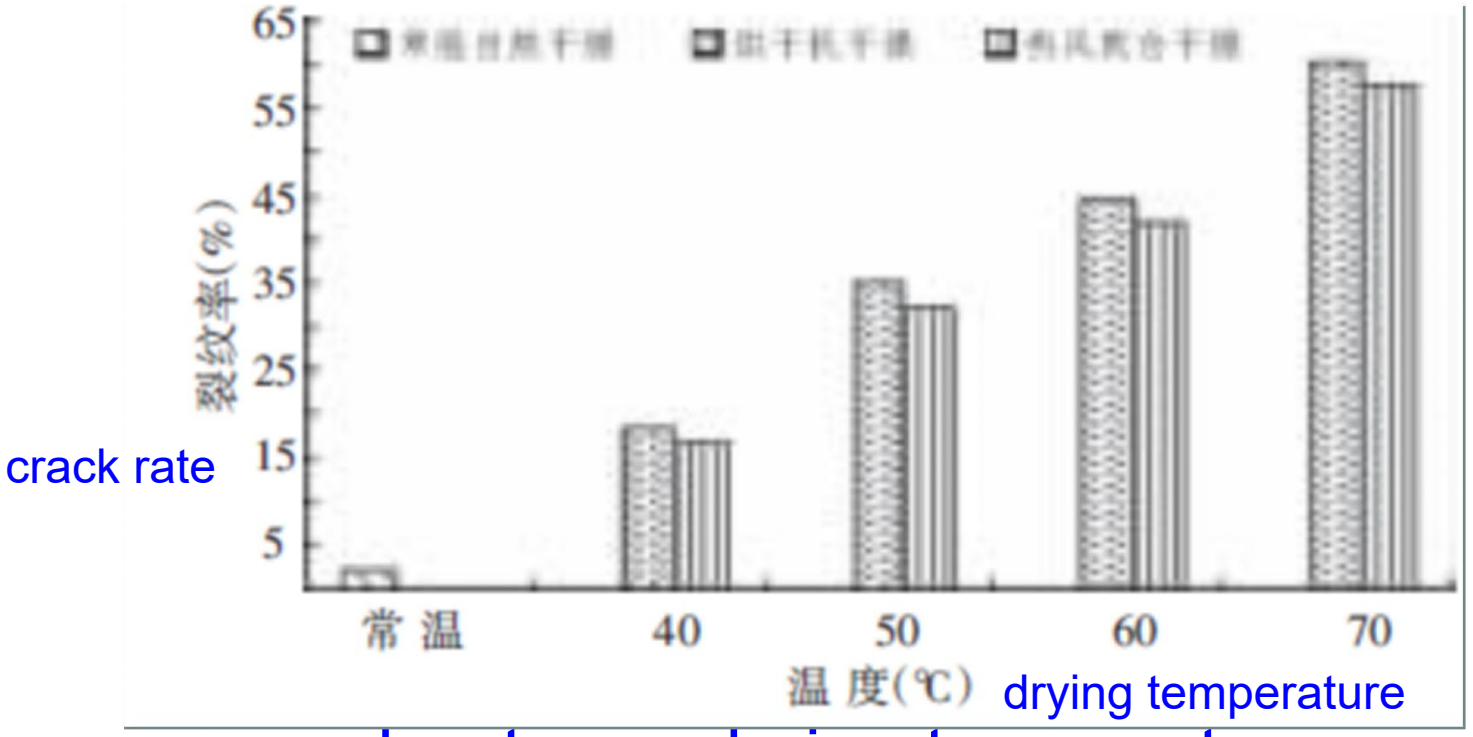
2.1.3 sufficient tempering

(control composition of air)

