Active cell phosphine generator SGF-M2 and fumigation technologies with its use

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Traditional technologies of grain fumigation in silos are mainly based on application of tablet form preparations directly into the grain mass during the process of grain transfer from one silo bin to another

The negative aspects:

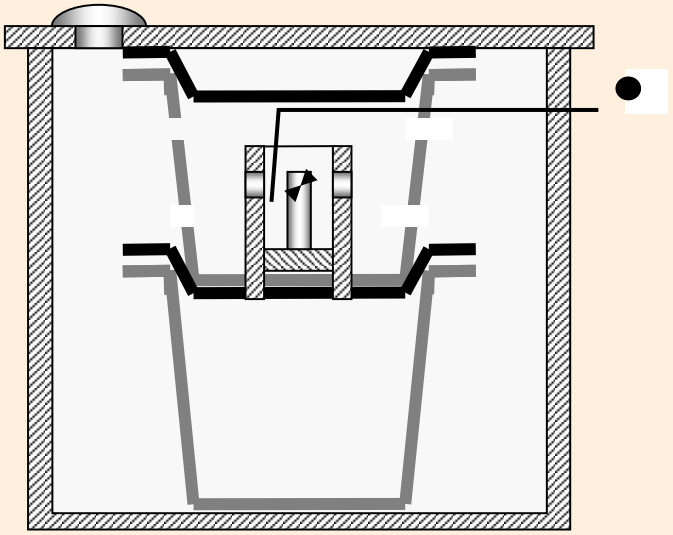
- **the application procedure is labour-intensive**
- **the gas development is slow**
- **the transfer operation damages the grain**

The NPF SCARABEY's team has developed:

- the new technical tool – the phosphine gas generator, SGF-M2

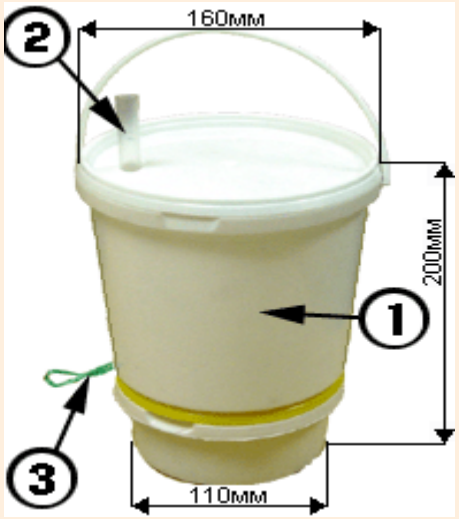
- fumigation technologies for its use

The SGF-M2 generator consists of two interconnected chambers containing raw chemical components



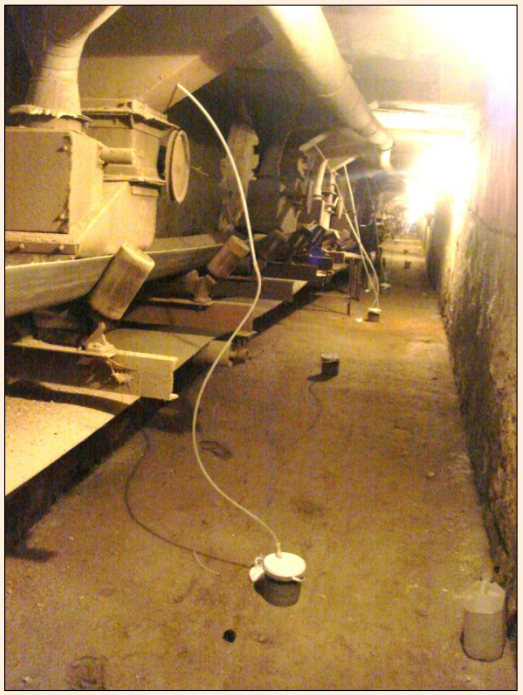
When the reactants are brought into contact, parallel chemical reactions start, resulting in fumigant gas development, being a mixture of phosphine and carbon dioxide

