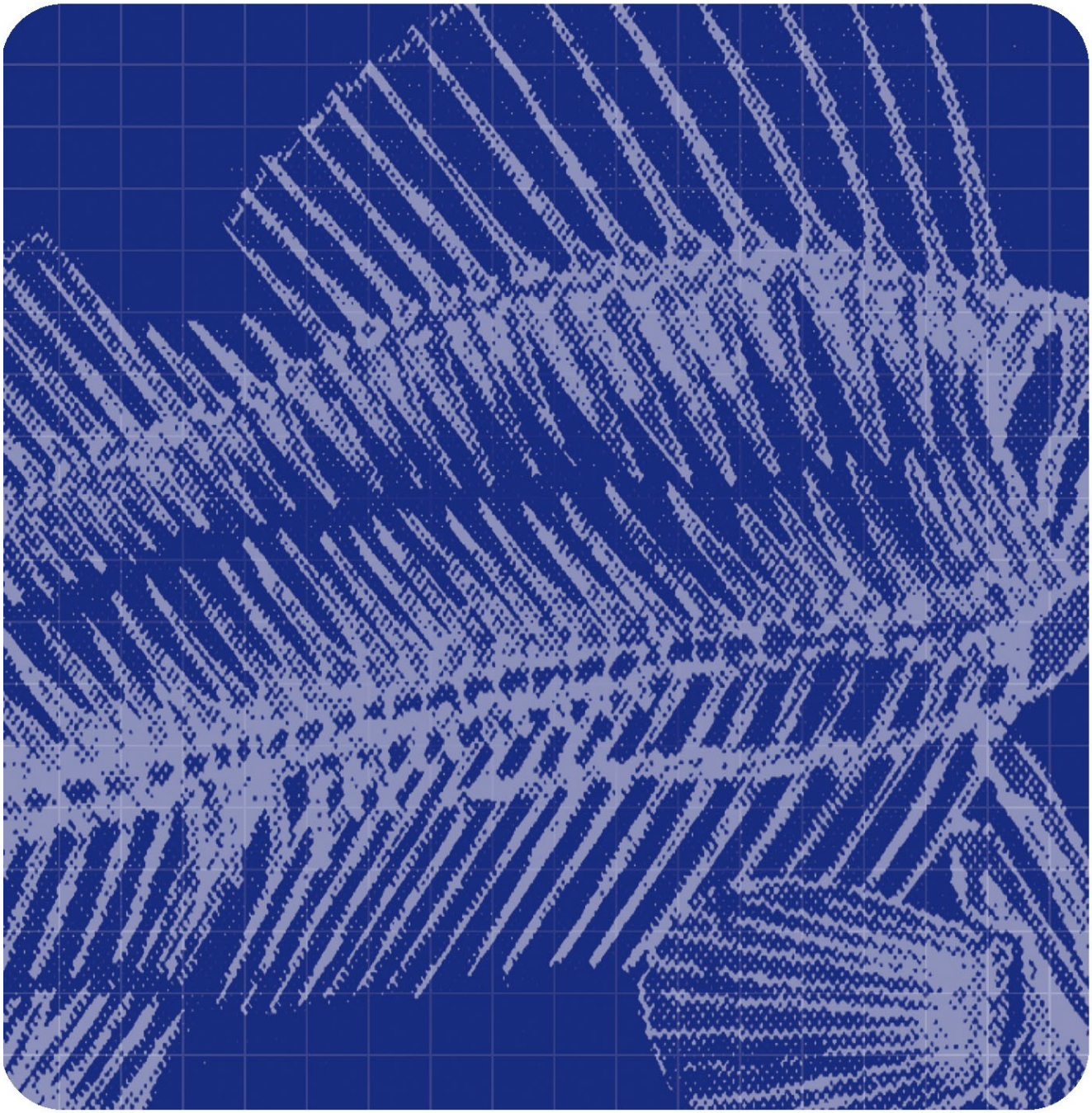
Fiskeriforskning

Report 4/2001 • Published March 2001

Wood in Food

Wood, waxed wood, plywood, polyethylene and stainless steel - a comparison of hygienic properties

Grete Lorentzen, The Norwegian Institute of Fisheries and Aquaculture Ltd.
Gunilla Beyer, The Swedish Institute for Wood Technology Research and
Ida Weider, The Norwegian Institute of Wood Technology



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Tromsø (head office)
Muninbakken 9-13, Breivika
P.O.box 6122
NO-9291 Tromsø
Norway
Tel.: +47 77 62 90 00
Fax: +47 77 62 91 00
E-mail:post@fiskeriforskning.no

Bergen
Kjerreidviken 16
NO-5141 Fyllingsdalen
Norway
Tel.: +47 55 50 12 00
Fax: +47 55 50 12 99
E-mail: office@fiskeriforskning.no

Internet: www.fiskeriforskning.no

Norwegian Institute of Fisheries and Aquaculture Research
Main office: P.O.box 6122, NO-9291 Tromsø
Visiting address: Muninbakken 9-13,
Tlf.: +47 77 62 90 00, fax: +47 77 62 91 00
E-mail: post@fiskeriforskning.no

Dept. Bergen: Kjerreidviken 16, NO-5141 Fyllingsdalen
Tlf.: +47 55 50 12 00, fax: +47 55 50 12 99
E-mail: office@fiskeriforskning.no

Internet: www.fiskeriforskning.no

Organisation no.: NO 964 441 898 MVA

REPORT

Accessibility: **Open**	*Report no:* 4/2001	*ISBN-no:* 82-7251-467-2

Title:
Wood, waxed wood, plywood, polyethylene and stainless steel - a comparison of hygienic properties

Date: 6. March 2001

Number of pages and appendixes: 21 +26

Author(s):
Grete Lorentzen, The Norwegian Institute of Fisheries and Aquaculture Ltd.
Gunilla Beyer, The Swedish Institute for Wood Technology Research and
Ida Weider, The Norwegian Institute of Wood Technology

Director of Research:
Knut Sunnanå

Centre:
Industrial Processing

Project no.:
8495

By agreement with:
The Swedish Institute for Wood Technology Research
The Norwegian Institute of Wood Technology

Employers ref.:

keywords:
Hygienic properties, competing materials, heating

Summary:
The aim of this experiment is to compare the hygienic properties of different types of materials. The materials to be tested comprise standard and processed plywood, spruce, pine (planed and not planed), polyethylene, stainless steel, waxed pine/spruce and beech.
After adding the microorganisms *Halobacterium salinarum* and microorganisms isolated from cod on the surface of the material, the hygienic properties will be measured in two parallel experiments. In the first experiment, the materials will be incubated at optimum growth conditions for the microorganisms in 2 hours or 7 days, respectively and then analysed by using the swabbing method. In the second experiment, the parallel materials which have been incubated in 2 hours or 7 days, respectively will be heated according to defined time and temperature conditions. After heating, the materials will be analysed by the swabbing method. Before the heating (after incubation), the hygienic properties of the material are interpreted as the ability to keep the microorganisms on the surface. Therefore, the material with the *highest* number of microorganisms detected on the surface is considered to be most hygienic. After the heating process, the hygienic properties are interpreted as a function of the incubation (time and temperature) and heating (time and temperature). After heating, the material with the *lowest* number of microorganisms detected on the surface is considered to be most hygienic. In general, these experiments show that the heating conditions as defined in previous experiments, are sufficient in order to attain an acceptable hygienic level for all the materials tested. The experiment show that wood, plywood or waxed wood are not less hygienic than polyethylene or stainless steel, supposed the material is heated adequate before use. The experiment shows whether or not the microorganisms may penetrate the surface of the materials. Processed plywood, polyethylene or stainless steel is less exposed to penetration; a larger amount of microorganisms remains on the surface during incubation compared to the other materials tested. Consequently, it is considered that processed plywood have equal hygienic properties to polyethylene or stainless steel.

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1 INTRODUCTION

The aim of this experiment is to compare the hygienic properties of different types of materials. The materials to be tested comprise standard and processed plywood, spruce, pine (planed and not planed), polyethylene, stainless steel, waxed pine/spruce and beech.

After adding the microorganisms *Halobacterium salinarum* and microorganisms isolated from cod on the surface of the material, the hygienic properties will be measured in two parallel experiments. In the first experiment, the materials will be incubated at optimum growth conditions for the microorganisms for 2 hours or 7 days, respectively, and then analysed by using the swabbing method. In the second experiment, the parallel materials, which have been incubated for 2 hours or 7 days, respectively, will be heated according to defined time and temperature conditions (Lorentzen, G. *et al*. 2000). After heating, the materials will be analysed by the swabbing method.

Before the heating (after incubation), the hygienic properties of the material are interpreted as the ability to keep the microorganisms on the surface. Therefore, the material with the *highest* number of microorganisms detected on the surface is considered to be most hygienic.

After the heating process, the hygienic properties are interpreted as a function of the incubation (time and temperature) and heating (time and temperature). After heating, the material with the *lowest* number of microorganisms detected on the surface is considered to be most hygienic.

2 MATERIAL AND METHODS

2.1 Materials

In this experiment, 19 different types of materials have been tested. The materials are listed below. All materials except the stainless steel were cut in 50 x 50 millimetres. The thickness varied from 2 (stainless steel) to 20 millimetre. For further information, specifications of the materials are shown in appendix 2.

- Polyethylene, undamaged
- Stainless steel (AISI 304)
- WISA Spruce (standard plywood)
- WISA Birch (standard plywood)
- WISA Form Birch (processed plywood)
- WISA Hexa (processed plywood)
- WISA Patio (processed plywood)
- WISA White (processed plywood)
- WISA Ply (processed plywood)
- Spruce, planed
- Spruce, not planed
- Pine, planed
- Pine, not planed
- Spruce 4 % wax treatment
- Pine 4 % wax treatment
- Pine Ultrawood 1 %, wax impregnation
- Pine Ultrawood 2 %, wax impregnation
- Beech
- Birch, planed

2.2 Experimental structure

Figure 1 and 2 show the structure of the experiments. Figure 1 shows the experiment where *H.salinarum* have been used as test microorganism on the materials. Figure 2 shows the experiment were microorganisms isolated from cod have been used as test microorganism on the materials.

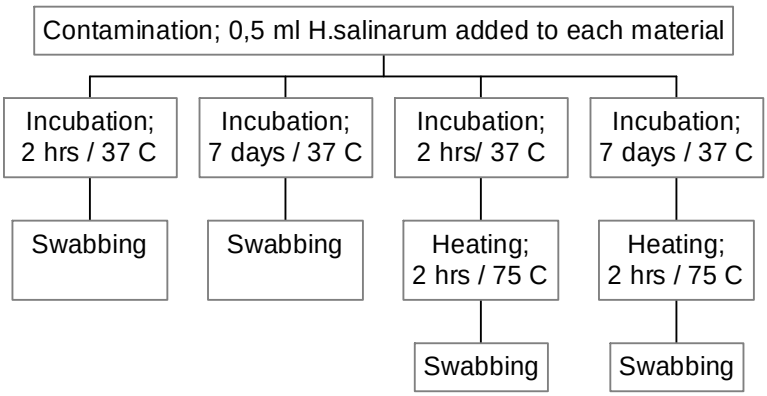

Figure 1. Structure of the experiment with H.salinarum as test microorganism. The experiment contains two parts. The first part is incubation at optimum growth condition for the test microorganism, followed by swabbing to detect the remaining microorganisms on the surface. The second part is incubation as described in the first part. After incubation the materials are heated at 75 °C for 2 hours. The materials are analysed by swabbing to detect the remaining microorganisms on the surface

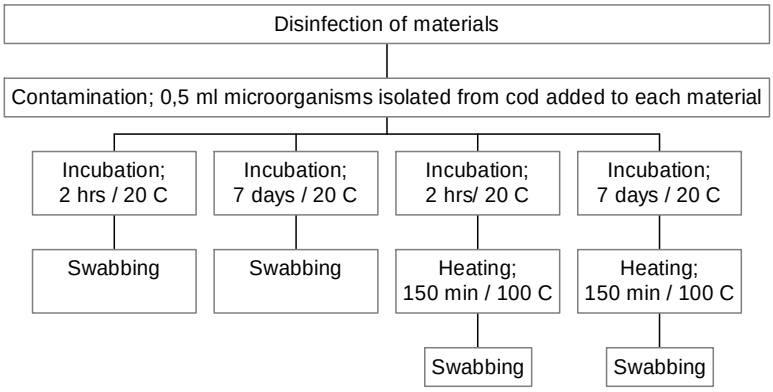

Figure 2. Structure of the experiments with microorganisms isolated from cod as test microorganisms. The experiment contains two parts. The first part is incubation at optimum growth condition for the test microorganism, followed by swabbing to detect the remaining microorganisms on the surface. The second part is incubation as described previously. After incubation the materials are heated at 100 °C for 150 minutes. The materials are analysed by swabbing to detect the remaining microorganisms on the surface.