2.1.1 low temperature drying

lower term. drying = lower crack rate

= lower quantity loss & quality loss



crack rate vs. drying temperature

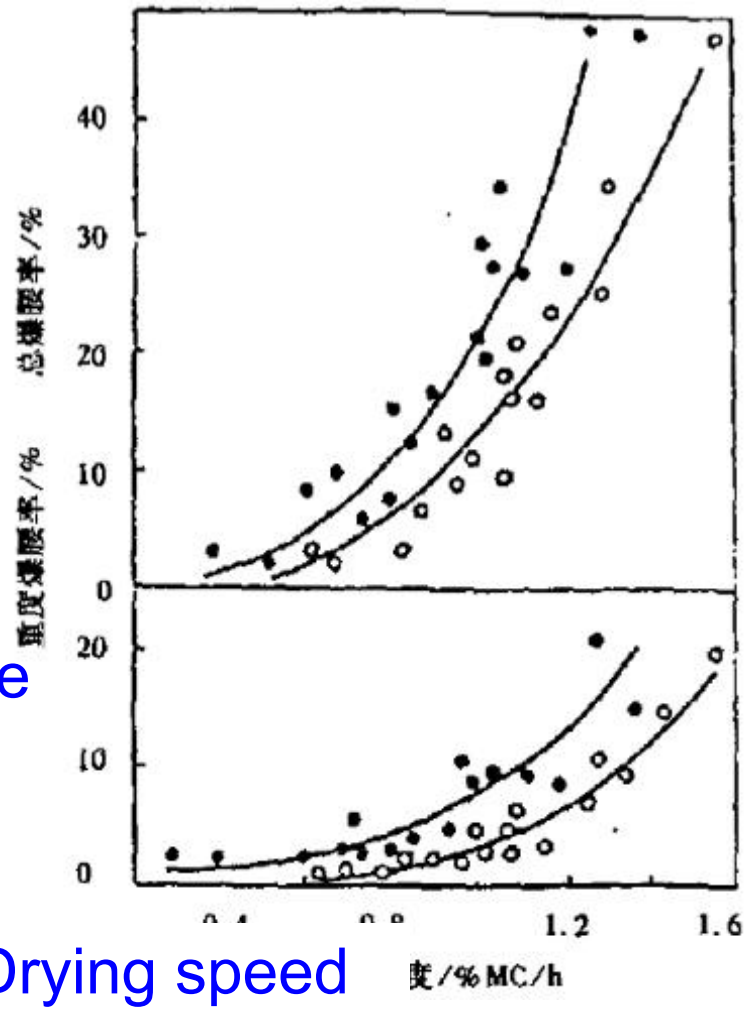
2.1.2 low speed drying

lower speed drying =

lower total crack rate raise,

lower heavy crack rate raise

= lower quantity loss & quality loss



2.1.3 sufficient tempering

sufficient tampering（let moisture tran. to the outside from inside

= less crack rate raise = less broke rate raise

= lower quantity loss & quality loss

	drying temp.	tampering time : drying time	
	(℃)	no stop	3:1
crack rate raise（pentagon point）	45	1.9	0.7
	50	6.6	1.9

combined drying flow

higher moisture content paddy（＞20%）

↓

1st drying （to ~20%）

↓

tempering bin/ chamber（sufficient time）

↓

2nd drying （low speed drying ）

↓

dried paddy （~15%）

2.2 Solutions for store

2.2.1 air-tight storage

(control air movement)

2.2.2 low temp. storage

(control air / grain temp.)

2.2.3 low O_2 storage

(control composition of air)

2.2.1 air-tight storage

(control air movement)

prevent moisture loss = lower quantity loss

prevent damaged by rats, bird, insect

= lower quantity loss + lower quality loss

2.2.2 low temp. storage

(control air / grain temp.)

