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Assessment of Some Clays From Gercus Formation (M. Eocene) for Brick Manufacture, Sulaimani Area, NE Iraq.

Tola A. Merza
Department of Geology, College of Science,University of Sulaimani, Kurdistan Region Iraq.

Abstract

This study deals with investigating some clay deposits from the upper part of Gercus Formation (Middle Eocene), northeastrn Iraq and their evaluation for brick manufactures. Grain size analyses and Atterberge limits of raw materials have been studied. Chemical analyses show that such materials are containing low percent of SiO_2 and Al_2O_3 and high percent of $CaCO_3$. Fourty test tiles were prepared from the clay samples by semi-dry pressing (250 $Kg./cm^2$ and about 8% moisture content) and fired at 700, 800, 900, 1000 and 1100°C. The various characteristics of the end products prepared from properly selected samples under optimum working conditions are determined.

Keywords:- Clay, Ceramic, Atterberge limits, Semi-dry pressing.

Introduction

Due to the increasing demand for ceramic product in Iraq which is currently imported at considerable cost, development of domestic ceramic industry has become a national motive. Extensive research works have recently been directed toward exploration and evaluation of local ceramic raw materials (1, 2).

The present work is devoted to study the possibility of manufacturing brick from the local raw materials, and the products belong to stoneware ceramic group which is characterized by high mechanical strength. Clays containing mineral impurities (i.e.quartz, iron compounds, feldspar, calcium carbonate, etc.) are mainly used in their manufacture since they can bring about partial melting of the body which is essential for densification. In addition, the main specific physical and chemical properties inherent to clays utilized for manufacturing ceramic products are indicated as follows:

a-should have high fusion point with wide vetrification range.

b-should have enough plasticity and good workability.

c-undergo uniform shrinkage during drying and firing,and

d-should be almost free from harmful impurities such as pyrite, gypsum, limestone and dissolved salt.

The studied area is located in Sulaimani region (Kani Shaitan Village) about 40Km. from the city (Fig.1). The studied samples were chosen from the red and green clay beds of the upper part of the Gercus Formation (Middle Eocene) (Fig.2). The Gercus Formation represents the second molasse sequence deposited after the Intra-Eocene movement in the northern geosynclinal areas (3) which is distributed widely in northeastern Iraq. Generally the formation is composed of red and purple shales, mudstones, sandy and gritty marls; with soft pebbly sandstones and conglomerates are occurring too. Lenticles of gypsum were found especially towards the top of the formation(4). This formation was deposited in a relatively broad sinking molasse trough (fore deep) (3).

Ameen(5)concluded that the formation deposited in subarial environments such as river channel, flood plain and tidal area with shallower marine. The presence of iron oxide in great amount is an important factor for colouring the rocks, which is exist in two main forms and easily transformed from one face to other as a result of oxidation and reduction (6).

At the studied area the Gercus Formation is underlain conformably by Sinjar Formation (Early Eocene) and it is graditional and the appearance of the first red clay bed represents the contact between them.The overlying formation is Pila Spi Formation (Late Eocene) with unconformable contact, marked by the presence of a thick bed of conglomerate. The claystone layers, which are the studied beds, ranges in thickness between 0.2m. to 4m. (Fig. 2).

Objective

The purpose of this study is to evaluate the possibility of utilizing the domestic red clay beds of Gercus Formation, which is distributed widely in northeastern of Iraq, for manufacture of bricks.

Experimental Work

Materials and specimens preparation:

The clay samples used in this investigation was taken from Gercus Formation at Kani Shaitan village. To study the assessment of this type of clay for brick manufacture, specimens were crushed in order to make a fine-powder. Each sample were moistured by adding 8% of water to 1Kg. Rectangular sample brick measuring 8* 4 * 1 cm. Were used and semi-dry pressing method (250Kg./cm².) was applied.

The pressed brick samples were dried first at room temperature and then dried at 105-110 °C. The dried sample sets fired in an electric furnace.

Ranging in temperature from 700 to 1100°C. The soaking time was 50 °C/hr.

Tests conducted:

Grim (7) and Dondi et. al. (8) are suggested many tests for evaluation of clays for brick industry. The physical tests performed on raw materials and brick specimens are; grain size distribution of the sample (by hydrometer method)(9), Atterberge limits (10) and drying shrinkage (11) of the raw materials and brick specimens were measured. Geochemical analyses of raw-materials were carried out using Atomic Absorption. X-ray diffraction (XRD) used to identify the mineralogical composition of clay raw-material and fired samples. Tests accomplished on fired specimens included; fired linear shrinkage, apparent porosity, water absorption, bulk density(12), and compressive strength (13). These tests were done at the Building Research Center, Baghdad in 1998.