2.3 Microorganisms

H. salinarum
This halophilic microorganism may cause problems in the salt-fish industry, since it is the most the most common cause of "pink" (pink spots) on salted fish.

When grown under optimum conditions, *H. salinarum* may be rod or disc shaped. However, some strains are highly pleomorphic even under optimum growth conditions. Most strains are strict aerobes, but facultative anaerobes growing with or without nitrate have also been described in the literature (Larsen, 1984). The optimum temperature is 40 °C, no growth occurs below 7-8 °C and the halophilic microorganisms are able to survive up to 82 °C (van Klavern and Legendre, 1965). The colonies are pink, red, or red-orange, they are opaque to translucent and oxidase- and catalase- positive. Most isolates require at least 2.5 M (15 %) NaCl and 0,1 – 0,5 M Mg^{2+} for growth. Growth is also reported in saturated NaCl solution (>5 M, or > 29 % NaCl), but optimum growth conditions are 3,5 – 4,5 M (20 – 26 %) NaCl. Growth is relatively slow; generation times of 3-6 hours are the fastest that have been reported in laboratory experiments (Larsen, 1984).

MICROORGANISMS ISOLATED FROM COD

To simulate contamination in the fish industry in general, microorganisms isolated from cod were used in the experiments. According to the literature (Hobbs G., 1991), 80 % of the total flora cover *Pseudomonas, Alteromonas, Shewanella, Moraxella* and *Acinetobacter* strains.

The materials were contaminated with quite high concentrations of microorganisms (10^8 CFU/ml). The same level of contamination was used in all experiments.

2.4 Media

The microorganisms were detected by using specific media.

2.4.1 H.salinarum

For detection of *H. salinarum*, a specific medium for halophilic microorganisms was used and the method is described in appendix 1. Prior to contamination of the materials, the *H. salinarum* was cultivated for 3-5 days in a liquid media (broth) under optimum growth conditions; 25 % NaCl, at 37 °C, light, aerobic condition and continuous shaking.

2.4.2 Microorganisms isolated from cod

A standard plate count agar (PCA-Oxoid) with 1,5 % NaCl added used to detect microorganisms isolated from cod. The inoculum used to contaminate the materials was cultivated in a liquid media (broth) for 3 days. After contamination, the materials were incubated at 20 °C.

2.5 Disinfection of materials

In experiments with microorganisms isolated from cod as contaminant, where crosscontamination was considered likely to occur, the materials were disinfected prior to contamination. This is shown in figure 2. The materials were wrapped in aluminium paper, put in autoclaveable bags, sealed with an autoclaveable tape and disinfected in an autoclave at 121 °C for 15 minutes.

Due to very strict growth conditions for H.salinarum, requirements for high levels of NaCl, risk of cross contamination from the materials were considered low. Consequently, the materials used in experiments with H.salinarum were not disinfected prior to contamination.

2.6 Contamination

A volume of 0.5 ml of the inoculum (microorganisms) was spread evenly on the surface of the material by using a pipette. For the wooden materials, the pith side was contaminated. For materials with a surface treatment (plywood and wax treated wood), the treated side was contaminated.

2.7 Conditions of incubation and heating

After incubation at optimum conditions for 2 hours or 7 days, respectively, the materials were analysed by the swabbing method. The incubation time is based on results from previous experiments (Lorentzen, G. *et al*. 2000).

To simulate if the worst comes to the worst, the contaminated materials were incubated for 7 days at optimum growth conditions for the test microorganisms used. The aim was to study how the microorganisms are influenced by the properties of the surface of the material over a longer period of time. The effect was measured as number of microorganisms detected by using the swabbing method after 7 days.

The heating conditions were based on results obtained in previous experiments (Lorentzen, G. *et al* 2000). Materials contaminated with microorganisms isolated from cod were heated at 100 °C in 150 minutes. Materials contaminated with *H.salinarum* were heated at 75 °C in 120 minutes. The heating was performed in humid conditions, by placing a bowl of water with the materials in the heating chamber.

2.8 Swabbing method

Based on results from previous experiments (Lorentzen, G., *et al*, 2000), the swabbing method was used to detect the remaining microorganisms left on the surface of the materials. After incubation for 2 hours or 7 days, the surface was swabbed by using a sterile cotton wool (swab), which were predipped into a sterile peptone / salt water liquid. The swab was put on the contaminated surface of the material and stroked over the surface according to a defined pattern. Afterwards, the swab was stirred in the sterile peptone / salt water liquid. The numbers of microbes in the salt/water liquid was determined by plate counting.

The microbes were cultivated in petri dishes, and incubated at optimum growth conditions for the test organism. Materials with *H. salinarum* were incubated at 37 °C, in light and aerobic condition, while materials with microorganisms isolated from cod were incubated at room temperature. The method for detection of halophilic and osmophilic microbes is described in appendix 1 (in Norwegian). All materials were analysed in duplicate.

2.9 Interpretation of results

According to figure 1 and 2, the materials were analysed twice; after incubation and after heating.

2.9.1 Interpretation of results after incubation

Materials with a high number of microorganisms left on the surface after incubation are considered to have the best hygienic properties. These materials do not act like a sponge. Materials with a low number of microorganisms left on the surface are considered to have poor hygienic properties. A low number of microorganisms may be caused by death due to lack of nutrition and / or by the sponge effect; the microorganisms penetrate the surface of the material.

Since the number of microorganisms detected after swabbing do vary, four scales for each microorganism / incubation time was defined in order to interpret the results. The scales are shown in table 1.

*Table 1. The criteria for classifying hygienic properties of materials after incubation. One asterisk (*) indicate good hygienic condition, and several asterisks (** - ****) indicate poor hygienic properties.*

Hygienic property	**Microorganisms isolated from cod**		***H.salinarum***	
	2 hours of incubation	**7 days of incubation**	**2 hours of incubation**	**7 days of incubation**
*	TNTC	> 500	TNTC	1 – 100
**	500 – 1000	> 300	> 1000	< 1
***	200 – 500	1 – 300	500 – 1000	
****	< 200	< 1	< 500	

TNTC – Too numerous to count

2.9.2 Interpretation of results after heating

The materials were also analysed by using the swabbing method after heating. The hygienic properties are interpreted as a function of the incubation (time and temperature) and heating (time and temperature). The criteria for acceptable hygiene after heating are *no* detection of the microorganisms.

3 RESULTS AND DISCUSSION

3.1 After incubation

Materials contaminated with microorganisms isolated from cod were incubated at 20 °C for 2 hours or 7 days. Materials contaminated with *H.salinarum* were incubated at 37 °C for 2 hours or 7 days before analysis. Tables 2 – 5 show the distribution of materials according to the ability to keep the contamination (microorganisms) on the surface.

Table 2 shows results from experiments where microorganisms isolated from cod were used as contaminant on 18 different materials. Spruce (not planed) was not tested in this experiment. The materials were incubated at 20 °C for 2 hours and then analysed by using the swabbing method.

Table 3 shows the results using the same microorganisms for contamination of on the 19 different materials (included spruce, not planed) and incubated for 7 days at 20 °C.

Table 4 shows the results from the experiments where *H.salinarum* were used as contaminant to the materials and incubated for 2 hours at 37 °C, while table 5 shows the results from the corresponding experiment using incubation for 7 days at 37 °C.

For tables 2 – 5, the materials in each hygienic level (number of ”*”) are listed randomly. Photos from some of the experiments are shown in appendix 3.

Table 2. Classifying of 18 materials according to hygienic properties. The materials are contaminated with 0,5 ml microorganisms isolated from cod (10^8 CFU/ml), incubated for 2 hours at 20 °C and then analysed by using the swabbing method.

Hygienic property; best (*), poor (****)	**Microorganisms detected after incubation (CFU/25 cm^2)**	**Materials incubated at 20 °C for 2 hours.**
*	TNTC	WISA Form Birch (processed plywood) WISA Hexa (processed plywood) WISA Patio (processed plywood) WISA White (processed plywood) Stainless steel Spruce 4 % wax treatment Pine 4 % wax treatment WISA Ply (processed plywood) Polyethylene
**	500 – 1000	WISA Spruce (standard plywood) WISA Birch (standard plywood) Pine Ultrawood 1 %, wax impregnation
***	200 – 500	Pine Ultrawood 2 %, wax impregnation Spruce, planed
****	< 200	Spruce, not planed Pine, not planed Pine, planed Beech

TNTC : Too numerous to count

Table 3.Classifying of 19 materials according to hygienic properties. The materials are contaminated with 0,5 ml microorganisms isolated from cod (10^8 CFU/ml), incubated for 7 days at 20 °C and then analysed by using the swabbing method

Hygienic property; best (*), poor (****)	**Microorganisms detected after incubation (CFU/25 cm^2)**	**Materials incubated at 20 °C for 7 days**
*	> 500	Polyethylene WISA White (processed plywood)
**	> 300	Stainless steel WISA Form Birch (processed plywood) WISA Hexa (processed plywood) WISA Patio (processed plywood) WISA Ply (processed plywood)
***	1 – 300	Spruce, not planed Spruce, planed WISA Spruce (standard plywood) WISA Birch (standard plywood) Birch, planed Beech Pine Ultrawood 1 %, wax impregnation Pine Ultrawood 2 %, wax impregnation Pine 4 % wax treatment Spruce 4 % wax treatment
****	< 1	Pine, not planed Pine, planed

Table 4. Classifying of 19 materials according to hygienic properties. The materials are contaminated with 0,5 ml *H.salinarum (*10^8 *CFU/ml),* incubated for *2 hours at 37 °C* and then analysed by using the swabbing method.

Hygienic property; best (*), poor (****)	***H.salinarum* detected after incubation (CFU/25cm^2)**	**Materials incubated at 37 °C for 2 hours**
*	TNTC	Spruce 4 % wax treatment Pine 4 % wax treatment WISA White (processed plywood) Pine, planed
**	> 1000	Pine Ultrawood 1 %, wax impregnation WISA Patio (processed plywood) WISA Hexa (processed plywood) WISA Form Birch (processed plywood) WISA Birch (standard plywood) WISA Spruce (standard plywood) Pine, not planed Polyethylene
***	500 – 1000	Birch, planed Stainless steel
****	< 500	Pine Ultrawood 2 %, wax impregnation Beech WISA Ply (processed plywood) Spruce, planed

TNTC : Too numerous to count.

Table 5 . Classifying of 19 materials according to hygienic properties. The materials are contaminated with 0,5 ml H.salinarum (*10^8* CFU/ml), *incubated for 7 days at 37 °C and then analysed by using the swabbing method.*

Hygienic property; best (*), poor (****)	***H.salinarum* detected after incubation (CFU / 25 cm^2)**	**Materials incubated at 37 °C for 7 days**
*	1 – 100	Stainless steel WISA Form Birch (processed plywood) WISA Hexa (processed plywood) WISA Patio (processed plywood) WISA White (processed plywood) WISA Ply (processed plywood) Pine Ultrawood 1 %, wax impregnation
**	< 1	Polyethylene Spruce, not planed Spruce, planed Pine, not planed Pine, planed WISA Spruce (standard plywood) WISA Birch (standard plywood) Birch, planed Beech Pine Ultrawood 2 %, wax impregnation Pine 4 % wax treatment Spruce 4 % wax treatment

If the surface of the material is porous, the added microorganisms will be able to penetrate the surface of the material. This is shown in previous experiments performed by Lorentzen *et al*. (2000) and Schőnwälder *et al.* (2000).

After 2 hours of incubation, the number of microorganisms left on the surface is dependent of the porosity of the material. After 7 days of incubation, the number of microorganisms left on the surface is considered to be dependent of two factors; porosity of the material and death of the microorganisms due to starvation.

Table 2 and 3 show that more of the microorganisms remain on the surface of processed plywood compared to the other materials like spruce and pine (both planed and not planed). After incubation for two hours, standard plywood has a lower number of microorganisms on the surface compared to processed plywood. Due to a non-porous surface, most of the microorganisms added to the materials of polyethylene and stainless steel showed equal hygienic properties to processed plywood and planed wood. After two hours of incubation, table 2 show that wax treatment gives slightly better hygienic properties compared to wax impregnation. After 7 days of incubation, table 3 show no differences of hygienic properties between wax treated wax impregnated wood.

For materials showing the best hygienic properties, i.e. processed plywood (table 2 and 3), the number of microorganisms decreases from 2 hours to 7 days of incubation. An incubation of

7 days involves an extensive death of the microbes due to starvation. Polyethylene and stainless steel seem to have the same hygienic properties as materials of processed plywood.

Table 4 show that more of the *H.salinarum* remains on the surface of wax treated pine and spruce compared to wax impregnated pine. These results are in accordance with experiments using microorganisms isolated from cod as test microorganisms (table 2). The results show no differences between standard and processed plywood. The other materials; planed and not planed wood are classified from best to poor hygienic conditions.

