

SULFURYL FLUORIDE AS AN ARTIFACT-FUMIGANT TO CONTROL THE *LYCTUS* BEETLE

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Introduction

During the last decades Methyl bromide was used to eradicate pests in artifacts in museums. But it is an ozone depletor and is classified as carcinogenic and it will be banned in the future. Stimulated by this present regulatory pressure we investigated Vikane* (= Sulfuryl fluoride) as a substitute for Methyl bromide to control wood infesting beetles in museum artifacts.

*Trademark of DowAgrosciences

The Gas

Sulfuryl fluoride (= SF) is an inflammable, not combustible, odor- and colorless inorganic gas composed of 99.8 % SO₂F₂ and 0.2 % impurities. Vikane is packaged in white steel cylinders containing 56.7 kg or 125 lbs. of SF as a liquid under pressure. The relative vapor density of SF is 3.52 (air = 1) and the vapor pressure is 18.2 bar at 26.9 °C. SF is relatively insoluble in water (750 ppm /25°C), rapidly aerates from fumigated

structures and objects leaving no breakdown residues.

SF kills insects by disrupting the glycolysis cycle, depriving the insect of necessary metabolic cell energy. Sometimes a delayed mortality is observed.

The required dosage and the initial concentration of SF are calculated by using a computer calculator system.

The efficacy of SF is mainly governed by

- temperature at the insect site
- the initial concentration of SF
- half loss time of SF
- exposure time

