



**International Conference on Sharing Innovative Agribusiness Solutions:**

**From Farms to Markets, Providing Know-how and Finance**

**26-27 November 2008, Cairo, Egypt**



## **About grain storage pest's and control technology**

Ladies and Gentleman:

Good afternoon. My name is Zhao Baoxing. I come from China, I am working in Beijing Liangmao Technology Development company. I am empowered to join this conference by State Administration of Grain, P.R. China (SAG). On behalf of SAG and our company, I would like to extend my sincere thanks to UNIDO and Egypt Government, they invited us to join this conference and give us a chance to introduce our country about grain storage pest's research and control technology. It is also a chance that we can learn from each other through this conference.



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The significance of pests control in storage grain

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General information of grain storage technologies in China

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General development on Methyl Bromide Phase-out in Chinese grain storage industries

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# 1. The significance of pests control in storage grain

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Pests and mouse spread diseases, contaminate and destroy grain supplies and annually cause million of dollars worth of damages to grain and grain products. Grain is a bare necessity of life. That is why it has to be safe and free of pests. Every year, pest's plagues are becoming a bigger problem in the grain storage. Grain and grain products coming from far away are often infested with pests, which cause damage to the grain. Pests in stored grain can increase and damage the grain. They can also spread to grain that are not infested yet. The result is to decrease value of the grain and grain products. So The pests control in grain storage is important.

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## 2. General information of grain storage technologies in China

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China is a major grain producer and a major grain consumer in the world, as well as a bigger grain storage country. There are 18 thousands grain storage corporation, 320 millions tons of granary storage abilities.

➤ About 36% of the total granaries have equipped with Phosphine Recirculation Fumigation System.

➤ About 49% of the total granaries have equipped with Grain Monitoring and Control System.

➤ About 67% of the total granaries have equipped with Aeration System for grain storage.

➤ About 800 of granaries have been equipped with grain cooler.



## 2. General information of grain storage technologies in China

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The Chinese government not only attaches great importance to grain storage infrastructure building, but also to the grain storage scientific and technical research work. About grain storage insect's some basic and theoretical research work, as follow:

- By the end of 2005, 270 kinds of stored grain insects had been denominated in whole China. in which 226 kinds are pests and 44 kinds are natural enemy insects.
- Since the 1950's of last century, many Chinese entomologists have been researching near 40 kinds of stored grain insects' biology and ecology.
- The classification and identification of stored grain pests
- Research on resistance of primary stored grain pests to phosphine.

## 2. General information of grain storage technologies in China

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Among the applied fumigation technique research work, fumigant Phosphine is an important part, including:

- Phosphine efficient (effect by dosage, tightness time, result of pest control).
- Factors of effecting efficient (different kinds of pests, various stage, different temperature, absorbability of grain to phosphine, granary of different sealed condition and performance, airflow in granary).
- Gas diffusion rule in warehouse and silos.
- Toxicity of phosphine to human being.
- The synergism of lowering oxygen content and increasing carbon dioxide content to common pests.

## 2. General information of grain storage technologies in China

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Among the different operational methods of phosphine fumigation techniques, recirculation fumigation with phosphine is an important part.

The result showed that phosphine recirculation fumigation was necessary and feasible for the safe grain storage in squat silos, normal silos, large warehouses and big stacks. The recirculation equipments improved the distribution of phosphine in granary. It was a simple, safe, economic and efficient technique. The dosage of aluminum phosphide is less using nearly 60 percent compare to other method.



## 2. General information of grain storage technologies in China

Some results of technique research work are used for national standards of recirculation fumigation with phosphine.

◆ The dosage of aluminum phosphide in recirculation fumigation is showed in follow table:

Design concentration (PPM)	Name of grain	Dosage of ALP (g/ M <sup>3</sup> )
100~300	Wheat	1-3
	Corn	1.5-3
	Paddy	2-3.5

## 2. General information of grain storage technologies in China

◆ Reference table on phosphine concentration at different temperature and different kind pests

pests species	Temp. ( °C )	Need Phosphine concentration at different temperature and different kinds pests (PPM)		
		14 ( d )	21 ( d )	28 ( d )
Susceptible pests: <i>Sitophilus zeamais</i> , <i>Latheticus oryzae</i> , <i>Tribolium confusum</i> , others	>25	200	150	100
	20 ~ 25	250	200	150
	15 ~ 20	—	250	200
resistance pests: <i>Rhizopertha dominica</i> , <i>Sitophilus oryzae</i> , <i>Cryptolestes pusilloides</i> , <i>Tribolium castaneum</i> , moth, others	>25	300	250	200
	20 ~ 25	350	300	250
	15 ~ 20	—	350	300

