

# DEVELOPMENT OF TECHNOLOGY FOR ONE-SIDED SURFACE CARBONIZATION OF WOOD

## INTRODUCTION

Wood is a relatively low-cost, easy choice for outside façade of buildings. With proper care and maintenance, wooden façades are a lasting, low-impact option that are easy to recycle and dispose at the end of service life. However, wood is susceptible to weathering caused by UV-radiation, temperature and humidity changes. As an alternative to traditional thermal modification, wood could be modified only from the exposed surface(s), sparing time and costs and preserving the structural properties of wood. One-sided surface charring has been traditionally utilized in Japan, where wood is burned with naked flame or a heated iron pad. So far, one-sided surface charring of beech wood at various time-temperature regimes using contact heating has not been scientifically investigated and knowledge about its performance is rather limited. Beech wood is the most spread broadleaf species in forests of the Czech Republic. In order to investigate the effect of one-sided carbonization on material properties of beech wood, several process parameters were tested and degree of carbonization analyzed.

## MATERIAL & METHODS

European beech (*Fagus sylvatica* L.) wood obtained from Czech forest enterprise was studied. Specimens of dimensions 50×20×350mm were sorted into twenty-two groups with ten specimens in each group. Specimens were one-sided carbonized using contact heating system with a hot plate on the radial and tangential surface at various time-temperature regimes (Reference, 200°C-6min, 200°C-20min, 250°C-4min, 250°C-6min, 300°C-4min, 300°C-2min, 350°C-2min, 350°C-1min, 400°C-1min and 400°C-0.5min). The degree of one-sided carbonization and its depth from modified surface was evaluated using temperature profiles, X-ray density profile and by spectrophotometric analysis of total carbohydrates at surface layers.



Figure 1 Laboratory contact heating system with hot plate

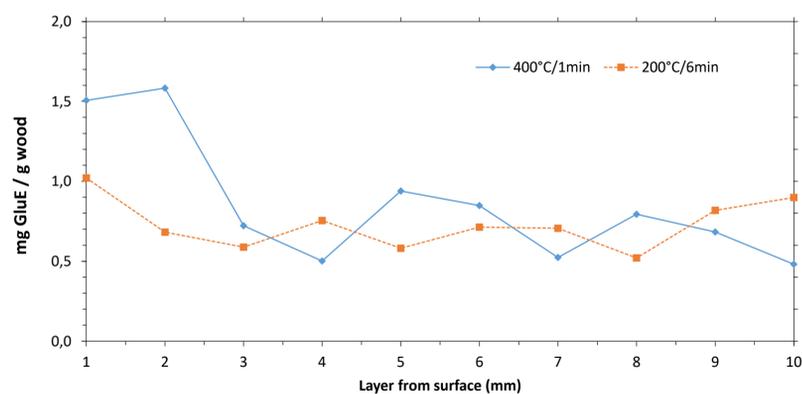


Figure 2 Total amount of soluble carbohydrates (mg/g) within analyzed specimens (400°C/1min and 200°C/6min) in various depth from charred surface

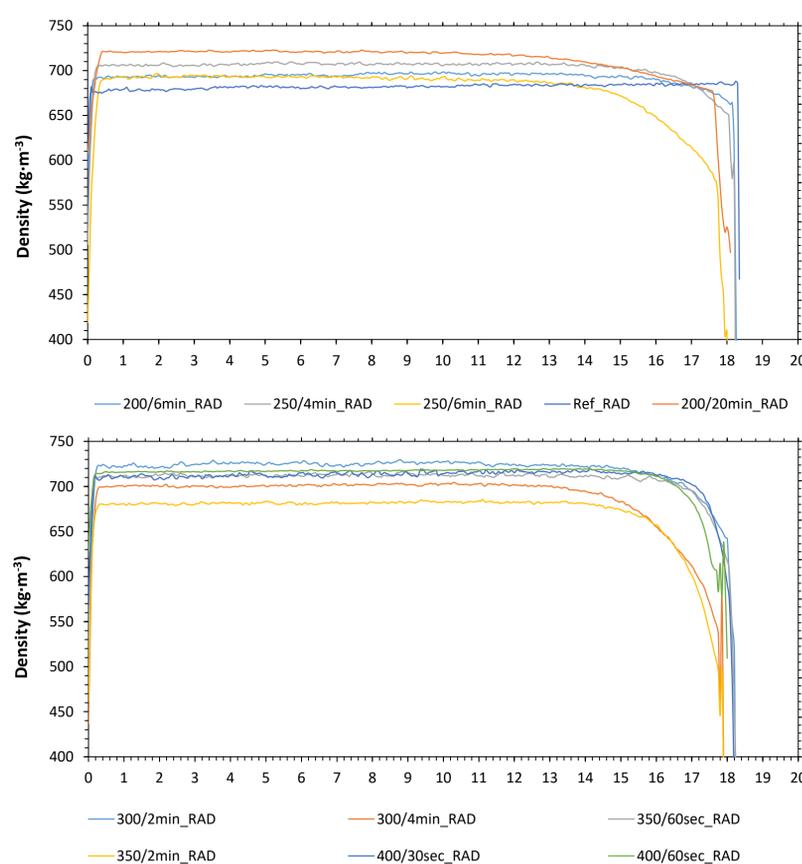


Figure 3 Density profiles of reference and one-sided specimens carbonized at 200/250°C (A) and at 300/350 and 400°C

## RESULTS AND DISCUSSION

An average total amount of carbohydrates of reference specimens was measured to be 0.75mg/g of dry wood mass for specimens. Due to the thermal degradation the sum of soluble carbohydrates increased significantly within surface layers of specimens carbonized at 400°C for 1 min and decreased with increasing distance from the heated surface (Fig. 1). According to analyzed data, it can be assumed that one-sided carbonization at 400°C for 1 min affected material properties to minimum of 2mm from the surface, while those at 200°C for 6 min only to maximum 1 mm. An average density (680kg·m<sup>-3</sup>) of reference specimens shows uniform density profile, while one-sided carbonized specimens tended to decrease according to time-temperature regime applied. It can be stated that one-sided carbonization affected wood properties to depth 2–4 mm from the surface, depending on used time-temperature regime

## CONCLUSIONS

The very first results of current research project shows that beech wood also exhibits favorable results in terms of surface moisture related characteristics, but more detailed studies are needed to exploit potential of surface carbonization method for future use of beech wood. The process of wood surface carbonization can be optimized according to these results, regarding to desired material properties

## ACKNOWLEDGEMENT

This study was funded by Technology Agency of the Czech Republic (TAČR), project no. TJ02000072 “Development of technology for surface carbonization of wooden building elements: elimination of moisture and biodegradation effects”.

## AUTHORS

Čermák Petr, Dömény Jakub, Oberle Anna,  
Machová Dita, Zárbynická Lucie,  
Dohnal Jakub, Vacenovská Veronika

## CONTACT

Mendel University in Brno  
Faculty of Forestry and Wood Technology  
Department of Wood Science and Technology

xcerma24@mendelu.cz  
web: mendelu.cz