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Field Trial Report on the Application Nitrogen (N_2) to Maintain Grain Quality

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Abstract: Since 1960's, nitrogen (N_2) – “green gas” has been used for grain storage to maintain grain quality, control of insect pests in our country, However, in order to annoy (N_2) the oxygen displacement, storehouse of the source, grain heap to annoy airtight, air to examine in the nitrogen and the safety operate protection's etc. a series of key technique a problem up found out to effectively resolve a method, so the green nitrogen (N_2) keep a grain technique, the research has been placed in small scale of on trial investigate stage, it adjusts with carbon dioxide (CO_2) to keep a grain technique similar temporarily return hard carry on large-scale production expansion application. My database in 2005 started adjusting to keep a grain technique to the green nitrogen (N_2) of particularly item research, by my database engineering technical personnel gram bitterness offend a pass, in solving to perplex green nitrogen (N_2) to adjust to keep a grain technique expansion an applied series of key technique a hard nut to crack obtained breakthrough progress, carried on green nitrogen (N_2) to adjust to keep the grain technique storage to experiment with expansion application study also obtained success, currently our database carry on green nitrogen (N_2) to adjust to keep the grain production experiment of grain already 52990.141 tons, have whole databases to always keep a grain of 78.2% .

1 Technique Principle

Make use of a forerunner of nitrogen (N_2) produce equipments produce high-pure nitrogen spirit (above 99.5%), pass in advance build in the database area the underground of the appropriation nitrogen (N_2) transport the piping (N_2) the nitrogen the importation the spirit the airtight function the good spirit adjust the storehouse, nitrogen (N_2) can from the storehouse ground of well ventilated way perhaps from the grain noodles the circulation tube got into a closeness grain a heap of inside space, opened appropriation air a density equilibrium system to carry on compulsive circulation, make each part in the storage of nitrogen (N_2) density even consistent, through going in

to high-pure nitrogen spirit after make the nitrogen in the grain heap spirit the density attain 98% to keep grain pest to cause death a density, and make the nitrogen in the storage annoy (N_2) density with long hours keep in the certain scope carry on high-pure oxygen to adjust to keep a grain, pass change closeness grain inside heap of air composition, making it become a disadvantage in keeping the grain pest and microorganism growth breed of higher - N & lower-oxygen ecosystem environment, attain to repress to keep grain pest stop endanger grain, can't grow to breed, until the asphyxiation die and reduce the grain oxygen (O_2) inside the heap material to the grain nourishment of depletion with oxidize inferior change, defer grain quality to be worse.

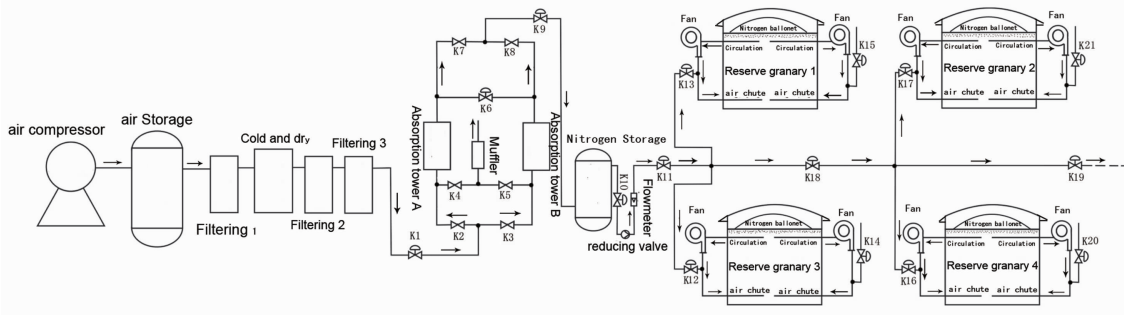


Fig. 1 green nitrogen (N_2) adjust to keep the grain technique work principle flow chart

2 Provide to Trying Storehouse

(1) Experiment a storage; to choose Guangxi national grain storage database on the 8th high & big one-storied storage is a green nitrogen (N_2) to adjust to keep a grain experiment storage, the storehouse grows 42 m, the breadth 30 m, pack the grain line high 6.1 m, after annoy air tightly reform, the storage annoys an airtight test to attain half-life ≥ 300 (-300 Pa descend to -150 Pa) and keep grain to produce the United States for 2003 importing soft and white wheat, save grain: 5 120 tons, pack the grain height 5.1 m, permit heavy: 811 g/L, water 10.0%, the miscellaneous quality is 0.6%, and corn warm is normal.

(2) storage of checking against; to choose Guangxi national grain storage database on the 7th a high and big one-storied storage is a green nitrogen (N_2) so as to adjust to keep a grain experiment check against a storage, the storehouse length is 36m, the breadth 30m, pack the grain line high 6.1m, keep grain produced by the United States in 2003 importing soft and white wheat, save grain: 4 882 tons, pack the grain height 5.6 m, permit heavy: 811 g/L, water 10.1%, the miscellaneous quality is 0.6%, and the corn warm is normal.

