

# KOFUSO

KOREA FURNITURE SOCIETY

KOFUSO International Furniture Design Seminar & Exhibition 2015



**INTERNATIONAL  
FURNITURE DESIGN  
SEMINAR & EXHIBITION**

**2015**



# KOFUSO

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## 2015 한국가구학회 국제학술세미나 및 국제교류전 INTERNATIONAL FURNITURE DESIGN SEMINAR & EXHIBITION 2015

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### 한국가구학회 국제학술세미나 International Furniture Design Seminar

디자인과 기능의 균형 \_ The Balance of Design & Functionality

2015. 8. 19(Wed.) 15:00 - 18:00

KINTEX 제1전시장 205호 (한국국제전시장) \_ KINTEX Room 205

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### 한국가구학회 국제교류전 International Furniture Design Exhibition

2015. 8. 19(Wed.) - 8. 23(Sun.) 10:00 - 18:00

KINTEX 제1전시장 3홀 (한국국제전시장) \_ KINTEX Exhibition Hall 3

Opening \_ 2015. 8. 19(Wed.) 14:00 - 14:30



|                    |   |
|--------------------|---|
| <b>주제 Theme</b>    | 디자인과 기능의 균형 _ The Balance of Design & Functionality<br>- 지속 가능한 디자인 _ Design for Sustainability<br>- 빛과 문화 _ Light and Culture<br>- 천연색소를 이용한 전통방식의 가구 유칠(油漆)<br>Traditional Oil Finishes for Furniture with Natural Dyes                       |
| <b>날짜 Date</b>     | 2015. 8. 19(Wed.) 15:00 – 18:00   |
| <b>장소 Location</b> | KINTEX 제1전시장 205호 (한국국제전시장, 경기도 일산 소재)<br>KINTEX Room 205   |
| <b>연사 Lecturer</b> | 스벤 쉘바흐 _ 홍익대학교 국제디자인전문대학원 교수<br>Sven Schelwach _ Professor, IDAS, Hongik University<br><br>노시청 _ (주)필룩스 회장<br>Si-chung Noh _ CEO & President, FEELUX<br><br>박령재 _ (사)한국전통염색협회 회장<br>Ryeong-jae Park _ Chairman, Korea Traditional Dye Institute |

|                     |   |
|---------------------|---|
| <b>사회 Moderator</b> | 정명택 _ 영남대학교 교수<br>Myung-taek Jung _ Professor, Yeungnam University  |
| <b>14:30-15:00</b>  | <b>등록 Registration</b> KINTEX 제1전시장 205호 _ KINTEX Room 205<br><b>이사회 Board of Directors</b>   |
| <b>15:00-15:15</b>  | <b>인사말 Welcoming Remarks</b> 윤여항 _ (사)한국가구학회 회장<br>Yeoh-hang Yoon _ President, Korea Furniture Society<br><b>축하의 말 Congratulatory Remarks</b> 남경필 _ 경기도지사<br>Kyung-pil Nam _ Governor, Gyeonggi Province<br><b>격려의 말 Encouraging Remarks</b> 김계원 _ 대한가구산업협동조합연합회 회장<br>Kye-won Kim _ President, KFFIC |
| <b>15:15-16:00</b>  | <b>특별강연 1 Special Lecture 1</b> 스벤 쉘바흐 _ 홍익대학교 국제디자인전문대학원 교수<br>Sven Schelwach _ Professor, IDAS, Hongik University   |
| <b>16:00-16:20</b>  | <b>휴식 Coffee Break</b> 업무협약 체결 _ MOU Agreement  |
| <b>16:20-17:40</b>  | <b>특별강연 2 Special Lecture 2</b> 노시청 _ (주)필룩스 대표이사 회장<br>Si-chung Noh _ CEO & President, FEELUX<br><b>특별강연 3 Special Lecture 3</b> 박령재 _ (사)한국전통염색협회 회장<br>Ryeong-jae Park _ Chairman, Korea Traditional Dye Institute   |
| <b>17:40-18:00</b>  | <b>감사패 수여 및 사진촬영</b> Appreciation Plaque Award Ceremony & Photo Session   |
| <b>18:00-</b>       | <b>폐회식 및 리셉션</b> Closing Ceremony & Reception   |

