QUICKPHLO-R® FORMULATION FUMIGANT GENERATORS: A NEW SAFER AND ENVIRONMENTALLY FRIENDLY PHOSPHINE FUMIGATION SYSTEM.

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Phosphine is the most commonly used fumigation fumigant worldwide. Aluminum phosphide has been the primary choice of commercial fumigators for decades. The use of phosphine is increasing with Methyl Bromide phase out. Conventional formulations of Aluminum Phosphide and Magnesium Phosphide have been used for more than the past half century without improvement in the method of application or formulation. There are many limitations to conventional phosphine formulations; manufacturing and application safety have continually been major concerns.

The QuickPHlo-R aluminum phosphide formulation and the QuickPHlo-R phosphine generator series were developed to overcome the conventional phosphine safety, environmental and consumer food contamination limitations. The QuickPHlo-R aluminum phosphide formulation is very safe to use. The QuickPHlo-R phosphine generator is very operator friendly and safe. This generator has a built-in deactivation system and scrubber to treat the residue of aluminum phosphide, drastically reducing levels of active ingredient to safe levels for disposal. This new innovative technology has many advantages which guarantee safety, quality and precision fumigations. The phosphine generators come in different sizes from 56 gram generation capacity to over 15000 gram generation capacity.

Current Aluminum Phosphide formulation in use: Aluminum Phosphide formulations, having an active ingredient of 56%, in the form of tablets / pellets / sachet are used as a fumigant to kill stored grain insects. They are extensively used for fumigation of grains, cereals, dried fruits, ships, food, tobacco and other products / commodities.

The new formulation QuickPHlo-R - Aluminum Phosphide has an active ingredient content of 77.5% and is granular. It is specifically designed for use in the QuickPHlo-R generator.

Benefits of new formulation versus conventional formulations:

Item No.	Activity	QuickPHlo-R Granules	Conventional formulation	Remarks
1	Active ingredient	77.5 %	56%	Less chemical used for generating the same quantity of Phosphine gas. A I content is 40% higher. With less starting material, less residue is also generated.
2	Operations	Automatic	All manual	The QuickPHlo- R generator has programmable Logic controller which controls all the operations, with built in check list. Where as in the conventional form, all operations are manual and the operator is exposed to dangerous working conditions.
3.	Dust content in the product	0	0.5 – 1 %	Very fine dust is in the tablets and pellets. This flies in air currents when the product is applied. Operator needs dust protection for respiratory system, eyes and hands.
4	Product Packing	Aluminum pouch	Aluminum flask	Flasks are very cumbersome and laborious to open, sometimes flashing when opened. Aluminum foil packing can be cut easily with a scissor / knife
5.	Product use	No ignition	Sometimes ignition can occur	Occasionally, it is observed that when the conventional formulation pack is opened, it ignites. The granules never have ignition on opening of the aluminum foil pack.
6.	Phosphine concentration	0 / extremely low	> 2000	Phosphine concentration on opening the flask is very high. When opening the granules, gas concentration is zero / very low – it is very safe for the operator.

7	Application of product – Starting	Poured into reaction pot of QuickPHlo–R generator	To be carried to the top of the silo / structure	Phosphine generator is placed on ground outside the structure. The granules are added to the reaction pot. This takes only a few seconds. Using conventional formulations, the product has to be carried to the top of the silo / storage structure and applied to the commodity manually. This takes much more time and is a hazardous operation. Phosphine gas release starts immediately and concentration starts building up in the structure / commodity when operator is still applying product.
8	Application of product – Ending	Product residue - QuickPHlo-R generator	Product residue stays in treated product in the silo / structure	The commodity fumigated gets contaminated with the product residue in the conventional formulation. With the QuickPHlo–R generator w/granular formulation, residue remains in the reaction pot, only Phosphine gas enters the structure / commodity
9.	Ammonia in the formulation	NO	YES	Ammonia is additional pollutant which is eliminated from the new granular formulation in QuickPHlo - R generator
10.	Gas generation active time	2 – 3 hrs	4 – 10 days	The gas generation is immediate in the QuickPHlo-R generator -- gas generation time independent of ambient conditions like temperature and humidity. The rate of generation of Phosphine gas from the conventional formulation is totally dependent on moisture in the atmosphere and temperature around phosphine formulation.
11	Gas concentration	Uniform in the entire commodity	Not uniform	The **QuickPHlo- R** generator has a fan which pushes the gas into and recirculates the gas through the entire structure. The conventional formulation has highest concentration around it and least away from it. In most

				conventional fumigations, the gas concentration is not uniform in the structure and efficacy is poor.
12	Hazards	Very limited -- fail-safe is built-in to all controls for all generator functions	More chances of danger or injury	In the conventional form, since the Phosphine gas generation is happening in the structure, there is potential for fire hazard. With QuickPHlo-R generator, all gas generation is outside the structure, only relatively selected gas concentrations are circulated.
13	A I content after decomposition	< 1%	3 – 4 %	**QuickPHlo-R** granules, after reaction with water have an A I content of less than 1% (which is further deactivated) after 2 hrs of reaction. Conventional phosphine has an A I content of 3 – 4% for days in tropical climate / higher when the temperatures are lower.
14	Residue	Liquid form	Fine dust	Fine dust handling is hazardous (still has high A I content)
15	Residue treatment	Clean disposal as part of generator auto. system process	Separate infrastructure required	The slurry after reaction is taken to a deactivation tank, where the waste water is treated and the A I content of the product is further reduced. Gas generated during deactivation is scrubbed in a charcoal scrubber, part of the **QuickPHlo-R** generator. Conventional formulation needs separate treatment facility where the higher A I (3 - 4 %) is treated. What ever gas is generated goes into atmosphere.
16	A I content after deactivation	< 0.1 %	> 1%	The residue in the conventional formulation needs 6 – 8 hours stirring to reach a level of >1%. Where as the **QuickPHlo-R** formulation has an AI of <0.1% after standard deactivation as standard generator cycle in 3 hrs.
17	Residue disposal	No	yes	Since the **QuickPHlo-R** granules are not applied to the commodity, so they do not have to be withdrawn for disposal. Residue of conventional fumigant has to be withdrawn / gets mixed with the commodity.