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The Integration Schemes of the Preston-Tonks-Wallace (PTW) Viscoplasticity Model JEEYEON PLOHR, Los Alamos National Laboratory — The Preston-Tonks-Wallace (PTW) viscoplasticity model is valid in the wide range of strain, strain rate, and temperature. In this paper, we examine how the Preston-Tonks-Wallace (PTW) flow stress was constructed: the closed form expression of the flow stress, which is known as the PTW model was obtained by integrating the differential form of the hardening law under the assumption that the strain rate is constant. We consider there are cases, like explosively driven deformation and high-velocity impacts, where this is not true. As a case study, we choose a gaussian function as a strain rate history and compare two different ways to use the PTW model. First, we integrate the differential form of the PTW model numerically, coupled with this non-constant strain rate function. Second, we use the closed form of the PTW (, which was already integrated for the fixed strain rate) and plug in the strain rate value at each discretized time. We draw the conclusion that based on the physical and mathematical arguments, one should solve the system of ODEs consisting of the differential form of the PTW model and the particular strain rate history of interest rather than using the closed form expression when the strain rate variation is large.

JeeYeon Plohr
Los Alamos National Laboratory

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