In general, table 5 shows that 7 days of incubation gives a low number of microorganisms for all materials tested compared to two hours of incubation (table 4). A number of 1 – 100 microorganisms are detected on materials of processed plywood, stainless steel and wax impregnated pine. No microorganisms were detected on the other materials tested. The low number of microorganisms is explained by a combination of death due to starvation and penetration of the surface of porous material.

3.2 After heating

After heating, *no* microorganisms were detected on the surface of any of the materials analysed in the experiments.

4 CONCLUSION

In general, these experiments show that the heating conditions as defined in previous experiments (Lorentzen. G. *et al*.2000), are sufficient to obtain an acceptable hygienic level for all the materials tested. The experiments show that wood, plywood or waxed wood are not less hygienic than polyethylene or stainless steel, provided the material is heated adequate before use.

4.1 After incubation

The experiment shows whether or not the microorganisms may penetrate the surface of the materials. Processed plywood, polyethylene or stainless steel is less exposed to penetration; a larger amount of microorganisms remains on the surface during incubation compared to the other materials tested. Consequently, it is considered that processed plywood have equal hygienic properties to polyethylene or stainless steel.

When using porous materials like spruce and pine (not planed), lower numbers of microorganisms were detected on the surface. A decrease in the number of microorganisms during incubation is assumed to be a combination of the sponge effect and natural death due to starvation.

4.2 After heating

The heating conditions defined in previous experiments for *Halobacterium salinarum* and microorganisms isolated from cod (Lorentzen, G., *et al* 2000) are adequate (fulfil the hygienic demands) for the 19 materials tested in this experiment.

In order to make sure that the hygienic requirements are fulfilled, for porous materials primarily, heat kills the microorganism wherever they are located.

In general, heating is considered to be a more convenient method for smaller equipment like cutting boards, trays, knives (with a handle of wood) and so on compared to i.e. pallets. However, at present time cutting boards made of polyethylene are necessarily used in the fish industry. The cause is that when these boards are illuminated from below, bones and parasites within the fish fillets may be visible and removable for the operator.

If microorganisms isolated from the meat industry show the same; heating instability as microorganisms used in this experiment, cutting boards of polyethylene can be replaced by wooden cutting boards, provided that heating is used as a method to kill the microorganisms.

4.3 Experiments for the future

The results presented in this report show that appropriate use of heating is a method that provides acceptable hygienic properties on any of the materials tested.

In the future, a standard cleaning and disinfection procedure should be drawn up for treatment of contaminated materials. Processed plywood should be compared to competing materials like ceramic tiles and other materials in order to study the hygienic properties. In previous and

present experiments performed at the Norwegian Institute of Fisheries and Aquaculture Ltd., only the representative microorganisms considered to be typical in the fish industry have been used as test microorganism. In the future, representative test microorganisms from other food industries should tested as well.

5 ACKNOWLEDGEMENTS

We would like to thank Guro Pedersen at the Norwegian Institute of Fisheries and Aquaculture Ltd. for performing all the experiments in the laboratory. Gunilla Beyer from the Swedish Institute for Wood Technology Research and Ida Weider from the Norwegian Institute of Wood Technology are thanked for useful help and input during the experiment. Margrethe Esaiassen at the Norwegian Institute of Fisheries and Aquaculture Ltd are thanked for useful corrections during our work.

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7 APPENDIX

App1: Halofile og osmofile mikrober (rød og brunmidd). Bestemmelse i fullsaltede fiskeprodukter (in Norwegian). 5 pages.

App 2: Specifications of the materials tested.

App 3: Photos from the experiment.

Appendix 1

Halofile og osmofile mikrober (rødmidd og brunmidd). Bestemmelse i fullsaltede fiskeprodukter.

1. Formål og anvendelsesområde

Metoden kan anvendes for å påvise rødmidd og brunmidd i saltfisk.

Nedre grense for deteksjon er 100 kim av aktuell mikrobe per gram prøve. Bemerk at det kan være store variasjoner i mikrobeinnhold på ulike deler av fisken.

2. Definisjoner og epidemiologiske aspekter

2.1 Rødmidd

Rødmidd er en tradisjonell bransjebetegnelse på synlig vekst av ekstremt halofile bakterier på fullsaltet fisk. Bakteriene tilhører familien Halobacteriaceae som omfatter kokker (Halococcus) og staver eller skiveformede (engelsk: disc-shaped) bakterier (Halobacterium). Halobacteriaceae tilhører klassen Archaeobacteria, og er strikt halofile. De har annerledes celleveggoppbygning enn de fleste andre bakterier, men gir Gram negativ reaksjon ved modifisert Gram test med KOH. De fleste arter av rødmidd er ubevegelige og strikt aerobe. Noen krever bare 8 % NaCl for å vokse, men i de fleste tilfellene behøves 17-23 % NaCl for god vekst. Koloniene har ulike fargenyanser av rødt; rosa, orange/rød, skarlagensrød eller rødfiolett mens andre kan være fargeløse. Halococcus og Halobacterium påvises ofte i samme materiale.

2.1.1 Halobacterium

Halobacterium er stav- eller skiveformede bakterier. De fleste isolerte stammene behøver minst 15 % NaCl for å vokse, og de vokser best ved 20 - 26 % NaCl. De kan også vokse i mettede saltløsninger; 29 % NaCl. Optimumstemperaturen for vekst er 40 - 50 °C. Disse organismene forårsaker blant annet rød misfarging på saltfisk (norsk bransjeuttrykk "rødmidd" eller engelsk "pink").
Organismene har et komplekst næringskrav; de trenger flere aminosyrer for å vokse. De kan også utnytte aminosyrer som energikilde. Halobacterium vokser sakte; en generasjonstid på 3-6 timer er det beste som er oppnådd i laboratorieforsøk.

Slekten Halobacterium omfatter artene:
Halobacterium salinarium, *Halobacterium volcanii*, *Halobacterium saccharovorum*, *Halobacterium vallismortis*, *Halobacterium pharaonis*

2.1.2 Halococcus

er kokker som opptrer enten parvis, i tetraeder, sarcinapakker eller i irregulære klaser. Halococcus krever minst 15 % NaCl for å vokse, og den vokser optimalt ved 20 - 26 % NaCl. Den kan vokse fra 8 til 55 °C, temperaturoptimum er 30- 37 °C. Bakterien vokser sakte (generasjonstid på 14 timer), selv under optimale vekstvilkår. Vekst av Halococcus indikeres ved synlige røde kolonier.

Slekten Halococcus består av en aktuell art:
Halococcus morrhuae

2.2 Brunmidd

Brunmidd (engelsk "dun") er en tradisjonell betegnelse på forekomst av brune kolonier (1-2 mm i diameter) på saltfisk. Brunmidd er en encellet sopp (*Wallemia sebi*, tidligere *Sporendonema epizoum*). Brunmidden er strikt aerob. Den er osmofil/xerofil, og vokser på substrat som inneholder 5 - 26 % NaCl, 20 % sukrose, og 20 % glyserol. Den vokser ved 5 - 37 °C, og ved pH 4–8. De optimale vekstvilkår er ved vannaktivitet tilsvarende 10 - 15 % NaCl, 75 % relativ fuktighet og 25 °C. Veksten stimuleres av lys. Soppcellene er klubbeformet. Fargen på pigmentet endres med saltinnholdet; lavt saltinnhold gir sjokolade brune kolonier, medium saltinnhold gir lysebrune kolonier og et høyt saltinnhold gir grønn/brune kolonier.

3. Referanser

3.1 NMKN 5, 1994, Handbok för mikrobiologiska laboratorier. Handledning för intern kvalitetskontroll av analysarbetet. 2. utgave

3.2 NMKN 91, 1988: Forbehandling av levnedsmidler til mikrobiologisk undersøgelse.

4. Prinsipp

Rød- og brunmidd kan påvises ved utsæd på egnede agarmedier. Prøver for rødmidd inkuberes lyst ved 37 °C i 2 uker, mens prøver for brunmidd inkuberes lyst ved 20 – 24 °C (romtemperatur) i 2 uker eller mer. I de fleste arter danner synlige kolonier innen 4 dager. Både rød- og brunmidd kjennetegnes ved at de gir pigmenterte kolonier.

5. Fortynningsvæske, substrater

5.1 Fortynningsmedium for rødmidd

Salt (NaCl)	250 g
Pepton	1.0 g
Destillert vann	1000 ml

Fortynningsmediet autoklaveres ved 121 °C i 20 minutter. Etter sterilisering skal pH i bruksferdig løsning være 7,4 +/- 0,2 målt ved 20-25 °C.

5.2 Fortynningsmedium for brunmidd

Salt (NaCl)	75 g
Pepton	1,0 g
Destillert vann	1000 ml

Autoklaver fortynningsmediet ved 121 °C i 20 minutter etter at ingrediensene er løst. Etter sterilisering skal den bruksferdige løsningen ha pH 5.6 ± 0.2 målt ved 20 - 25 °C.

5.3 Rødmidd – medium

Kasaminosyrer	7,5 g
Gjærekstrakt	10 g
Natriumklorid (NaCl)	250 g
Magnesiumsulfat ($MgSO_4$ x $7H_2O$)	20 g
Natriumcitrat	3.0 g
Kaliumklorid	2.0 g
Jernsulfat ($FeSO_4$ x $7H_2O$)	0,05 g
Mangansulfat ($MnSO_4$ x H_2O)	0,20 mg
Agar	20 g
Destillert vann	1000 ml

Løs opp stoffene under omrøring og juster pH. Tilsett agar, og autoklaver ved 121 °C i 20 minutter. Etter sterilisering skal pH i bruksferdige substrat være 7,4 ± 0,2 målt ved 20 - 25 °C.

5.4 Brunmidd - medium

5.4.1 Alternativ I (Modifisert Vaisey medium)

Kasiton	2,5 g
Magnesiumsulfat ($MgSO_4$)	0,2 g
Jern (II) sulfat	0,02 g
Dikaliumhydrogenfosfat	1,0 g
Natriumklorid	75 g
Glucose	9,0 g
Agar	25 g
Destillert vann	1000 ml

Løs opp alle stoffer unntatt magnesiumsulfat og jernsulfat. Løs opp 2 g magnesiumsulfat og 0,2 g jernsulfat i 10 ml destillert vann (stamløsning). Pipetter ut 1 ml av stamløsningen og tilsett mediet. Juster pH og autoklaver ved 121 °C i 20 minutter. Etter sterilisering skal pH i bruksferdig medium være 7,2 +/- 0,2 målt ved 20-25 °C.

5.4.2 Alternativ II (Modifisert dichloran – glyserol (DG 18) Agar Base)

Bemerk at mediet er noe forskjellig fra DG 18 – mediet som er beskrevet i NMKLs metodeforslag nr. 98, 3. opplag 1995.

Pepton	5,0 g
Glukose	10 g
Dikaliumhydrogensulfat	1,0 g
Magnesiumsulfat ($MgSO4x7H_2O$)	0,5 g
2,6-Diklor-4-nitroanilin (Dichloran)	0,002 g
Agar	15 g
Glyserol (p.a.)	220 g
Kloramfenikol	0,10 g
Destillert vann	1000 ml

Løs opp alle ingrediensene, glyserol og kloramfenikol til de løses. Bruk maksimalt 500 ml medium (målt før tilsats av glycerol) i hver kolbe. Juster pH og tilsett glyserol. Mediet steriliseres ved autoklavering ved 121 °C i 20 minutter. Kjøl ned til ca 50 °C og tilsett steril kloramfenikolløsning. Hell mediet over i sterile pestriskåler. Etter sterilisering skal pH i det bruksferdige substrat være 5.6 ± 0.2 målt ved 20 - 25 °C

Dehydrert basismedium og steril kloramfenikol supplement finnes kommersielt tilgjengelig.

6. Apparatur og glassutstyr

Normal utrustning for et mikrobiologisk laboratorium.

Termostatskap med lys, 37,0 ± 1,0 °C.

7. Prøveuttak

Foreta prøveuttak med steril skalpell på overflaten av saltfisken etter vanlige bakteriologiske prinsipper, slik at prøven blir mest mulig representativ. Prøven kan transporteres før analyse. Påse at prøven er godt innpakket.

8. Fremgangsmåte

8.1 Forbehandling

Utfør forbehandling og fortynning av prøvene i samsvar med NMKL-metode nr. 91. Bemerk at fortynningsvæsken i denne metoden er forskjellig fra den som er beskrevet i nr 91.

8.2 Utsæd, inkubasjon og avlesing

8.2.1 Rødmidd

Overfør 0,1 ml av homogenisatet til en petriskål med ferdigstøpt rødmidd medium. Dersom det ikke er synlig rødskjær eller kolonier av rødmidd på fisken er det ikke nødvendig å lage fortynningsrekke. Stryk prøvematerialet inn i mediet med en steril og avkjølt glasstav. Petriskålene pakkes inn i plastikkposer og inkuberes lyst ved 37 °C. Vekst indikeres ved utvikling av røde kolonier. Rødmiddkolonier kan være synlige allerede etter 4-7 døgn. Dersom det ikke er synlige kolonier etter 2-3 uker regnes prøven som negativ.