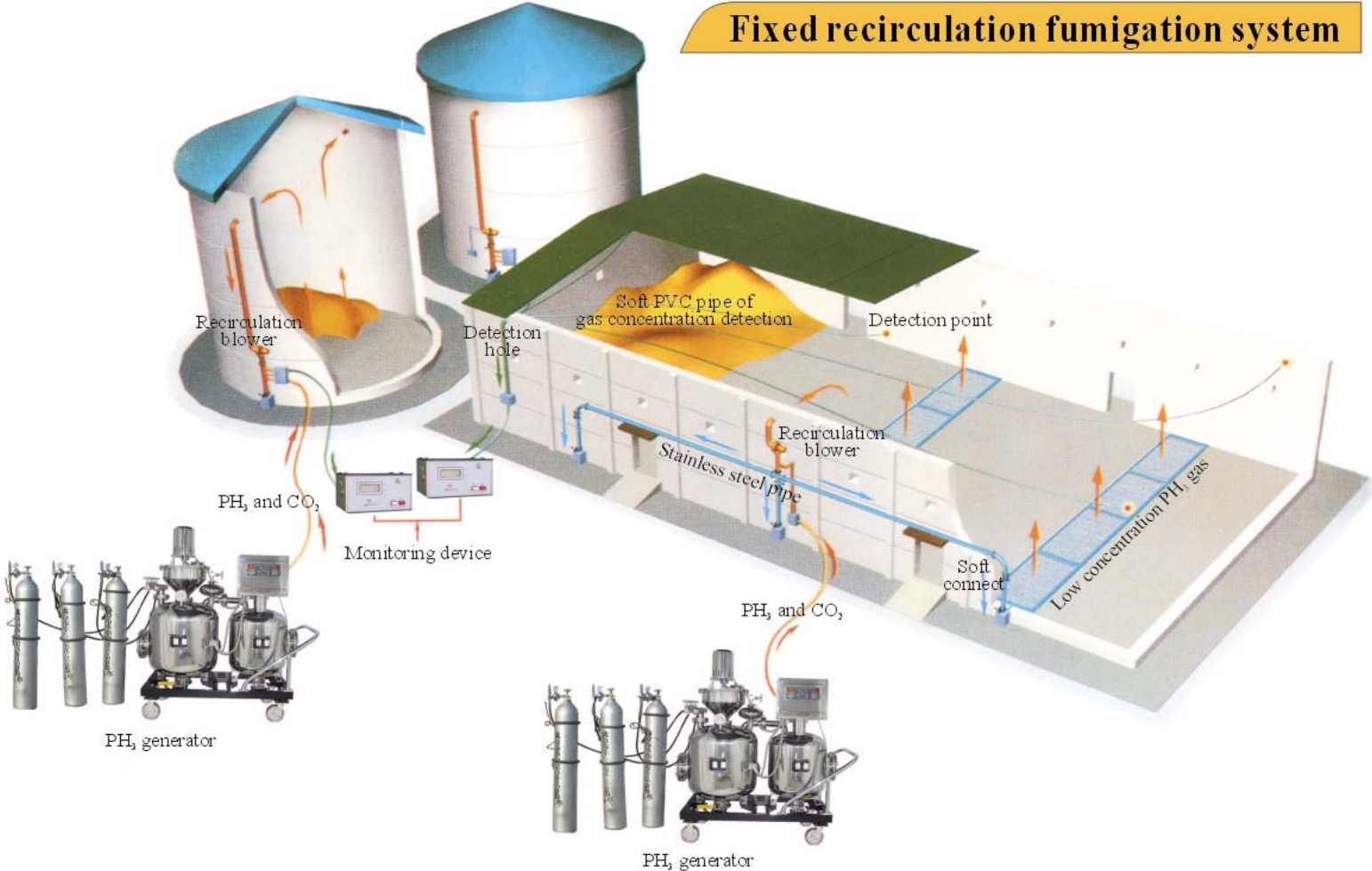
## 2. General information of grain storage technologies in China

◆ The result showed that the gas tightness was the key factor that affected the efficacy of fumigation. The fumigation effect was obviously better when in a gas tightness test, the decrease in the pressure from 500 Pa to 250 Pa take 200 seconds in squat silos or 60 seconds in large warehouse. According the case of the gas tightness, using differ methods of application with phosphine.

