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Vortex breakdown in a coaxial swirling jet with a density difference: an experimental study AHMAD ADZLAN FADZLI BIN KHAIRI, Universiti Malaysia Sarawak, HIROSHI GOTODA, Ritsumeikan University — The vortex breakdown (VB) in a coaxial swirling jet with a density difference has been experimentally investigated in this work, focusing on how the Reynolds number of the outer jet affects the presence and height of the stagnation point in the swirling jet undergoing VB. When the Reynolds number of the outer jet is increased, the degree of flow divergence of both air and CO_2 jets decrease, with the degree of flow divergence of the air jet decreasing more compared to the CO_2 jet at the same Reynolds number of the outer jet. The stagnation point for the air jet was also found to disappear more easily compared to the CO_2 jet, and its height of the stagnation point increases more compared to that of the CO_2 jet. Investigation of the velocity field revealed that increasing the Reynolds number of the outer jet during VB induces a decrease in the gradient of the axial velocity distribution along the perpendicular line connecting the stagnation point and the $r = 0$ plane, causing the height of the stagnation point to increase. When the distribution no longer tends to zero, the stagnation point disappears. A physical model is considered in this presentation to explain these observations by estimating the momentum balance in the flow, based on a simplified Navier-Stokes equation (A. Adzlan, H. Gotoda, Chemical Engineering Science, 2012) – the first of its kind reported in the field of fluid dynamics.

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