(3) The expansion applies a storage; to choose Guangxi national grain storage database on the 1st, on the 3rd and on the 4th a high and big one-storied house storage is a green nitrogen (N_2) to adjust to keep the grain expansion application storage, 3 above storehouses all length 72m, the breadth 30m, pack the grain line high 6.1m, after annoy airtightly reform, the storage of above three storages annoy airtight the test all attains half-life ≥ 300 (the 300 Pa descend to -150 Pa:00). The 1 among those numbers storage bulky cargo saves a grain: 9 307. 08 tons, pack the grain height 6.15m, water is 13.2%, miscellaneous quality 0.8%; The No. 3 storage bulky cargo saves a grain: 9 271. 24 tons, pack the grain height 6.15m, water is 13.2%, miscellaneous quality 0.8%; The No. 4 storage bulky cargo saves a grain: 9276. 68 tons, pack the grain height 6.15m, water is 13.1%, the miscellaneous quality is 0.5%, above each storage grain be normal and have never had fever mildewed to change phenomenon.

(4) Experiment storage pest a circumstance:

Pest inside the storage: The grain samples were taken to examine No. 8 the insect of the storage density, such as *Rhyzopertha dominica*

(*Fabricius*), *Tribolium castaneum* (Herbst), *Cryptolestes ferrugineus* (Stephens), *C. turcicus* (Grouville), the main insect the density is 35/kg. Experiment insect: According to experiment a project to request, combine a this database actual circumstance, select by examinations of experiment insect kind mainly with collect in this database to appear more, *R. dominica*, *T. castaneum*, *C. ferrugineus*, *C. turcicus* (because of *R. dominica* individual be too small and can't pack into the insect cage), and be divided into its 11 groups & 10 *R. dominica*, 10 *T. castaneum*, 30 *C. ferrugineus*.

(5) The expansion applies storage pest a circumstance:

Used for carrying on large-scale nitrogen to adjust to keep the grain production research of the 1st, the high and big one-storied storage totally stores northeast corn 27 855 tons on the 3rd and on the 4th, should criticize corn to belong to produce in 2006, through Tieling-Liaoning Province, Tongliao-Nei Moggal, Siping, Jilin Province of northeast of our country of the corn habitat, the corn of above three storages arrives to defend city harbor to store in warehouse through a sea transportation in May, 2007, June and July respectively, the corn stored in warehouse headway to go in addition to miscellaneous. Through the check, should criticize the keep of corn grain insect to grow to mainly about: *R. dominica*, *T. castaneum*, *C. ferrugineus*, *C. turcicus*.

3 Experiment Material

(1) Make nitrogen machine a set: BE together developed completion by my database and the professional factory house, produce nitrogen (N_2) to measure to 30 square per hour, the design nitrogen (N_2) outputs the pure degree as 99.5% and actually measure nitrogen (N_2) to output a pure degree tallest can reach to 99.99%.

(2) One set of The oxygen quantity analyzes instrument: The model number is the NFY - I C; Measure scope: 0.00 - 25.0% O_2 .

(3) One set of the nitrogen (N_2) density circulation inside the storage equilibrium system. (BE developed by this database independence)

(4) One set of airtightness Various Types of Squat Silos

(5) The storehouse annoys airtight material: The nylon thin film, appropriation seals completely a slot tube, seal completely gum, appro-

priation to seal completely gum and change asphalt some.

(6) One set of Air Line Breathing Apparatus: breath mask, Multi-inlet Valve, Gasholder, An Alarm Apparatus, air compressor etc. use: Mainly to adjust to carry on a grain feeling check inside storage, if that breather used for the normal regulations chemistry medicine smoked steam to destroy insects Be a protection device effect better.

4 Experiment Methods

(1) Experiment storage (No. 8 storage) is provided to try pest to place: Before experiment, the grain samples will be taken to check the density of insect pest in the storage, try 11 sets to insect to pack into the insect cage before sealing completely a storehouse, press the figure 2 positions for mark to use bulk grain to pack insect cage to place the different part of grain heap.

• 8 # up. 0.3m 9 # Mid. 10 # Und 5.5m			5 # UP 0.3m 6 # Mid 3m 7 # Und 5.5m		3 # UP 0.3m
					4 # UP 0.3m 2 # Mid 3m 1 # Und 5.5m
11 # Up 0.3m					

Fig. 2 No. 8 Warehouse Insect cage Distribution

(2) Expansion application the storage has never provide to try pest to place. The reason is the 1st which stores corn, the high and big one-storied storage belongs to an expansion application storage on the 3rd and on the 4th, and 3 storage all belong to an insect grain and need to be carry on immediately in addition to cure, our purposes are the grains which keeps nitrogen spirit to adjust to keep inside grain storage and keep the grain pest ecosystem and grain database normally keep a grain state of nature homology, adjust to keep a grain by the observation nitrogen spirit to the prevention and cure effect which keeps grain pest, so don't provide to additionally be provided to try pest.

(3) Experiment a storage, extension production storage closeness a processing: Wheat (experimental storage) and corn (the extension produce research storage) go into before the storage, should first storehouse ground the stretch and shrink of the ping sew, crack etc. the grain grain, dust, freestone within blind side clean off (the one who have condition can use compressed air to carry on tidy up), then infuse

go into change sex asphalt cool stem need to be use; Closeness treatment of the wall in the warehouse; On all sides pack the wall of grain line in wall inside the storehouse up install appropriation to seal completely a slot tube (double slot tube), with the nylon thin film seal completely gum to press into the appropriation seal completely a slot tube to make it hang in the hand over of wall inside the warehouse, nylon thin film and ground connect place to use to seal chewing gum to glue to stick like then; The storehouse front door, air-vent adds appropriation to seal completely gum to carry on sealing completely a processing with the nylon thin film; The closeness method of grain heap in the storehouse surface is: First weld into the whole ratio grain heap surface to accumulate slightly big thin film with several nylon thin films, then seal completely a slot tube and seal completely gum to seal completely thin film with the appropriation, the whole storage become the closeness mode that five noodles thin films of a typical model seal. Storehouse closeness work completion behind have to be also carry on annoying an airtight sex examination, the storage annoys airtight and have to attain above square for 5 minutes is a pass, otherwise should continue to check to leak to repair hole until reach mark.