gas tightness	method of application with phosphine
Good	● Normal phosphine recirculation fumigation in whole granary
Popularly or Bad	● Phosphine recirculation fumigation under plastic sheeting (the surface of grain is cover with plastic sheeting for airproof) ● phosphine recirculation fumigation and mixing with 5 %carbon dioxide (depending on volume of granary)

# 2. General information of grain storage technologies in China

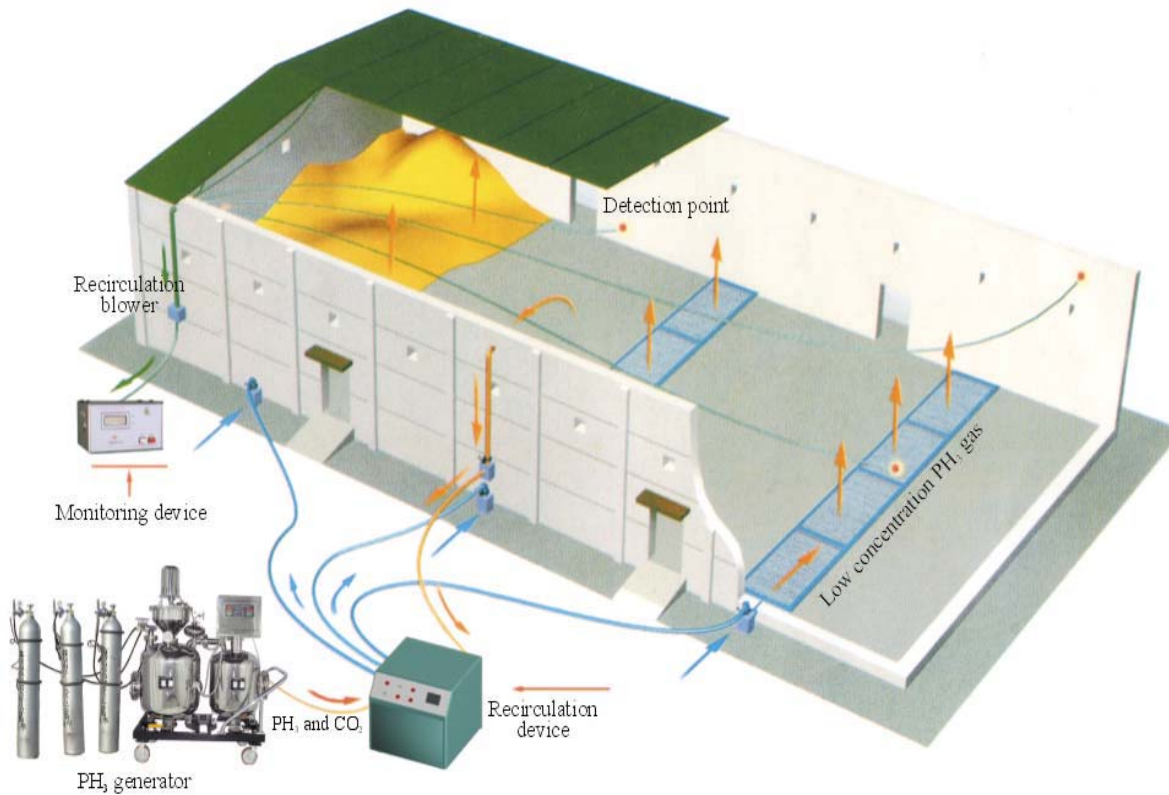
- Normal phosphine recirculation fumigation in whole granary



