

Contrast Trial about the Relationship between Gas Tightness and Fumigation Effect

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Abstract: The contrast trials about the relationship between gas tightness and fumigation effect were carried out. The results showed that, the better gas tightness of the storehouses have, the longer time the effective concentration can be maintained, and the better fumigation effect can be achieved.

Key words: half - life; fumigation; gas tightness

Introduction

State Grain Reserves Ningxiang Depot has 17 large storehouses and 4 squat silos, 16 and 4 of which are started to set up in the end of 1999 and 2001, and to load grain for the first time in the beginning of 2000 and 2002, respectively. For having been used for 4 - 6 years, all storehouses, especially the doors, windows and vents, show the aging phenomenon to some certain extent, which affects gas tightness of the storehouses, mostly shown as the gradual increase of the phosphine concentration decline speed and the dose of fumigation to rise year by year. In this trial, 5 representative storehouses were chosen to test the gas tightness and the relationship between gas tightness and fumigation effect was introduced.

1 Materials and Methods

1.1 Materials

1.1.1 4 - 72 - 6c type Centrifugal Fan; U type manometer; stopwatch

1.1.2 Experimental Storehouses (table 1)

Table 1. Basic Circs of the Experimental Storehouses

No.	Shape	Year to set up	Year to get use	Gas tightness Measures	Full or Empty
10	large storehouse	1999	2000	door and windows; Sealed completely and heat preservation	full
15	squat silo	1999	2000	routine measures	full
16	squat silo	1999	2000	routine measures	full

No.	Shape	Year to set up	Year to get use	Gas tightness Measures	Full or Empty
19	large storehouse	2001	2002	windows: Sealed completely and heat preservation; door: sealed by film	full
20	large storehouse	2001	2002	windows: Sealed completely and heat preservation; door: sealed by film	full

1.2 Experimental Methods

1.2.1 storehouses Gas tightness Test

(1) Experimental storehouses gas tightness were tested and strengthened according to the request.

(2) U type manometer was connected with the phosphine check-conduit through tube; two or three experimenters went inside of storehouses and prepared to check the air leaks; Centrifugal fan was used to add pressure into storehouses through air-conduits. when the pressure fell to 700 - 800Pa, air - conduits were closed, and when the pressure decreased to 500Pa, stopwatch was turned on, when the pressure fell to 250Pa, stopwatch was turned off and the reading was noted.

1.2.2 Fumigation

LS/T 1 201 - 2 002 Aluminium Phosphide Recirculation Fumigation

2 Results and Discussions

2.1 Results of Storehouses Gas Tightness Test

The gas tightness tests carried out from March 28 to 29 in 2006 indicated that gas tightness of the most storehouses did not meet the technical specification request (table 2).

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Table 2. Results of Storehouses Gas tightness Test

NO.	Item	First	Second	Third	Expectation of Half - life	Standard	Crucial Air Leak Location
10	Max pressure (Pa)	400	400	400	-	≥40 "	14 of 16 windows leaked air seriously, resulting in the pressure too low to test the half - life
	Time pressure (Pa)	-	-	-			
	End pressure (Pa)	-	-	-			
	Half-life (s)	-	-	-			
15	Max pressure (Pa)	700	700	700	68 ~ 17	≥60 "	1) the grain subway exits ; 2) the boundary edge of electric cable to measure temperature and the roof of storehouse ; 3) the manholes and the entrance of illuminate electric wire ; 4) the grain exit of scraping transport machine ;
	Time pressure (Pa)	500	500	500			
	End pressure (Pa)	250	250	250			
	Half-life (s)	45 ~ 65	44 ~ 32	44 ~ 02			
16	Max pressure (Pa)	800	800	800	75 ~ 57	≥60 "	1) the grain subway exits ; 2) two holes of centrifugal fan ; 3) the manholes
	Time pressure (Pa)	500	500	500			
	End pressure (Pa)	250	250	250			
	Half-life (s)	80 ~ 95	77 ~ 47	68 ~ 28			
19	Max pressure (Pa)	800	800	800	44 ~ 66	≥40 "	1) 12 of the windows ; 2) the door
	Time pressure (Pa)	500	500	500			
	End pressure (Pa)	250	250	250			
	Half-life (s)	66 ~ 30	70 ~ 00	68 ~ 20			
20	Max pressure (Pa)	800	800	800	30 ~ 03	≥40 "	All of the windows
	Time pressure (Pa)	500	500	500			
	End pressure (Pa)	250	250	250			
	Half-life (s)	31 ~ 84	30 ~ 64	30 ~ 61			

2.2 Fumigation before Gastight Strengthen

Table 3. Luminium Phosphide Recirculation Fumigation in 2005

Gas - Tightness Grade	NO.	Amount of grain, t	Breed	vol. , m ³	Times	Dosage of Aluminium Phosphide					
						First Dosage, kg	Dosage Compensation		Total Dosage, kg	Dose, g/m ³	
						Times	Dosage, kg				
1	10	4606	indica	10527	1		51	2	24	76	7
2	20	5315	indica	15065	1		60	2	36	96	6
3	19	5326	indica	15065	1		60	1	18	78	5
4	15	5157	wheat	8900	1		36	0	0	36	4
5	16	4217	indica	8900	1		36	0	0	36	4

2.3 Effects of Gas Tightness on Fumigation

According to the fumigation of five experimental warehouses, Gastightness is a critical key to a successful fumigation. The relationship between half-life, valid phosphine concentration and dose is shown in figure 1, the change of phosphine concentration is shown in figure 2.

