

RESEARCH OF WOOD PENETRATION WITH HYDROGEN CYANIDE

Tomáš ČAPOUN, Jana KRYKORKOVÁ
tomas.capoun@ioolb.izscr.cz

Abstract

The report describes tests aimed at the penetration of Hydrogen Cyanide into samples of pine and spruce wood. Wooden joists were exposed to the high concentration of Hydrogen Cyanide in a test hermetic chamber. After being withdrawn from the chamber, wood sample layers were removed from the joists, and Hydrogen Cyanide concentration in the extract was determined. In terms of determined concentrations, Hydrogen –Cyanide content was calculated after the conversion to the sample mass in dependence on the wood layer thickness.

Keywords

Hydrogen Cyanide, Hydrogen Cyanide penetration into wood, Hydrogen Cyanide concentration.

1. Introduction

In connection with the removal of consequences of bird flue in large scale poultry breeding, several projects were kicked off. The initiator was Fire & Rescue Service of the CR. One of the projects is large volume gassing of halls with poultry infected by the bird flue virus. Draslovka company Kolín, Lučební plants charged Population Protection Institute with the task aimed at the matter of the possibility of wood penetration by gas Hydrogen Cyanide with the aim to inactivate viruses and other organisms in various materials. This matter is closely connected with the depth of the Hydrogen Cyanide penetration into wood samples.

2. Performance of experiments

Experimental verifying of the penetration of Hydrogen Cyanide into wood samples was performed in the experimental hermetic chamber¹, which represents a unique experimental establishment of MI – GD of HRS of the CR, Population Protection Institute. Penetration was investigated on joists of pine and spruce wood, size **9,0 x 9,0 x 29,5 cm**.

On the grid of an experimental hermetic chamber the samples of wooden joists were placed. The chamber was hermetically closed, conformably with the method for chamber² the stirring prop (fan) was switched on and then 123 g of Hydrogen Cyanide (liquid, stabilized, Lučební plants Draslovka Kolín) were dispersed by a spray. Theoretical concentration of Hydrogen Cyanide in the chamber amounted to 24,1 g/m³, i.e. 2,18 % volume. Wooden samples were exposed to the effects of Hydrogen Cyanide for 41 hours.



Picture 1
Dispersion of Hydrogen Cyanide in the chamber

Next sampling procedure followed. In order to eliminate the influence of penetration of Hydrogen Cyanide by the front of a wooden joist, at first, parts 10cm long were cut off on its both ends, so there was a cube with the edge of 9 cm. This cube was the center of a former sample. From originally four outside sides of a joist then samples were gradually taken per 0,5 cm with a jack-plane and chisel. For each thickness of a layer of 0,5 cm there were now four parallel samples.

Removed chips and cuttings were divided into smaller parts of which a definite share (according to the size of the sample) was put into beforehand weighed Erlenmeyer bulbs of the volume 250 ml and the bulb was weighed again in order to determine the weight of a withdrawn sample. The samples were extracted into 50 ml of solvent which was the solution of Sodium Hydroxide of concentration of 0,1 mol/l.

Determination of Hydrogen Cyanide in the extract was done by a photometric method with a Pyridine Barbiturate surfactant³. Cyanides react in the acid medium with chloramine T at rise of Chlorine Cyan which with pyridine and acid barbiturate colours red and violet. The intensity of colouring is proportional to the concentration of cyanides in the solution⁴⁻⁷.

From determined concentrations of Hydrogen Cyanide in the extract, the values of the content of Hydrogen Cyanide in the wood Dalton in unites mg/kg were calculated. The values of the content of Hydrogen Cyanide were statistically evaluated with statistic software⁸.

