

## A Failure Criterion for Unsupported Boreholes in Poorly Cemented Granular Formations

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**Abstract :** The breakage of bonding between sand particles and their dislodgment from the borehole wall are among the main factors resulting in a borehole failure in poorly cemented granular formations. The grain debonding usually precedes the borehole failure and it can be considered as a sign that the onset of the borehole collapse is imminent. Detecting the bonding breakage point and introducing an appropriate failure criterion will play an important role in borehole stability analysis. To study the influence of different factors on the initiation of sand bonding breakage at the borehole wall, a series of laboratory tests was designed and conducted on poorly cemented sand samples. The total absorbed strain energy per volume of material up to the point of the observed particle debonding was computed. The results indicated that the particle bonding breakage point at the borehole wall was reached both before and after the peak strength of the thick-walled hollow cylinder specimens depending on the stress path and cement content. Three different cement contents and two borehole sizes were investigated to study the influence of the bonding strength and scale on the particle dislodgment. Test results showed that the stress path has a significant influence on the onset of the sand bonding breakage. It was shown that for various stress paths, there is a near linear relationship between the absorbed energy and the normal effective mean stress.

**Keywords :** borehole stability, experimental studies, poorly cemented sands, total absorbed strain energy

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