8.2.2 Brunmidd

Overfør 0,1 ml av homogenisatet til en petriskål med ferdigstøpt brunmidd medium. Dersom det ikke er brune prikker på fisken er det ikke nødvendig å lage fortynningsrekke. Stryk prøvematerialet inn i mediet med en steril og avkjølt glasstav. Petriskålene pakkes inn i plastikkposer og inkuberes lyst ved ca 20 °C / romtemperatur. Vekst indikeres ved utvikling av lysbrune/beige kolonier. Brunmiddkolonier kan være synlige allerede etter 3-4 døgn. Dersom det ikke er synlige kolonier etter 1-2 uker regnes prøven som negativ.

9. Konfirmering

9.1 Rødmidd

Vekst på rødmiddmediet men ikke på brunmiddmediet.

9.2 Brunmidd

Vekst på brunmiddmediet men ikke på rødmiddmediet.

9. Resultat

Tell antall pigmenterte kolonier, hhv røde og brune, og regn ut antall kolonier og angi resultatets kolonitall per gram prøve eller per cm^2 overflate.
Upigmenterte kolonier regnes ikke med.

11. Litteratur

Referanser for mediene i denne oppskriften har vært følgende:

Rødmiddmedium
DSMZ nr 97 (Deutsche Sammlung von Mikroorganismen und Zellkulturen GmbH)

Brunmidd medium med 7,5 % NaCl
Burgos J, Sala FJ, Lopéz A, 1973, Quinones and respiratory activity in Spoendonema epizoum. Phytochemistry 12:1201-1206.

Brunmiddmedium med Dichloran-glycerol (DG18) agar base

1. Hocking A. D. And Pitt J. I. 1980. J. Appl. & Env. Microbiol. 39. 488 – 492.

2. Beckers, H. J., Boer, E., van Eikelenboom, C., Hartog, B. J., Kuik, D., Mol, N., Nooitgedagt, A. J., Northolt, M., O. & Samson, R. A. 1982. Intern. Stand. Org. Document ISO/TC34/SC9/N151

12. Referenter for metoden

Denne NMKL-metoden er utarbeidet av Grete Lorentzen, Guro Pedersen og Olaug Taran Skjerdal, Fiskeriforskning, Tromsø, Norge.

Appendix 2

Specifications of the materials tested

The information about the polyethylene is provided by Glassmester Eriksen AS, Tromsø. The Information about the plywood is provided by Schaumann, Carina Jägenstedt. The information about the waxed wood is provided by Gunilla Beyer at the Swedish Institute for Wood Technology Research. The information about the not treated wood is provided by Ida Weider at the Norwegian Institute of Wood Technology.

1. Polyethylene (polyethylene), undamaged

Polyethylen er en termoplast med forkorstelsen PE.

- Egenskaper
- Lav fiksjonskoeffisient
- God slitestyrke
- Ingen spenningskorrosjon
- Tåler temperaturer ned til –260 C
- Ingen giftige tilsetninger
- Brenner langsomt
- Gode elektriske egenskaper
- Lav vannabsorbering
- Kan forsterkes med glassfiber
- Gos slagseighet over et bredt temperaturområde
- Lav ripefasthet

Tekniske spesifikasjoner

Fysiske egenskaper	**Testmetode**	**Enhet**	**PE**
Densitet	DIN 53479	G / cm^3	0,95
Elastisitetsmodul	DIN 53457	GPA	1,1
Strekkfasthet	DIN 53455	Mpa	28
Bøyeholdfasthet	DIN 54452	Mpa	40
Slagseighet	DIN 53453	KJ/m^2	Ikke brudd
Friksjonskoeffisient			0,20 – 0,25
Smeltepunkt (myktemp.)	DIN 53736		130
Bruksområde		°C	- 75 – 70 /90
Varmeledningsegenskaper	DIN 52612	W/m x °C	0,48
Vannabsorpsjon	DIN 53714	%	0

Stainless steel (AISI 304)
The stainless steel is processed according to the standard EN 10088.

2. WISA Spruce (standard plywood)

Wisa-Spruce plywood is made using only spruce veneers. Ply thickness vary from 1.4 mm to 3.2 mm, depending on the end use. Spruce plywood is lightweight and economical to use in construction and packaging, for example.

3. WISA Birch (standard plywood)

Wisa-Birch plywood is made using normally only 1.4 mm thick cross-banded birch plies. Multi-layer construction and the good mechanical properties of birch, ensure that the plywood is both strong and largely homogeneous in its mechanical properties. The appearance of the panel surface is governed by the choice of face veneer. Birch plywood is used where special strength is required, such as vehicle floors and furniture, where strength is combined with the light colour of birch.

General product information

Product description	WISA-Birch plywood is used e.g. in furniture, transportation, construction and joinery industries.
Base board	Birch plywood, made of thin 1.4 mm veneers. Also scarfjointed maxi sizes available.
Bonding	Phenolic resin cross-bonded weather resistant glueing according to EN 314-2/class 3 (DIN 68705 Teil 3: BFU 100; BS 6566 Part 8: WBP).
Surface	Face veneer qualities as per SFS 2413 (Quality requirements for appearance of plywood with outer plies of birch).
Machining	Edge and CNC machinings available at request.

Design information

Moisture content 8-10%

Properties of panel surface	Face grades: B - surface for lacquering, S - surface for painting and for coating, BB - surface for painting and for coating with thicker materials, WG - surface for reverse sides.

Strength values As per the Handbook of Finnish Plywood.
The strength of the scarfjoint abt 10-30% less than that of standard panels.

Other information
Wood being a living material, every panel is unique. Thus a photograph or a sample piece cannot represent all the panels, as regards colours, shades, graining, knots etc.

Liabilities Any defects other than caused by clearly verified production or service faults by the supplier are the responsibility of the user. Any claim for compensation is limited to the value of the defected panels.

Miljövarudeklaration

Produkt
Björkplywood används till speciellt krävande ändamål
där hög styrka och hållfasthet önskas. Tex. inom transportmedelsindustrin, möbelindustrin och till emballage. Råvaran är hårda tätfibriga björkfaner som krysslimmas med fenolhartslim.

Träslag 100 vikt % Björk
Lim ca 7 vikt % fenolhartslim
Densitet 700 kg/m3

Bränslevärde 2.9 MWh/m3

Användning

Ekologi- och giftinformation
Innehåller inga ämnen enligt R-sats R50-R53 (miljögifter)
Innehåller inga ämnen enligt R-sats R20-R48 (hälsofarliga)

Flyktiga organiska ämnen
Formaldehydemission <0,1 ppm (enligt standard EN 120)

Klassificering av Godkänd enlig finska "Finishing materials class M1).
Separat datablad.
ytbearbetning för inomhusbruk

4. WISA Form Birch (processed plywood)

Wisa-Form is a plywood panel coated on both sides with phenolic film. Wisa-Form panels are used for concrete formwork, vehicle building and construction in agriculture. Standard colour is dark brown. Base panel is birch, combi or spruce.
Wisa-Form Special is a concrete formwork panel with improved wear resistance.
Wisa-Form Super is a strong special panel for demanding formwork. A well-kept panel can be used more than a hundred times.

General product information

Product description	Phenolic film coated panel for usage in concrete formwork where high requirements are set on the concrete surface and the number of reuses.
Base board	Birch plywood, made of thin 1.4 mm veneers.
Bonding	Phenolic resin cross-bonded weather resistant glueing according to EN 314-2/class 3 (DIN 68705 Teil 3: BFU 100; BS 6566 Part 8: WBP).
Surface	Face and reverse: Brown phenolic film (abt RAL 8017). Coatings 120 and 220 g/m2. Edge protection: Acryl-based paint.
Machining	Edge and CNC machinings available at request.
	Moisture content 8-10%
	Improved water resistance through coating. The coating is resistant to weak alkalis. Direct exposure to sunlight may accelerate the ageing and colour alterations of the surface.
	The coating thickness must be chosen according to the designed concrete quality, number of reuses and casting conditions.
	Moisture content 27%
	The design tables have been drawn up for average casting needs of 20-30 reuses. If the panels are used for a long period with repeated castings at short intervals or if the conditions are otherwise difficult, the load values need to be reduced by 20-30%. The users are advised to consult the supplier before the final design of the forms.

Liabilities	Any defects other than caused by clearly verified production or service faults by the supplier are the responsibility of the user. Any claim for compensation is limited to the value of the defected panels.

Environmental Declaration

Product	Wisa-Form is used for concrete formwork, vehicle building and construction in agriculture. Standard colour is dark brown. The raw material are birch and/or spruce veneers which are bonded together with phenol-formaldehyde resin. The panel is coated on both sides with 120-220 g/m2 phenolic film.
Wood species	100 weight % of birch (Wisa-Form Birch) 68 weight % of birch and 32 weight % of spruce (Wisa-Form Combi)
Amount of glue	7-8 weight % of phenol-formaldehyde resin
Density	640-700 kg/m3

Fuel value of the product 2.9 MWh/m3

Ecological and toxicological information

Does not contain compounds in accordance with R-phrases R50-R53 (ecotoxicity).
Does not contain compounds in accordance with R-phrases R20-R48 (humantoxicity).

Volatile organic compounds

Formaldehyde emission less than 0.1 ppm (according to standard EN 120).

Classification of finishing materials used indoors

Approved in Finland to Finishing materials class M1. Separate data sheet available.

5. WISA Hexa (processed plywood)

Wisa-Hexa products are flooring panels coated with phenolic resin laminate imprinted with a hexagonal pattern. Different qualities -Strong, Grip and Step- are designed for different uses. Standard colour is dark brown.

General product information

Product description

Flooring plywood coated with a phenolic resin film and imprinted with a hexagonal pattern.

Base board	Birch plywood, made of thin 1.4 mm veneers. Scarfjointed maxi panels available.

Bonding Phenolic resin cross-bonded weather resistant glueing according to EN 314-2/class 3 (DIN 68705 Teil 3: BFU 100; BS 6566 Part 8: WBP).

Surface Face: Brown (abt. RAL 8017) phenolic resin film, the hexagonal pattern with diameter 10 mm. Reverse: Smooth or imprinted, coated with a phenolic moisture barrier. Edge protection: Acryl-based paint.

Impregnation Can be impregnated according to AQIS requirements for sea containers.

Moisture content 8-10%

Properties of panel surface Wear resistance (Taber DIN 53799) average 630 cycles. Improved water resistance through coating. Chemical resistance: endures mild alkalis. Direct exposure to sunlight may accelerate the ageing and colour alterations of the surface.

Strength values The strength of the scarfjoint is abt 10-30% less than that of standard panels.

Recommendations for use Suitable for flooring applications where big localised loadings do not occur. Scarfjointed one piece floors give large seamless surfaces.

Miljövarudeklaration

Produkt WISA-Hexa är golvskivor belagda med halkskyddande Sexkantmönstrat fenollaminat. WISA-Hexa finns i tre olika kvaliteter -Strong, -Grip och -Step som är anpassade för olika användningsområden och krav på slitstyrka. Standardfärgen är mörkbrun.

Träslag 100 vikt % Björk
Lim ca 7 vikt % fenolhartslim
Densitet 700 kg/m3

Bränslevärde 2.9 MWh/m3

Användning
Ekologi- och giftinformation
Innehåller inga ämnen enligt R-sats R50-R53 (miljögifter)
Innehåller inga ämnen enligt R-sats R20-R48 (hälsofarliga)

Flyktiga organiska ämnen
Formaldehydemission <0,1 ppm (enligt standard EN 120)

6. WISA Patio (processed plywood)

Wisa-Patio is a plywood panel developed for balconies and other demanding outdoor applications. The panel is coated with weather and UV resistant polyester resin. Coating colour is grey, with a hexagonal imprint. Base panel is birch.

General product information

Product description

WISA-PATIO is a wood-based laminated panel product intended for floor constructions such as patios, terraces, balconies and light commercial vehicles.

Base board Birch plywood.

Bonding Phenolic resin cross-bonded weather resistant glueing according to EN 314-2/Class 3 (DIN 68705: BFU 100, BS 6566: WBP).

Surface Top side
Phenolic resin impregnated grey (RAL 7036) multilayer laminate with a hexagonal pattern.
Reverse side
Phenolic moisture barrier.

Impregnation

Base panel can be impregnated against rot and fungi.

Thickness valid at 8-10 % moisture content.
* These tolerances meet the ISO and EN requirements
** Estimated weights are based on the nominal thickness and average weight of birch 700 kg/m³

Properties of panel surface Top side

Taber abraser value (DIN53799)	4500 rounds
Water absorption (Cobb/7 d)	25 g/m²
Reverse side	
Water absorption (Cobb/7 d)	200 g/m²

The surface laminate of WISA-PATIO is resistant to UV-rays and changing weather conditions and is easy to keep clean.