The energy produced by these chemical reactions drives the fumigant gas into the object of fumigation through plastic delivery tubing (2)



The approximate time of the fumigant gas development by one SGF-M2 generator is 2:00 hours with a yield of 80 g phosphine

In the first series of trials,
studies were conducted to determine the "fumigation wave" output peak time
and value as determined by the grain height in a concrete silo bin



Wheat grain was stored in three 30 m high concrete silo bins, with a cross-sectional area of 9 m^2

Silo bins were filled with grain to 15, 12 and 10.5 m high

The fumigant gas was applied from SGF-M2 generators to the bottom of each bin through the injection tubing at the dosage of 3 g m^{-3}

The phosphine concentration in the grain mass was measured at 0.5 m depth from the surface of the grain, i.e. at approx. 14.5, 11.5, and 10 m distance from the gas injection point

The grain temperature during the study period averaged 21 - 22 ºC

The air temperature ranged from 9 ºC (night) to 15 ºC (day)

The "fumigation wave" peak dependence on the height of grain mass in silo bins

Silo bin number	Grain mass height (m)	PH_3 concentration (g m^{-3})	Exposure time (h)
1	10.5	0.6	15
		2,8	20
		4,2	22
		5,0	23
		5,5	24
		5,8	25
		6,1	26
		5,7	27
		5,3	28
2	12	0.3	15
		1.3	20
		5.4	25
		5.9	26
		6.6	27
		7.1	28
		6.7	29
		6.7	30
3	15	0	15
		0.1	20
		0.9	25
		3.6	30
		5.9	34
		6.8	35
		7.3	36
		7.0	37
		6.1	38

In the second series of trials,
fumigation was carried out in non-gastight metal silos
with 27 m high walls, 3.5 m high cone, 30 m diameter,
containing 5000 tonnes of malt barley, occupying 5900 m^3 of volume

The fumigant gas was applied through tubing to the air duct during the trial period of 5 days

Total of 160 generators
(12.8 kg PH_3, 2.15 g m^{-3} dosage)
were used

Temperatures:

- **air 10-12 ºC (day)**
- **air 3-4 ºC (night)**
- **grain 17-22 ºC**

Phosphine distribution in the grain mass in metal silos, showing fumigation efficiency on *Sitophilus granarius* mortality in bioassays

Measuring point	PH_3 concentration (mg m^{-3}) after		S. granarius mortality, %
	20 hours	32 hours	
Grain, depth of 1 m,			
from the bin wall: 1.5 m	10	50	100
15.0 m	20	90	100
Grain, depth of 12 m,			
from the bin wall: 1.5 m	60	90	100
15.0 m	90	250	100
Grain, depth of 24 m,			
from the bin wall: 1.5 m	100	110	100
15.0 m	140	400	100

In the third series of trials,
studies were conducted to determine the time and efficiency of wheat (68 t) fumigation with generators SGF-M2 in a hopper car

Two plastic tubes
were introduced into the grain
(through loading hatches #1 and #3)
at 2 m depth
from the grain surface

The injection time of 160 g of gas was 2:00 hrs

Grain temperature was 15 ºC
The air temperature ranged
from 4 ºC (night) to 10 ºC (day)

The exposure time was 15 hours

Phosphine distribution in the grain mass in hopper car, showing fumigation efficiency on *Sitophilus granarius* mortality in bioassays

PH_3 check point and bioassay locations	Check time after first generator start (h)	PH_3 concentration ($g\ m^{-3}$)	*S. granarius* mortality, %
Grain mass at 0.1m, loading hatch #2 area	1 2 3 4 5 9 15	0 0.2 0.3 0.7 0.8 0.8 0.8	100
Grain mass at 0.1m loading hatch #4 area	1 2 3 4 6 9 15	0 0.4 0.8 0.8 0.8 0.8 0.8	100

- Have you uderstood anything?

- And what about you?

Thank you very much!