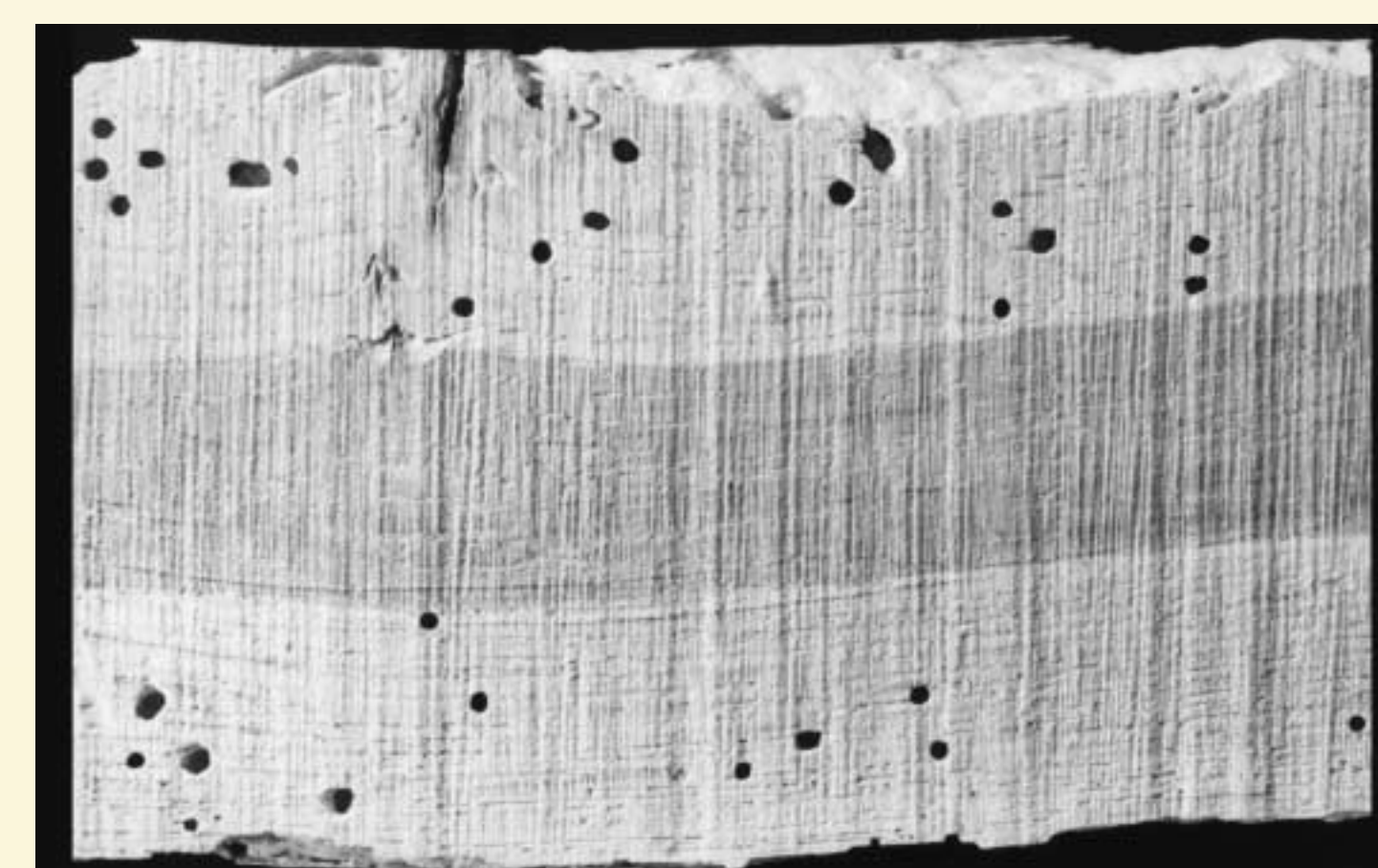
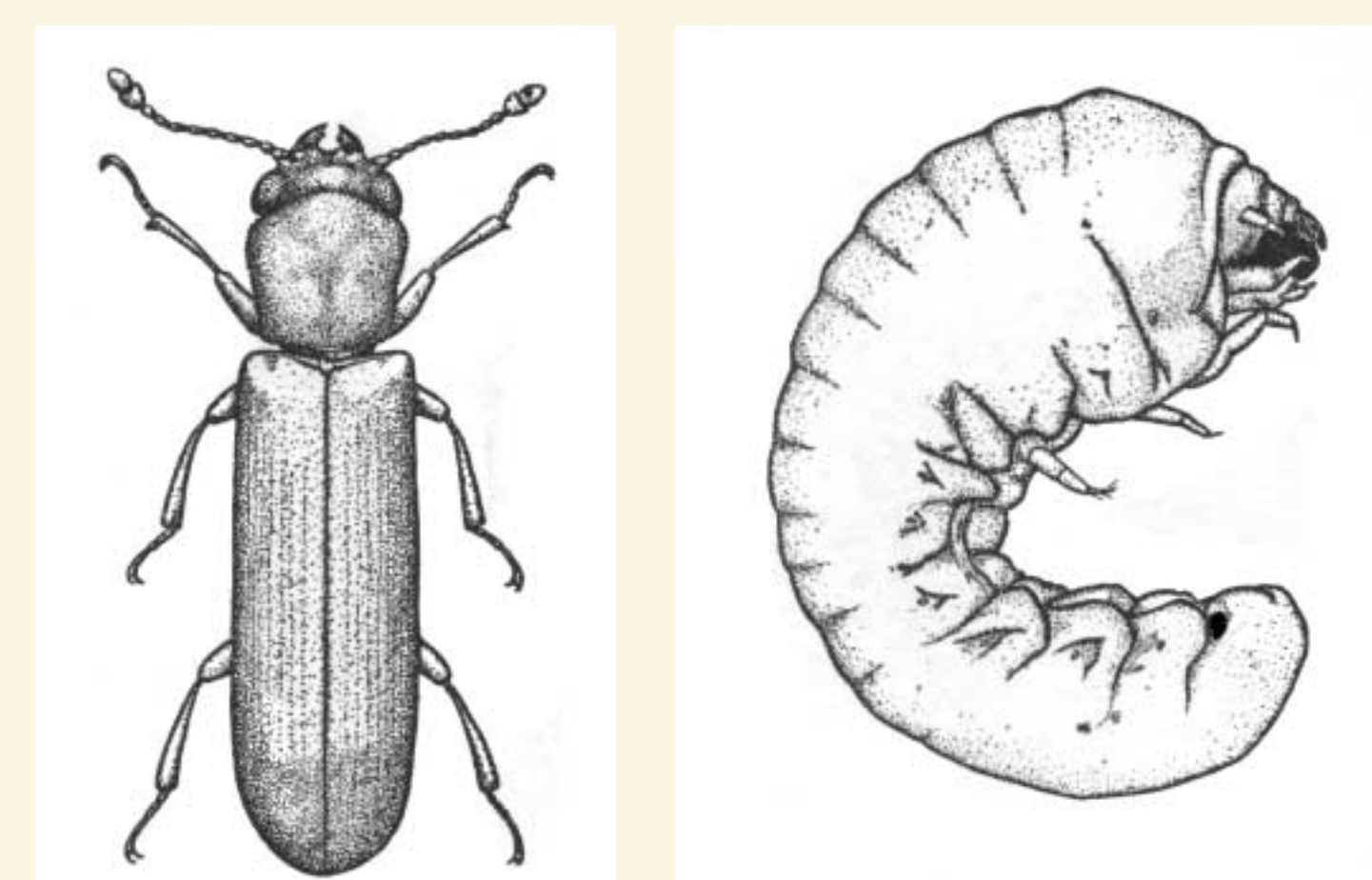
The *Lyctus* Beetle (*Lyctus brunneus* (Stephens))