control insect, fungi & lower FAV

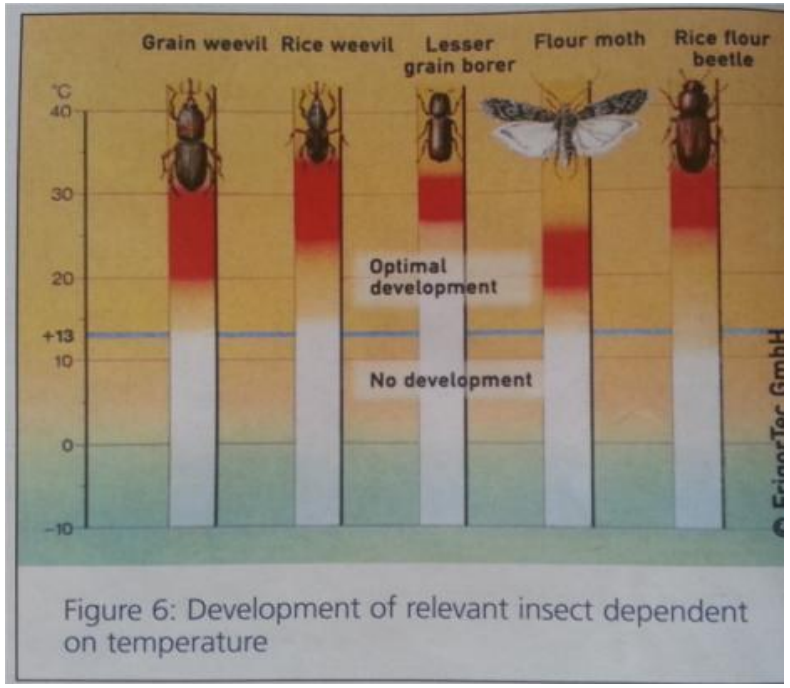


Figure 6: Development of relevant insect dependent on temperature

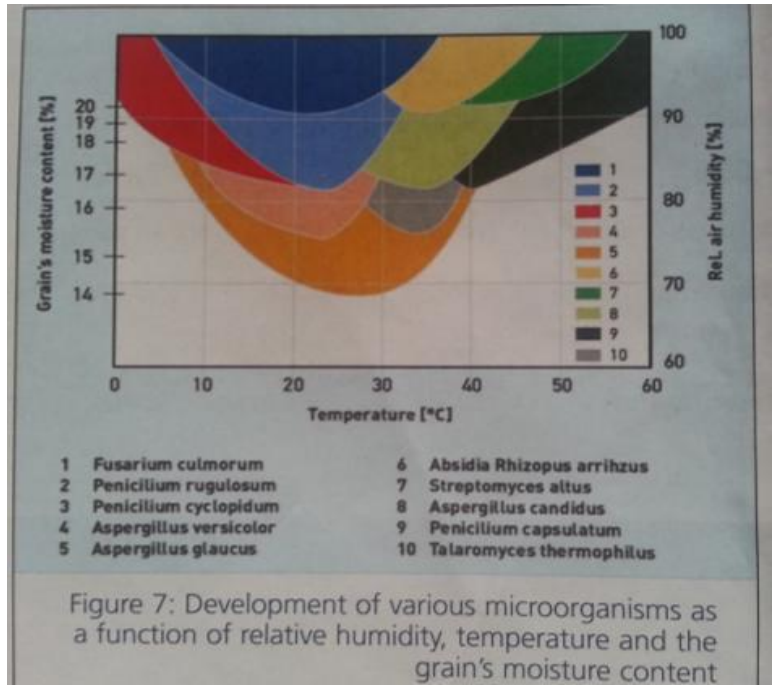
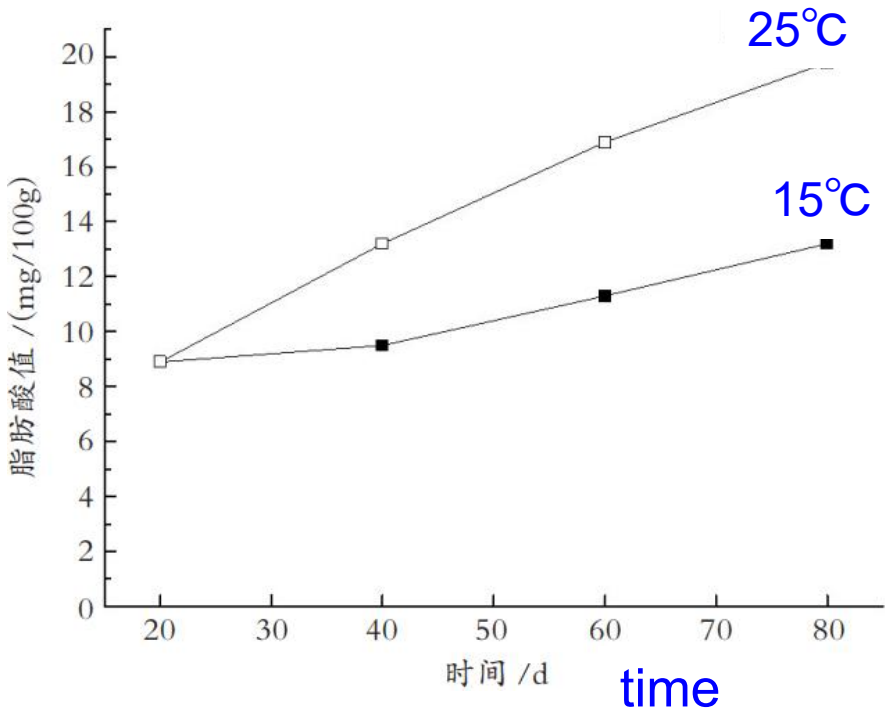


