TECHNICAL NOTE CEF No.001/2021

Use of sleeves in agricultural cargo fumigation procedures, on board of vessels destined for export.

Introduction

In recent decades, the fumigation of grains and meal with aluminum phosphide has been an important tool to ensure the product quality during interoceanic travels in international trade and to prevent the introduction and spread of agricultural pests between different countries.

Aluminum phosphide products react with moisture from the air to form phosphine gas, a powerful insecticide that eliminates stored grain pests. The result of this reaction leaves a gray-white powder, inert, composed primarily of aluminum hydroxide. This process is called **fumigation**.

For the Brazilian market, the commercial product comes in the form of 3.0 g tablets, 0.6 g pellets or 34 g sachets. The composition of all is almost the same: 57% of aluminum phosphide and the remaining of adjuvants and inerts.

In the process of grain and meal fumigation in ships holds, any of the types presented can be used, since they all produce the same amount of phosphine gas in relation to their commercial weight. The difference from what today is called as the **method** is the possibility of removing the dust that results from the decomposition of aluminum phosphide. If the method is tablets and pellets, the residue mixes with the cargo and cannot be removed. If the option is using sachets or sleeves, the powder is retained and can be removed afterward.

For commercial and quality reasons, certain countries and overseas cargo recipients require that residual dust, even if it is inert, is removed from the cargo before the unloading. In these cases, fumigation companies must use sachets or sleeves.

The sleeves are fabric bags that will be filled with aluminum phosphide tablets or pellets, and that, at the end of the fumigation period, must be removed from inside the vessel holds, thus fulfilling the same function as sachets.

Objective

This document was developed to serve as technical guidance and model for the manufacturing and use of sleeves in phytosanitary treatments - fumigation - of agricultural cargoes stored in ship holds in international trade.

Due to the lack of technical studies that can demonstrate and guide the best way to use sleeves, the committee of fumigation companies of ANEC, National Association of Cereal Exporters, developed this Technical Note.

This document contains a series of important information which have been compiled and improved over decades by the most important companies in the sector, in Brazil and overseas. The parameters presented here are the gathering of what was the best generated in good use practices, with a very high success rate in the results of fumigations conducted in Brazilian ports destined for other countries.

Purposes

The use of sleeves has basically two purposes:

- First: to enable the tablets placed inside it to react equally, through and through.
- Second: that all residue generated can be removed at the end of the fumigation process.

In order to achieve these purposes, the main points are highlighted below and must be observed for a safe and efficient procedure.

Fabric Type

The chosen fabric must fulfill three functions:

Resistance: To support the forces of the tablets and the residual powder at the end of the process;

Permeability: To enable the moisture and gas exchange between the outside atmosphere and inside the sleeve;

Retention: The fabric's weft must be suitable to retain the dust that will form at the end of the process.

The fabric that has shown the best result, considering the cost-benefit ratio, is TNT - Non-Woven Fabric. For this type, the minimum weight of 40g/m² is recommended.

Another option that brings great results is the faille, a synthetic fabric, very thin and light, made 100% of Polyester.

Very fragile fabrics or TNT with a lower weight than recommended can tear during fumigation or during removal at the destination, leaking the residual powder into the cargo.

Attention: If the sleeve tears off or comes loose during application, replace it with a new one. Do not cover the damaged sleeve with a new one, as this may prevent tablets from reacting

Sewing type

One of the most common problems with using sleeves is seam rupture during filling. Usually the bottom opens up and the tablets spill out on the deck or on the cargo itself, depending on where the filling is being done.

Apart from causing delay in the operation to collect the tablets, this situation brings the risk that some of them get lost on deck and react outside the ship hold, and may cause confusion in the measurements performed to check for leaks at the end of the fumigation.

That's why it's very important that the sewing is well done. The best results have been obtained on **overlock** stitched sleeves, producing flexible, interlocked stitches that do not break when the fabric is subjected to external pressure or stretched.

Size

The size is directly related to the amount of tablets that will be used to fill the sleeves. The commercial product manufacturer recommends filling with a maximum of **1 kg of fumigant tablets**.

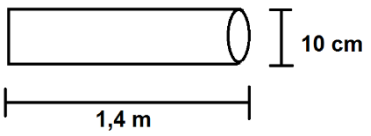
The biggest problem with fumigations using sleeves is the possibility of **non-reaction of the tablets** inside.

If the tablets are not well distributed, a common phenomenon may occur, which is that the tablets in the center are covered by residual powder from the tablets in the outer layer. This smothering prevents moisture from the outside from reaching the central tablets, and as the result, there is no reaction of the aluminum phosphide to produce the active ingredient phosphine.

The consequences of this are: lower dosage of phosphine acting inside the ship hold and delayed onset of some tablets reaction, which may occur at the time of removal of the sleeves.

The late onset of reaction can lead to explosion risks in the waste conditioning and risks of intoxication for the workers involved in the material removal. For this reason, it is very important that the company contracted for the removal at the destination is also a fumigation company, with the knowledge to deal with the collected material and knowledge of HSE – Health, Safety and Environment.

Therefore, the size must be compatible with the number of tablets that will be placed. In practice, sleeves with a length of 1.40 m and an opening of 10 cm wide have good spreading conditions for 1 kg of tablets.



Other sleeves sizes can be used, as long as they allow the tablets distribution without bunching them up.

Application

Once the sleeves are filled with the tablets, they must be closed at the end. The most common way is through a knot at the end of the fabric itself.

The application should be done according to the manufacturer's package insert. The distribution in the cargo should be uniform and the sleeves arranged manually, so that the tablets are evenly spread out. Then they should be buried approximately 30cm into the grain, cereal or meal. This will prevent any condensation formed on the cargo hatch and dripping onto the fumigant, increasing its reaction speed, generating high and undesirable concentrations of phosphine.

The ends of the sleeves should be visible on the surface of the mass of grain, cereal and meal. The sleeves must be attached to each other by a strong rope or steel cable with the end tied outside the cargo hold. The rope should be strong enough to support the weight of the sleeves. However, the rope or steel cable is only a guide so that the sleeves do not get lost in the cargo. The correct removal must be done individually and they must not be pulled by the guide rope or wire rope tied outside the cargo hold, as this could tear the sleeves apart and spill the contents of the sleeves into the grain, cereal or meal.

Other information

Each ship and its cargo holds have different characteristics and the agronomist on board must evaluate and decide the best way to apply and distribute the fumigant, taking into account the efficiency and also the HSE aspects – Health, Safety, and Environment.

This Technical Note is a guide to good practice and does not replace the technical instructions from MAPA (MINISTRY OF AGRICULTURE, LIVESTOCK AND FOOD SUPPLY), ABNT (Brazilian Association of Technical Standards,) or other authorized sources, and in case of doubts or divergences, the latter will prevail. **The assessment of the conditions at the time of fumigation** should always guide the decisions for this type of work.

It is also essential that everyone involved is familiar with the recommendations in the manufacturer's package insert, application guide and all legislation regulating the agrochemicals application in vessels holds.

ANEC stresses that this is best practice guidance, without any direct responsibility from the association.

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