3. Discussing the Hydrogen Cyanide penetration into wood sample

The amount of penetrated and adsorbed Hydrogen Cyanide into the depth of wood samples is evident from the graphs in pictures 2 and 3, which represent the

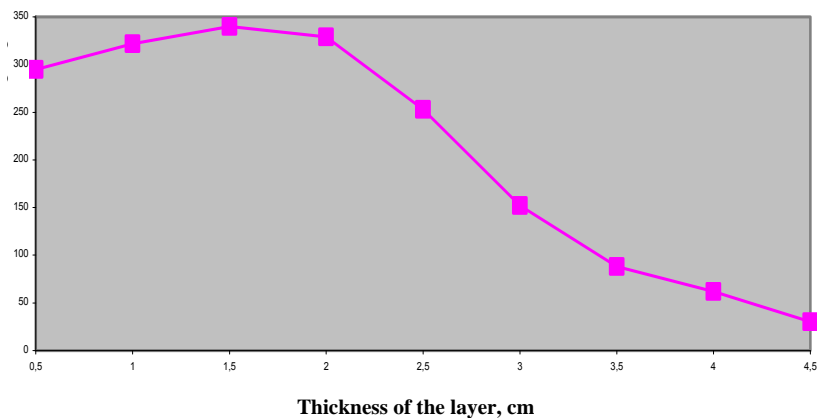
dependencies of the Hydrogen Cyanide content in Dalton in pine (picture 2) and in spruce (picture 3) wood on the thickness of the wood layer. The amount of Hydrogen Cyanide in individual layers is also demonstrated as a scheme in the picture 4 for pine wood and picture 5 for spruce wood.

From mentioned pictures flows the unambiguous conclusion⁹. In a given environment **Hydrogen Cyanide penetrated into the entire volume of tested wood samples** as it was found right in the middle of a joist, i. e. in the depth of 4,5 cm.

From comparisons of dependencies in pictures 2 and 3 or comparisons in pictures 4 and 5 it is evident that the **content of Hydrogen Cyanide was significantly higher in spruce wood than in pine wood**, respectively in the total cross-section of the sample. On the base of performed experiments however, it is not possible to decide if it is the question of better penetration into spruce wood or the result of higher adsorption in this wood. As it flows from the experimental part of this publication, at the ending it involved the extraction of adsorbed amount of Hydrogen Cyanide in the wood, whereas the sorption ability of different kinds of wood does not have to be the same and may theoretically decide the determined amount independently on the velocity or the amount of penetration.

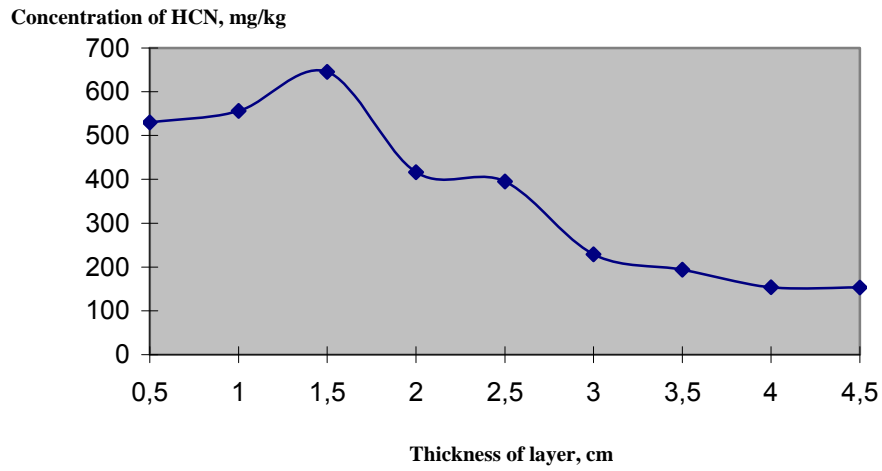
Further from the dependencies in pictures flow that both kinds of wood have similar course: in surface layer app. 1 cm the amount is relatively high and grows till the depth app. 1,5 cm, then the amount drops towards the joist center. At the same time it is absolutely clear that during the exposition of wood by Hydrogen Cyanide itself, its highest content must be on the surface. The mentioned phenomenon may be explained by adsorption which presents a physically reverse action. After the ending of exposition wooden joists were for some time in the chamber in the flow of clear air. The chamber was washed with this clear air, then after its opening the samples were freely in the air and transferred into the laboratory. It is possible to say that during this time desorption of Hydrogen Cyanide from the surface layer occurred and therefore lower amount was found then.