Figure 7: Development of various microorganisms as a function of relative humidity, temperature and the grain's moisture content

FAV



2.2.2 low temp. storage

(control air / grain temp.)

control insect, fungi & lower FAV

air tight + heat isolation + ventilation system / air conditioner / grain chiller

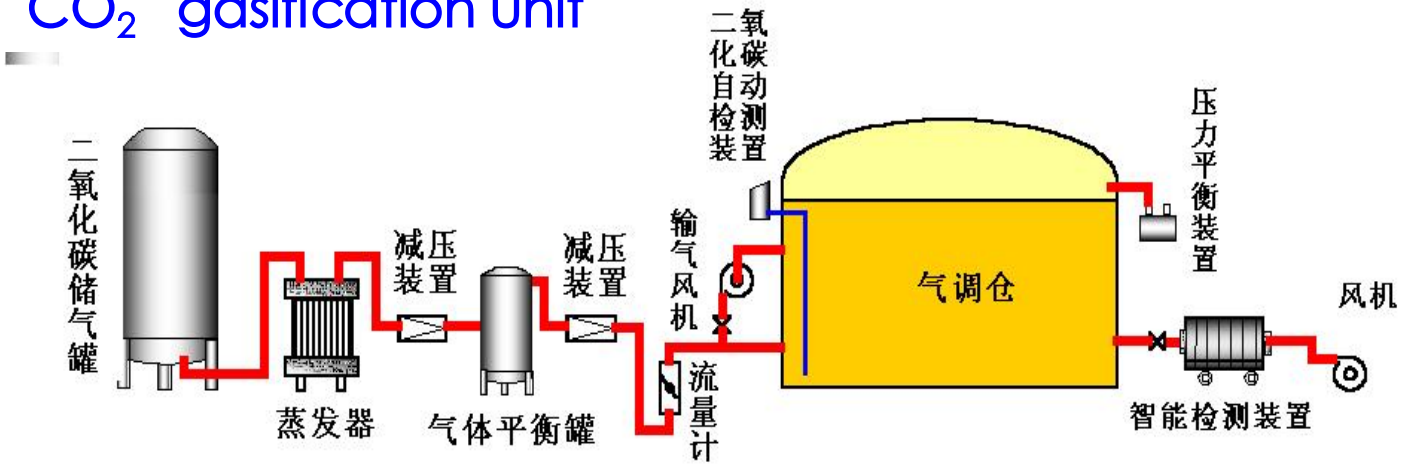
2.2.3 low O_2 storage

(control composition of air)

control insect & lower FAV

CO_2 tank

CO_2 gasification unit



N_2 separator

2.3 Solutions for milling

2.3.1 lower grain content in impurities/ by products
(precise separation to reduce
paddy content in impurities/
whole kernel white rice in brokens/
white rice in bran or in bran powder)

2.3.2 low pressure husking
(control pressure between husker's rolls)

2.3.3 low temp. raise whitening
(control temp. raise in whitening process)

