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Computational analysis of DOD drop formation QI XU, OSMAN BASARAN, Purdue University — A fundamental theoretical understanding of drop-on-demand (DOD) ink jet printing remains weak despite the widespread use of the method in practical applications for two decades. To overcome this deficiency, a computational analysis is carried out to simulate the formation of liquid drops of incompressible Newtonian fluids from a nozzle by imposing a transient flow rate upstream of the nozzle exit. The dynamics are studied as functions of the Ohnesorge number Oh (viscous/surface tension force) and the Weber number We (inertial/surface tension force). For a common ink forming from a nozzle of 10 micrometer radius, Oh=0.1. For this typical case, a phase or operability diagram is developed that shows that three regimes of operation are possible. In the first regime, where We is low, breakup does not occur, and drops remain pendant from the nozzle and undergo time periodic oscillations. Thus, the simulations show that sufficient fluid inertia, or a sufficiently large We, is required if a DOD drop is to form, in accord with intuition. At high We, two regimes exist. In the first of these two regimes, DOD drops do form but have negative velocities, i.e. they would move toward the nozzle upon breakup, which is undesirable. In the second breakup regime, not only are DOD drops formed but they do so with positive velocities.

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