## INTRODUCTION

- 탄화보드는 숯과 유사한 성질을 가진 편상(板狀)의 다공질(porous) 탄소 집합체로서 폼알데하이드, 휘발성유기화합물(VOC), 라돈과 같은 유해화학물질에 대한 높은 흡착 기능을 가지며, 또한 실내 인테리어 건축재료로서 필수적인 난연성능(fire retardant)을 지니고 있음을 확인하였다.
- 선형 연구에서 목질판상제품으로부터 탄화보드를 대나무숯가마를 이용하여 성공적으로 제조하였다. 하지만 여전히 미끄러운 무늬와 천연 원목이 아니라는 목질재료의 한계를 극복하지는 못하고 있다.
- 본 연구에서는 제재, 집성 등 목재가공산업의 부산물로 배출되는 소형의 제재목의 고부가가치화를 위하여 대나무숯가마를 이용하여 목탄타일을 제조하고자 한다.
- 목탄타일은 숯의 기능을 지니고 있을 뿐 아니라 목재 고유의 고온 무늬결을 나타내 실내 인테리어용 건축재료로 활용이 가능하다.
- 대나무숯가마는 등유버너로 직접가열하기 때문에 내부 온도를 제어하기 힘들어 탄화과정 중 빠른 승온속도로 인해 목재의 파손율이 높은 단점이 있다.
- 본 실험에서는 목재에 타공-배합 처리를 하고 적재할 내부를 불연재료로 덧대는 처리를 하여 손상(크랙, 갈라짐) 없는 목탄타일을 제조하고자 하였다.

## MATERIALS AND METHODS

- 탄화재료 - 함수율 12%의 백합나무, 잣나무, 낙엽송, 낙엽송집성재
- 탄화재료 크기 - 110 x 180 mm x 25 mm (T)
- 처리방법
  - 탄화과정 중 열충격을 방지하기 위해 타공 및 배합(背割) 처리
  - 대나무숯가마 내부의 승온온도를 천천히 하기 위해 작은 구경의 버너노즐(Φ1.25 mm)을 사용
  - 열전도율을 낮추기 위하여 불연재료(세라크롬)로 적재할 내부를 감싼 후 목탄타일의 제조를 시도
  - 뒤를꿈을 막기 위해 스테인레스판으로 상부(15mm), 중간부(3mm)에 허중을 가함

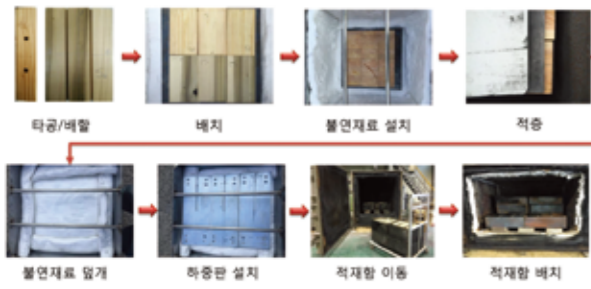


Fig. 1. Pictures of the loading process in stainless steel container with non-flammable material.

## RESULTS AND DISCUSSION



Fig. 2. Pictures of container(A), stacking order of samples(B), and bamboo charcoal kiln(C).

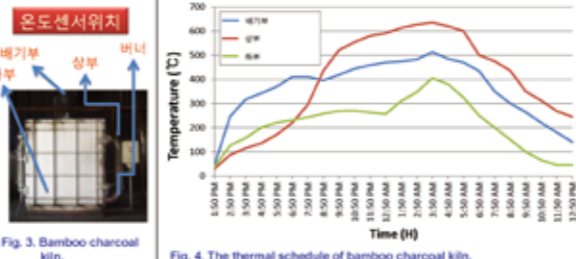


Table 1. Dimensional changes and weight loss of samples after carbonization by bamboo charcoal kiln