## 2. General information of grain storage technologies in China

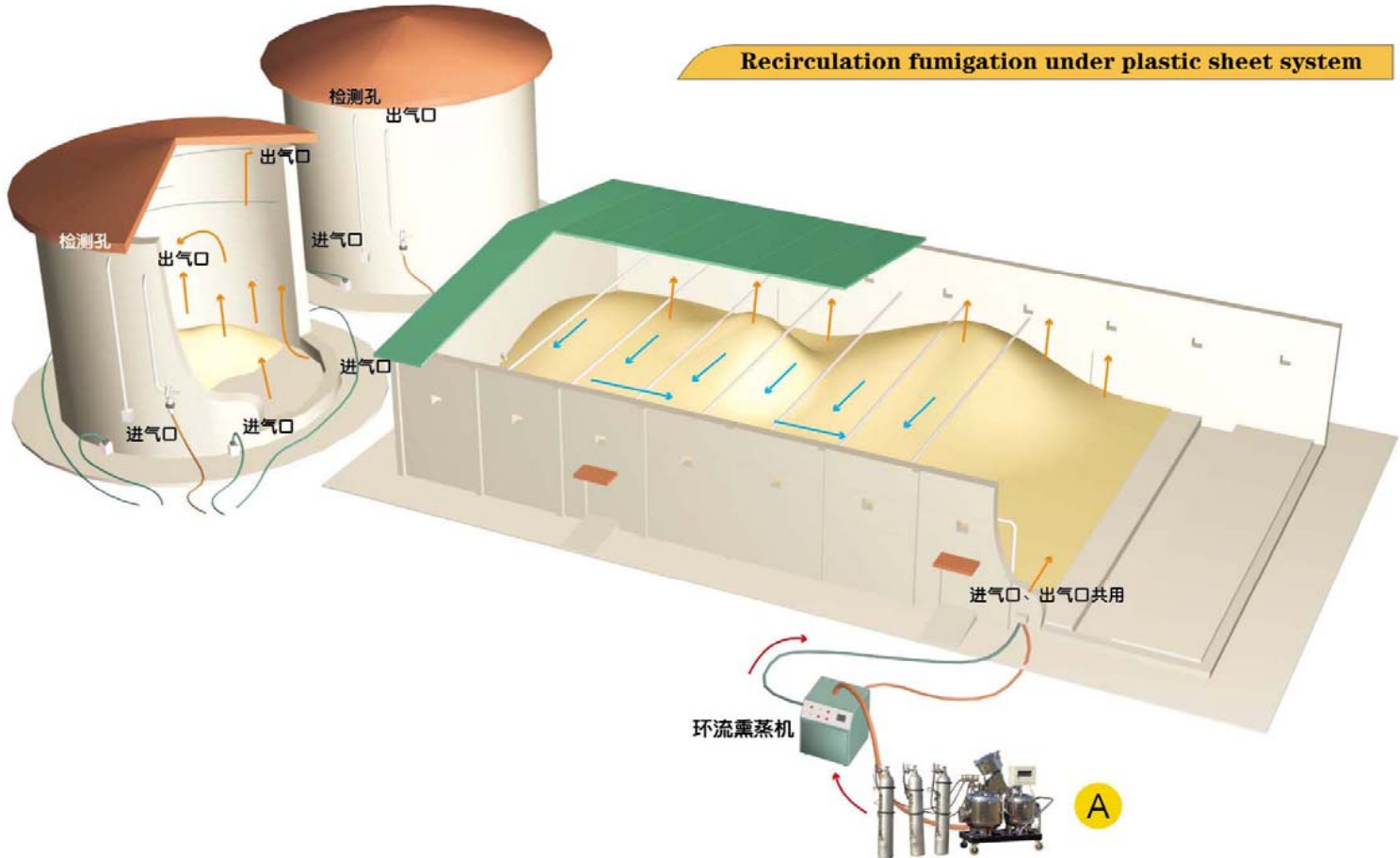
- Normal phosphine recirculation fumigation in whole granary

### Mobile recirculation fumigation system



# 2. General information of grain storage technologies in China

- Phosphine recirculation fumigation under plastic sheeting (the surface of grain is cover with plastic sheeting for airproof)



## 2. General information of grain storage technologies in China

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The national standards about phosphine fumigation for grain storage in China has established

Phosphine is an effective fumigant in grain fumigation, which can effectively control pests when being used according to scientific approaches. However, due to improper application in many circumstances, pests have developed strong resistance and become more difficult to control. Therefore, it is imperative to draw up a systematic and standardized regulation for phosphine fumigation to serve as scientific guidelines. About national standards include:

- ✓ Phosphine recirculation equipment for grain storage GB/T17913-1999
- ✓ Fumigation regulation of phosphine recirculation LS/T1201-2000



