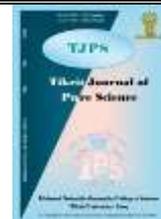




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The validity of limestone rocks belonging to the Pila Spi and Sinjar formations within the Bazian fold / Sulaymaniyah governorate for riprap purposes

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ABSTRACT

The study aims to know some of the physical and mechanical properties of limestone rocks within the Pila Spi and Sinjar Formations at the southwestern limb of Bazian Fold within the Sulaymaniyah Governorate, in order to show their suitability as riprap stones. The tests showed that the values of the dry density of these rocks ranged between (1.857-2.341) g/cm³, the water absorption rate ranged from (1.848-9.87)%, and the specific weight ranged from (2.167-2.255), and the values of the chemical erosion ratio ranged between (8.9-29)%. After knowing the physical and mechanical properties of these limestone rocks and comparing them with the standard specifications of the riprap stones, it was found that these rocks are not suitable for riprap purposes in all the stations of the study area most of the stations of the study area.

Introduction

The movement of water flow leads to the erosion of the banks of rivers, streams and slopes, removing the crumbly materials from their place and depositing them towards the bottom of the river or stream, and it can also work on refining the facilities in the river course. Just as human-induced changes in river banks, disturbance of bottom soils, or removal of vegetation cover can stimulate or increase erosion processes of their banks and bottoms, properly designed riprap works prevent or reduce erosion caused by erosion or erosion. riprap is defined as a layer of crushed stones or boulders thrown or placed by hand on structures and structures exposed to water currents such as earth mounds, dams or slopes, banks and river bottoms and bridge supports bases to avoid erosion, erosion or deterioration. surface and planted in the soil of origin [1]. Rock riprap is the most widely used and popular type in the United States of America, as it is suitable for most of the environmental surrounding. Rock riprap is divided into dumped riprap, hand placed riprap, and plated or keyed riprap [2]. The effectiveness of the riprap can

remain when some scattered stones are lost and can be easily repaired. Well-constructed riprap provides long-term protection, on condition that it is checked regularly and maintained, especially after floods. The riprap does not cause pollution. The riprap provides hiding places for fish and aquatic invertebrates during the natural flow of the river. The riprap design needs to know the river bank and bed, the flow velocity, the depth of the water, the direction and the characteristics of the riprap stones in terms of density, size, durability, availability, direction of sidewalks and buttresses, their dimensions, location, bank orientation, and the type of interfacial bonding material that connects the riprap and the foundation [3].

The study area is 25 km from the center of the city of Sulaymaniyah, towards the southwest of the city, in the north-east of Iraq. In terms of coordinates, the area is limited to (y:3928000 , y:3932000) (x:520000 , x:517500), Fig (1).

