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Proposal of FSM (Fluid Sand Material) technology to fill out the Sinkhole

1. INTRODUCTION

Fluid Sand material (FSM) technology* has been developed by Fudo Tetra Corporation in Japan and widely used as the filling material for compaction method of loosed sandy ground to mitigate liquefaction since 2008 (SAVE-SP method).

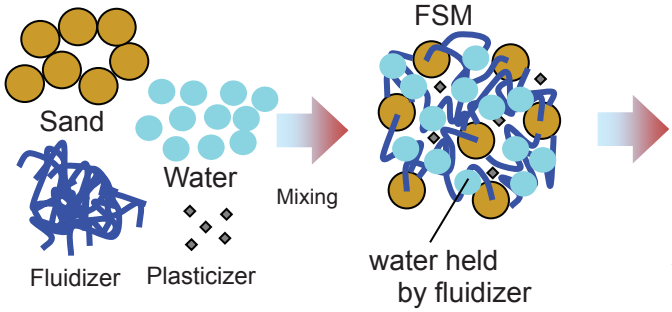
FSM produced by mixing the well-grading sand and special agents (fluidizer='L1-anion type' /plasticizer='P1-cation type') are also expected to be used to fill out the natural Sinkhole in Florida, Texas, Alabama, Missouri, Kentucky, Tennessee, and Pennsylvania. We have tested the fluidity effect with using 'Bahama oolite sand' which has higher content of calcium and carbonate and found it works. In addition, due to plenty of Calcium ion, no plasticizer was required to be back to original condition.

***Patent; U.S. Patent Application No. 17/123,431, FLUIDIZD SAND AND METHOD OF DENSITY CONTROL**

2. SAFETY

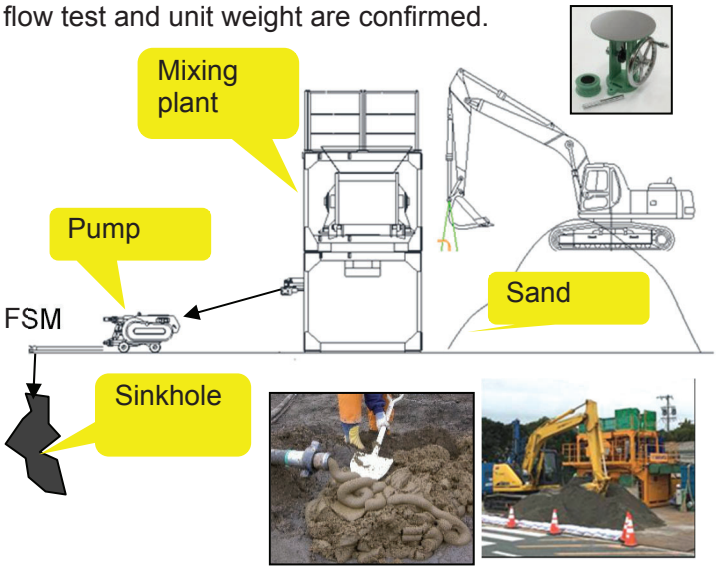
The fluidizer and plasticizer are proved to be environmentally friendly. These agents are the water-soluble polymers (Polyacrylamide) and are widely used for the water treatment (absorbent / mud improvement agent) in the municipal sewage plant.

After the filling work, it is very easy to excavate the FSM sand and it does not disturb the ground water flow. In addition, after filing out the sinkhole by the FSM, no cavity is remained in the holes so no more water flow is going in the ground. So, we anticipate that it could avoid the dissolution of limestone.



3. PROCEDURE OF THE FSM FILLING

Small mixing plant to measure the weight of L1 and water, pump, excavator to supply sand to the mixing plant are prepared in the job site. Before the production start, trial mixing with local sand, L1 and water is conducted and the fluidity through the Table-flow test and unit weight are confirmed.



4. SPT N-Value

We have observed the SPT N-value at the center of injected, compacted and drained fluid sand area. Accordingly, the average N> 20 are measured in the test area. However, for the simple falling FSM, the condition is same as usual falling sand.