INSECT DISINFESTATIONS OF HISTORIC ARTIFACTS BY MODIFIED ATMOSPHERES

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ABSTRACT
Methyl bromide (MBr) use in Turkey has completely been banned in postharvest sector (except quarantine&presipment applications) since 2004. Besides the agriculture, MBr ban caused insect disinfestations problems in other fields of application. Thus, museums & historic buildings/artifacts which previously fumigated with MBr faced with a pest extermination problem. This paper provides some information on the effectiveness & applicability of high nitrogen gas treatments of historic artifacts, as one of the current alternative methods to MBr in Turkey.

INTRODUCTION
A number of pest species inhabit historical buildings (Schrock, 1988) and can cause big damages to valuable artifacts in the lack of appropriate control measures (Reichmuth *et al*., 1993). MBr ban in Turkey led to search for urgent alternative fumigation methods/tehniques for the fumigation of historic wood artifacts against wood-boring insects such as furniture beetle. Amongst the available methods, modified atmosphere application is the most advantegous one posing no risk to applicators/the environment or to the treated artifacts (Reichmuth *et al*., 1993; Rust and Kennedy, 1993).

In this communication, portable wooden artifacts, which has previously been fumigated with MBr were treated by low oxygen atmospheres composed of high nitrogen (≈99%).

MATERIALS AND METHODS
All life stages of khapra beetle, lesser grain borer, confused and red flour beetles were used as the test insects. Test individuals are confined in 10-20 ml PVC vials whose lids have fine mesh covered holes with 1 cm diameter to keep insects inside and to secure air exchange. Wood pieces showing activity of *Anobium punctatum* larvae were also used in the tests as infested wood materials.

High nitrogen gas treatments were made in PVC cubes of 30 m^3 volume each. The cubes with an internal frame had a bottom floor and a top cover part which were joined together with a PVC gas-tigh zipper. For gas flushing, cubes were provided with inlet and outlets openings at opposite directions, which can be closed by screw lids. A conditioned low oxygen atmosphere of 1% O_2 was created in the cubes using a nitrogen gas generator of 4 Nm3/h outlet flow capacity (On Site Gas Systems, Inc., USA) and maintained throughout the exposure period of 30 days with the help of a PLC SCADA system,

The cubes were initially washed with a high flow rate of nitrogen using nitrogen dewars to have a shorter purging time and when the oxygen level inside the cubes was below 3%, nitrogen gas generator with the PLC Scada system was run to have a

further decrease to 1%. The oxygen concentrations, and relative humidity & temperature levels in the cubes were continuously recorded. After the treatments, test individuals were brought to laboratory to evaluate the mortalities.Wood pieces showing insect activity were kept at the laboratory for 2 years to check the insect activity.

RESULTS AND DISCUSSION

Results indicated that oxygen levels inside the cubes were between 1-1.5% during the application period of 30 days and all the tested insects were recorded as dead after the treatments. Infested wood pieces which kept at the laboratory after the treatments did not show any insect activity during 2 years of observation. Similar results were also reported by previous workers on the effectiveness of high nitrogen treatments against insect pests of historic artifacts (Hanlon *et al*., 1993; Reichmuth *et al*., 1993; Rust and Kennedy, 1993).

It can be concluded that high nitrogen treatments in PVC cubes can offer an effective way of eradicating insect pests of historic artifacts in a manner safe for operators & humans, for artefacts and for the environment. The PLC Scada system was also effective to maintain high nitrogen concentrations at stable levels inside the several units of PVC cubes without human interference.

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