# Evaluation and estimation of durability of sedimentary rocks in Sheikhan Valley (northwest of Khorramabad) against salt weathering

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## Extended Abstract

### Introduction

Crystallization of soluble salts is one of the most important weathering agents in nature that can cause deterioration and decrease the durability of rocks. Durability is defined as a measure of the ability of a rock to maintain its characteristic properties such as strength, degree of resistance to environmental factors, as well as its appearance. Salt weathering causes chemical and physical damage, changes in appearance (color and efflorescence), and physical and strength properties of rock outcrops as well as rocks used in engineering structures. These changes in turn alter the durability of the stone. Therefore, evaluating the durability and deterioration of rocks to evaluate the stability of rock slopes or the use of rocks as building materials is indispensable and inevitable.

So far, various aspects of the effect of salt weathering on the physical, strength properties and durability of different types of rocks have been addressed. In addition, a number of researchers have studied the crystallization pattern, the thermodynamic conditions of weathering of different salts and their crystallization.

In most previous studies, salt weathering experiments have been conducted to accelerate the weathering process, in sodium and magnesium sulfate salt solutions or in some cases sodium chloride. One of the disadvantages of this research is its disregard for the type of actual salts present at the site of use of the rock. On the other hand, in the previous researches it is quite evident that there are no statistical models based on simple and suitable parameters that can predict the durability of samples in salt weathering experiments.

In the present study, 8 different sedimentary rock samples were collected in rock outcrops of Sheikhan Valley, northwest of Khorramabad. In order to affect the salt weathering on the samples, a durability test in salt solution up to 15 cycles was performed. The results are analyzed for two objectives: 1) to study the durability of the samples against salt weathering and its relationship with porosity, strength and mineralogical composition 2) to provide a statistical model by performing multivariate regression analyzes based on porosity and point load index to estimate long-term durability of samples against salt weathering

**Material and methods**

The study area is called Sheikhan Valley located northwest of Khorramabad on the Khorramabad-Alastar road with geographical coordinates between '15 ° 48 to '22 ° 48 east longitude and between '30 ° 33 to '37 ° 33 north latitude. To achieve the objectives of the study, blocks from 8 different rock samples with appropriate dimensions were prepared during the several stages of field visit to the area for the predicted experiments. Experiments include determination of porosity, point load index, and durability in salt solution. The obtained results were analyzed and a multivariate regression relation was proposed to predict the durability of rocks against salt crystallization.

**Results and discussion**

It was observed that the durability index of samples in cycle 2 and 15 were different. According to Franklin and Chandler's classification for durability of rocks, based on the durability index of the 2th cycle in salt solution, all samples are classified as extremely high-durability rocks ($Id_2$ 95-100 (%)). However, the durability of the samples in the 15th cycle of the test in salt solution indicates that gypsum, marl, dolomitic shale, and siltstone were found in high durability rocks ($Id_{15}$ 75-90 (%)) and sandstone, dolomite, limestone and conglomerate are classified as very durable rocks ($Id_{15}$ 90-95 (%)).

The results showed that gypsum, marl, shale dolomite and siltstone having higher porosity (porosity between 7.7 to 14.5%) than other samples (porosity between 4.6 to 7.1%) were less durable and they experienced greater weight loss during durability testing.

Based on the strength of the rock, an evaluation of its durability against salt weathering can be made. According to the results, gypsum, marl, shale dolomite and siltstone have lower point load index than the other samples. On the other hand, these samples are less resistant to salt weathering. However, it was observed that gypsum, marl, shale dolomite and siltstone with point load index ranged between 2.7 and 1.5 MPa compared to sandstone, dolomite, limestone

and conglomerate samples with point load index 5.9 to 7.1 Mpa, showed less durability against salt weathering.

The studied samples can be divided into two groups of samples with clay minerals (gypsum, marl, dolomitic shale and siltstone) and clay-free samples (sandstone, dolomite, limestone and conglomerate). Clay minerals, due to their high water absorption and structure, are more susceptible to degradation by weathering and successive wetting-drying than other minerals forming sedimentary rocks such as calcite, quartz, feldspar. For this reason, gypsum, marl, shale dolomitic and siltstone samples due to clay lacking clay minerals, are less durable than clay minerals, dolomite, limestone and conglomerate.

**Conclusion**

1.With increasing number of test cycles of durability test, the durability of samples decreased. The reason for this is the increase in salt content and accumulation in the voids of samples, which results in increased salt crystallization pressure and degradation of the samples.

2. Porosity, strength and mineralogical composition of the samples played an important role in the durability of the samples against salt weathering. The results showed that samples with high porosity, low strength and clay mineral in their composition, were less resistant to crystallization pressure during the salt weathering. On the other hand, with increasing porosity and decreasing strength, the durability of samples against salt weathering decreased.

3.Clay minerals, due to their high water absorption ability, are more susceptible to degradation by weathering processes during wet and dry cycles than other minerals such as calcite, quartz, feldspar. Sequential tests of persistence are failure. For this reason, the studied specimens, including Gypsum, Marl, Shale dolomitic and siltstone, due to their clay minerals were less durable than other samples with clay minerals.

4.In the present study, a statistical model was presented using multivariate regression analysis to estimate the durability of the samples in the salt weatering test. In this model, the durability after the test cycles is considered as the dependent parameter and porosity and the point load index as the independent parameters. Accuracy of this model were evaluated using statistical tests and 1:1 line, which shows its proper performance and accuracy ($R^2$ = 0.95) in estimating sample durability.

**Keywords:** Sedimentary rock, Durability, Salt weathering, Porosity, Point load index, Statistical model

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