

Response to Reviewer 1 Comments

Dear Reviewer 1,

We would like to express our sincere gratitude for taking the time to review our article titled "*Analysis of Ballistic Impact of Rifle Projectile 7.62 mm FMJ M80 into the Composite Armor Twaron/UHMWPE*"

We sincerely appreciate the comments you provided, and your review comments and suggestions have helped us to refine and improve the final version of our article. We have taken each of your suggestions to heart and have very carefully revised the manuscript accordingly. Your comments helped us identify areas for improvement and enhance the content to achieve overall clarity and coherence of the article to meet the high quality standards of the journal.

Below we provide point-by-point responses. All revisions to the article are highlighted in yellow.

Sincerely,

Jindřich Viliš

jindrich.vilis@unob.cz

Department of Mechanical Engineering

University of Defence in Brno

Point 1: The paper is interesting, but it must underline more the novel character of the study or its elements. Namely, what was unique here? Armor composition, manufacturing methodology or/and something else?

Response 1: Thank you very much. We revised the sentence as follows:

“The designed layered composite armor, which combines para-aramid fabric and material UHMWPE represents the suitable material combination in this assembly, which depending on the synergistic properties of these materials guarantees the required ballistic protection according to the AEP standard, level 1. The properties of para-aramid fabric and material UHMWPE provide high ballistic protection while preserving important factors such as low weight and high mobility for armoring military equipment. In general, the uniqueness of this type of composite armor is the ability to effectively resist and dissipate energy in multiple hits of the projectile 7.62 mm FMJ NATO M80.”
[Page 2-3, Ln 95-103]

Point 2: Comparison or at least description of other composite armor solutions could be presented.

Response 2: We revised the sentence as follows:

“The issue of ballistic resistance of composite ballistic protection systems has received considerable attention. The ballistic performance of layered composite ballistic protections has been described by Braga et al. [13], Demosthenes et al. [14], Scazzosi et al. [15], Mujiyono et al. [16], etc. Braga et al. [13] in their study compared the ballistic resistance of polyester composites that were reinforced with curau fibres. The tested composites were subjected to ballistic impact of projectiles calibre 7.62 mm. These composites were reinforced with 0, 10, 20 and 30 vol% curau fibres. The ballistic results showed that the pure polyester resin exhibited the highest ability to absorb the kinetic energy of the projectiles, but its fragmentation characteristic is unsuitable for military applications depending on achieving the ability to resist multiple hits. After ballistic testing, the composite reinforced with 30 vol% curau fibers showed higher cohesion. Demosthenes et al. [14] evaluate the ballistic resistance of the layered armor system subjected to the high velocity impact of projectile 7.62 × 51 mm. This armor consisted of the 10 mm hexagonal alumina ceramic plate, the second layer consisted of the 10 mm epoxy composite with 10 vol%, 20 vol% and 30 vol% buriti fabric. The last part was formed by the 5 mm aluminum alloy sheet 5052-H34. From the ballistic results, all composites showed the satisfactory back side signature (BFS), which was significantly lower than the 44 mm lethal trauma specified by NIJ 0101.06 standard. However, it is worth noting that only the composite reinforced with 30 vol% buriti fabric retains full integrity and guarantees protection against the other projectile 7.62 mm. Scazzosi et al. [15] discuss the experimental and numerical evaluation of the ballistic resistance of the layered ballistic protection, which consisted of Al₂O₃ ceramic and para-aramid fabric Kevlar 29 impregnated with epoxy resin. The ballistic protection was tested with projectiles of 7.62 × 51 mm with impact velocity of (800-1000) m/s. From the results obtained, the limiting ballistic velocity was determined to be 816.53 m/s. Mujiyono et al. [16] analyzed the ballistic performance of the layered ballistic protection, which was composed of the front strike layer and the rear tougher layer. The front strike layer was composed of ballistic ceramic (tungsten carbide) and the rear tougher layer was composed of ramie fibers with epoxy resin. Ballistic resistance was tested with projectiles 7.62 × 51 mm with lead core and 7.62 × 51 mm AP with steel core. These

projectiles were unable to penetrate the given layered armor, but brittle fracture occurred with the ballistic ceramic.” [Page 2, Ln 46-76]

Point 3: More explanation in reference to the previous papers of the team (cited as 39 and 40 in the manuscript) should be stated.

Response 3: We revised the sentence as follows:

“In published articles [43, 44] the limiting thicknesses of composite materials were determined. The ballistic resistance of para-aramid fabric Twaron CT 747 was tested in according to AEP-55, level1. In article [43], the ballistic resistance of para-aramid fabric Twaron CT 747 impregnated with the matrix consisting of LG700 epoxy resin and HG700 hardener was determined. The limiting thickness of the tested configuration was 47.9 mm with the weight of 5.6 kg. In study [44], the limiting thickness of para-aramid fabric Twaron CT 747, which was impregnated with thermoplastic resin TH110, was determined. This limiting thickness was 41.2 mm and the weight was 4.1 kg. For this fabric, which was impregnated with thermosetting resin ER 68 and cured in the autoclave, no limit thickness was determined due to the penetration of the composite armor.” [Page 16, Ln 344-353]

Point 4: UHMWPE abbreviation should be explained before first use

Response 4: We revised the sentence as follows:

“UHMWPE (Ultra High Molecular Weight Polyethylene)” [Page 3, Ln 106-107]

Point 5: Line 282-283, the area is presented in mm units? Probably it is the diameter of the hole?

Response 5: We revised the sentence as follows:

“The diameter of damage on the front side of the armor after the projectile impact was approximately 13.2 mm.” [Page 14, Ln 325-326]