The lyctid beetles form a family composed of about sixty species but with worldwide distribution. The Lyctidae, the Powder Post beetles, are closely related to the Bostrichidae family, the Auger Beetles.

Lyctus brunneus (Stephens) is the most common species of the lyctid beetles. This is a cosmopolitan species and occurs especially in the tropics but has been introduced and spread into buildings and museums by way of ethnographic objects and carpentry work in Europe too. *L. brunneus* is able to attack a range of hardwood timbers. The beetles infest only the starch-containing sapwood of hardwoods because they can not produce cellulases (Peters et al. 2002). The larvae reduce the timbers completely to a fine soft powder earning them the name powder post beetle.



Lyctus brunneus (Stephens): Beetle, larva and typical damage



Sealing-technique

Practical fumigation

SF was used in this study to eradicate an infestation by *Lyctus brunneus* (Stephens) (Brown Powder Post Beetle) in the Museum of Modern Art in the city of Bonn-Germany. Wood frames of pictures and paintings were infested by *L. brunneus*. The artifacts were enclosed in gastight bubbles for fumigation. SF was released from cylinders and passed through a filtering system, which removed the acid impurities in SF like Hydrogen fluoride and Sulfur dioxide to zero. This highly purified SF made sure not to alter or tarnish sensitive materials and surfaces of artifacts. The SF fumigation was monitored to insure efficiency of the fumigation and to reach a 100% mortality of the target insects including the eggs. The eggs are the most tolerant life stage. When the target ct-products in the bubbles were accumulated, assuming all target pests were eradicated, aeration was carried out. A fan and ducting were used to aerate SF from the bubbles following fumigation.

The low sorption and non-reactivity of SF gas fumigant with artifacts are extremely favourable properties for rapid aeration. Following the aeration period, the artifacts were tested with an approved detection device of sufficient sensitivity to confirm a concentration of SF of 1 ppm or less in the breathing zone. No altering was seen on the artifacts. All infested storage rooms of the museum were sprayed additionally prior to aeration of the bubbles with a Pyrethrum formulation in order to kill *L. brunneus* adults on walls and floors. No reinfestation or survivors were observed 6 months after the fumigation.



Release of SF using a filtering system

Bioassay

Williams and Sprenkel (1990) showed in preliminary tests the young eggs (2-4 days old) to be the most tolerant life stages. ct-products of 1120 gh/m³ at 22.2 °C showed complete egg-kill. Our fumigation was carried out between 20-22 °C (48-53 % rel.H). Adults, larvae, pupae and eggs of *L. brunneus* in different ages were sealed in wooden blocks (Unger 1998). The blocks were removed during the fumigation from the bubbles at different exposure times to accumulate increasing ct-products. The accumulated ct-products were 543, 1739, 2495 and 6525 gh/m³. All fumigated life stages showed 100 % mortality.

References

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