Mechanical Engineering
Spring 2008 Seminar

Wed., February 20, 2008
1:00pm – 2:30pm
ROOM 224 MEC

Supersonic Liquid Projectiles: A Novel Materials Processing and Energy Conversion Tool

ERNEST S.GESKIN
Waterjet Technology Laboratory
Mechanical Engineering Department
New Jersey Institute of Technology
University Heights, Newark, NJ 07102
Ext 3338. geskin@njit.edu; http://mechanical.njit.edu/people/profiles/geskin2.php

Formation and practical applications of supersonic liquid projectiles were investigated by the NJIT's Waterjet Laboratory (E.S. Geskin, O.Petrenko, V. Samardzic, K.Kluz, T. Bitadze) during last 10 years. The projectiles were generated in the course of unsteady liquid (water) acceleration in a converging nozzle. The liquid was driven by a moving piston or by powder combustion (explosion). Several versions of the launcher were tested and process conditions were evaluated. While the formation of supersonic jets in a converging-diverging nozzle is intensively investigated, knowledge about the supersonic acceleration in a converging nozzle is insufficient attest. Several numerical models describing energy injection into the liquid and liquid acceleration were constructed in the course of the performed study and experimentally validated. The results of modeling were applied to analysis of the mechanism of the supersonic acceleration and to evaluation of the effect of process conditions on the projectiles properties. Several experimental techniques were used to investigate the motion of a projectile between the exit of the launcher and impacting a target. The major effort, however, involved the study of the projectile-target interaction and, thus, potential practical applications of the proposed technology. It was shown that a projectile affects a target similarly to an explosive deposited on the target surface. Explosion-free neutralization of non-dischargeable explosive setup demonstrated the rate of target deformation by the impacting projectiles, while crashing of heavy reinforced concrete plates and piercing steel plates at extremely high rate showed the intensity of the impact. The further experiments showed feasibility of the projectiles applications for various forming operations including the micro forming, welding of similar and dissimilar metals and rock boring. It is suggested that potential applications will include nanoimprint technology, solid free form fabrication of heterogeneous parts and emission-free coal combustion. The most immediate application, however, probably will be mass production of inexpensive micro parts using various metals and alloys.

For More Information Contact: Dr. Ernest Geskin (973) 596-3338, geskin@njit.edu