A comparative study on the ballistic performance of High Nitrogen Steel and Rolled Homogeneous Armour steel against 7.62 ball and 12.7AP projectiles

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ABSTRACT

Traditionally, Rolled Homogeneous Armour (RHA) steel plates (in quench and tempered condition) are widely used in various structural armour applications. However, there is a need to develop better materials which will result in weight reduction of armour platforms. In the present study, ballistic performance of a nickel free high-nitrogen steel (HNS) are evaluated against 7.62 ball and 12.7mm armour piercing (AP) projectiles and the results are compared with RHA steel plates. The ballistic tests on HNS and RHA steel plates were carried out against 7.62 ball and 12.7mm AP projectiles at velocities of 840±10 m/s and 830±10 m/s respectively. The ballistic performance was evaluated by finding out the minimum thickness required to stop the projectile without perforation. HNS plates showed better ballistic performance (in terms of minimum areal density required) in comparison RHA steel plates against both 7.62 ball and 12.7mm armour piercing projectiles. Better ballistic performance of HNS could be attributed to its higher dynamic flow stress in comparison to RHA steel. In addition, ballistic performance was also analyzed with help of post ballistic microstructural investigations and hardness measurements. Post ballistic microstructural analysis revealed that adiabatic shear band induced plugging and ductile hole growth are the major failure mechanisms against 7.62 ball and 12.7 AP projectiles respectively. It was found that HNS has higher resistance to ASB induced plugging and ductile-hole growth process. Hardness measurements on crater cross sections showed that HNS has higher volume involved in energy absorption than that of RHA steel.

Keywords: High-nitrogen steel, Rolled Homogeneous Armour (RHA) steel, ballistic performance, high strain rate