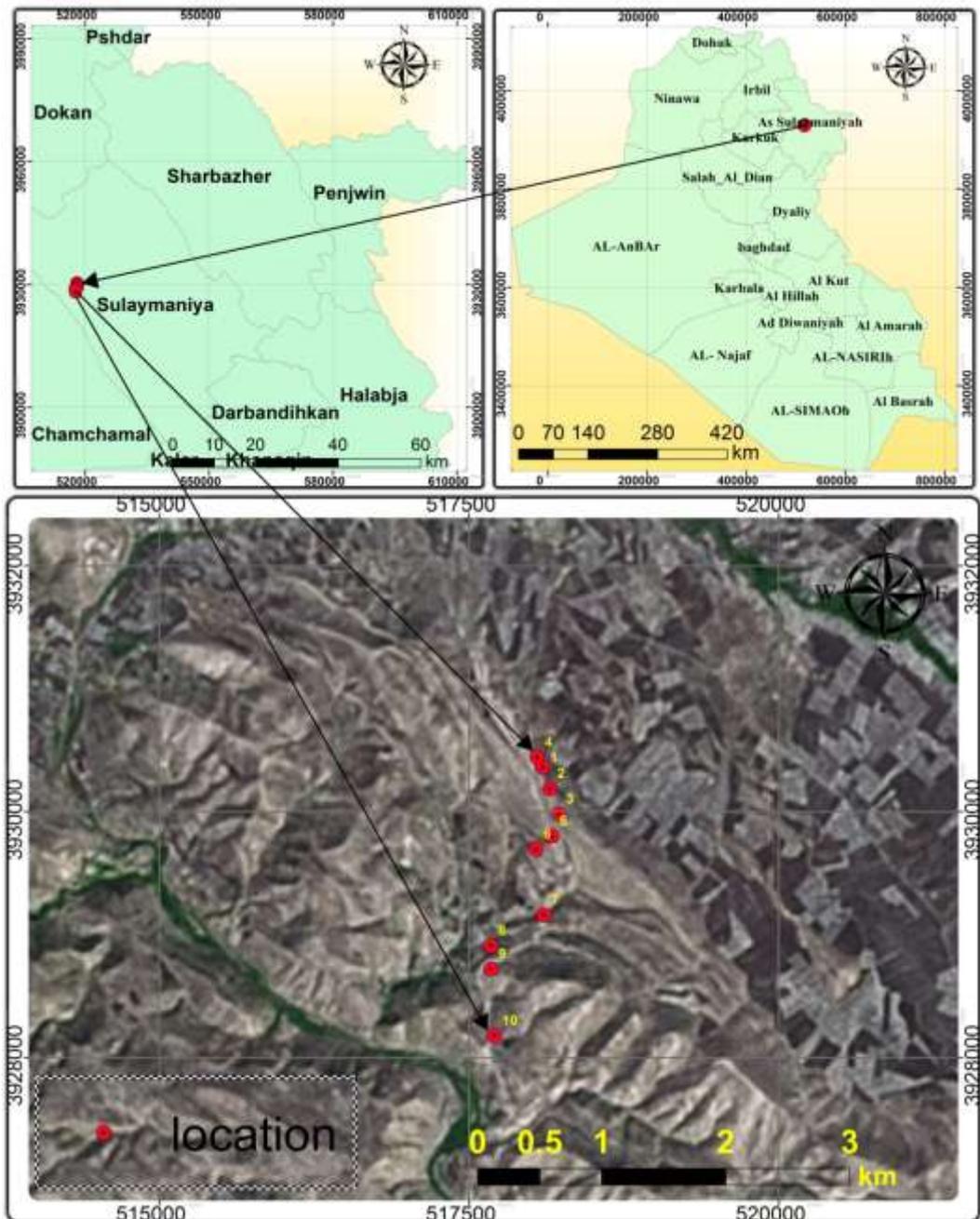


Fig. 1: A map with a visual of the area showing the locations of the study stations

Tectonically, the region is located within the high fold range. The Bazian chain is a natural belt separating the high and low fold zone. The Bazian series resulted from the collision of the Arabian plate with the Iranian plate. Complex structural features were formed due to severe folding.

Stratigraphically reveal the following Formations Sinjar and pilaspi, the Sinjar Formation consists of layers of argillaceous limestone, sandy limestone, gray limestone and conglomerate limestone.

While the Pila Spi Formation consists of layers of crushed limestone, chalk limestone, dolomite, and dolomite limestone [4].

The most important geomorphological features present in the region are hills, ravines, cross-valleys and tree, parallel and semi-parallel drainage systems.

In addition to the presence of Cuesta and Mesa and the phenomena of rock fall.

Laboratory tests:

The most important geotechnical tests required in evaluating limestone for riprap purposes are the specific weight, absorption rate and chemical corrosion rate. The specific weight varies according to the type of minerals that make up the rock [5], and the specific weight is a function when evaluating and classifying rocks [6]. It was found according to the American Standard [7]. from the equation True. $G_s = \frac{M_d}{(M_d - M_{sub})}$ table(1)

The absorption property is also very important in evaluating the viability of rocks for engineering purposes because the rock with little absorption is more tolerant and less affected by freezing, thawing

and changes in drought and humidity [8], and it was found according to the [7].

from Equation $W.ab = (Msat - Md) / Md \times 100\%$ table(1)

As for chemical abrasion testing, it is one of the most important tests that are carried out on rock aggregates that are used in construction and roads, especially constructions built on coastal areas. This test is

performed using saturated sodium sulfate solution or saturated magnesium sulfate solution. In our current study, the test was carried out using saturated sodium sulfate solution according to the American Standard [9]. by immersing the rock sample in saturated sodium sulfate solution for (16-18) hours, then drying for 8 hours for five successive cycles of immersion and drying. table(1)

