

# **The use of formaldehyde as a biocide for water disinfection (PT2) in the Dutch flower bulb industry and potential candidates for substitution**

**NON-CONFIDENTIAL**

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## 1. THE DUTCH FLOWER BULB INDUSTRY

The flower bulb sector is a sector to be proud of. Flower bulbs and bulb flowers from the Netherlands are distributed all over the world. Almost two thirds of the worldwide flower bulb production is produced in the Netherlands. This makes high demands on the sector. It is not only important that cultivation progresses without fault, but nothing may go wrong in flower production, trade and export either. Each link in the chain wishes to supply the best product while making sufficient profit at the same time.

Flower bulb cultivation is an important economic activity in the Netherlands and adds about 1.2 billion euros to the Dutch economy per year. The tulip is the most widely known bulb flower and is the national symbol of the Netherlands. Dutch bulb forcers produce about 1.6 billion tulips per year and account for a very large majority of tulips that are sold in Europe. The flower bulb industry is an industry that is uniquely Dutch but also has some unique requirements when it comes to crop protection.

## 2. THE ROYAL GENERAL BULB GROWERS ASSOCIATION

The Royal General Bulb Growers Association [Dutch: Koninklijke Algemeene Vereeniging voor Bloembollencultuur or KAVB] is the trade organisation for breeders, growers, forcers and wholesalers of flower bulbs. The KAVB was founded in 1860 and currently has about 1,200 members. The KAVB represents 70% to 75% of all flower bulb growers in the Netherlands. This statement was written with great and overwhelming support of the members of the KAVB.

## 3. HOT WATER TREATMENT OF FLOWER BULBS

Most flower bulbs including tulips and daffodils are susceptible to stem and bulb nematodes. Growers live in fear of the small pathogens as just one affected bulb can be disastrous for an entire batch. Ever since it was invented in 1915, hot water treatment has been a successful and environmentally friendly method to kill nematodes in bulbs. Precision is important as the temperature must be just right during the pre-treatment and the hot water treatment. If the temperature is too high, the bulb is damaged. If it is too low, the nematodes survive. Temperatures generally vary from 32 to 48 degrees Celsius, depending on the stage of the treatment and the specific cultivar that is subjected to it.

Unfortunately, hot water treatment of flower bulbs has two potentially damaging side-effects: the spread of basal rot (*Fusarium*) which is harmful to flower bulbs and the spread of *Legionella Pneumophila* which is harmful to humans. To prevent the spread of fungi and bacteria, flower bulbs growers have extensively used formaldehyde. Bulb growers generally use a 0.5% solution of formalin containing 37% formaldehyde in the hot water baths. This means that hot water baths effectively consist of a solution of 0.185% formaldehyde and 99.815% water.

Over the years, flower bulb growers have consistently adapted the use of hot water baths to ensure formaldehyde is applied in a safe way without risk to humans, animals and the environment. Human exposure to formaldehyde vapour is minimised by ventilation of the hot water baths and by ensuring that hot water treatment only takes place in sections that are closed off to visitors and to workers that are not essential to the treatment. Formaldehyde may only be used by persons who have had proper training (certified by the Dutch government) and who use personal protection equipment.

#### **4. POSSIBLE SUBSTITUTES FOR FORMALDEHYDE**

Over the past 15 years, the KAVB, the Product Board for Horticulture, the Dutch government and individual flower bulb growers have invested several millions euros in research with the goal of finding a substitute for formaldehyde. While there are several products on the market that disinfect water, none of these products have so far proven to be a successful substitute for formaldehyde for the use in hot water baths for flower bulbs. The problem is that flower bulbs cause a high level of organic matter in hot water baths. The activity of possible substitutes diminishes rapidly due to high levels of organic matter. The activity of formaldehyde only diminishes slowly, even in hot water baths with high levels of organic matter.

The search for substitutes includes research on the following active substances:

- Hydrogen peroxide
- Peracetic acid
- Sodium hypochlorite
- Chlorine dioxide
- Ozone
- Potassium iodide
- Potassium thiocyanate
- Potassium peroxymonosulfate
- Ascorbic acid
- Electrolysed water

The research on these possible substitutes continues with financial support of the KAVB and its members. However, the hot water treatment of flower bulbs currently still necessitates the use of formaldehyde. The KAVB works together with all parties involved to ensure that formaldehyde is used in an absolutely safe way without risk to humans, animals and the environment.

#### **5. CONCLUSION**

The production of flower bulbs is an important agricultural industry in the Netherlands. The Dutch flower bulbs and bulb flowers account for a majority of flower bulb products in the world. For an effective and environmentally friendly method to kill nematodes, hot water treatment of flower bulbs is essential. A very low solution of formaldehyde in the hot water baths prevents the spread of fungi and bacteria that are harmful not only to the flower bulbs but also to humans. For the use in hot water baths, formaldehyde is applied in a safe way without risk to humans, animals and the environment. The activity of possible substitutes for formaldehyde diminishes rapidly in hot water baths due to high levels of organic matter. Research on possible substitutes continues, but at this moment the flower bulb industry is unable to produce flower bulbs without the use of formaldehyde.