ABSTRACT

The objective of this research is to study on the characteristics of high-speed Non-Newtonian fluid jets injected in water and ambient air. The high-speed liquid jets were generated using impact driven method in a Horizontal Single Stage Powder Gun (HSSPG). To produce the jets by this technique, the liquid contained inside a nozzle is driven by the impact of a high-speed projectile. In this study, the projectile velocity of 950 ± 30 m/s and 30° conical nozzle having orifice diameter of 0.7 mm were used for jet generation. Characteristics of four liquid types were described by visualization using a high-speed digital video camera with and without shadowgraph technique in normal and axial views. The four liquid types are milk, salad dressing, tomato sauce and toothpaste being classified as Pseudoplastic, Dilatant, Plastic and Bingham plastic, respectively. From shadowgraph images, the jet body of whole liquid jets was quite similar. Jet-generated shock wave, change in shock angle, break-up, atomization and vaporization of the jets were obviously observed. The maximum average jet velocities in air of milk, salad dressing, tomato sauce and toothpaste jets were 1 ,802.18 m/s, 1,262.38 m/s, 1,045.60 m/s and 1,024.35 m/s, respectively, while they in water were 288.92 m/s, 199.67 m/s, 165.77 m/s and 233.72 m/s, respectively. The maximum average velocity of jets injected in water was slower than that in air because the hydrodynamic drag is much higher than the aerodynamic drag. Moreover, water-vapor bubble, expansion and contraction of the jet-induced bubble, shock wave in water, compressed wave and rebound shock wave being generated by water bubble collapse could be obviously observed. From the visualization without shadowgraph technique, the bubble generation, expansion, contraction and collapse of the bubble were clearly seen and easily interpreted, while the shock wave and rebound shock in water could not be observed with this visualization. Besides, the generation, expansion and contraction of the bubble were clearly observed and easily interpreted using visualization on the axial view, while the shock wave and rebound shock in water could not be observed with this visualization as well. The maximum expansion rate ($V_{x,e}$) and contraction rate ($V_{x,c}$) in x-axis of the bubble are 25.95 m/s and 19.40 m/s, respectively, obtained by salad dressing jet and tomato sauce jet, respectively. The maximum expansion rate ($V_{y,e}$) and contraction rate ($V_{y,c}$) in y-axis of the bubble are 19.36 m/s and 19.55 m/s, respectively, obtained by milk jet and tomato sauce jet, respectively.

กิตติกรรมประกาศ

คณะผู้วิจัยขอขอบคุณ ดร.วุฒิชัย สิทธิ สาขาวิชาวิศวกรรมเครื่องกล คณะเกษตรศาสตร์และเทคโนโลยี มหาวิทยาลัยเทคโนโลยีราชมงคลอีสาน วิทยาเขตสุรินทร์ ที่ช่วยดำเนินการทำงานทดลองและรวบรวมผลการทดลองตลอดระยะเวลาที่ทำการวิจัย โครงการวิจัยนี้ได้รับเงินอุดหนุนการวิจัยจากมหาวิทยาลัยอุบลราชธานี

คณะผู้วิจัย