The significance of pests control in storage grain

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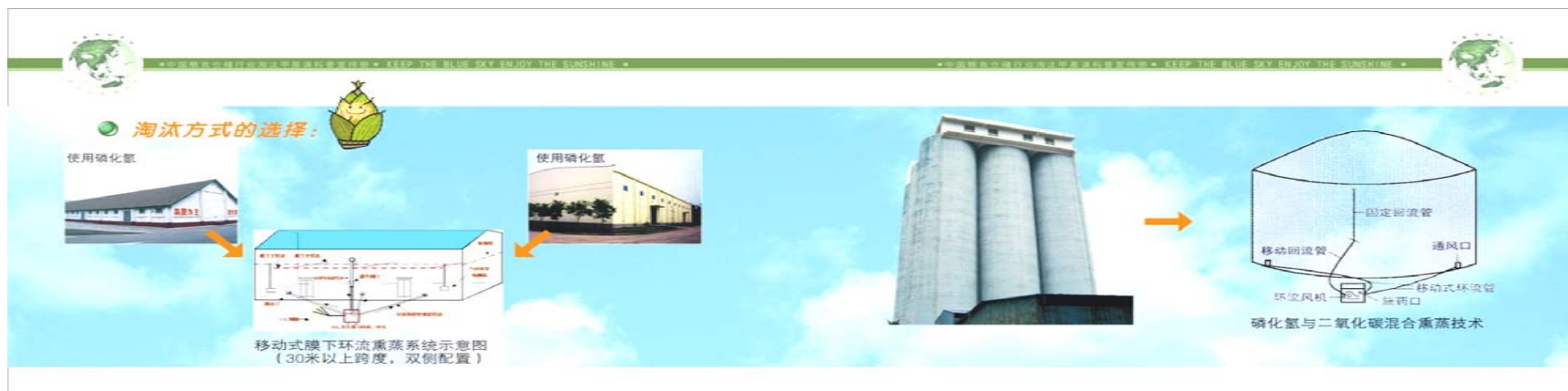
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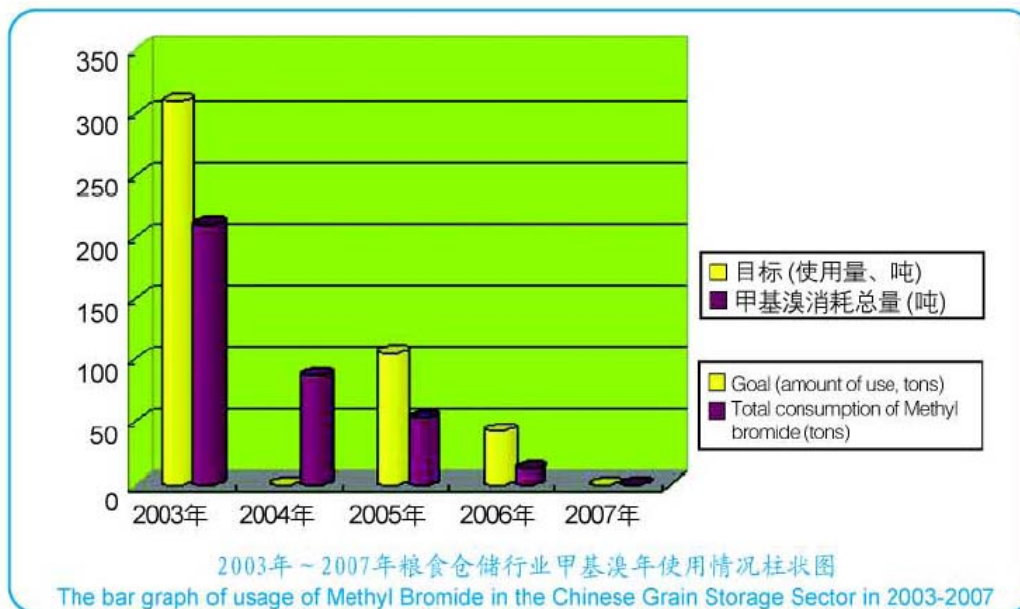
### 3. General development on MB Phase-out in China



Identifying the main alternative technologies, such as

- Normal phosphine recirculation fumigation in whole granary
- Phosphine recirculation fumigation under plastic sheeting (the surface of grain is cover with plastic sheeting for airproof)
- phosphine recirculation fumigation and mixing with 5 %carbon dioxide (depending on volume of granary)

### 3. General development on MB Phase-out in China



The total consumption of MBr in Chinese grain storage industries reduced from the average 210 tons ( 126t ODP /year ) to 87 tons in 2004 ( 52.2t ODP /year), 53 tons in 2005 ( 31.8t ODP /year ) , 11.6 tons in 2006 ( 6.96t ODP /year ) , zero in 2007. It has completed the project overall objectives ahead of schedule, and made a positive contribution for China's fulfillment of the International Convention.

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## 4. About Beijing Liangmao Technology Development Co., Ltd

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### 4.1 General introduction of the company

Beijing Liangmao Technology Development Co., Ltd is specialized company to develop the new method for pests control in grain storage. We strive to provide the highest quality products, end-user education and services through innovative technology and dedicated personnel.

