Lab versus field slaking behavior of clay-bearing rocks

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Clay-bearing rocks are highly prone to slaking upon interaction with water. This study aims at evaluating and comparing the slaking behavior of common clay-bearing rocks under field and lab conditions. Twenty clay-bearing rocks were selected including 5 shales, 5 claystones, 5 mudstones, and 5 siltstones. These rocks were slaked in the laboratory, using up to five cycles, according to the slake durability test method, specified by the American Society for Testing and Materials. The grain size distribution curve of the slaked material for each rock was used to determine the disintegration ratio (D_R). Disintegration ratio is defined as the ratio of the area under the grain size distribution curve for a given clay-bearing rock to the total area encompassing grain size distribution curves of all rock samples. A disintegration ratio close to 1 indicates a highly durable rock whereas a value close to zero indicates very low durability.

The experimental set up for investigating the field disintegration behavior consisted of exposing 240 samples, containing 12 replicates of each of the 20 clay-bearing rocks, to natural climatic conditions. Each sample consisted of 10 pieces and weighed from 450 to 550 g. The samples were placed on the roof of McGilvrey Hall at Kent State University for a period of 1 year. Each month, one of the replicate samples from each of twenty rock types was taken down to the laboratory for grain size analysis and determination of disintegration ratios.

The preliminary results show a moderate degree of correlation between disintegration ratios of the samples determined after 2nd cycle durability test in the laboratory and the samples slaked for twelve months under atmospheric conditions. Samples slaked in the laboratory have average D_R values of 0.705 for shales, 0.324 for claystones, 0.462 for mudstones, and 0.847 for siltstones whereas field-slaked samples have D_R values of 0.494 for shales, 0.223 for claystones, 0.302 for mudstones, and 0.698 for siltstones after 3 months of slaking. The best correlation between D_R values is exhibited by samples subjected to two cycles of durability testing in the lab and samples exposed to atmospheric conditions for two months.

Keywords: slaking, clay-bearing rocks, disintegration ratio, grain size distribution