2.3.4 low O_2 or light proof packing

2.3.1 lower grain content in impurities/ by products

(precise sorting /separation)

separator

paddy from air

less paddy be carry away by aspiration System

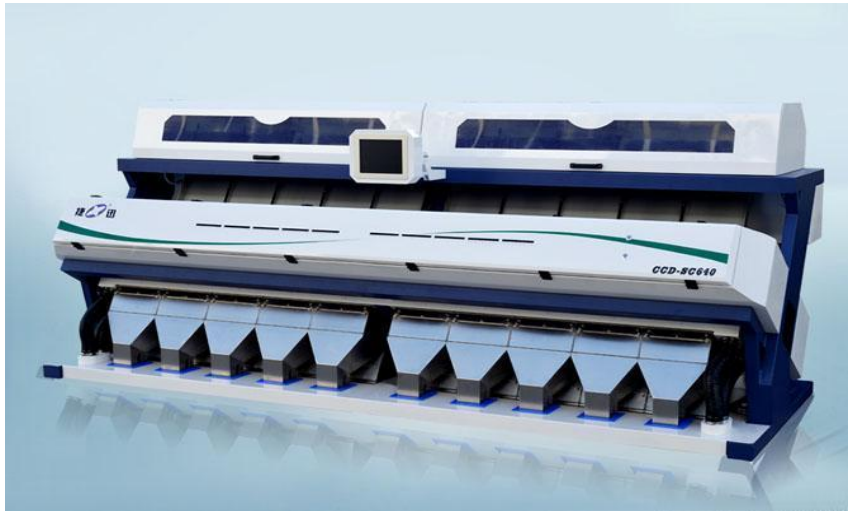
stoner

paddy back to machine

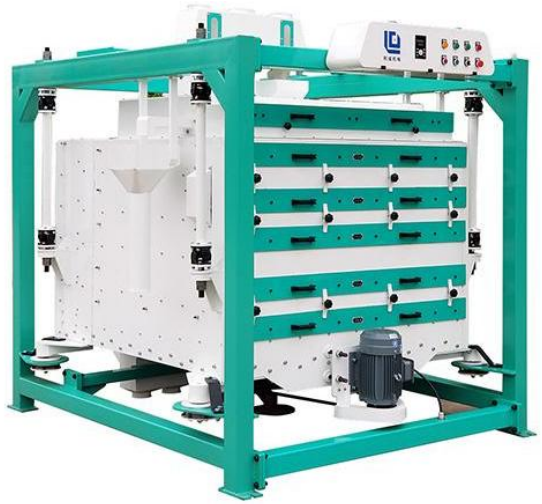
less paddy be carry away

2.3.1 lower grain content in impurities/ by products

(precise sorting /separation)



vs



\+

color sorting

sifter

length grader

precise control broken rice content

2.3.2 low pressure husking

(control pressure between husker's rolls)

Intelligent control frequency conversion (patent)

- Auto adjust the speed of fast roller and slow roller respectively, according to the change of rollers' diameter stabilized line-speed difference, lineal-speed sum

- breaken rate drop : ＞1 percentage point and more

2.3.3 low temp. raise whitening

(control temp. raise in whitening process)

whitening machine（lower temp. raise type）

compared with traditional whitening machine

temperature raise: ↓15 ℃~20 ℃

broken rate: ↓6 percentage points

power consumption: ↓10 kWh /Mt milled rice

- frequency conversion
- HMI touch screen control
- automation

2.3.4 low O_2 or light proof packing

keep the product in right condition， for longer Shelf Life

- ✓ **air-tight**： plastic bag, PET bottle & tinplate can or Al can
- ✓ **vacuum**， CO_2 fiiling or N_2 fiiling
- ✓ **light proof**： tinplate can / Al can /

Solution on rice post-harvest loss reduction

- low temperature drying
- low speed drying
- sufficient tempering
- air-tight storage
- low temp. storage
- low O_2 storage
- precise sorting /separation
- low pressure husking
- low temp. raise whitening
- low O_2 or light proof packing

Thank you

谢谢聆听！

pxiejian@126.com