



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

G. MALUSHKOV, D. PROKOPOV, L. TIKHONOVA

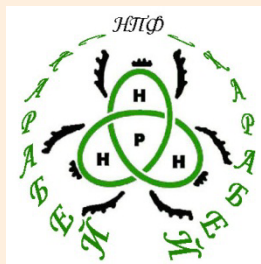
***NPF SCARABEY LTD.
RUSSIA***

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:

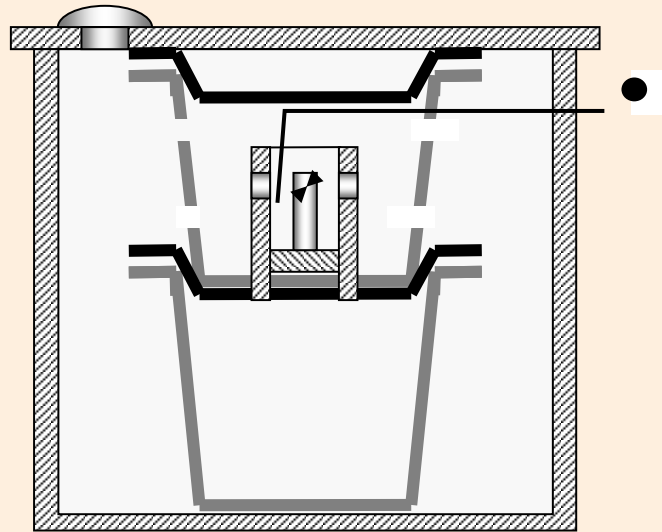
- the application procedure is labour-intensive**
- the gas development is slow**
- the transfer operation damages the grain**



The NPF SCARABEY's team has developed:

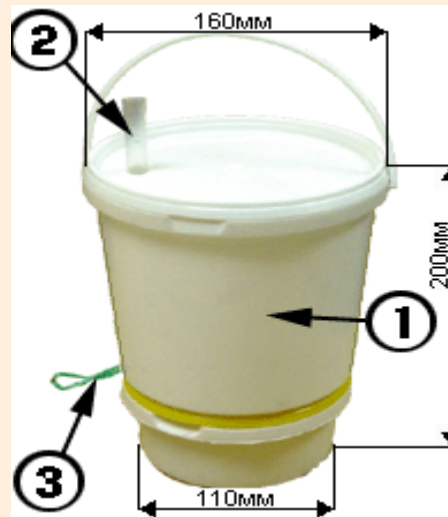
- the new technical tool – the phosphine gas generator, SGF-M2**
- fumigation technologies for its use**

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 m²**

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 °C

The air temperature ranged from 9 °C (night) to 15 °C (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 m³ 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 PH₃, 2.15 g m⁻³ dosage)
were used

Temperatures:

- air 10-12 °C (day)
- air 3-4 °C (night)
- grain 17-22 °C

**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 15.0 m	10	50	100
	20	90	100
Grain, depth of 12 m, from the bin wall: 1.5 m 15.0 m	60	90	100
	90	250	100
Grain, depth of 24 m, from the bin wall: 1.5 m 15.0 m	100	110	100
	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 °C
The air temperature ranged
from 4 °C (night) to 10 °C (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**

PH₃ check point and bioassay locations	Check time after first generator start (h)	PH₃ concentration (g m⁻³)	<i>S. granarius</i> mortality, %
Grain mass at 0.1m, loading hatch #2 area	1	0	100
	2	0.2	
	3	0.3	
	4	0.7	
	5	0.8	
	9	0.8	
	15	0.8	
Grain mass at 0.1m loading hatch #4 area	1	0	100
	2	0.4	
	3	0.8	
	4	0.8	
	6	0.8	
	9	0.8	
	15	0.8	



- Have you understood anything?

- And what about you?

Thank you very much!