

# ENGINEERING OF NIJ STANDARD LEVEL IV BULLETS RESISTANCE PANELS FROM RAMIE FIBER COMPOSITE AND HARDFACING MATERIALS (HMHV1000) WITH EPOXY MATRIX

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## ABSTRACT

Bulletproof panels are one of the main operational needs of the TNI, but most are still imported. The main objective of the research is to make a prototype of composite panels NIJ standard level IV bulletproof flax fiber for increased independence nation to imported products. This hemp composite is hybridized with a hard and thin metal that mounted on the front layer as a bullet collector, hereinafter known as Composite Hemp-Hard Metal Hybrid Epoxy (KEHR-LK). This research studies the optimization of hardfacing materials through the heat treatment process and the processing of hemp starting from planting, caring, harvesting, decotying, water immersion, drying, storage, cutting, weaving, composite molding process and the ballistic test process at the Yogyakarta AAU shooting range. Hemp fiber (*Boehmeria nivea*) is a cellulose-based natural fiber from renewable sources having high tensile strength so that it has the potential as a base material for bullet-resistant composite panels. Hemp plants have been successfully cultivated in the Wonosobo area, Central Java so that availability of raw materials can be sufficient. This research is a follow-up research that carried out by the proposing team from 2007, the latest research shows that the composite hemp-epoxy is feasible and the optimal thickness of the composite as bullet-resistant panels has been obtained NIJ standard level IIIA, but when the level IV firing test was carried out, all panels were not able to withstand bullet penetration. One of the causes of this failure is the sharpness of the bullet which rips the woven flax fiber. Therefore, a hard layer is needed to blunt the bullet. Hardfacing Material (HM) HV-1000 is a material with hardness 1000 VHN, while the bullet material is from brass 850 VHN. This hard metal layer is hybridized with hemp fiber. Hemp fiber is woven in a woven roving manner so that it becomes a sheet. This woven hemp is put into a mold and moistened with an epoxy matrix with the hand lay-up method. After 14 layers of woven hemp, hard metal plate insert in mold and given epoxy and then add 2 layers of hemp fiber. Next print closed and pressed to obtain a thickness of 20-22 mm to obtain the volume fraction of hemp fiber 55%. After 8 hours, the mold was opened and the KEHR-LK panel was ready to be fired. Composite Arrangement becomes 90/0/90/0/90/0/90/0/90/0/90/0/90/0/LK/90/0.

The results showed that all composite panels managed to withstand level . bullets NIJ standard IV at 3000 fps. Addition of a hard metal layer of Hardfacing The Material (HM) HV-1000 in this hemp fiber composite can blunt bullets so they don't able to penetrate the KEHR-LK panel. But when shot in the opposite direction, it turns out that this composite panel is translucent so that the addition of hard metal is not effective. So hemp composites are very effective against bullets when they are blunt.

Kata Kunci: *panel KEHR-LK, komposit, serat rami, lapisan logam keras, NIJ level IV*