

A Comparative Study of the Effects of Vibratory Stress Relief and Thermal Aging on the Residual Stress of Explosives Materials

Authors : Xuemei Yang, Xin Sun, Cheng Fu, Qiong Lan, Chao Han

Abstract : Residual stresses, which can be produced during the manufacturing process of plastic bonded explosive (PBX), play an important role in weapon system security and reliability. Residual stresses can and do change in service. This paper mainly studies the influence of vibratory stress relief (VSR) and thermal aging on residual stress of explosives. Firstly, the residual stress relaxation of PBX via different physical condition of VSR, such as vibration time, amplitude and dynamic strain, were studied by drill-hole technique. The result indicated that the vibratory amplitude, time and dynamic strain had a significant influence on the residual stress relief of PBX. The rate of residual stress relief of PBX increases first and then decreases with the increase of dynamic strain, amplitude and time, because the activation energy is too small to make the PBX yield plastic deformation at first. Then the dynamic strain, time and amplitude exceed a certain threshold, the residual stress changes show the same rule and decrease sharply, this sharply drop of residual stress relief rate may have been caused by over vibration. Meanwhile, the comparison between VSR and thermal aging was also studied. The conclusion is that the reduction ratio of residual stress after VSR process with applicable vibratory parameters could be equivalent to 73% of thermal aging with 7 days. In addition, the density attenuation rate, mechanical property, and dimensional stability with 3 months after VSR process was almost the same compared with thermal aging. However, compared with traditional thermal aging, VSR only takes a very short time, which greatly improves the efficiency of aging treatment for explosive materials. Therefore, the VSR could be a potential alternative technique in the industry of residual stress relaxation of PBX explosives.

Keywords : explosives, residual stresses, thermal aging, vibratory stress relief, VSR

Conference Title : ICEM 2019 : International Conference on Energetic Materials

Conference Location : Singapore, Singapore

Conference Dates : May 02-03, 2019