(4) Oxygen (the nitrogen annoy) examination: During the period of experimenting a storage to carry on nitrogen to adjust, the our usage NFY - I C amount of oxygen analysis the instrument carries on an examination to the air density in the grain heap, the oxygen (nitrogen spirit) density examination cloth orders plane chart to see figure 3.

• Mid. 3m		• Up. 0.6m		• Up. 0.6m		• Up. 0.5m
	• Mid. 3m			• Up. 0.6m	• Up. 0.6m	
• Und. 5.5m		• Mid. 3m				• Up. 0.5m

Fig. 3 No. 8 Warehouse Distribution of gas Pai Layout

(5) Experiment the storage (No. 8 storage) nitrogen (N₂) operation: Have carried on nitrogen (N₂) since September 12, 2006, will experiment the enter of storage spirit valve door to open first before the nitrogen, close row spirit valve door, then start to make nitrogen machine a set the beginning system for make nitrogen (notice; In order to making the nitrogen ma-

•2#Und.5.5m	•3#Und.4m 5#Und.4m	•2#Up.1m	•3#Up.2m 5#Mid.3m
•4# Space Points (District 2 Detection)		•4# Space Points (District 3 Detection)	
•1#Mid.3m	6#Up.1m	•1#Und.4m	6#Und.5.5m
•2#Up.1m	•3#Up.2m 5#Mid.3m	•2#Und.5.5m	•3#Und.4m 5#Und.4m
•4# Space Points (District 1 Detection)		•4# Space Points (District 4 Detection)	
•1#Und.4m	6#Und.5.5m	•1#Mid.3m	6#Up.1m

No. 1,3,4 Warehouse Gas detection of Pai Layout

chine nitrogen that set produce when just begin to work (N₂) a pure degree lower, generally only 90% be or so, this part of low and pure degree nitrogen spirits can carry on lining up a vacancy reason), the nitrogen that is on the observation system nitrogen machine set spirit density examination instrument, be the exportation nitrogen of appearance annoy (N₂) of when the density manifestation attain above 99.5%, open to make nitrogen machine a set a valve door to pass appropriation to lose a windpipe way a beginning to experiment storage go into nitrogen (N₂), this is that storage carries on first stage (time) of the nitrogen spirit adjust to keep a grain, go into nitrogen spirit of the amount usually takes signing a square rice as unit to compute. (according to the grain that warehouse keep of how much with storage inside space of size, each storage generally once can go into nitrogen annoy 1 000 – s 10 000 sign the square rice doesn't wait) Experiment storage when the first stage nitrogen spirit adjust to keep a grain work be over total go into a pure degree annoy for 99.9% nitrogen 1 937.32 sign a square rice, immediately after start the nitrogen in the storage (N₂) the density equilibrium system to carry on the nitrogen in the storage (N₂) density circulation balance, use the NFY – I C oxygen quantity analysis an instrument to nitrogen in the grain heap annoy a density (adopt nitrogen, oxygen density to pour calculate way) to carry on an examination, be the each examination point in grain heap in the storehouse of nitrogen (N₂) density bad value < 2%, then think the nitrogen in the storage spirit density already basic balanced consistent, can stop nitrogen (N₂) a density equilibrium system a work; The whole storage got at this time according to the examination in the meantime average nitrogen spirit density with keep grain pest to cause death nitrogen spirit a density 98% to carry on a comparison, if reach a mark can stop carrying on nitrogen to that storage, the nitrogen

work namely tells be over; If the whole storage average nitrogen spirit density end attains to 98% ly keep grain pest with the result that the density has to then carry on the nitrogen (N₂) of next stage work, be each stage of nitrogen work completion after, nitrogen in the grain heap space spirit density will go up further, but the oxygen density will then descend further, the general building type storage usually needs through 4 and 5 stages (point a grain behind familiar period function not obvious or breath the strength be weaker to keep a grain) of nitrogen behind then can attain the cause death of pest nitrogen (N₂) density. (that density is 98%). When experiment the storage (8 storages) carry on arrive the fifth stage nitrogen (namely on October 3, 2006), the nitrogen in the storage spirit density through examination already 98.12%, immediately shut down stop nitrogen, that storage total goes into a pure degree to annoy for 99.9% nitrogen 9 849 sign a square rice, the nitrogen always uses is 351.75 hour, the nitrogen current of air measures to 28 to sign a square per hour.