Concentration HCN, mg/kg

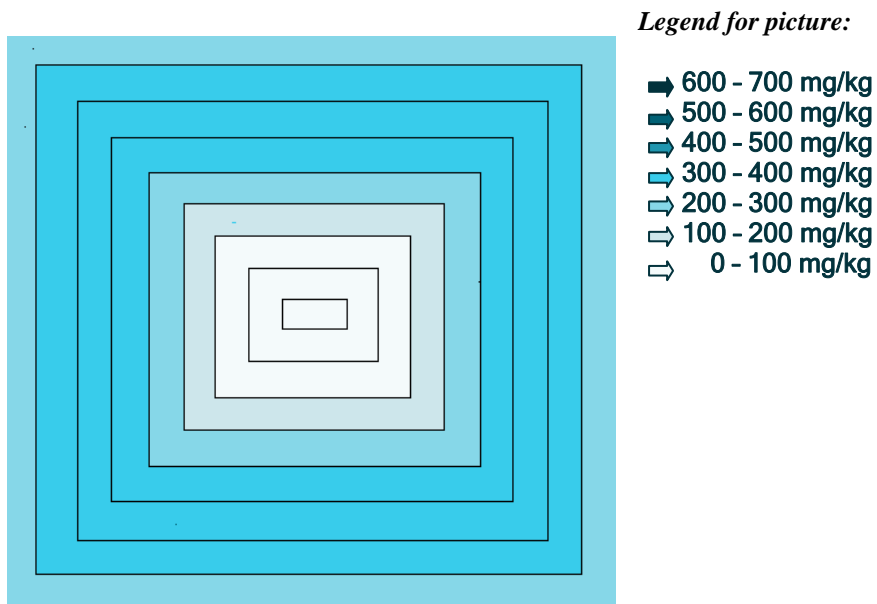


Picture 2

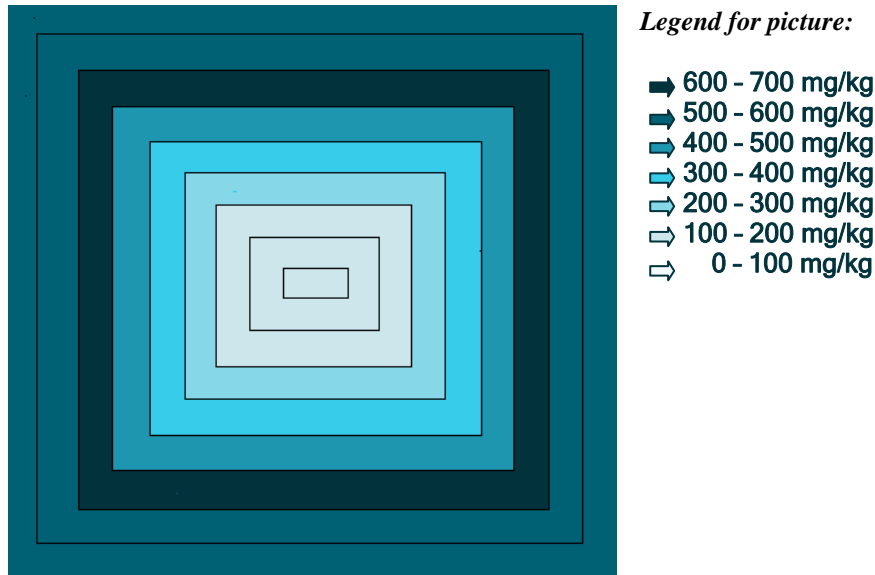
Dependency of the Hydrogen Cyanide content in pine wood on the thickness of wood layer



