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Pests control by inert gases in XVII c wooden sculpture

PIOTR WITOMSKI[1], ADAM KRAJEWSKI[1], MARIA SERAFINOWICZ[2], AND JOANNA BONECKA[3]

[1] Department of Wood Science and Wood Protection, Warsaw University of Life Sciences - SGGW

[2] Lublin Open Air Village Museum, Lublin

[3] Department of Small Animal Diseases with Clinic, Faculty of Veterinary Medicine, Warsaw University of Life Sciences – SGGW

Abstract: The study was carried out on a wooden sculpture from the turn of the sixteenth and the seventeenth century. The presence of damaged parts in the statue made it necessary to try to eliminate fungi and / or insects from the wood. Due to the historic nature of the object, low-reactive gases were used for eradication. The gases are not harmful to warm-blooded organisms and contains little environmental contaminants. The use of such procedures is the latest innovation in the control of insects in wooden monuments. Fumigation treatment carried out using a low-reactive gas (nitrogen) gave the positive effect of eradicating xylophagous insects.

Keywords: wooden sculpture, low-reactive gases, wood conservation, ancient wood

INTRODUCTION

The conservation work was carried out on a wooden sculpture of the resurrected Jesus which comes from St. Lawrence' the Deacon Martyr parish church in Czerniejewo. The sculpture (fig.1.) with dimensions of 92 cm (height) 36 cm (width) and a base of 30 x 20 cm, is made of poly-chromed wood. Over the centuries, the sculpture was exhibited and stored in varying climatic conditions. The analysis conducted on the formal features of the piece and technological research of pigments, showed the influence of Gothic Malopolska sculpture School and that it originates from the turn of the sixteenth and the seventeenth century. The presence of damaged parts in the statue made it necessary to try to eliminate fungi and / or insects from the wood. The popular methods used to eradicate both fungi and insects are physical methods (Krajewski et al 2005), but fumigation is also often used (Witomski, Ważny 2002, Wojcik, Krajewski 2013). Due to the historic nature of the object, low-reactive gases were used which does not harmful to warm-blooded organisms and contains little environmental contaminants. The use of such procedures is the latest innovation in the control of insects in wooden monuments.

THE OBJECTIVE AND SCOPE OF WORK

The objective and scope of maintenance work were:
• Defining the condition of the object
• Identification of factors responsible for biological corrosion
• Pest control using low-reactive gases (safe for humans and the environment)
• Elimination of the effects of the existing damage
• Restoration of aesthetic values
• Work documentation

Fig.1. A general view of the object

METHODOLOGY

Property damage assessment was carried out by the visual palpation method. Bio-corrosion factor results were made on the basis of descriptions in the literature, Atlases and keys wood-destroying fungi and insects - technical wood pests. Assessment of the xylophagous insect was guided by the shape and size of the exit holes and evidence of feeding (their shape and containing dust and fecal pellets). An important criterion was the knowledge of the biology of the species - their habitat preferences, such as wood species, age, area (sapwood and heartwood), the preferred moisture and wood fungus, preferred temperature – which was useful in determining the presence of a particular species in a particular area. Markings were made directly on site and samples taken for analysis. The observation was carried out macroscopically and microscopically with stereoscopic Zeiss microscope device using low magnification (up to 8x) while utilizing palpation research at the same time.

RESULTS AND DISSCUSION - THE CONDITION OF THE ARTIFACT

By analyzing the content of galleries (dust taken from exit holes) we observed two types of fecal pellets: the first - smaller form a conical, pointed and elongated, the second - in the form of slightly larger flattened balls. In parts of the decayed wood (fot.2) death watch beetle were observed feeding, which then moved from there to "healthy" areas. The 'healthy' - not decayed (fot.2., 3.) also contained the galleries of the common furniture beetle. In this case, the development of the Anobiidae was associated with increased humidity and local wood fungal attack. The cause of gungi, and to some extent the infestation by insects was due to increased moisture. Exposure, because of building on the premises (church) caused periodically high relative humidity while low temperatures resulted in raising the moisture content of the wood (the so-called moisture equivalent). Another source of moisture was probably the capillary water from the surface on which the statue stood. Ceramic materials such as brick, stone, stucco, have a greater potential to transmit moisture than wood, resulting in wood in contact with these materials absorbing the water and becoming saturated. Increased humidity allowed the development of fungi on the base of the statue. At the same time it enabled the development of xylophagous insects of the Anobiidae genus. Wood moisture measurements carried out during tests of the statue, showed wood moisture content of approx. 12%. It is the "safe" humidity which prevents further growth of fungi and greatly hinders the development of xylophagous insects.