(6) The expansion applied (the 1st, the 3rd, the 4th) storage nitrogen (N₂) operation: The 1st stored corn, the 3rd, No. 4 the storage belong to a high and big one – storied storage, the storehouse all grows a 72 ms, the breadth 30 ms, pack the grain line high 6.1 ms, the storehouse area reaches to 2 160 square meters and single storage is anticipated to be need every time above 99.5% nitrogen about 5 000 – 7 000 sign a square rice or so, is the storage nitrogen method to separately carry on nitrogen to what above three storages adopt, namely each time as to it's win a storage carry on nitrogen, according to the corn is into the dissimilarity of storage time, our arrangement above three storages carry on nitrogen of order of sequence is: No. 1 storage → No. 3 → No. 4 storage. We carry on nitrogen an operation to the No. 1 storage on August 22, 2007: annoy the No. 1 enter of storage a valve door first to open, close row spirit valve door, and close the grain database other storehouses of enter spirit valve door, in order to prevent annoy nitrogen mistake into other storehouses. Start system nitrogen machine set make of beginning system nitrogen (N₂), observation system nitrogen machine the nitrogen on the set spirit density examination appearance, be appearance of the exportation nitrogen annoy (N₂) of when the density manifestation attain above 99.5%, immediately open make nitrogen

machine a set nitrogen spirit exportation a valve door make the nitrogen spirit pass appropriation lose a windpipe way toward No. 1 storage nitrogen (N_2), in the nitrogen the process we adopt every 24 hour respectively replace from the grain heap first floor and grain noodles nitrogen spirit of the method carry on nitrogen, so can make into a grain heap of nitrogen spirit density more even, go to No. 1 storage first stage nitrogen be over (namely grain heap the air sac can bear of safe tolerance) that storage total pure the degree annoy for 99.9% nitrogen 6 203.96 sign a square rice, the pass stop make a nitrogen machine set, close enter spirit valve door, and start the nitrogen in the storage (N_2) a density equilibrium system carry on nitrogen the density of the spirit (N_2) circulation balance, use the NFY - I C oxygen quantity analysis instrument to grain heap inside of the air density carry on an examination and observe the oxygen density in the storage of variety circumstance, nitrogen spirit density whether have already attained to keep grain pest with the result that density with make sure whether next stage needs the nitrogen of continue or not. On top of that, we distinguish on September 21, 2007 and on September 30 to the carry on of storage of the No. 3 storage, No. 4 nitrogen of this database, concrete nitrogen operation and No. 1 storage completely same, this text no longer replies to say, go to nitrogen operation be over (namely grain heap the air sac can bear of safe tolerance) the No. 3 storage total pure degree to annoy for 99.9% nitrogen 5 952.8 sign a square rice, the No. 4 storage total pure the degree annoys for 99.9% nitrogen 6 440 sign a square rice.

5 Experiment Results

(1) Experiment the storage (No. 8 storage) destroys insects effect: Can prognosticate to start carry on more violent activity at grain heap surface and aisle plank top at this time, they express for the fluster and have no a purpose to crawl along everywhere; While carrying on the second stage nitrogen operation, the nitrogen spirit density in the storage rises to 91.74% from 86.83%, the above-mentioned pest starts more violently crawling along everywhere, also a little amount pest body be inside out, feet dynasty the God present to die appearance; While carrying on the third stage nitrogen, the nitrogen density in the storage rises to 94.82% from 91.74% at this time, keep the performance of grain pest as activity dilatoriness

in the grain heap, walk to stop, have already can't endanger grain, body much is feet dynasty the God's inside out appearance. While carrying on the fourth stage nitrogen, the nitrogen density in the storage rises to 96.75% from 94.82% at this time and the above-mentioned pest continues to express for the appearance which is on the brink of to die, besides which, present the appearance that will soon die; While carrying on arrive the fifth stage nitrogen, grain heap nitrogen the density has already rise to 98.12% and each kind of pest has already continuously died. Haven't discovered live insect while going to the tenth day (namely on October 13) to check into the storage. The storage's nitrogen annoys density to descend from 98.12% to 92.36% totally kept for 131 days (in the center don't add another nitrogen), Be done not discover live insects by check, until discover on the grain noodles aisle plank on February 21, 2007 that all pests have already been placed in to die appearance, we immediately carry on adding higher pure nitrogen (99.9%) to that storage about 1960 sign a square, nitrogen be over the nitrogen of the grain heap the density rises to 95.5%, in addition, for keeping higher nitrogen to annoy a density ($\geq 92\%$) inside storages, we still on November 16, 2007 give that storage complement higher pure nitrogen spirit (99.9%) about 1904 sign a square, close to February 16, 2008, through examination experiment storage 8 storages grain heap space of nitrogen the density remain about 92% and have no insect to expect as long as 491 days (namely since October 13, 2006 - February 16, 2008), till the day that this text cuts a draft experiment storage 8 storages still kept doing not discover to live an insect.

The pest experiments aspect and we choose each insect cage to put them into carrying on experimenting an observation. While carrying on first stage nitrogen (nitrogen density 86.83%), the pest performance is extremely nervous and without intermission carry on climbing to move; to discover insect cage while carrying on the second rank nitrogen (nitrogen density 91.74%) in equally have already had 30% pest death (the comparison, insect of death pest in each insect cage grow basic homology), survive down of try an insect to run about slow-moving, near to die; while arriving the third stage nitrogen to end (namely carry on the 11th day of nitrogen, the nitrogen in the storage density is 94.82%), the speed died from the pest to see, provide to try the pest in the insect

cage compare the pest in the storage death the speed want to have to be more quickly and investigate its reason us to recognize that the insect cage space is smaller, space oxygen the density be low, but provide density of try the pest again more big, two kinds of pest together entwine, squeezes depletion of accelerate its physique mutually, this is quickly to result in death main reason and in addition lay in grain heap, the death speed of the bottom layer insect cage pest ratio upper level insect the pest of the cage quick. Therefore, we think when doing nitrogen adjusts to keep grain pest death rate an examination, the death rate which provides to try pest probably also incompletely represents the death rate of storage pest, more at this time nitrogen in the storage annoy the density is a cause death of pest density, various measurements of data should with solid the warehouse grain death rate of the pest for 100% is standard for reference and we should specially notice this kind of special phenomenon.