Installation instructions

The panels are fixed to the underlaying construction with glue and/or screws.

Other information

Panels can be disposed by combustion mixed with other fuel at a minimum temperature of 850° C. WISA-PATIO is not designed to be used in heavy-duty applications.

7. WISA White (processed plywood)

Wisa-White is a birch or combi panel coated with special white laminate. Coating ensures good resistance to chemicals and ultraviolet rays. Wisa-White can be used for example as signposts and advertising boards.

General product information

Product description

Melamine coated birch or combi plywood. Used eg. in signs, billboards and shelves.

Base board — Birch plywood, made of thin 1.4 mm veneers.

Bonding — Phenolic resin cross-bonded weather resistant glueing according to EN 314-2/class 3 (DIN 68705 Teil 3: BFU 100; BS 6566 Part 8: WBP).

Surface — Face and reverse: White melamine resin coating (colour abt. RAL 9010), coating weight abt 250/250 g/m2.
Edge protection: White acryl-based paint.

*) The melamine coating both sides adds to the weight abt 0.5 kg/m2.
Moisture content 8-10%

Properties of panel surface

Wear resistance Taber (DIN 53799) average 800 rev's. The UV resistance (DIN 54004) good. The water absorption (Cobb 7 days) less than 200 g/m2.

The WISA-White surface can be painted e.g. with two-component polyurethane paints. Tapes adhere also to the surface.

Other information

Wisa-White is not recommended for applications where an impact resistance is needed or the panel surface is perforated.The melamine surface is hard-brittle and cracks easily.

Environmental Declaration

Product	Wisa-White is a birch or combi panel which can be used for example as signposts and advertising boards. The panel is coated on both sides with 250/250 g/m2 white melamine resin coating. Coating ensures good resistance to chemicals and ultraviolet rays. Edges are protected with white acrylic based paint.
Wood species	100 weight % of birch (Wisa-White Birch) 68 weight % of birch and 32 weight % of spruce (Wisa-White Combi)
Amount of glue	7-8 weight % of phenol-formaldehyde resin
Density	640-700 kg/m3

Fuel value of the product 2.6 - 2.9 MWh/m3

Ecological and toxicological information

Does not contain compounds in accordance with R-phrases R50-R53 (ecotoxicity).
Does not contain compounds in accordance with R-phrases R20-R48 (humantoxicity).

Volatile organic compounds

Formaldehyde emission less than 0.1 ppm (according to standard EN 120).

8. WISA Ply (processed plywood)

General product information

Product description

Lacquered plywood boards, used mainly as decorating panels in interior claddings.

Base board	Birch, combi or mirror plywoods, made of birch and spruce veneers, thin-ply constructions. Interior bonded boards are available only in birch throughout.
Bonding	Phenolic resin cross-bonded weather resistant glueing according to EN 314-2/class 3 (DIN 68705: BFU 100, BS 6566: WBP) or urea-formaldehyde resin cross-bonded glueing according to EN 314-2/class 2 (DIN 68705: BFU 20, BS 6566 Part 8; 1985 Type interior).

Surface
Transparent lacquering options (wet weight abt. 150 g/m2):
1) Catalytic lacquer, 2) Water-dilutable acrylic lacquer.
Edges protected with transparent or nearly transparent acrylic based lacquer.
Face grades B, S, BB, WG, (SFS 2413 Quality requirements for appearance of plywood with outer plies of birch)

Properties of panel surface
When kept in the direct sun light the UV-radiation darkens the wood surface under the lacquer although the lacquer itself endures UV-radiation fairly well.

Strength values
Strength properties as per the Handbook of Finnish Plywood.

Recommendations for use
For applications where visual appearance is one of the most important product properties, only base panel with B face grade is recommended.

Wisa-Ply Lacquered products with interior bonding are not recommended for exterior use or for interior applications where moisture durability is needed.

Other information
Wood being a living material, every panel is unique. Thus a photograph or a sample piece cannot represent all the panels, as regards colours, shades, graining, knots etc.

Product
Wisa-Ply laquered is a thin-ply construction birch, combi or mirror panel which is mainly used as decorating panels in interior claddings. The panel is lacquered with catalytic lacquer or water-dilutable acrylic lacquer. Edges are protected with transparent or nearly transparent acrylic based lacquer.

Wood species
00 weight % of birch (birch base panel)
68 weight % of birch and 32 weight % of spruce (combi base panel) about 60 weight % of birch and 40 weight % of spruce (mirror base panel)

Amount of glue abt.6-8 weight % phenol formaldehyde resin

Density 700 kg/m3 birch base panel
620 kg/m3 combi base panel
560 kg/m2 mirror base panel

Fuel value of the product 2.6-2.9 MWh/m3

Ecological and toxicological information Does not contain compounds in accordance with R-phrases R50-R53 (ecotoxicity). Does not contain compounds in accordance with R-phrases R20-R48 (humantoxicity).

Volatile organic compounds Water-dilutable acrylic lacquered panels: formaldehyde emission less than 0.1 ppm (according to standard EN 120). Catalytic lacquered panels: fromaldehyde emission class B according to EN 717-2 .

9. Spruce, pine (planed and not planed) and beech, planed

The materials are dried at the saw mills at approximately 17 % humidity. In the laboratory where the experiments are carried out, the air is drier. It is estimated that the humidity in the materials have decreased to 15% or less (ref. e-mail 26.01.2001, from Ida Weider, the Norwegian Institute of Wood Technology)

Material	**Density (g/cm^2 v/ 15 % fuktighet)**
Spruce	0,47
Pine	0,51
Beech	0,70

10. Spruce 4 % wax treatment, pine 4 % wax treatment, pine ultrawood 1 %, wax impregnation and pine ultrawood 2 %, wax impregnation

The materials are treated with a wax emulsion (wax treatment) wich causes a water-repellent effect, which is a fairly simple and inexpensive method. The waterabsorption is reduced with 40-60%. The growth of blue stain and mould is also reduced. Another method is impregnation with a water-repellent agent (wax impregnation).

Wax treated and wax impregnated materials were exposed to accelerated ageing, 10 cycles, in a Atlas Weather-o-Meter Ci 65 with 24 hours watersprinkling and 24 hours drying per cycle. After watersprinkling, 30 l/material/h, the weight was noted and the waterabsorption is expressed in %. The drying cycles were under exposure of UV-light for 24 hours according to ASTM standard G26-92.

Wax treatment

Wood materials of spruce (*Picea Abies*) and pine, were treated with a wax emulsion, Mobilcer 45, corresponding to 80-90 g/m2 (called wax1) respectively around 160 g/m2 (called wax2).

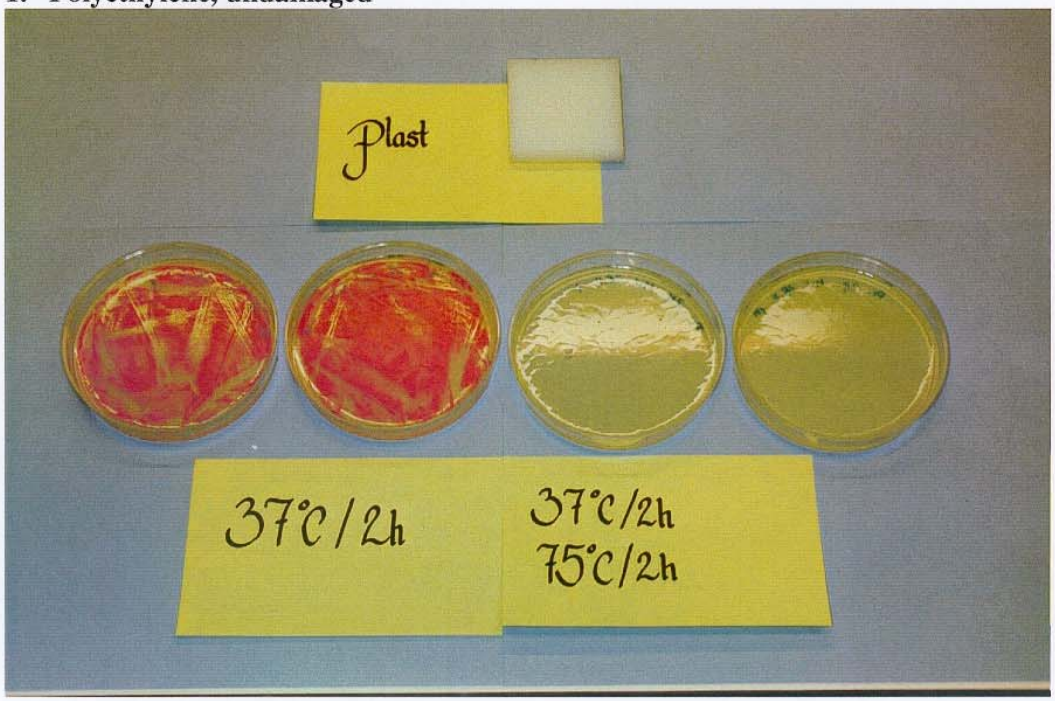
Wax impregantion

Wood materials of pine, were impregnated with Ultra Wood (UW) at two different concentrations - 1% and 2% active substance.

Appendix 3

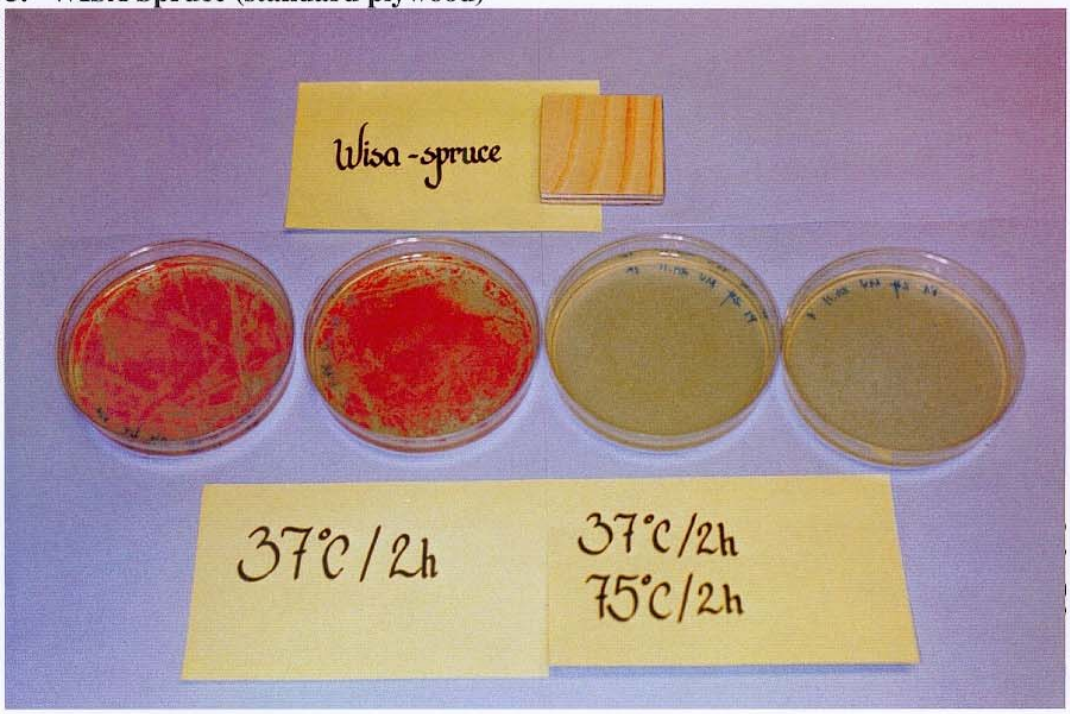
Photos from the experiment.
Materials contaminated with *H.salinarum*. Photo after two hours incubation at 37 °C and after heating at 75 °C in two hours. All photos are taken by Guro Pedersen, Fiskeriforskning.