Figure 1 and figure 2 show the effects of gas tightness on fumigation: 1) The better gas tightness of the warehouse has, the much lag in the decay of PH₃ concentration;

2) the longer pressure decay half life is, the longer time the effective concentration can be maintained;

3) the shorter pressure decay half life is,

the larger the dose should be;

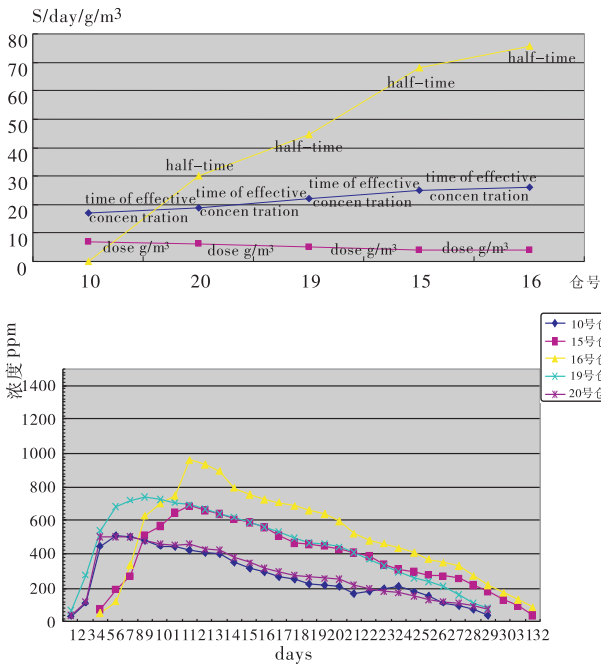


Fig. 1 and Fig. 2 show the effects of gas tightness on fumigation.

4) The time of effective phosphine concentration is not directly proportional to dose, which indicates that even as more aluminium phosphide is used, the maintenance time of effective concentration is not guaranteed.

2.4 Reasons of bad gas tightness

In the gas tightness tests, the air leak positions are mostly the windows of storehouses, as well as the conjunctions, various exits, entrances of the facilities and wall body of storehouses. The main reasons that result in the bad gas tightness of storehouses are as follows:

1) Aging of the Seal Materials.

Confined to existing seal material service life, seal materials of the doors and windows are

gradually aging for long-term use, mainly appeared as the deformation, the flexibility decrease, and that can not be sealed completely.

2) The manufacture technologies is weak

After large storehouses were treated with sealed and heat-keeping doors and windows, with the increase of use time the structure begin to deform because of manufacture technologies, and then storehouses couldn't be sealed completely; the craft design of grain exits of scraping transport machines and grain subway exits of squat silos roof is not good enough.

3) The air leak positions are concealed

The air leak positions such as the boundary of various pipeline and storehouses body etc., have always been ignored at check.

4) Other Reasons

Ground subside, heat expansion and cold contract results in the partial crack of the wall.

2.5 Measures of Gastight Treatment

1) Windows sealed by metal should be reconstructed. Materials with long service life and strong flexibility were chosen to replace those used in doors and windows now. And the deformed windows should be repaired. A system of periodical check and replace should be formed.

2) All parts that were connected with wall body of storehouses should be checked and treated by proper gastight methods

3) All of cracks of storehouses should be sealed completely with special materials.

4) Seal technologies should be improved and seal materials should be added for holes of grain exits and entrances of squat silos.

2.6 Fumigation after Gastight Strengthen

The situations of fumigation after taking the above-mentioned measures is in the table 4.

Table 4 Situations of fumigation after Gastight Strengthen in 2006

No.	Half - life	Time of 250ppm, day	Times of Fumigation	Dosage of Aluminium Phosphide				
				First Dosage, kg	Dosage Compensation		Total Dosage, kg	Dose, g/m ³
				Times	Dosage, kg			
10	50 ~ 02	18	1	60	0	0	60	5.7
19	60 ~ 23	15	1	60	0	0	60	4
20	58 ~ 40	15	1	60	0	0	60	4

The gas tightness performance of large storehouses No. 10, 19 and 20, which were treated by gastight, can attain more than 40 seconds, and the dosages of aluminium phosphide decreased by 21%, 23%, 38% respectively, the time of effective phosphine concentration met

the requirement to kill pests thoroughly, avoiding dosage compensation and reducing the labor intensity of the personnel.

2.7 Conclusions

1) It is very necessary to carry out gas

tightness tests and take measures according to test results for better fumigation effects and lower fumigation expenditure.

2) Gas tightness is a critical key to the successful fumigation. The better gas tightness of the storehouse have, the longer time the ef-

fective concentration can be maintained, and the better fumigation effect can be achieved.

3 Acknowledgements

We thank Dr Digvir Jayas for editorial comments in this manuscript.