(2) The expansion application (the 1st, the 3rd, 4 numbers) storage destroys insects effect: No. 1 the storage is from 2007 years after August 22 started nitrogen, we every morning 8:30 - 11:30 cent arrange specially assigned to the nitrogen storage carry on an oxygen density an examination, nitrogen go to the third weather discover that the storage appeared an oxygen density sharply descend of special phenomenon, then again always with quicker speed quickly descend, be the No. 1 storage first stage nitrogen end (9 days) the storage oxygen the density has already descended to 5.0% (but the theories decline an oxygen value just for 10.2%), to the 30th day (namely September 21) whole storage oxygen the average density has already descended to 1.7%, go to the 40th weather (namely October 1) whole storage oxygen the average density has already descended to 0.93%, go to the 50th weather (namely October 11) whole storage oxygen the average density has already descended to 0.5%, go to the 60th weather (namely October 21) whole storage oxygen the average density has already descended to 0.7% and have go to since the 70th day (namely October 31) 2008 years February 16 Japanese theses cut a draft, that each oxygen of storage the examination order keep an oxygen density all for 0 time already 108 days, because of oxygen quantity analysis instrument already can't examine a grain heap of oxygen density, so we can treat it as unique oxygen or nitrogen spirit the density is for 99.9% (de-

tailed see the No. 1 storage oxygen a density variety curve Figure) Owing to the No. 1 storage grain oxygen density inside the heap's exceeding the speed limit to descend, and have already attained the pest that the nitrogen keeps a grain to cause death a density 98% in advance. So our decision to that storage no longer carry on the 2 and 3rd stage nitrogen, change to continuing to observe an its oxygen density variety circumstance, can economize a great deal of nitrogen expenses so. No. 1 storage nitrogen spirit empress because oxygen density inside the grain heap quickly descends, various keep grain pest to cause because of the anoxia disspread from the grain heap, intermediate climb to a grain heap a surface layer, greatly part of keep grain pest gathering on the on all sides aisle plank of the warehouse wall, the parts of pest bodies are inside out, feet dynasty the god make to get close to die flounder form, continue to descend along with oxygen density inside the grain heap, go to 28 weathers through get into inside storage to grain each part of heap carry on sampling to sieve a check to discover inside storage of keep the grain pest has already all died. In addition, the No. 3 storage, No. 4 storage adjusts to keep at the nitrogen spirit the death circumstance of the pest within grain process and the variety circumstance of the oxygen density and No. 1 storage also greatly goes to a homology, this text no longer repeated, the oxygen density of these two storages variety detailed see the variety curve Figure of the 3rd, the No. 4 storage oxygen density.

In the No. 1 the storage nitrogen the spirit adjust keep the grain process is the reason why cause that storage of does the oxygen density exceed the speed limit to descend because according to compute that storage to carry on first stage after the nitrogen the its theories oxygen density at most can decline to 10.2%, but the oxygen density in the warehouse's grain heap has already all descended to 0 now, we analysis result in this kind of phenomenon of reason may be No. 1 storage, No. 3 storage, No. 4 storage store of the corn be the new corn which produces in 2006, corn go into storage empress because of afterward familiar period function and water be higher to cause breath quantity to enlarge but quickly finish consume the oxygen in the grain heap, cause thus after the nitrogen the closeness grain oxygen density within heap quickly descend. No. 1 storage's appearing this kind of oxygen density to exceed the speed limit the descendent phenomenon isn't accidental,

and close behind carry on g nitrogen spirit to adjust a No. 3 storage of keep the grain ,No. 4 , the storage also appeared a similar oxygen density to exceed the speed limit to descend phenomenon and also proved this kind of to calculate of accuracy , so we think such as the soybean ,wheat ,rice valley etc. of new results after familiar period obvious ,breathe to have great capacity of grain when aftertime carry on nitrogen to adjust to keep a grain also very probably appear this kind of oxygen density to above exceed the speed limit the descendent phenomenon. Is exactly in order to appearing this kind of oxygen density to exceed the speed limit the descendent phenomenon ,make to plan to carry on originally four-five stage nitrogen decline the work of oxygen to become to carry on first stage all completion , saved a great deal of nitrogen expenses ,the normal nitrogen spirit adjusts to keep grain expenses of 20% - 30% .