|    | Yellow poplar |       |         | Korean white pine |       |         | Japanese larch |     |         | Laminated Japanese larch |      |         |
|----|---------------|-------|---------|-------------------|-------|---------|----------------|-----|---------|--------------------------|------|---------|
|    | 전             | 후     | 변화율 (%) | 전                 | 후     | 변화율 (%) | 전              | 후   | 변화율 (%) | 전                        | 후    | 변화율 (%) |
| 가로 | 110           | 80.3  | 27      | 110               | 79.5  | 28      | 138            | 108 | 22      | 110                      | 85   | 23      |
| 세로 | 180           | 133.0 | 26      | 180               | 138.5 | 23      | 200            | 156 | 22      | 180                      | 140  | 22      |
| 두께 | 32.7          | 26.5  | 19      | 31.7              | 26    | 18      | 36.5           | 30  | 18      | 33.6                     | 27.1 | 19      |
| 무게 | 264.3         | 56.0  | 79      | 223.2             | 54    | 76      | 588.4          | 146 | 75      | 334.2                    | 86.0 | 74      |

## CONCLUSIONS

- 1) 기존 실험에서 대나무숯가마의 높은 내부 승온온도에 의해 대부분의 목재시료가 깨지거나 갈라지는 단점이 있어, 이러한 문제점을 해결하기 위해 불연재료인 세라크롬을 사용하여 적재할 내부를 감싸 목탄타일을 제조하였다.
- 2) 낙엽송의 경우 높은 파손율(90%)과 휘현상 나타나 목탄타일 제조에 어려움이 있었으며, 백합나무와 잣나무의 경우 50%의 파손율을 보였다.
- 3) 낙엽송집성재의 경우, 작은 크랙들이 관찰되었지만 목탄타일로 제조 가능성이 있음을 확인하였다.
- 4) 향후 시험에서 대나무숯가마를 이용하여 다양한 수종의 목재와 열처리목재(240 °C)에 대한 목탄타일 제조기술을 확립해 나갈 계획이다.

## INTRODUCTION

Physical properties of wood can improve by heat treatment. Heat treatment is an environmental friendly method due to the absence of toxic chemical in the process. Colour change is one of the most common effects of heat treatment, in which darker wood colour can be obtained after heat treatment. However, many study reported that heat treatment reduce strength properties of wood, especially bending strength. Heat treatment method with minimum bending strength reduction is needed. Therefore this study was performed to determine the effects of clamping method and treatment time on the colour and mechanical properties of Okan wood.

## MATERIALS & METHODS

**Materials**

OKAN (*Cylicodiscus gabunensis*)

- Diameter: 20-25 mm (with selection from 15 to 20 mm)
- Boards dimension: 200 mm x 30 mm x 25 mm (L x W x T)
- Air-dried density (green): 0.710 g/cm<sup>3</sup>

**BOARD STACKING**

**With Clamp**

- Each board was fixed and fastened by using bolts and nuts equipped with metal spring
- The boards were stacked using metal clamp, and each set of board consists of 60 specimens

**Without Clamp**

- Another set of boards was stacked without metal clamp for comparison

**Heat Treatment**

- Okan boards were heat-treated in an electric oven with programmable controller (L-Series, JCO TECH Ltd., Korea)
- The heat treatment was started at initial temperature of 25°C - 30°C
- The temperature was then increased to target temperature of 180°C with a heating rate of 4°C/minute
- The target temperature was maintained over a period of 1, 2, 3, and 4 hours
- At the end of the heat treatment, the oven was turned off and the boards were taken out
- The boards were allowed to cool naturally in desiccator before further measurement

**Board evaluation**

**COLOUR CHANGE**

- Three measurements of each specimen before and after heat treatment were taken using KONICA MINOLTA CR-400 Chroma Meter.
- Lightness (L\*), chromaticity coordinate (a\*) and blue-yellow chromaticity coordinate (b\*) were obtained.
- The ΔE\* (color difference between heat-treated and control samples) was measured through following equation:

$$\Delta E^* = \sqrt{\Delta L^{*2} + \Delta a^{*2} + \Delta b^{*2}}$$

where:  
 ΔL\* = lightness coordinate variation  
 Δa\* = red-green coordinate variation  
 Δb\* = yellow-blue coordinate variation

