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Formation regimes of vortex rings in negatively buoyant starting jets CAROLINA MARUGAN-CRUZ, JAVIER RODRIGUEZ-RODRIGUEZ, Carlos III Univ. of Madrid, CARLOS MARTINEZ-BAZAN, Univ. of Jaen — The formation of vortex rings (VR) in negatively buoyant starting jets has been studied numerically for different values of the Richardson number covering the range of weak to moderate buoyancy effects ($0 \leq Ri < 0.20$). We have identified two different regimes in the vortex formation whose transition takes place at about $Ri \approx 0.03$. The vorticity distribution inside the VR after pinching-off as well as the total amount of circulation it encloses (characterized by the formation number, F) show different behaviors with Ri in both regimes. Nevertheless, the physical mechanism limiting the circulation of the vortex, or equivalently the formation number, is the same in both cases. Thus, the formation number of a negatively buoyant VR, whose propagating velocity is slower than that of a neutrally buoyant one due to gravity effects, can be determined considering that it is nearly the same as that of a neutrally buoyant VR moving with the velocity corresponding to the negatively buoyant vortex. Based on this simple idea, a phenomenological model is presented to quantitatively describe the evolution of the formation number with the Richardson number, $F(Ri)$, obtained numerically. We also discuss the limitations of different vortex identification to evaluate the vortex properties in buoyant flows. Supported by the Spanish Ministry of Science grant DPI2008-06369.

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