Fig.2. The object base. Brown-rot of wood in contact with other materials. At the same time seen exit-holes of death watch beetle

Fig.3. The exit-holes of xylophagous insects. The smaller (2 mm) - common furniture beetle, larger (4 mm) - death watch beetle

Fig.4. Fumigation using reactive gases

As a result of feeding xylophagous insects, we decided to conduct preventive disinfestation treatment. Suffocating gases were used to disinfect the wood (ie. low-reactive). Because of the innovative nature of the work, aerating installation used very low pressure. The installation consisted of a working chamber made of sheet steel, a vacuum pump, band reducers, tees, valves, pipes and gas cylinders. The gas used was nitrogen. The procedure was carried out in two stages. After the introduction of objects into the working chamber (fot.4.),

the object was subjected to very low pressure, close to an absolute vacuum - pressure 0,01mbara for approx. 12 hours. This was to remove the air from the wood pores and produce an anaerobic atmosphere. The cell was then filled with nitrogen over 72 hours. After the surgery the gassing facility was aired and addressed to further the work of the art conservation. The effectiveness of the treatment on insect control was tested using computed tomography. In a further step, the statue was subjected to restoration work. Using a 4% solution of rabbit glue heat was conducted to consolidate the mortar and poly-chrome chipping and edge protection. The top layer of paint was removed successively and without polychrome wood parts. A lot of the wood fiber structure destroyed by bio-corrosive, was reinforced with a solution of 15% paraloid B-72 in a mixture of organic solvents. Reconstruction of the missing elements of the figure, was done using lime wood. They used a reversible and easy to dismantle combination of new elements on the oak pegs and glue. In order to reduce the effects of the contrast of the original and added elements, thin strips of cotton canvas were glued on the border of contact. The original polychrome varnish was secured. Then, exposed portions of insulated wooden substrate, were supplemented by layers of chalk - adhesive mortar, formed artistically. The surface of the reconstituted mortar was then covered with shellac. The surface of the whole sculpture was protected with a satin varnish f. Lefranc. In order to protect the surface of the base it was made from a piece of plank of a type of spacer outline consistent with the projection of the base, counter-stained and secured with shellac.

CONCLUSION

• In the entire cross-section of the object feeding xylophagous insects were observed.
• Insects responsible for the destruction of wood tissue were the common furniture beetle and death watch beetle.
• In the base of statue brown-rot was observed.
• Fumigation treatment carried out using a low-reactive gas (nitrogen) gave the effect of eradicating xylophagous insects.

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Streszczenie: *Zwalczanie owadów ksylofagicznych przy użyciu gazów niereaktywnych w drewnianej rzeźbie z XVII w.* Przedmiotem prac konserwatorskich była drewniana rzeźba Jezusa pochodząca z przełomu XVI i XVII w. wykonana z drewna i polichromowana. Rzeźba na przestrzeni wieków była eksponowana i przechowywana w różnych warunkach klimatycznych, efektem czego był lokalny rozwój zagrzybienia i żerowanie owadów ksylofagivznych. W sytuacji stwierdzenia w obiekcie czynników korozji drewna podjęto prace zwalczające eliminujące grzyby i/lub owady. Z uwagi na zabytkowy charakter obiektu do prac dezynsekcyjnych zastosowano gazy duszące (tzw. nie reaktywne), nie stanowiące zagrożenia dla organizmów stałocieplnych i nie skażające środowiska. Stosowanie tego typu zabiegów jest najnowszym kierunkiem zwalczania owadów w zabytkach drewnianych. Uzyskano pozytywne efekty zabiegu zwalczania.

Słowa kluczowe: historyczne rzeźby, gazy niereaktywne, konserwacja drewna, stare drewno

Corresponding authors:

Piotr Witomski
piotr_witomski@sggw.pl
Department of Wood Science and Wood Preservation
Faculty of Wood Technology
Warsaw University of Life Sciences - SGGW
Nowoursynowska 166
02-787 Warsaw, Poland

Adam Krajewski
adam_krajewski@sggw.pl
Department of Wood Science and Wood Preservation
Faculty of Wood Technology
Warsaw University of Life Sciences - SGGW
Nowoursynowska 166
02-787 Warsaw, Poland

Maria Serafinowicz
m.sefafinowicz@gmail.com
Lublin Open Air Village Museum
Warszawska 96
20-824 Lublin, Poland

Joanna Bonecka
joanna_bonecka@sggw.pl
Department of Small Animal Diseases with Clinic
Faculty of Veterinary Medicine
Warsaw University of Life Sciences - SGGW
Nowoursynowska 166
02-787 Warsaw, Poland