

Hole Characteristics of Percussion and Single Pulse Laser-Incised Radiata Pine and the Effects of Wood Anatomy on Laser-Incision

Authors : Subhasisa Nath, David Waugh, Graham Ormondroyd, Morwenna Spear, Andy Pitman, Paul Mason

Abstract : Wood is one of the most sustainable and environmentally favourable materials and is chemically treated in timber industries to maximise durability. To increase the chemical preservative uptake and retention by the wood, current limiting incision technologies are commonly used. This work reports the effects of single pulse CO₂ laser-incision and frequency tripled Nd:YAG percussion laser-incision on the characteristics of laser-incised holes in the Radiata Pine. The laser-incision studies were based on changing laser wavelengths, energies and focal planes to conclude on an optimised combination for the laser-incision of Radiata Pine. The laser pulse duration had a dominant effect over laser power in controlling hole aspect ratio in CO₂ laser-incision. A maximum depth of ~ 30 mm was measured with a laser power output of 170 W and a pulse duration of 80 ms. However, increased laser power led to increased carbonisation of holes. The carbonisation effect was reduced during laser-incision in the ultra-violet (UV) regime. Deposition of a foamy phase on the laser-incised hole wall was evident irrespective of laser radiation wavelength and energy. A maximum hole depth of ~20 mm was measured in the percussion laser-incision in the UV regime (355 nm) with a pulse energy of 320 mJ. The radial and tangential faces had a significant effect on laser-incision efficiency for all laser wavelengths. The laser-incised hole shapes and circularities were affected by the wood anatomy (earlywoods and latewoods in the structure). Subsequently, the mechanism of laser-incision is proposed by analysing the internal structure of laser-incised holes.

Keywords : CO₂ Laser, Nd: YAG laser, incision, drilling, wood, hole characteristics

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