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Some Studies on Woven Aramid Soft Armor Fabric for Stab Resistant Applications

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Structured Abstract

Background: Knife-related attacks are a growing concern in Malaysia, affecting both civilians and security personnel. Typical stab-resistant vests, while effective, are often heavy and bulky and uncomfortable, limiting practically in hot and humid climates. This study investigates the design, fabrication and Type 1 stab resistance performance of woven aramid soft armour for civilian use.

Methods: Samples were fabricated using Kevlar 129 woven fabric, arranged in multi-layered configurations. Stab resistance procedures were conducted according to the National Institute of Justice (NIJ) Type 1 standard, employing three knife probes: spike, double-edged and single-edged. Penetration depth, maximum force absorption and deformation were recorded for each configuration. Comparisons were made between different layers (5, 10, and 15 layers) and weave orientations (0°/0°, 0°/90°, 90°/90°).

Results: The woven aramid soft body armour specimens demonstrated effective resistance against stab penetration with the highest resistance observed for the spike probe. Knife probes resulted in greater penetration compared to the spike, with noticeable differences between single-edged and double-edged blades, indicating the influence of blade geometry on armour performance. The layered woven aramid structure facilitated efficient impact energy loss, while fabric orientation contributed to improved stab resistance. The 15-layer configuration provides the maximum-security measure, with nearly total resistance offered throughout the entire range. The penetration achieved from the 0.5m height is virtually non-existent, having a range from 0.0 cm to 0.1 cm. Even when tested with the maximum height at 1.5m, the penetration was successfully restricted to between 0.3 cm to 0.5 cm. At this thickness, the total frictional resistance from the layers is enough to overcome the lubrication effects of water, maintaining consistent protection with only minimal variation among orientations. These results highlight the capability of woven aramid fabrics to provide protective performance suitable for soft armour applications.

Conclusion: In conclusion, the woven aramid showed good resistance against spike, single-edged and double-edged knives especially for 15-layer configurations. The layered fabric assisted to absorb impact energy and the way the fabric was arranged improved protection. This shows that woven aramids are effective in providing protection while still being comfortable for civilians

Keywords: Woven aramid, soft armour, stab resistance, Kevlar 129, knives

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