- From 1997, we began to develop phosphine generator.
- From 1998, we began to promote our business, during 1998 until now, the State Administration of Grain P.R. China (SAG) bought our phosphine fumigation equipment about 1200 sets through open bidding. At present more than 1000 granarys in the different regions in china have been using our equipment, and they are very satisfied with our products.

## 4. About Beijing Liangmao Technology Development Co., Ltd

### 4.1 General introduction of the company

- In 2001, we obtained ISO9001 Quality Management System Certificate.
- In 2002, we obtained two Chinese patent certificate, their numbers are ZL01222988.1 and ZL01229826.3.
- From 2007, we began to export our phosphine generator to overseas markets.
- In 2008, we obtained the CE certificate.



## 4. About Beijing Liangmao Technology Development Co., Ltd

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4.2 Liangmao Company has two kinds of phosphine fumigation system.

**One is recirculation fumigation with phosphine system.**

**It is composed by five portions, include:**

- A. Phosphine generator.
- B. Recirculation fan.
- C. Aeration pipe on the bottom of granary.
- D. Recirculation pipe on the surface of grain and under plastic sheeting.
- E. Recirculation pipe on the outside wall of granary.

Look at the follow picture, the red arrowhead expresses the move direction of phosphine in the recirculation fumigation system.

## 4. About Beijing Liangmao Technology Development Co., Ltd



A.



B.



C.



D.



E.

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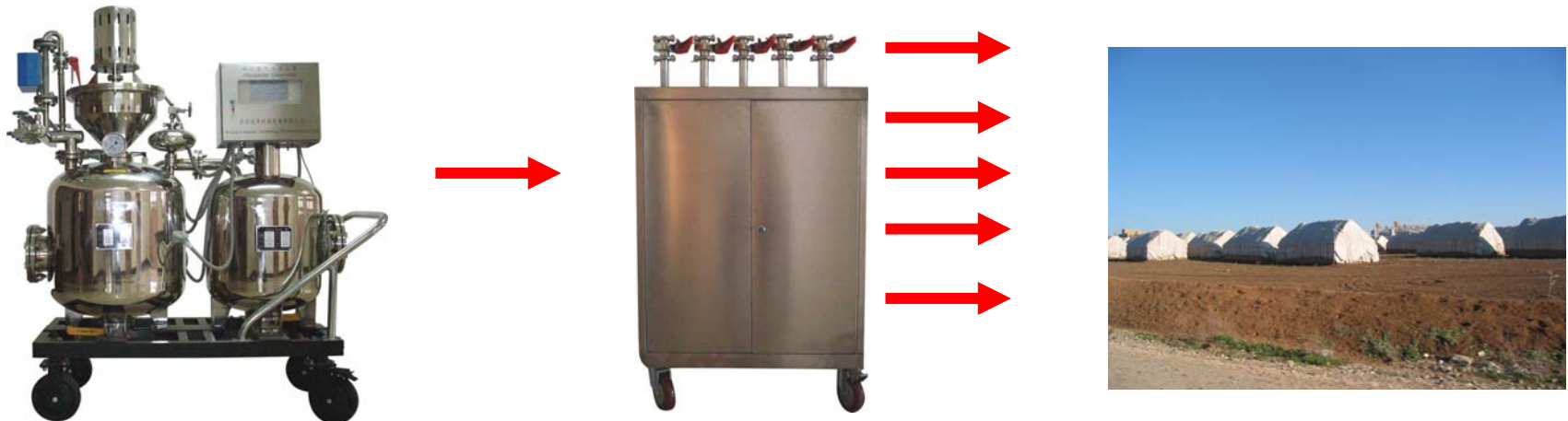
4.2 Liangmao Company has two kinds of phosphine fumigation system.

The other one is regulating distributes fumigation with phosphine system.

It is compose by two portions, include:

- A. phosphine generator.
- B. gas distributor.
- C. several small warehouses, several small stacks or several containers

Look at the follow picture, the red arrowhead expresses the move direction of phosphine in the regulating distributes fumigation system.



