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LETTER

Rapid Index Tests for Transitional Materials

To the editor:

The writer was pleased to read of the study on transitional materials in the article by Dusseault et al[1] in the June 1983 issue of the *Geotechnical Testing Journal*. Transitional materials (for example, shales, siltstones, claystones, and so forth) have been a subject of ongoing research at Purdue University for more than twelve years [*1–9*]. As a result, this research developed new testing and classification guidelines. Part of the task specified a classification system based on rapid index tests.

With regard to classification purposes, both of the tests mentioned in this paper are, for the most part, a test of slaking resistance. As is mentioned, slaking tests alone are not sufficient to classify shales. The static swell/slake test is almost identical to the jar slake test. It is well known that shales slake over a matter of years. With regard to the long-term behavior, 24 h of soaking without a means of accelerating slaking is often not long enough to determine if a shale will slake in service. For this reason the test may underestimate the durability of the shale. Some kind of energy input is needed to accelerate the process. Two techniques are commonly used: tumbling, as in the dynamic dispersion test, or cyclic wetting and drying. The determination of swelling by this test may not be appropriate for some situations. Swelling is a factor of many parameters including compactive effort and confining pressure [*6*]. To obtain a more general prediction of swelling, a test that accounts for these parameters is needed.

An additional drawback of this test is that it is not quantitative; the classification is based on observations. The writer would like that the trend of testing be to phase out nonnumeric judgement categories and replace them with absolute numeric scales that give constant calculation and can be easily digitized for use in computer routines. This can easily be done by screening and weighing the material after soaking and drying. Judgement categories and written discriptions are useful supplements to a numeric rating scale.

The dynamic dispersion test described is a modification of the Franklin slake durability test [*10*]. The new device was said to be adapted because the original device was too severe. Both devices have the advantage of a tumbling action, which adds energy to accelerate the slaking process. There are however several disadvantages of this new device with respect to the original. The first is that a separate screening process must be used to obtain the quantitative value of the slaking. The Franklin device is made of wire mesh that automatically screens out the slaked particles. Second, because there is a fixed amount of water inside the device, the slaked particles become an abrasive mixture in the water. The longer the test runs, the more abrasive the medium. The test is then uncontrolled because it is becoming more severe with time. In the original Franklin device, the slaked material falls to the bottom of the tank where it is away from the tumbling action. Another advantage of the Franklin device is that it is commercially available.

In addition, both of the tests mentioned are dependent on the first cycle of wetting. This, in some cases, may be deceiving because of part of the loss caused by loose material lightly adhered to the rock. It has been shown that more consistant results can usually be obtained during a second cycle [*9*].

Research at Purdue University has led to separate tests to determine the slaking, hardness, and swelling properties of transitional materials [*9*]. A quantitative, continuous scale classification system is recommended. A battery of further tests has also been developed to determine design and construction parameters [*9*].

The slaking properties of the shale are determined by the two-cycle slake durability test using the device and procedure developed by Franklin. This test was found to be of appropriate severity to test a wide range of transitional materials to be used in many applications. If, however, a special application did require a less severe test, it is recommended that this test still be used with fewer or slower revolutions or both, or even a finer mesh screen.

The more durable materials will behave as rocks while the less durable will be expected to slake and act as fine grained soils. Based on the results of the slake durability test, the more durable materials are tested for hardness by the point load test. The characteristics of the material comprising the less durable rocks are subjected to the Atterberg limits tests. The materials can then be classified using the Franklin rating system. This rating, a value from zero to nine, has been correlated to the behavior of the materials used in many different situations [*10*].

Research at Purdue University has shown that the slake durability test may be replaced by a five-cycle slaking test [*9*]. This test is slightly more severe but it is felt to approximate field conditions more accurately with its respective wetting and drying action.

The recommended testing procedure for determining the swelling characteristics of transitional materials attempts to account for all of the conditions that control swelling [*9*]. The material is compacted using a kneading action and trimmed to fit a 15-mm (4-in.) oedometer cell. The material is loaded to a simulated confining pressure and back pressure saturated. The resulting swell (or collapse) can be monitored and has been found to be a function of confining pressure, compactive effort, as-compacted water content, and compaction fluid [*6*].

In summary, the engineering properties of shales depend on several shale characteristics: durability, hardness, swelling characteristics, and so forth. Being at least partially independent of each other, each property should be tested individually with attention to all variables involved. A classification scheme should represent these characteristics. Finally, the future of classification lies in continuous numerical scales that identify materials by quantitative test results.

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