1. Polyethylene, undamaged

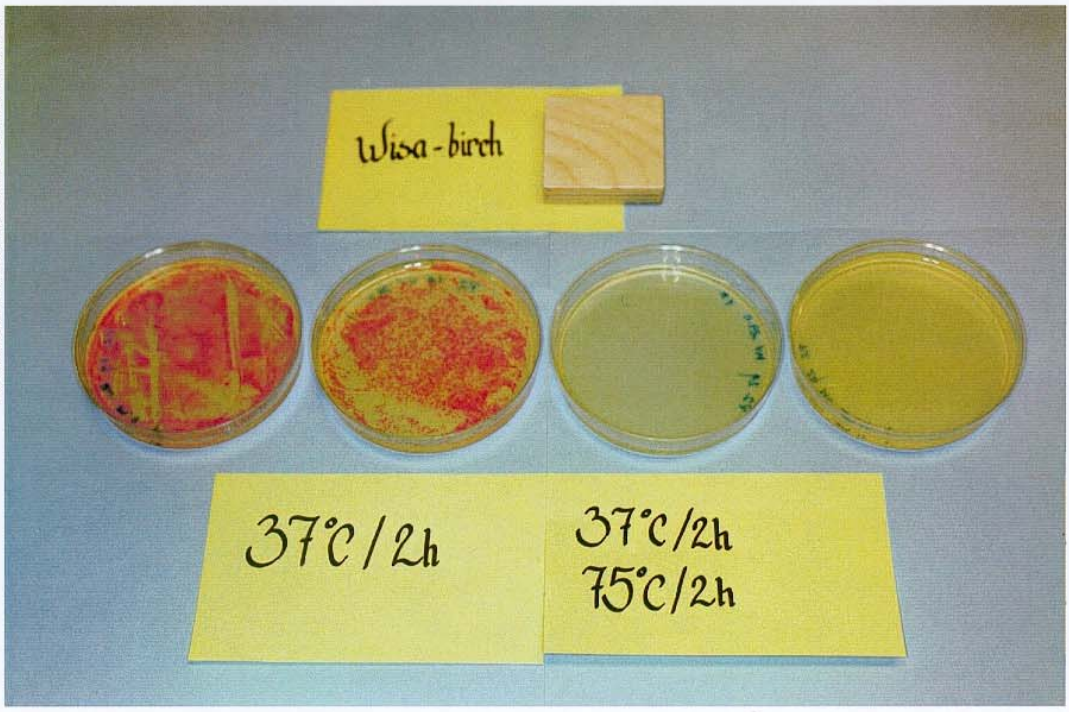


2. Stainless steel (AISI 304)

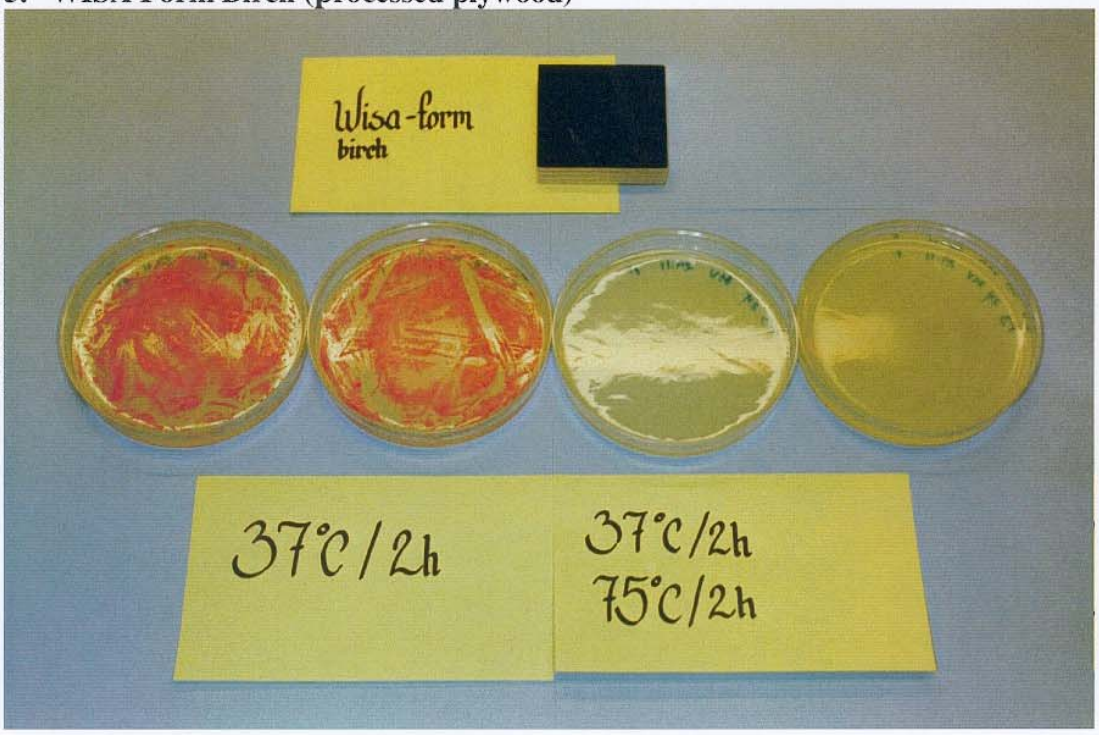
3. **WISA Spruce (standard plywood)**



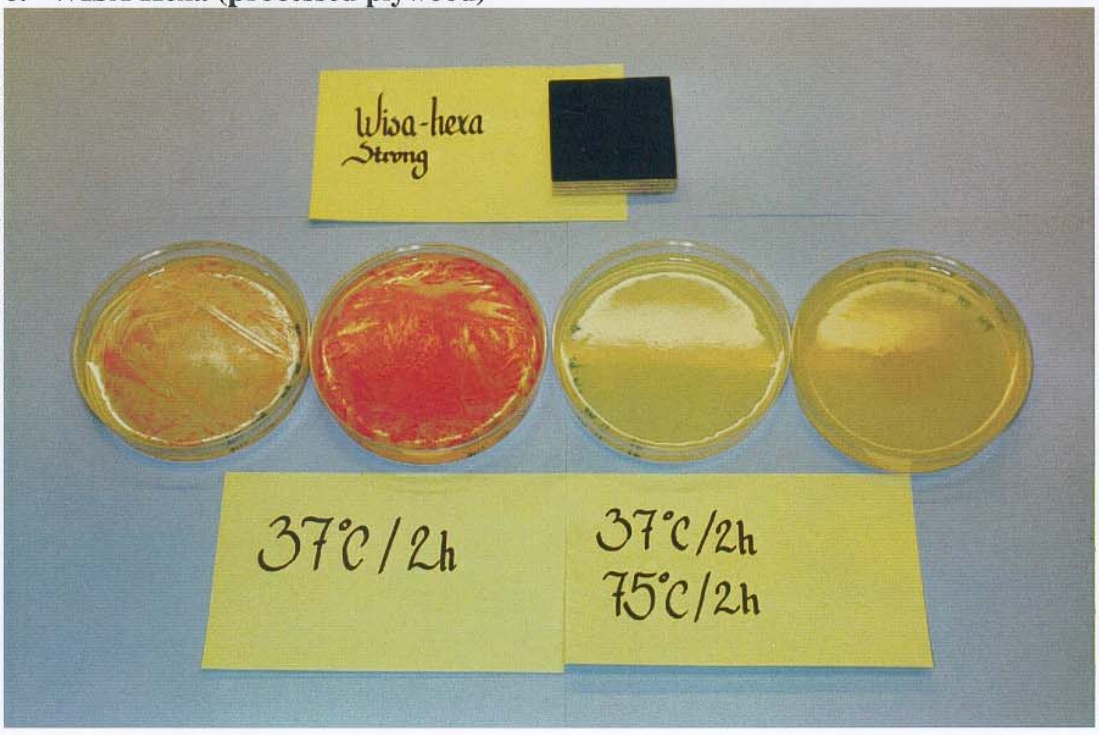
4. **WISA Birch (standard plywood)**



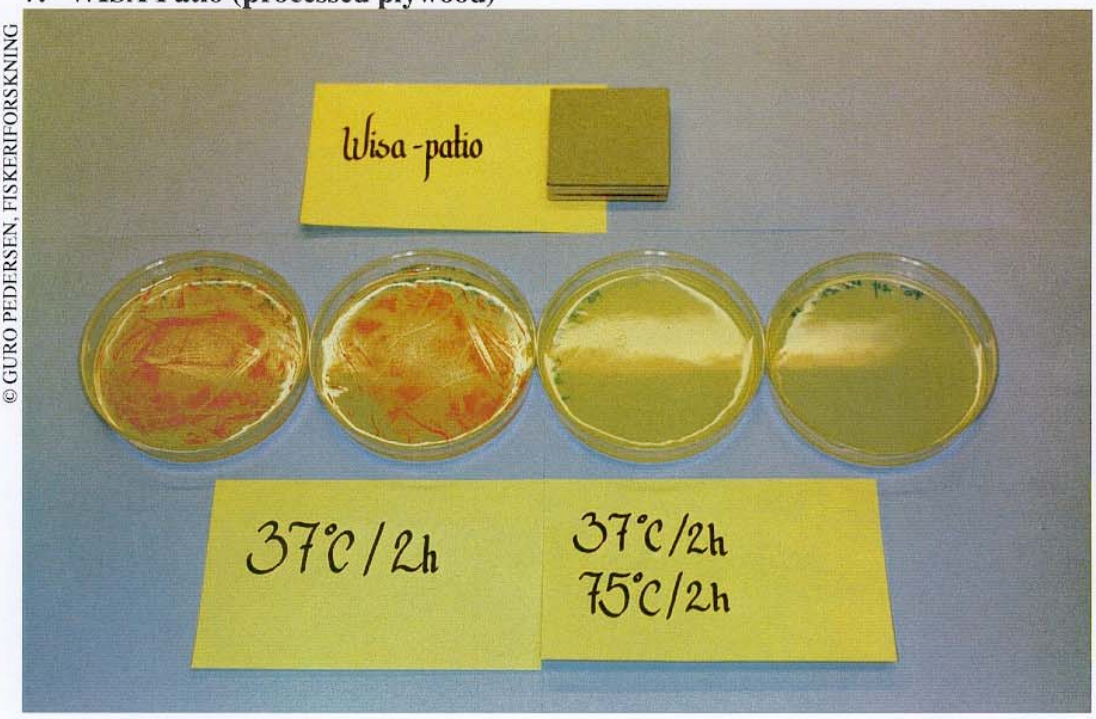
5. **WISA Form Birch (processed plywood)**