## 4. About Beijing Liangmao Technology Development Co., Ltd

4.3 Recirculation fumigation with phosphine can be using in follow cases.

A: Bigger warehouse

B: Bigger stack



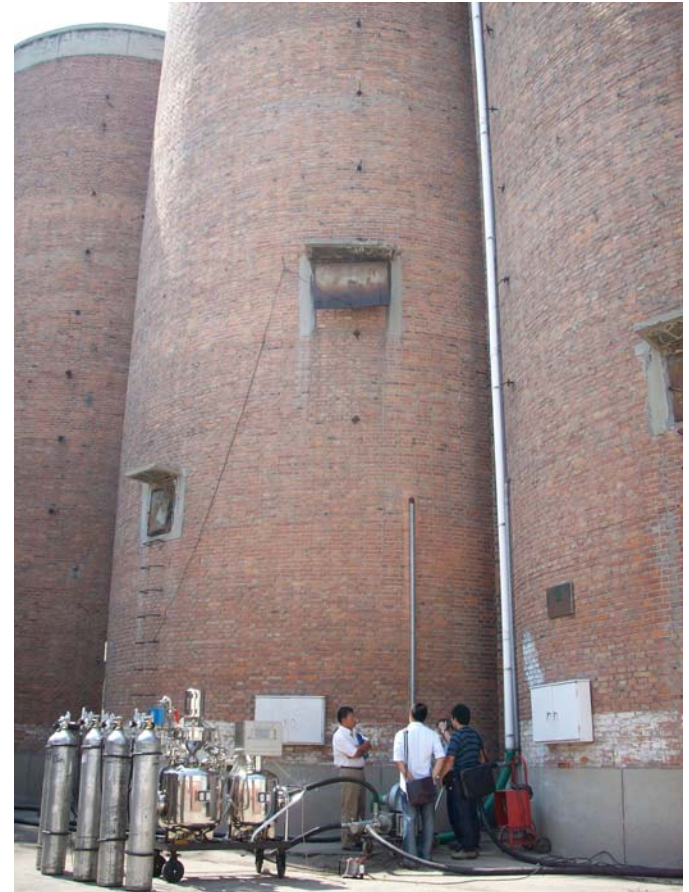
## 4. About Beijing Liangmao Technology Development Co., Ltd

4.3 Recirculation fumigation with phosphine can be using in follow cases.

C: Squat silo



D: Normal silo



## 4. About Beijing Liangmao Technology Development Co., Ltd

4. 4 Regulating distributes fumigation with phosphine can be using for several small warehouses, several small stacks, or several containers and so on at the same time.

small stacks



small stacks



## 4. About Beijing Liangmao Technology Development Co., Ltd

### 4.5 General introduction of the products

#### 4.5.1.1 Work principle of liangmao phosphine generator



The Liangmao Phosphine Generator is a device for the rapid production and introduction of phosphine into the stored grain. The aluminum phosphide are use as raw material. Their content is 56%. The generator is operated outside of the granary, and the phosphine is introduced into the granary, directly through the gas distributor or through recirculation fumigation systems. The generator can produce about 2.66Kg of phosphine in two hours.

#### 4.5.1 phosphine generator

## 4. About Beijing Liangmao Technology Development Co., Ltd

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### 4.5 General introduction of the products

#### 4.5.1.1 Work principle of liangmao phosphine generator (continue)

The generator is first flushed with a certain quantity of carbon dioxide to remove air from its internal chamber, and then a timing motor device carries the tablets or pellets of aluminum phosphide to a water reaction chamber automatically. Aluminum Phosphide and water take place hydrolyze reaction at once. The chemical formula is:

$\text{AlP} + 3\text{H}_2\text{O} = \text{Al}(\text{OH})_3 + \text{PH}_3$ . Phosphine is produced and carried by carbon dioxide into the storage grain.

## 4. About Beijing Liangmao Technology Development Co., Ltd

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### 4.5 General introduction of the products

#### 4.5.1.1 Work principle of liangmao phosphine generator (continue)

According to the amount of phosphine generated in per unit time, mixing an amount of carbon dioxide with it, and controlling the proportion between phosphine and carbon dioxide. If the phosphine concentration is less or equal 2% in mixing gas ( $\text{PH}_3$  and  $\text{CO}_2$ ), fire or explosion can be avoided in the fumigation process. The generator is operated through a touch screen. Once programmed, it will be operated automatically, until the 8Kg aluminum phosphide has been finished.

## 4. About Beijing Liangmao Technology Development Co., Ltd

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### 4.5 General introduction of the products

#### 4.5.1.2 Prepare work for fumigation

A fumigation process needs 8Kg aluminum phosphide, 180Kg water, eight cylinders that each one has 20Kg-25Kg of carbon dioxide, 110 Voltage or 220 Voltage electrical sources.

#### 4.5.1.3 Safety features about the Liangmao phosphine generator.

The generator will automatically stop producing of phosphine gas if one of the following things happens:

- There is an insufficient flow of carbon dioxide.
- There is an excess pressure in internal chamber.
- The temperature of water in the reaction chamber becomes too high.
- There is a malfunction in the power supply.