Picture 3
 Dependency of Hydrogen Cyanide content in spruce wood on the thickness of wood layer



Picture 4
 Schematic demonstration of the Hydrogen Cyanide content in the cross-section of pine wood



Picture 5
Schematic demonstration of the Hydrogen Cyanide content in the cross-section of spruce wood

Recognized values of the Hydrogen Cyanide content in individual layers of wood were characterized by very high reproducibility. Relative reproducibility (relative standard inclination) in individual layers, i. e. during 4 parallel measurements was low and moved from 2,1 to 18,1 %. Total relative reproducibility for all measurements amounted to 10,0%. From this it is possible to make conclusion that the penetration of Hydrogen Cyanide through wood and adsorption in it was on the entire surface **equal**.

4. Conclusion

Crucial conclusions of the investigation of the penetration of Hydrogen Cyanide into wood samples, size 9 x 9 x 29,5 cm exposed by Hydrogen Cyanide with concentration 2,18 % volume during 41 hours is possible to summarize into following points:

1. Hydrogen Cyanide penetrated into the entire volume of tested wood samples.
2. Significantly higher content of Hydrogen Cyanide was found in spruce wood in comparison with pine wood.
3. Penetration of Hydrogen Cyanide through wood and adsorption in it was on the entire surface equal.

4. The highest content of Hydrogen Cyanide was found in the depth app. 1,5 cm. Lower content of Hydrogen Cyanide in the surface layer was obviously caused by its desorption during the time between penetration and taking of samples.

Résumé

Due to Lučební plants Draslovka company Kolín requirement, Hydrogen Cyanide penetration into wood samples was researched. The penetration was verified on joists made from pine and spruce wood of 9 x 9 x 29,5 cm size. The samples were exposed to the Hydrogen Cyanide in concentration of 2.18 % by volume during 41 hours.

Crucial conclusions apply to untreated wood samples and may be formulated as follows:

1. *Hydrogen Cyanide penetrated into the entire volume of tested wood samples.*
2. *Considerable higher Hydrogen Cyanide content was found in the spruce wood than in the pine wood.*
3. *Hydrogen Cyanide penetration through the wood and adsorption in it was equal all over the surface.*
4. *The highest Hydrogen Cyanide content for untreated samples was found in the depth of app. 1,5 cm. Lower content of the Hydrogen Cyanide in the surface layer was evidently caused by its desorption between the penetration and sampling.*

Literature

1. Operational order of experimental polygon. Workplace with experimental chamber. Lázně Bohdaneč, MI – GD FRS CR, Population Protection Institute 2002.
2. ČAPOUN, T. *Calibration of detectors DL-101, PD-6 and GADET-P for selected industrial injurants*. [Research report]. Lázně Bohdaneč, Civil Protection Institute CR 1994.
3. SOP V12: Determination of cyanides in waters by a photometric method. 1st edition Lázně Bohdaneč, MI – GD FRS CR, Population Protection Institute 2004.
4. ČSN ISO 6703: Quality of waters. Determination of cyanides and total chlorine.
5. ČSN 83 0520: Physically chemical analysis of potable water. Part 15. Determination of cyanides.
6. KALAVSKÁ, D., HOLOUBEK, I. *Waters analysis*. 1st edition Alfa, Bratislava 1987.
7. LURJE, J.J. *Unified methods of waters analysis*. 1st edition Chimija, Moscow 1971.
8. EffiValidation 3.0. EffiChem. Oulehla, 2002.
9. ČAPOUN, T., KRYKORKOVÁ, J. *Research of penetration of hydrogen cyanide into wood samples*. [Research report]. Lázně Bohdaneč, MI – GD FRS CR, Population Protection Institute 2007.