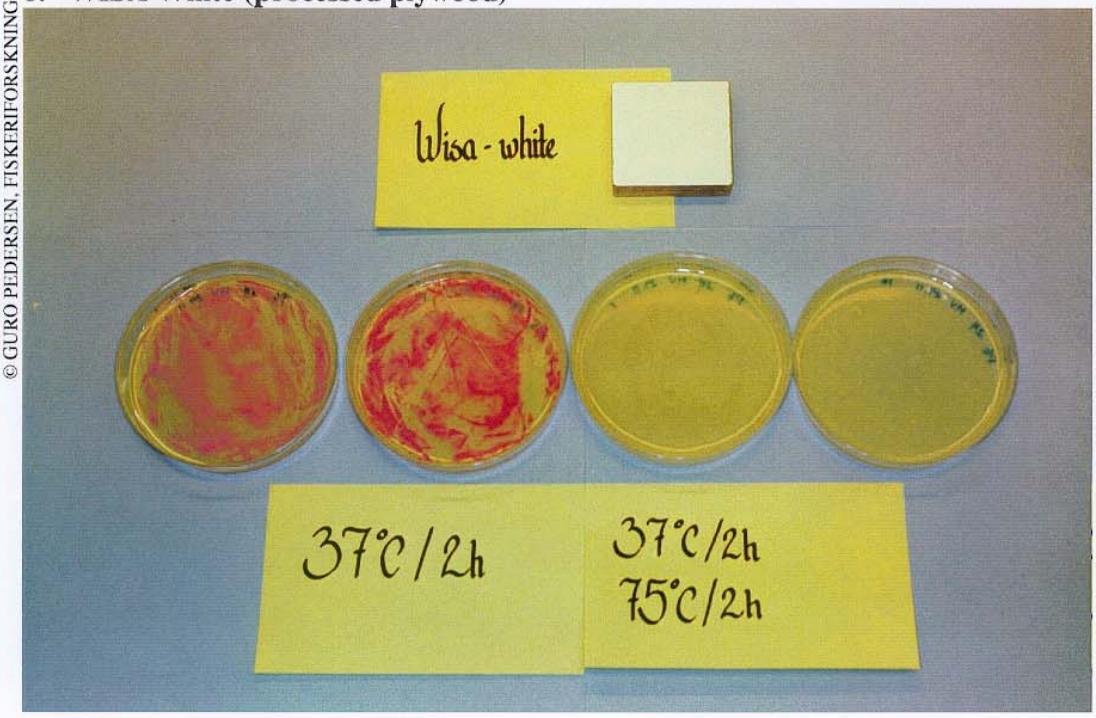
6. **WISA Hexa (processed plywood)**



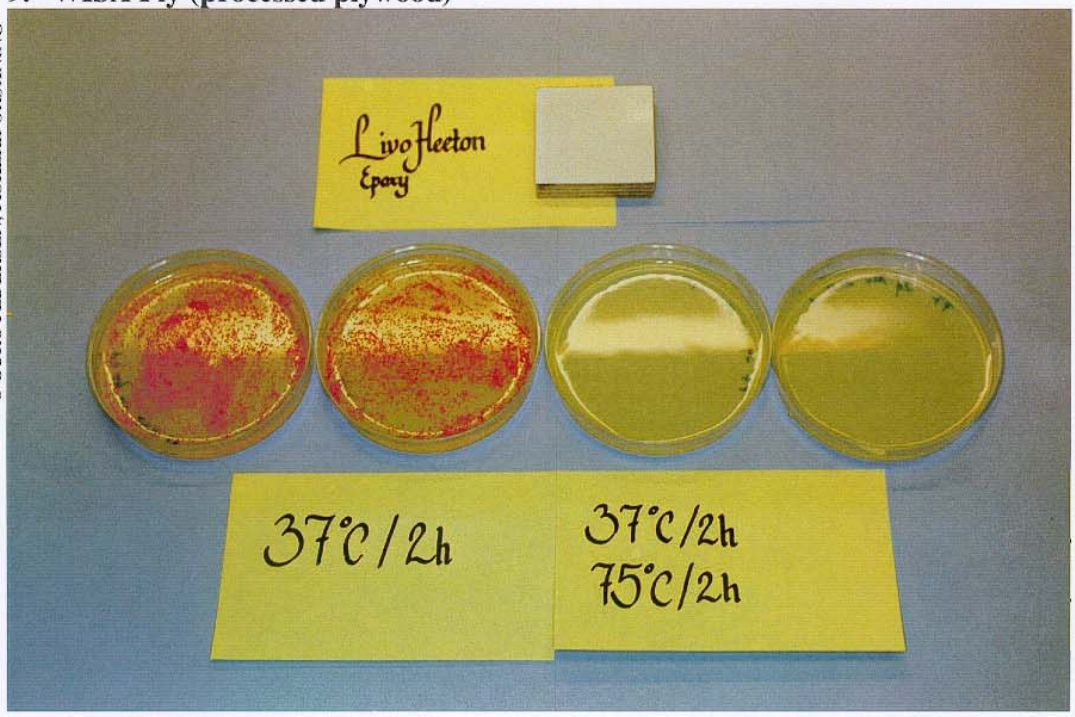
7. **WISA Patio (processed plywood)**



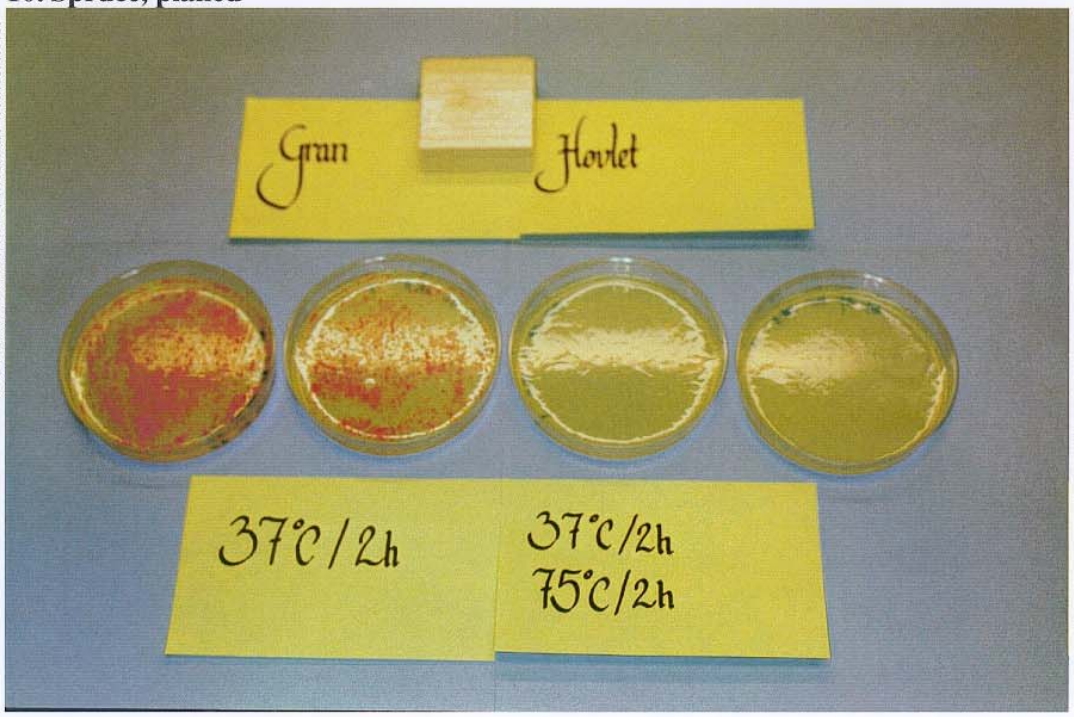
8. **WISA White (processed plywood)**



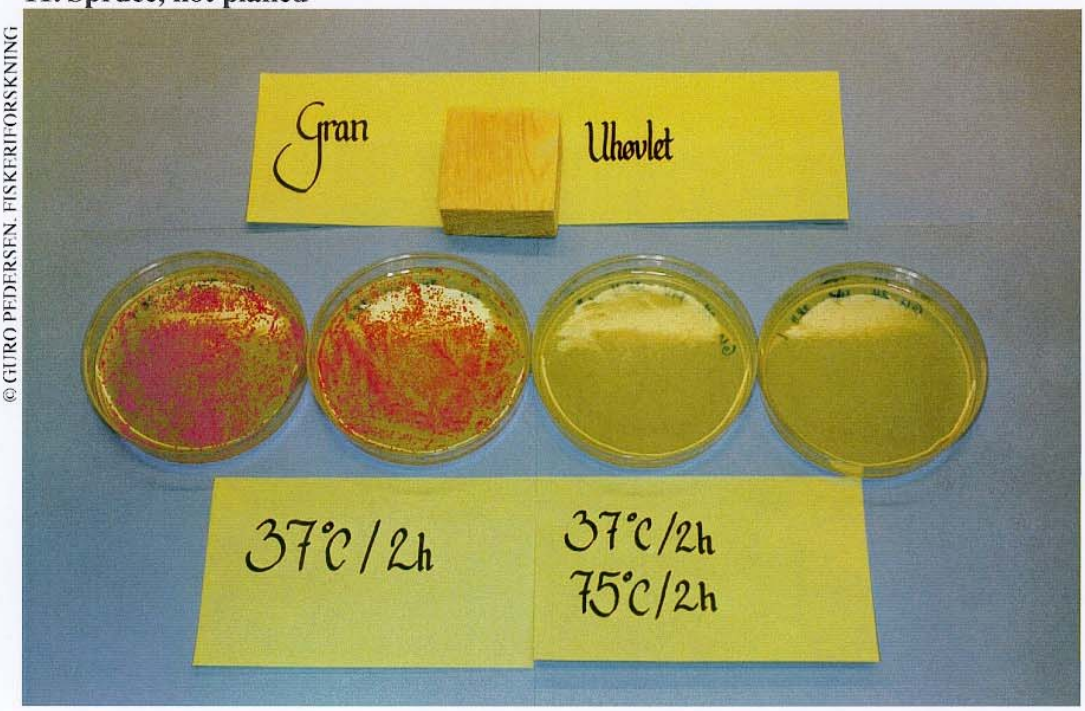
9. WISA Ply (processed plywood)



