

Influence of initial density of granular stack on transient regime of homogeneous fluidization

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THIS STUDY COMPLEMENTS A SERIES OF PRELIMINARY EXPERIMENTAL STUDIES of the destabilization of a granular stack immersed by fluidization, the particular case being the transient regime of homogeneous fluidization. The significant influence of the initial density (initial volume fraction) of the granular stack on the transient homogeneous fluidization regime is highlighted. In an initially loose stack fluidizes turbulently and chaotically in a few seconds, from the bottom zone to the top of the granular layer. Conversely, for the same material in an initially dense state, there is a mass takeoff of the stack, which is followed by the propagation of porosity wave instability from the bottom to the top of the stack with fast kinetics that decompacts the medium. The results also showed that the velocity of this porosity wave seems almost constant regardless of the fluidization velocity.

Key words: fluidization, hydro-mechanical instabilities, immersed granular media, transient regime.

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1. Introduction

FLUIDIZATION OCCURS WHEN A SET OF IMMOBILE PARTICLES IS SET IN DISPERSED MOTION under the effect of a fluid flow. This requires strong hydrodynamic coupling between the phases in the presence of fluid, so that the stresses exerted by the fluid on the grains result in the destabilization of the material. The term “fluidization” comes from the fact that the suspension is brought into a state similar to that of fluids [1]. However, localized fluidization is relevant in the context of the safety of civil engineering structures (embankment dams and protective dikes) that are likely to erode by one or more of four internal erosion processes [2, 3] until the formation of a conduit leading downstream of the structure. This conduit develops under the influence of an internal hydraulic flow which, after infiltration, can generate downstream of the structure an overpressure below the surface layer of the soil that subsequently causes an overall lifting of the granular structure and possibly hydraulic fracturing. In addition,