**BENDING STRENGTH**

- Modulus of Rupture (MOR) and Modulus of Elasticity were evaluated by using UTM (Instron 4002) and calculated using following equation:

$$MOR (N/mm^2) = \frac{3FL}{2bd^2}$$

$$MOE (N/mm^2) = \frac{FL^3}{4bd^3\Delta}$$

where:  
 F = Max. load at the point of rupture (N)  
 L = Span length (mm)  
 b = width of specimen (mm)  
 d = thickness of specimen (mm)  
 Δ = deflection at proportional limit (mm)

**Acknowledgement**  
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## RESULTS

**Colour properties of Okan wood before and after heat treatment**

| Time    | L*              |                 | a*             |                | b*              |                 | ΔE*             |                 |
|---------|-----------------|-----------------|----------------|----------------|-----------------|-----------------|-----------------|-----------------|
|         | With clamp      | Without clamp   | With clamp     | Without clamp  | With clamp      | Without clamp   | With clamp      | Without clamp   |
| Control | 49.47<br>(3.12) | 49.47<br>(3.12) | 7.94<br>(1.74) | 7.94<br>(1.74) | 24.12<br>(1.81) | 24.12<br>(1.81) | -               | -               |
| 1 hour  | 47.27<br>(3.94) | 44.93<br>(6.20) | 6.77<br>(0.85) | 6.73<br>(0.89) | 33.84<br>(1.25) | 31.80<br>(1.10) | 2.23<br>(0.10)  | 8.11<br>(0.52)  |
| 2 hours | 44.12<br>(1.83) | 37.20<br>(2.43) | 4.89<br>(1.72) | 4.32<br>(1.78) | 33.80<br>(1.25) | 24.95<br>(1.14) | 5.84<br>(1.24)  | 15.99<br>(1.24) |
| 3 hours | 39.57<br>(2.20) | 30.74<br>(1.27) | 4.29<br>(0.38) | 3.86<br>(1.20) | 35.25<br>(2.84) | 21.85<br>(2.86) | 11.13<br>(1.85) | 22.91<br>(0.40) |
| 4 hours | 32.51<br>(3.13) | 47.93<br>(1.83) | 4.89<br>(0.24) | 4.81<br>(0.65) | 24.14<br>(0.94) | 18.20<br>(0.91) | 18.70<br>(0.91) | 26.23<br>(0.26) |

Note: Numbers in parentheses are standard deviations. Means are average of 30 replications.

Fig. 1. Colour change of Okan after heat treatment at 180°C for 1, 2, 3, and 4 hours

**Mechanical properties of Okan wood before and after heat treatment**

| Time    | MOR (N/mm <sup>2</sup> ) |               | MOE (N/mm <sup>2</sup> ) |                 |
|---------|--------------------------|---------------|--------------------------|-----------------|
|         | With clamp               | Without clamp | With clamp               | Without clamp   |
| Control | 92<br>(12)               | 92<br>(12)    | 9,775<br>(689)           | 9,775<br>(689)  |
| 1 hour  | 102<br>(15)              | 86<br>(9)     | 10,628<br>(742)          | 10,119<br>(753) |
| 2 hours | 101<br>(7)               | 72<br>(11)    | 10,955<br>(901)          | 9,412<br>(784)  |
| 3 hours | 86<br>(14)               | 62<br>(13)    | 9,952<br>(744)           | 8,309<br>(755)  |
| 4 hours | 81<br>(13)               | 57<br>(11)    | 8,508<br>(725)           | 7,084<br>(752)  |

Note: Numbers in parentheses are standard deviations. Means are average of 3 replications.

Fig. 2. (a) MOR change and (b) MOE change of Okan after heat treatment at 180°C for 1, 2, 3, and 4 hours

## CONCLUSIONS

- All colour parameters (L\*, a\*, and b\*) were affected by heat treatment. Overall, colour change (E\*) value increased with increasing treatment time.
- Colour change of Okan without clamp more obvious compared to without clamp. At treatment time of 1, 2, and 3 hours, colour change value of Okan without clamp was more than twice compared to with clamp. However at treatment time of 4 hours, the colour change value difference between sample without clamp and with clamp become slighter.
- For Okan with clamp, the MOR and MOE value increased slightly after heat treatment at 180°C for 1 and 2 hours. In contrast, MOR and MOE value of Okan without clamp decreased with increasing treatment time.
- The use of metal clamp successfully minimize the reduction of MOR and MOE value.

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