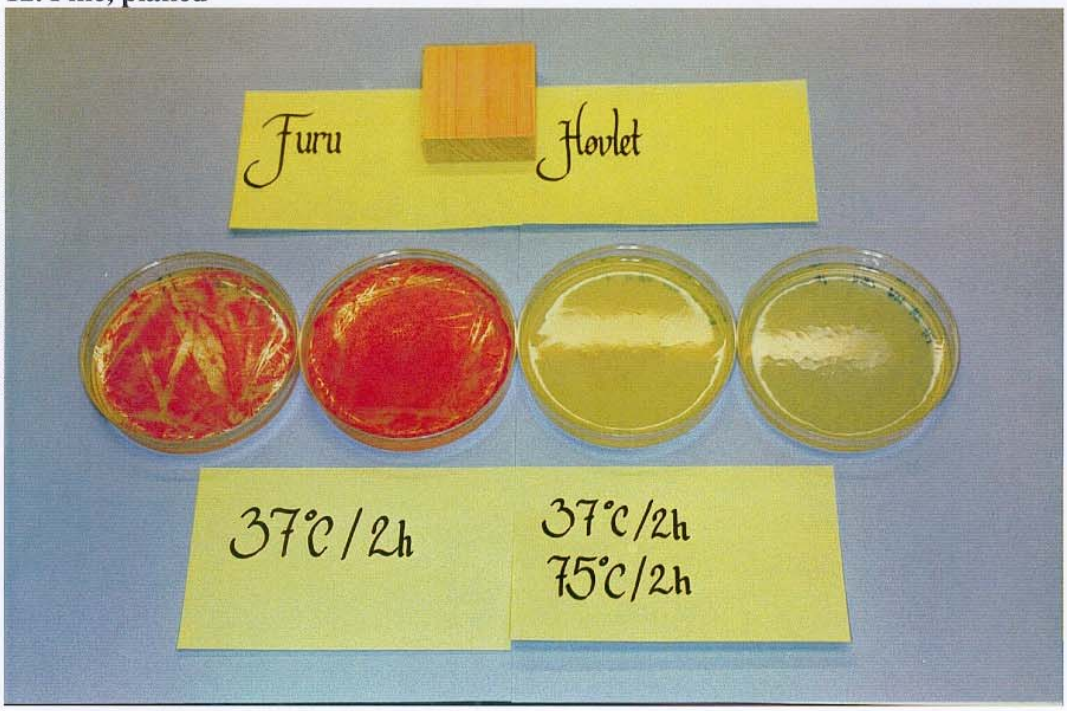
10. Spruce, planed



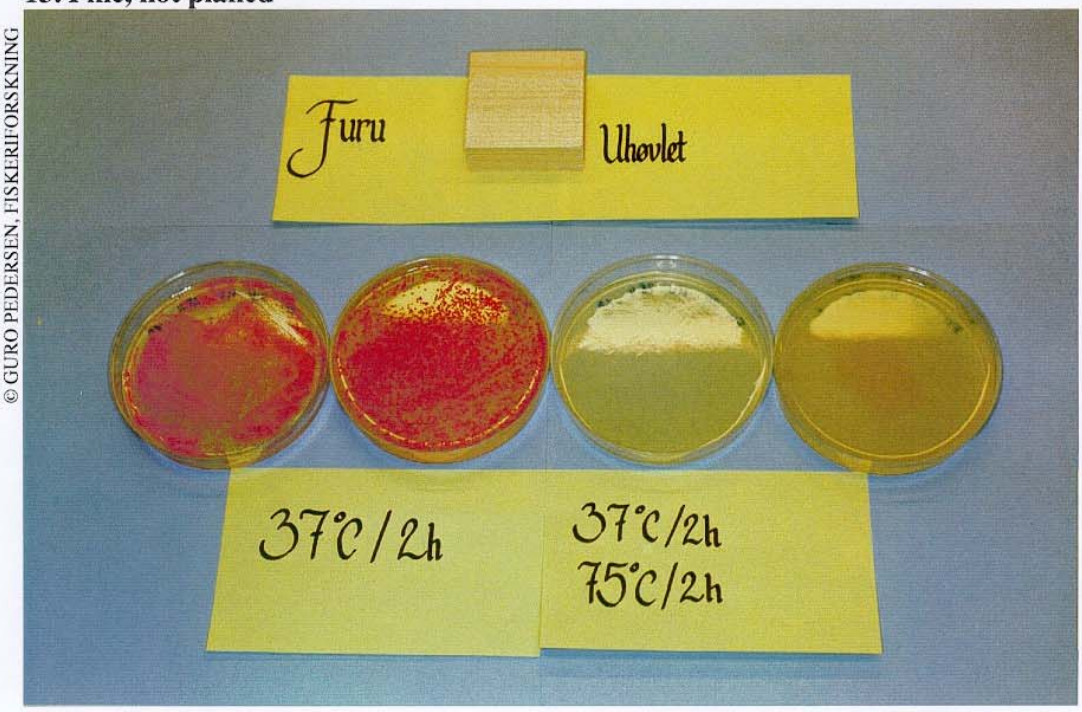
11. Spruce, not planed



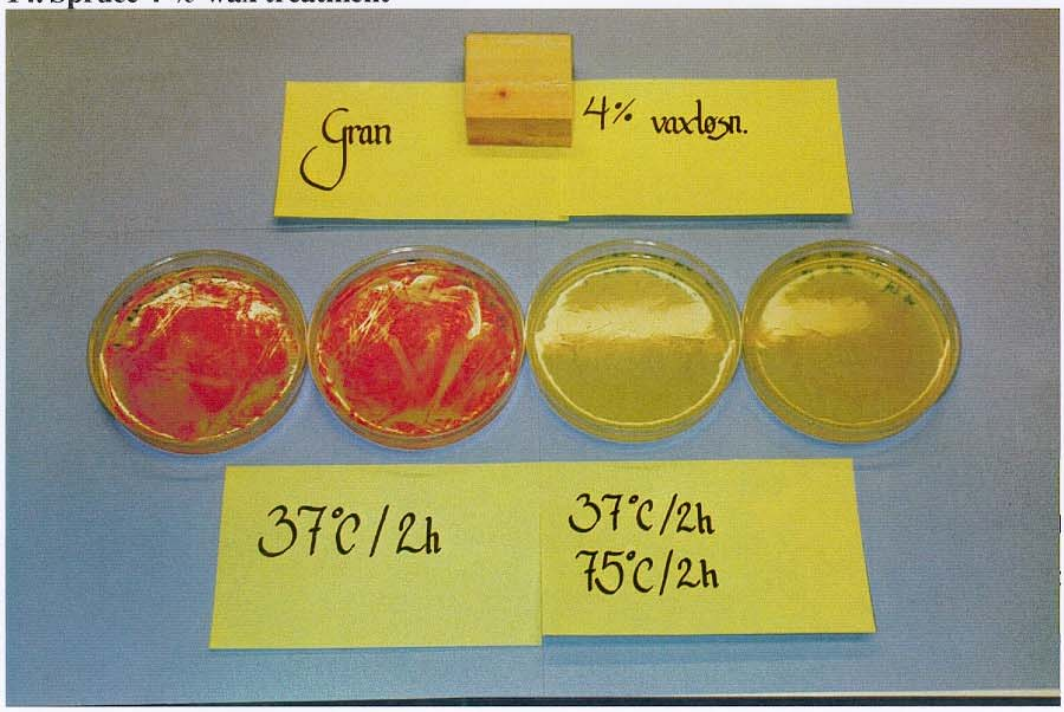
12. Pine, planed



13. Pine, not planed

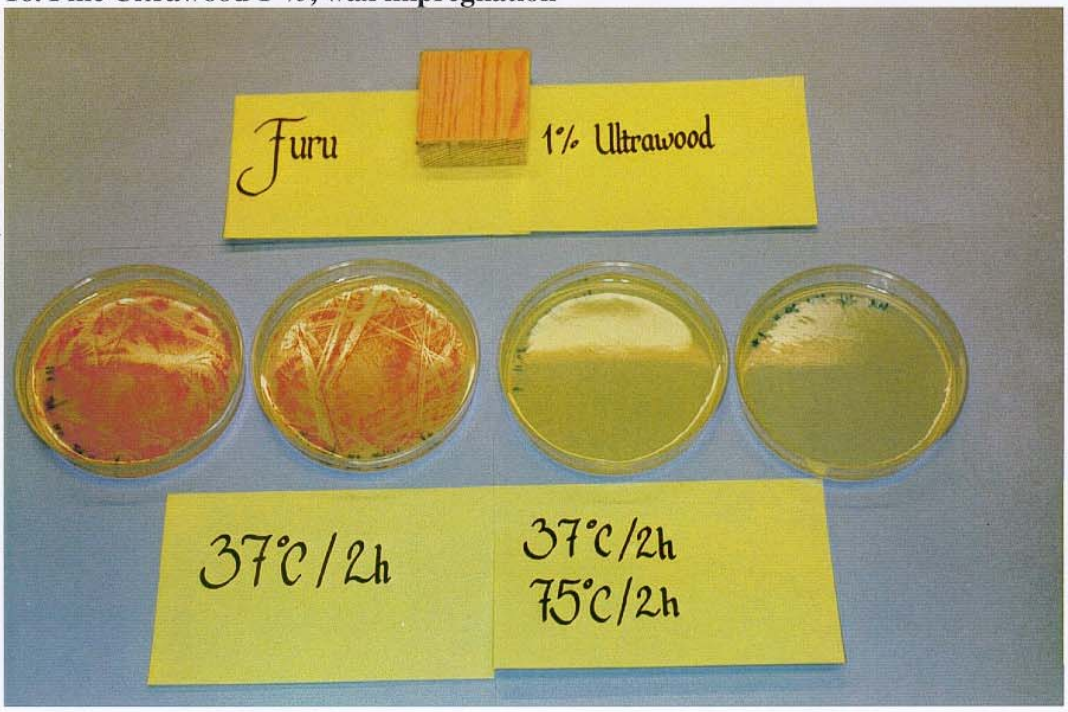


14. Spruce 4 % wax treatment

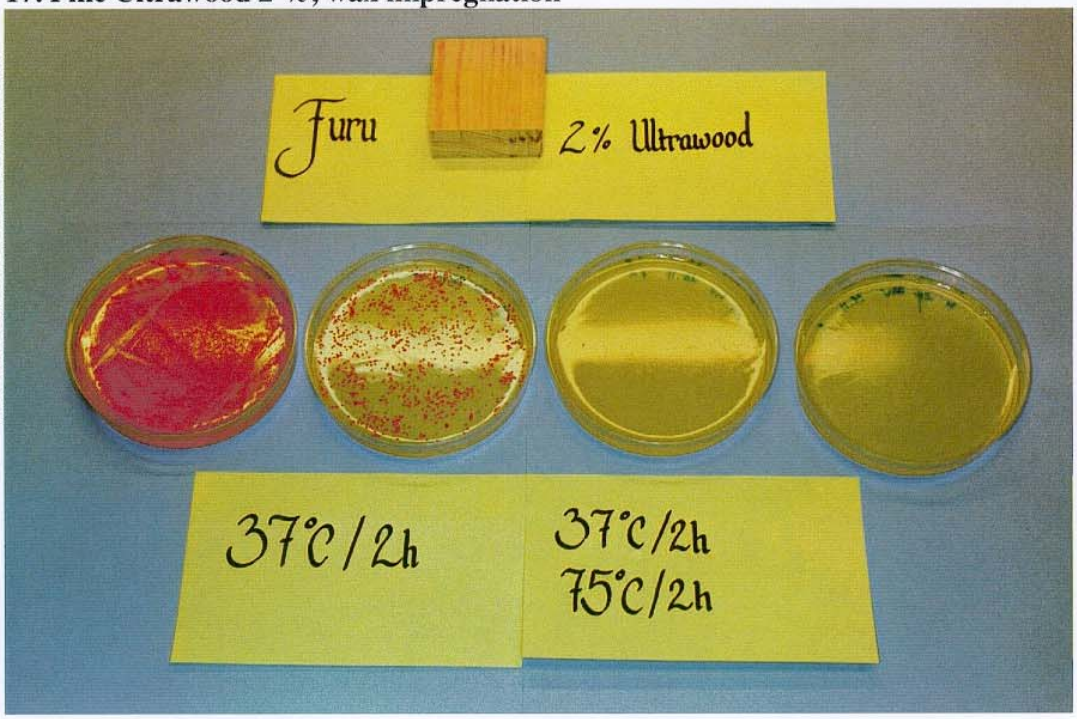


15. Pine 4 % wax treatment

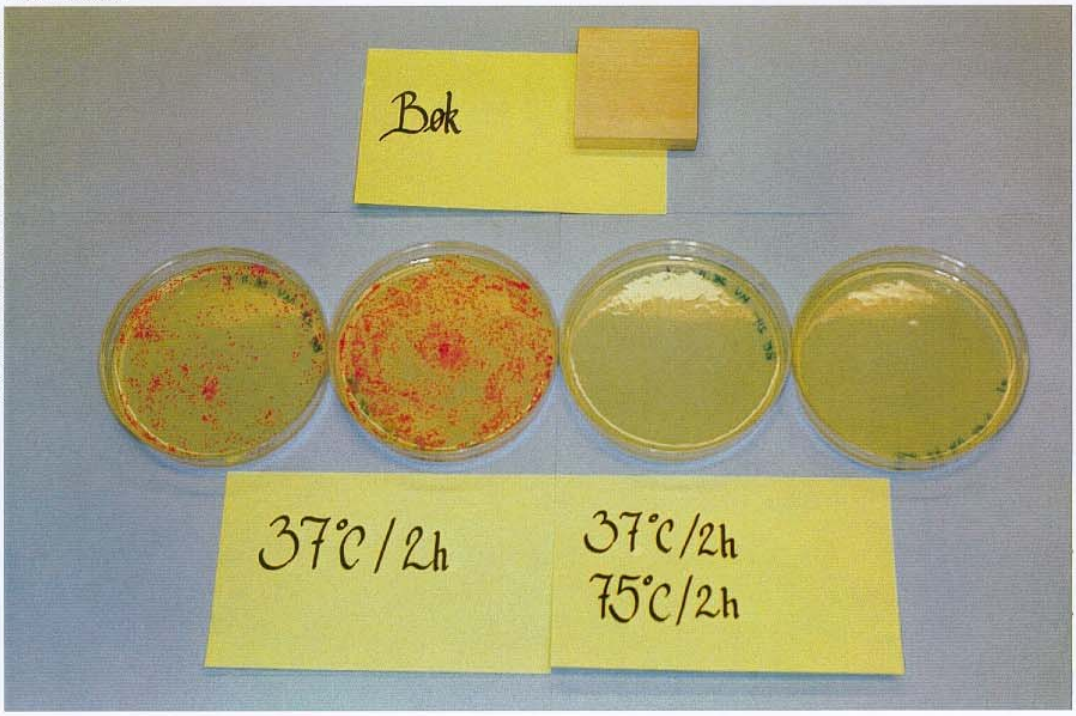
16. Pine Ultrawood 1 %, wax impregnation



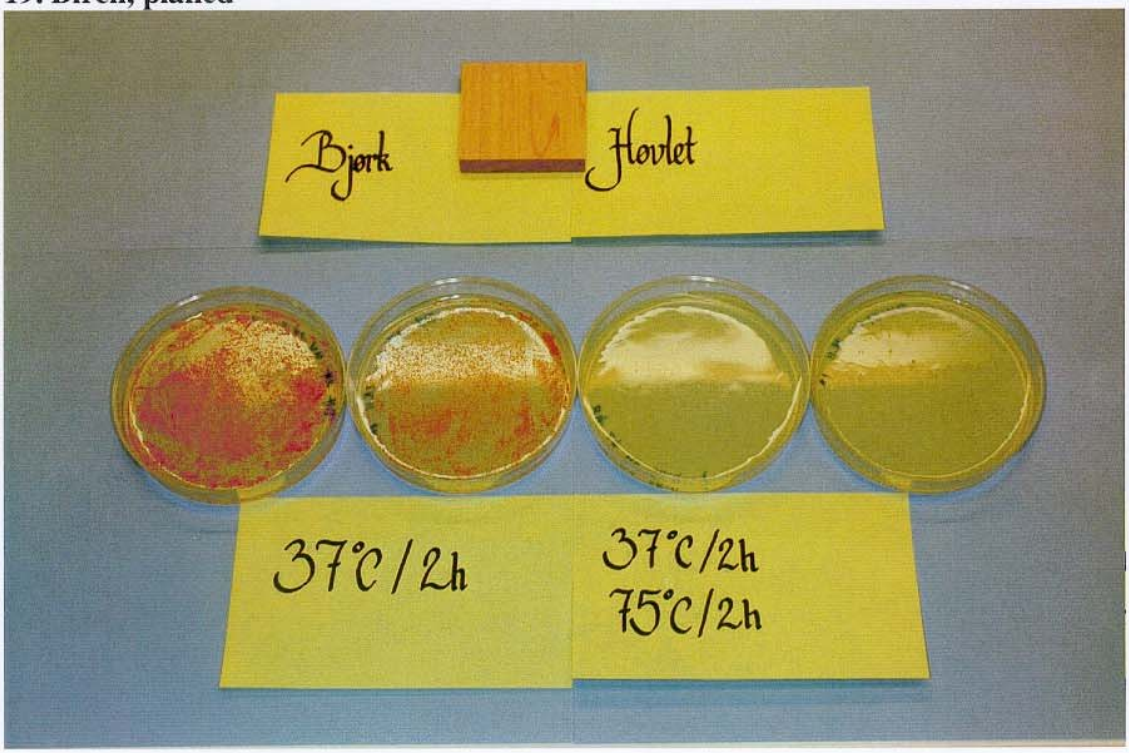
17. Pine Ultrawood 2 %, wax impregnation



18. Beech



19. Birch, planed



Fiskeriforskning

Tromsø (head office)
Muninbakken 9-13, Breivika
P.O.box 6122
NO-9291 Tromsø
Norway
Tel.: +47 77 62 90 00
Fax: +47 77 62 91 00
E-mail:post@fiskeriforskning.no

Bergen
Kjerreidviken 16
NO-5141 Fyllingsdalen
Norway
Tel.: +47 55 50 12 00
Fax: +47 55 50 12 99
E-mail: office@fiskeriforskning.no

Internet: www.fiskeriforskning.no

ISBN 82-7251-467-2
ISSN 0806-6221