Lisa Rose Logel
Flow Visualization
MCEN 4151
Prof. Jean Hertzberg

Team Project #2

Ultrasonic Nebulizer

For the second group project, my team, team 8, used an ultrasonic nebulizer obtained from Davis Fogerty's mother. The bowl housing the working fluid has a unique lip, resembling that of a wave, with alternating convex and concave inflections that can bee seen in Figure 1. The uniqueness of the bowl's geometry inspired the intention for my image to capture how the fluid flow behaves when passing over different surface geometries.

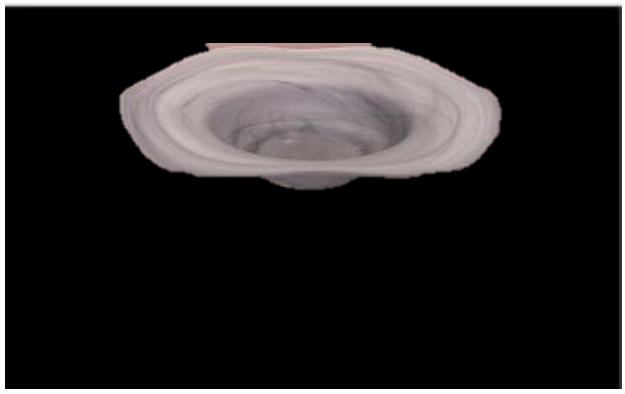

Figure 1: Schematic of flow apparatus

The flow apparatus was simple; the nebulizer was placed on a black poster board (to eliminate distracting backgrounds) and then filled with approximately 16oz of tap water. Then the nebulizer was plugged into a standard outlet, and instantly the water began to nebulize. At the bottom of the bowl is a transformer that emits ultrasonic waves that in turn create surface waves within the water until resonance is reached, and the water is broken into droplets. The droplets are small enough and composed of hydrogen and oxygen atoms, which are lighter than the nitrogen atoms that make up the majority of the surrounding air, and therefore are able to rise up and out of the bowl. The phenomena can be seen in my picture shown in Figure 2. Because the water droplets are visible, though not distinguishable, and they remain close to the surface of the bowl and the poster board, the diameter if individual droplets are much larger than that of water vapor. This increased diameter, thus increased mass, of individual droplets attributes to the "twisting" of the streamlines, which is visible in Figure 2, especially to the left of the frame.

Figure 2: Submitted team assignment two photograph

The particles are subject to two forces, considering friction to be negligible, affecting their motion, and consequentially the appearance of the twisting streamlines. The force due to gravity tends the particle from an unstable position on a convex section of the bowl's lip to a stable position at the lowest point on a concave section. Additionally, the buoyant force as a result of the previously discussed relationship between the water molecules and air molecules tends the particles up and out of the bowl. A free body diagram of the body forces as shown from a top view is presented in Figure 3.

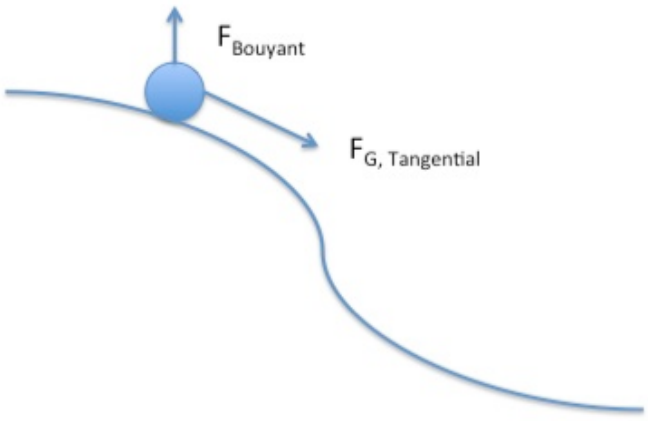

Figure 3: Free body diagram of particle at an unstable position on the bowl lip

The picture presenting Figure 2 was taken in the University of Colorado, Boulder mechanical engineering department's Durning lab using the overhead lighting provided. The camera was placed two feet away and a foot above the nebulizer. The image was then cropped and turned to black and white in Photoshop. I am very happy with how my picture turned out and it answers my question about the behavior of the flow for the concave and convex sections of the bowl. Namely, the flow will ten to the lowest point of the concave section of the bowl's lip because that is the stable point.