Table 1: The results of the important geotechnical tests in evaluating the riprap stones of the limestone samples taken from the study area

| formation | station number | Specific weight | % absorption | chemical corrosion% |
|-----------|----------------|-----------------|--------------|---------------------|
| Sinjar | 4 | 2.434 | 1.626 | 14.7% |
| | 5 | 2.255 | 2.231 | 8.9% |
| Pila spi | 8 | 2.226 | 8.931 | 24.6% |
| | 10 | 2.409 | 9.876 | 29% |

Discussion

The petrographic properties have a significant impact on their geotechnical properties, as the effect of the slight dissolution process, cementation and mineral composition in the Sinjar formation rocks were observed on the low absorption ratio, increase in

specific gravity, and low chemical abrasion ratio compared to its value in the Pila Spi formation rocks.

Evaluation of the suitability of limestone rocks for use in riprap:

The suitability of limestone rocks for riprap purposes against water erosion was evaluated according to the American Standard [10] shown in Table (2)

Table 2: represents the specifications of the rocks used for riprap purposes according to [10]

| Geotechnical property | first class | second class | third class |
|---|------------------|------------------|-------------------|
| Specific gravity | no less than 2.5 | no less than 2.5 | not less than 2.3 |
| % absorption | no more than 2% | no more than 2% | no more than 4% |
| Chemical abrasion% with Na ₂ SO ₄ | no more than 10% | no more than 25% | no more than 25% |

After comparing the results of the geotechnical tests of limestone rocks taken from the study area with the American Standard [10], the results of the final evaluation were reached, Table (3) where as the

limestone rocks in the Sinjar Formation conform the specification, while the limestone rocks in the Pila Spi Formation are not conform to the specification.

Table 3: Results of evaluating limestone rocks as riprap stones

| formation | station number | Specific weight | % absorption | chemical corrosion% |
|-----------|----------------|----------------------------------|-----------------------|---|
| Sinjar | 4 | It conform to the third category | Agrees with all types | It conform to the second and third category |
| | 5 | doesn't work | Agrees with all types | Agrees with all types |
| Pila spi | 8 | doesn't work | did not agree | It conform to the second and third category |
| | 10 | It conform to the third category | did not agree | did not agree |

So only the station sample 4 is valid for stone riprap purposes

Conclusions

1. The Formations that unfold in the studied area are PilaSpi, Jerkes Sinjar, and recent deposits.
2. The limestone rocks in the study area are affected by weathering at a medium to high rate which led to an increase in the absorption rate and an increase in the chemical erosion of these rocks.
3. Most of the rocks of the study area stations are not suitable for riprap purposes.

4. The Sinjar Formation rocks are better than Pila Spi Formation rocks as riprap stones.

Recommendations

1. Conducting a similar study in the areas close to the study area in order to obtain rocks suitable for riprap.
2. Choosing a source of riprap rocks close to the project in which the riprap is to be carried out to reduce the economic cost.

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صلاحية الصخور الكلسية العائدة لتكويني بلاسبي وسنجان ضمن طية بازيان/محافظة السليمانية لأغراض التكسية

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الملخص

تهدف الدراسة إلى معرفة بعض الخواص الفيزيائية والميكانيكية للصخور الكلسية ضمن تكويني بيلا سبي وسنجان في الطرف الجنوبي الغربي لطيبة بازيان ضمن محافظة السليمانية لبيان مدى صلاحيتها كأحجار تكسية. وقد أظهرت الفحوصات إن قيم الكثافة الجافة لهذه لصخور تتراوح بين g/cm^3 (1.857-2.341) ونسبة امتصاص الماء تتراوح من % (1.848-9.87) والوزن النوعي من (2.167-2.255) وتراوحت قيم نسبة التآكل الكيميائي بين % (8.9-29). وبعد معرفة الخواص الفيزيائية والميكانيكية لهذه الصخور الكلسية ومقارنتها مع المواصفات القياسية لأحجار التكسية وجد ان هذا الصخور غير صالح لأغراض التكسية في اغلب محطات منطقة الدراسة.