(2) Experiment the variety circumstance of the storage nitrogen and oxygen density

Table 1. Experiment the storage (No. 8 storage) nitrogen, oxygen density variety

Date	Times	Oxygen concentration	Concentration of nitrogen	time of Filling nitrogen time	Filled nitrogen
2006. 9. 10	0	21% (Air)	78% (Air)	0	0
2006. 9. 12	1	13. 17%	86. 83%	69. 19	1937. 32
2006. 9. 18	2	8. 26%	91. 74%	70. 16	1964. 48
2006. 9. 23	3	5. 18%	94. 82%	70. 92	1985. 76
2006. 9. 28	4	3. 25%	96. 75%	70	1960. 00
2006. 10. 3	5	1. 88%	98. 12%	71. 48	2001. 44

Table 2. Expansion application storage (No. 1 storage) nitrogen, oxygen density variety

Date	Times of filling nitrogen	Oxygen concentration	Concentration of nitrogen	time of Filling nitrogen time	Filled nitrogen
2007. 8. 22	1	21% (Grain reactor)	99. 9% (Filled)	221. 57	6203. 96
2007. 10. 18		2% (Grain reactor)	98% (Grain reactor)		
2007. 10. 29		0 (Grain reactor)	99. 9% (Grain reactor)		

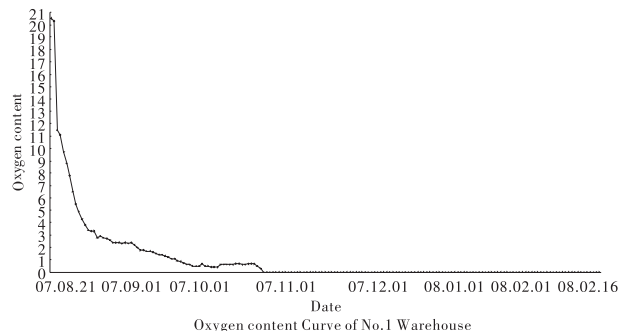


Table 3. Expansion application storage (No. 3 storage) nitrogen, oxygen density variety

Date	Times of filling nitrogen	Oxygen concentration	Concentration of nitrogen	time of filling nitrogen time	Filled nitrogen
2007. 9. 21	1	16. 5% (Grain reactor)	99. 9% (Filled)	212. 6	5952. 8
2007. 10. 9		1. 9% (Grain reactor)	98. 1% (Grain reactor)		
2007. 10. 25		0 (Grain reactor)	99. 9% (Grain reactor)		

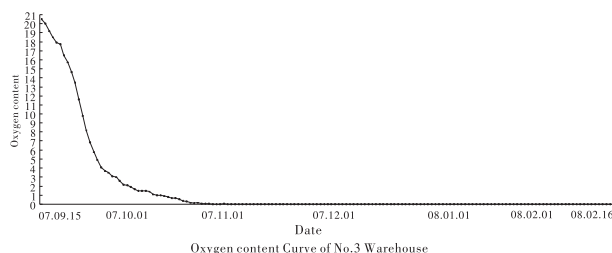
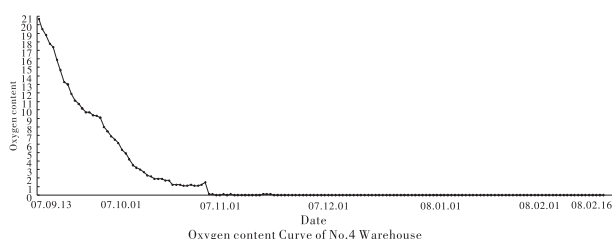


Table 4. expansion application storage (No. 4 storage) nitrogen, oxygen density variety

Date	Times of filling nitrogen	Oxygen concentration	Concentration of nitrogen	time of filling nitrogen time	Filled nitrogen
2007. 9. 30	1	9. 1% (Grain reactor)	99. 9% (Filled)	230	6440
2007. 9. 15		1. 9% (Grain reactor)	98. 1% (Grain reactor)		
2007. 10. 29		0 (Grain reactor)	99. 9% (Grain reactor)		



Note :table 1 ,2 ,3 and 4 of nitrogen parameter is :Output the nitrogen current of air measures to 28 to sign a square rice/hour and output the nitrogen pure degree is 99. 9% .

Seen from the table 1 , experiment a storage since September 12 ,2006 first stage (namely stage 1) nitrogen to October 3 ,2006 the fifth stage (namely stage 5) nitrogen be over ,nitrogen spirit density from normal 78% of air rises to 98. 12% ; But the oxygen density then descend from 21% of normal air to 1. 88% . Make nitrogen machine a set total work time is 351. 75 hour ,the total goes into a pure degree to annoy for 99. 8% nitrogen 9849 sign a square. The storage ' s nitrogen time across the degree as 31 days and this be the cause that the nitrogen which all wants to carry on about 24 hours behind because of the stage be over of each nitrogen annoys density circulation bal-

ance.

Saw from the table 2,3 and 4, expansion application storage 1,3, No. 4 storage because the empress familiar period of corn mightiness store breathes a function, just through first stage nitrogen all of above 3 oxygen densities in storage grain heap descend to 0, keep grain pest death rate for 100%, because above 3 storage adopted the forerunner's grain storehouse to annoy airtight sex reformation technique, arrive this text to cut a draft above each storage keep an oxygen density is 0 of time already 96 day, the oxygen density in the storage rose of visible result, 1,3, No. 4 the corn grain that storage keep feeling stability, have never appeared corn to have fever the phenomenon that mildewed change.

(3) Grain during the period of experiment of quality variety

Experiment storage (No. 8 storage) nitrogen (N_2) compared with check against a storage (No. 7 storage).