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### 4.5 General introduction of the products



The gas distributor is mainly composed of five gas flow meters, which are specially used for regulating the flux of carbon dioxide. By adjusting the five gas flow meters, the mixing gas of phosphine and carbon dioxide which come from phosphine generator can be disjoined into five embranchments according as definite proportion. By using the gas distributor, the phosphine gas is introduced into the stored grain. It can be realized to fumigate several warehouses or several stacks at the same time.

#### 4.5.2 Gas Distributor

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### 4.5 General introduction of the products



#### 4.5.3 Recirculation Fan

The recirculation fan is used in recirculation fumigation system. When the recirculation fan is working, the mixture gas of phosphine and carbon dioxide which come from phosphine generator is directly add the outlet of recirculation fan and the flowing air carries the mixture gas into the ventilation system on the bottom of granary. By using the recirculation fan, the phosphine gas is introduced into the stored grain. Through the ventilation system the phosphine gas can be uniformly distributed.

## 4. About Beijing Liangmao Technology Development Co., Ltd

### 4.5 General introduction of the products



Phosphine Concentration Detector is used to detect the phosphine concentration. During the fumigation process, using the detector the operator can predominate the phosphine concentration inside of stored grain. Its detect range is from 0 ~2000 ppm.

#### 4.5.4 Phosphine Concentration Detector

## 4. About Beijing Liangmao Technology Development Co., Ltd

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### 4.5 General introduction of the products



Phosphine alarm is a specially designed pocket sized instrument to protect workers from the hazards of phosphine gas inhalation during fumigation process. If the concentration value of phosphine around the work site reaches to 0.3 ppm, it will alarm with sound and light.

#### 4.5.5 Phosphine Alarm

## 4. About Beijing Liangmao Technology Development Co., Ltd

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### 4.6 Our phosphine fumigation technology has some advantages as follows:

- ✓ Worker exposure during application of phosphine is complete avoidance.
- ✓ The rate of phosphine production and introduction into the storage grain is very rapid.
- ✓ No reentry into the granary to add additional phosphine to the storage grain.
- ✓ Ambient temperature and humidity do not affect the phosphine generation rate.
- ✓ The fumigant is completely reacted
- ✓ There is no danger of fire.
- ✓ The waste is not hazardous.
- ✓ Multiple fumigations can be conducted from a control location using a gas distribution system.
- ✓ Aluminum phosphide pesticide made from different factories can be used.
- ✓ The fumigation cost is lower than other methods.

## 4. About Beijing Liangmao Technology Development Co., Ltd

### 4.7 International Exchanges on Phosphine Fumigation Technology



## 4. About Beijing Liangmao Technology Development Co., Ltd

### 4.7 International Exchanges on Phosphine Fumigation Technology



## 4. About Beijing Liangmao Technology Development Co., Ltd

4.8 Our phohphine fumigation equipments have being exported to overseas market.

In Mexico



In Syria



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## 5. About this conference

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5.1 What was the problem or market opportunity?

Many developmental countries are agriculture countries. We think our phosphine fumigation technology may be useful these countries.

5.2 What were the areas of impact (e.g. trade, productivity, employment, quality, safety, food security/availability)?

- Improve International Exchanges on Phosphine Fumigation Technology
- Reduce the grain damage lead by the pests
- Realize the methyl bromide phase-out completely.

5.3 What were the challenges that had to be overcome?

- The problem is gas leak in granary about agriculture products.
- The problem is supply of CO<sub>2</sub> on market.

## 5. About this conference

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### 5.4 What factors led to its success?

- Our phosphine fumigation technology is very safe and effective.
- The operation of our equipments are very easy and simple.
- The fumigation cost is lower then other method.

### 5.5 How was the solution financed?

- Invite the official of Egypt to our country and visit our company, the cost is about US 10000-20000 dollar.
- We take the fumigation equipments to Egypt for demonstration, the cost is about US 40000-50000 dollar.
- These cost of above is afforded by UNIDO, and Egypt Government.
- The costs of demonstration in china is afforded by our company.

## 5. About this conference

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5.6 How could it be scaled up and/or replicated in other places?

- After first time of demonstration, we are going to evaluate the feasibility about our fumigation technology in Egypt, and establish an improve project. The improve project should be fit for Egypt.
- According the improve project we will replicate Phosphine fumigation technology in other places

5.7 What are the resources needed to scale up and/or replicate this solution?

- The management experience about Chinese grain storage.
- The technology and equipments about Phosphine fumigation .

Thanks you for your attention!  
Welcome to China!  
Welcome to Beijing Liangmao!