Table 5. The wheat stores quality variety comparison

Ware house	Inspection date	Moisture (%)	Bulk density (g/L)	Reinforcement of water (%)	Scores of taste
No. 8	2006. 8. 29	10.0	811	195.9	82
	2007. 5. 31	10.2	811	194.8	81
	2007. 9. 7	10.1	811	197.2	84
	2008. 2. 9	10.1	811	197.0	84
No. 7	2006. 8. 29	10.1	809	196.2	81
	2007. 5. 31	10.2	809	191.1	78
	2007. 9. 7	10.2	809	192.7	78
	2008. 2. 9	10.0	809	191.5	76

From the table 5 we can see, experimented a storage (No. 8 storage) have carried on nitrogen since September 12, 2006 to adjust to keep after the grain wheat of the hoard quality had obvious variety, went to May 31, 2007 to carry on hoard quality an examination wheat of wheat gluten absorb water quantity from 195.9% just a little descended to 194.8% (not expel the examination error margin factor), carried on nitrogen to keep grain about after a year, its hoard quality not only descended to on the contrary have an obvious exaltation, wheat gluten absorb water quantity from 194.8% rise to 197.2%, go to on February 9, 2008 its wheat gluten absorb water quantity to still keep 197.0%, wheat gluten absorb water quantity and taste a grade point value respectively compare check against a storage (No. 7 storage) 5.5 high percentage

points with 7 divide. But 2 checked against a storage (No. 7 storage) because of having never carried nitrogen to adjust to keep grain store quality indices to present straightly descend trend, its wheat gluten absorb water quantity from 196.2 descend to 191.5, taste a grade point value to descend from 81 to 76, descend of the ranges all have more and greatly.

By Table 6 we can know green nitrogen to adjust to keep grain expansion applied of 3 storage (1,3, No. 4 storage), in order to go into the nitrogen of higher pure to plus a corn oneself the breath function of the mightiness inside the storage, make the closeness grain oxygen density in the heap quickly descend to 0, and can with long hours keep, so the corn is under this kind of environment which looked like unique oxygen stored the fat in the grain grain to decelerate the progress that it oxidize because of anoxia, stored in warehouse to store more than 8 months. It mainly stores quality indices fatty acids a value ascension extremely slow - moving, equally only increase 1.2 fatty acids values, according to fatty acids value thus of growth speed, above 3 expansion application storage of the corn rotates its fatty acids value inside the period (in two years) in a hoard will probably can't over 50 this is proper to save with light the degree should not save this important boundary, if 60% storage corns in the whole country carry on green nitrogen spirit to adjust to keep a grain, will be able to significant exaltation storage corn of proper save a rate and save to rotate expenses, the hoard that even can also consider adjustment or prolong corn or other grain species in the future rotate a period, for the country house economy a great deal of storage the grain rotate expenses.

Table 6. The expansion application storage (1,3, No. 4 storage. corn stores quality variety

Ware house	Inspection date	Moisture (%)	Bulk density (g/L)	Fatty acids	Scores of taste
No. 1	2007. 6. 29	13.2	722	43.6	86
	2007. 8. 15	13.2	722	43.7	86
	2008. 2. 5	13.3	722	44.5	85
No. 3	2007. 6. 29	13.3	728	42.2	87
	2007. 8. 15	13.2	728	43.6	86
	2008. 2. 5	13.3	728	43.9	86
No. 4	2007. 7. 26	13.2	726	43.2	86
	2007. 8. 15	13.0	726	43.5	86
	2008. 2. 5	13.1	726	44.1	86

(4) The economic performance contrast
The nitrogen adjust to keep grain to exper-

iment((No. 8 storage) and normal regulations to keep grain to check against storage (the 7th) to carry on to normally keep grain for a

year of movement expenses comparison, the contrast sees table as a result 7.

Table 7. The nitrogen adjusts to keep grain to experiment storage and normal regulations to keep grain to check against storage expenses to relatively analyze. Unit: (Yuan/Tonne of grain)

Warehouse	Capacity (t)	Amount (t)	Fumigation costs		Film grain costs	Nutritional supplement	Circulation electricity costs	Total costs	Costs/T
			N ₂	ALP					
8	5500	5120	3940		1200		28	5168	1.01
7	5000	4882		2500	150	3255	55	5960	1.22

Note: The normal regulations keeps grain to check against a storage to press to carry on annually two times smoked steam to destroy insects the expenditure expenses needed.

According Table 7: expenses expenditures are analytical from the table more medium see, the nitrogen adjust to keep grain to experiment a year of storage (No. 8 storage) ton grain expenses 1.01 Yuan/year/ton and normal regulations keep grain to check against a year of storage (No. 7 storage) expenses 1.22 Yuan/year/Ton. Carrying on single storage expenditure expenses lower 0.21 Yuan/Year/Ton, actually because of the nitrogen adjust to keep grain still

have many storage nitrogen tail comprehensive the advantage of exploitation, significant decrease expenses expenditure 20% - 50%, therefore, the nitrogen spirit adjust actual grain expenses expenditure of keep the grain generally for 0.5 - 0.8 Yuan/year/Ton. To carry on normal regulations smoked steam to keep the expenses of expenditure that grain need to still want low.

Table 8. The storage (1, 3, No. 4 storage) nitrogen of the expansion application adjusts to keep the grain expenses expenditure. Unit: (Yuan/Ton)

Ware house	Capacity (t)	Amount (t)	Nitrogen costs	Film grain costs	Circulation electricity costs	Total costs	Costs/T
1	9000	9307.08	2041.8	2900	52	4993.8	0.536
3	9000	9271.24	2060.1	2900	52	5012.1	0.54
4	9000	9276.68	2228.7	2900	52	5180.7	0.56

From the table 8 data we can see, carry on green nitrogen to adjust to keep grain of expansion application storage 1, 3, No. 4 storage because the grain keep by belong to new results corn, the nitrogen lowered the oxygen density in the storage of in the meantime, corn oneself mightiness of after the familiar period breathe a function also consumed grain is a great deal of oxygen inside the heap, cause the oxygen in the storage density only descended to 0 by all of a nitrogen, expansion application storage 1, 3, No. 4 storage because of adopting the patent technique for possess singly to carry on annoying an airtight reformation, the storehouse have very and goodly annoy airtight function, so far above three oxygen densities of storage still keep to 0, have no ascension of trend, the nitrogen in the storage also didn't leak of phenomenon, the grain keep have no insect, have never had fever mildewed change phenomenon, grain feeling stability, keep grain safety, according to the green nitrogen spirit adjust keep grain of ex-

pansion application storage 1, 3, No. 4 storage current development trend, the corn that 3 storages keep is in this the hoard rotate the period (two years) won't need again additional complement higher pure nitrogen, as a result saved about 75% nitrogen expenses expenditures, so rotate a period (namely in two years) to only need the expenditure nitrogen expenses in this hoard: 0.55 Yuan per ton.

6 Analyze with Discussion

(1) Destroy insects effect analysis: Store a method with the grain of the adoption normal regulations to compare, the green nitrogen (N₂) adjust to keep grain technique regardless to all have very big advantage in destroying insects effect and preventing and cure expenses, and availablely avoided normal regulations keeping the grain chemistry medicine's pollution for the grain and the environment and provided for the drug-resistant which represses to keep grain pest new method. Experiment storage higher N₂

& with lower oxygen environment under the condition, successfully repressed the growth of insect, mildewed to breed. There is good prevention and cure effect, the insect pest death rate is 100%, such as *R. dominica*, *T. castaneum*, *C. ferrugineu* and *C. turcicus*. Destroy insects the effect outran our expectations, investigate its reason is to keep the grain pest basically can't breed under this kind of bad environment condition of higher N_2 & lower oxygen, existence, so adopt nitrogen green to keep grain technique prevention and cure to keep grain pest is a depopulation type of, but the adoption keep the prevention and cure pest of the grain chemistry medicine then to attain this effect. Time which checks against storage no longer than 10 months carried on to turn the aluminum chemistry medicine smoked steam to destroy insects.

(2) The spirit adjusts to keep grain function analysis: Occupy pass data introduction, foreign open the exhibition carbon dioxide (CO_2) or nitrogen (N_2) to adjust to keep with domestic currently the grain generally and all relatively is over-emphasize in spirit to adjust to destroy insects this function, but adjust to keep grain then give attention to both. But, we think no matter what it is adjust to keep grain technique, it has to have the following two functions: Since can adjust means to availably prevent and cure to keep through the grain pest adjusts means to keep through again the grain make grain of hoard quality can the biggest limit's keep (or protect fresh) just can be called real of the green keep a grain technique and lack a Our development, develop of the green nitrogen (N_2) adjust to keep technical biggest advantage of grain be-namely since can destroy insects and keep a grain, the storehouse which passes to adopt a forerunner annoys airtight patent a technique, adopt special closeness material and closeness method, it can make the grain heap keep disadvantage to breed at the pest growth over a long period of time, but be advantageous to the ecosystem environment of higher N_2 & lower oxygen of the grain hoard. It is a more perfect for green nitrogen to adjust to keep grain technique. In addition, adopting green nitrogen to adjust to keep grain technique can al-

so solve many adopted a normal regulations method to keep in the past the grain can't solve of hard nut to crack, such as in the normal regulations method the hoard the process because of over a long period of time adopt hydrogen phosphide smoked steam a grain, usually result in the integrated circuit to monitor the system to grain feeling collect a machine and measure electric resistance to be decayed damage; Caused to keep grain pest to produce a serious drug-resistant, and we can not destroy the life of *R. dominica*, *T. castaneum*, *C. ferrugineu* and *C. turcicus*. So as to be result in the problems of medicine remains & pollute grain and endanger a human body's health and break environment etc.

7 The Green Nitrogen (N_2) Adjusts to Keep the Grain Technical Applied Foreground Outlook

Of development, research green keep the grain new technique is a local and foreign grain to store currently technical main development direction, and it is an irresistible general trend, but the green nitrogen (N_2) adjust to keep a grain technique doubtless again is various green keep to have to develop a potential most in the grain technique of one of the technique, pass to open an exhibition green to keep grain since can reduce to keep the grain chemistry medicine's pollution for the grain and the environment, and then can reduce a drug-resistant of keep the grain pest and keep a save of grain quality. Along with the progress in ages, it is every to will have green nitrogen (N_2) to adjust to keep from now on grain technique when the grain of the hoard carry on market sale, certainly will increase its merchandise additional value, this again for aftertime green keep grain of the expansion application got into the development orbit of virtuous cycle to create a beneficial condition and making the green nitrogen (N_2) adjust to keep grain technique will have vaster market foreground.

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