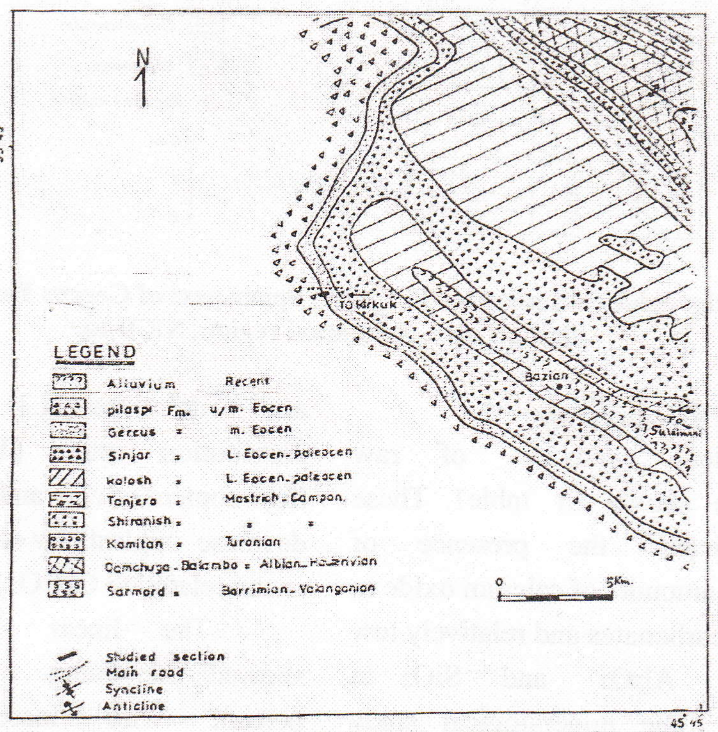

Fig.(1): Geological map of the study area (after I. P. C., 1920).

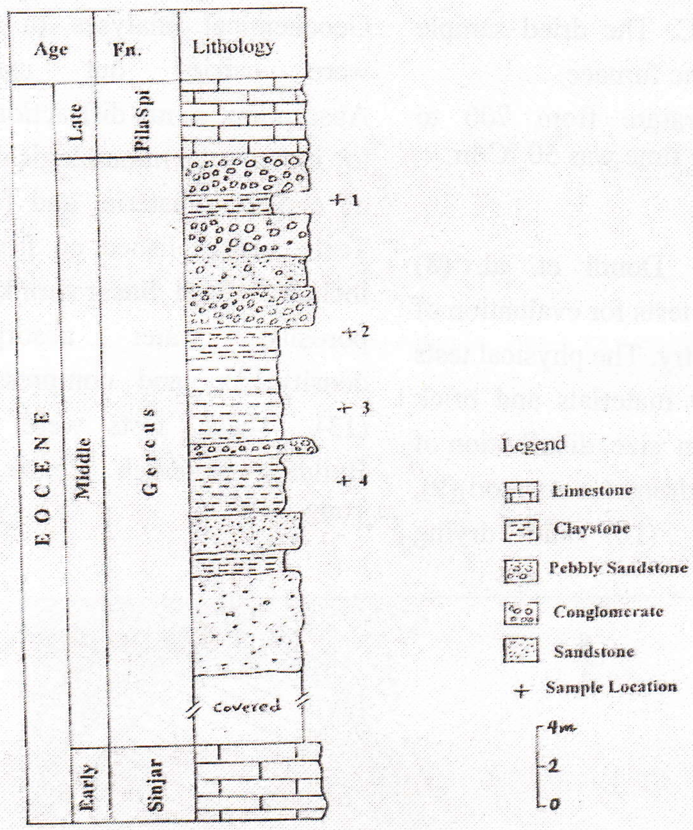

Fig.(2):Stratigraphic columnar section of the upper part of Gercus Formation, in Kani Shaitan area, Sulaimani region, NE Iraq.

Results and Discussions

Chemical analyses of raw materials are shown in table1. These results indicate the presence of considerable amount of calcium oxide in the form of carbonates and relatively low content of Al_2O_3 and SiO_2 in compositions. The mineralogical study revealed that the major clay minerals present are; Palygorskite, Smectite and Kaolinite; in addition to quartz, calcite and dolomite(Fig.3). Grain size distribution results (Table 2) indicated high content of clay and silt fractions. The decrease in plasticity coefficient observed is can related to $CaCO_3$ content (Table 3).

The linear shrinkage results showed the rising of linear shrinkage percent with increase of firing temperature(Fig 4). The changes in apparent porosity, water absorption and bulk density results are related with

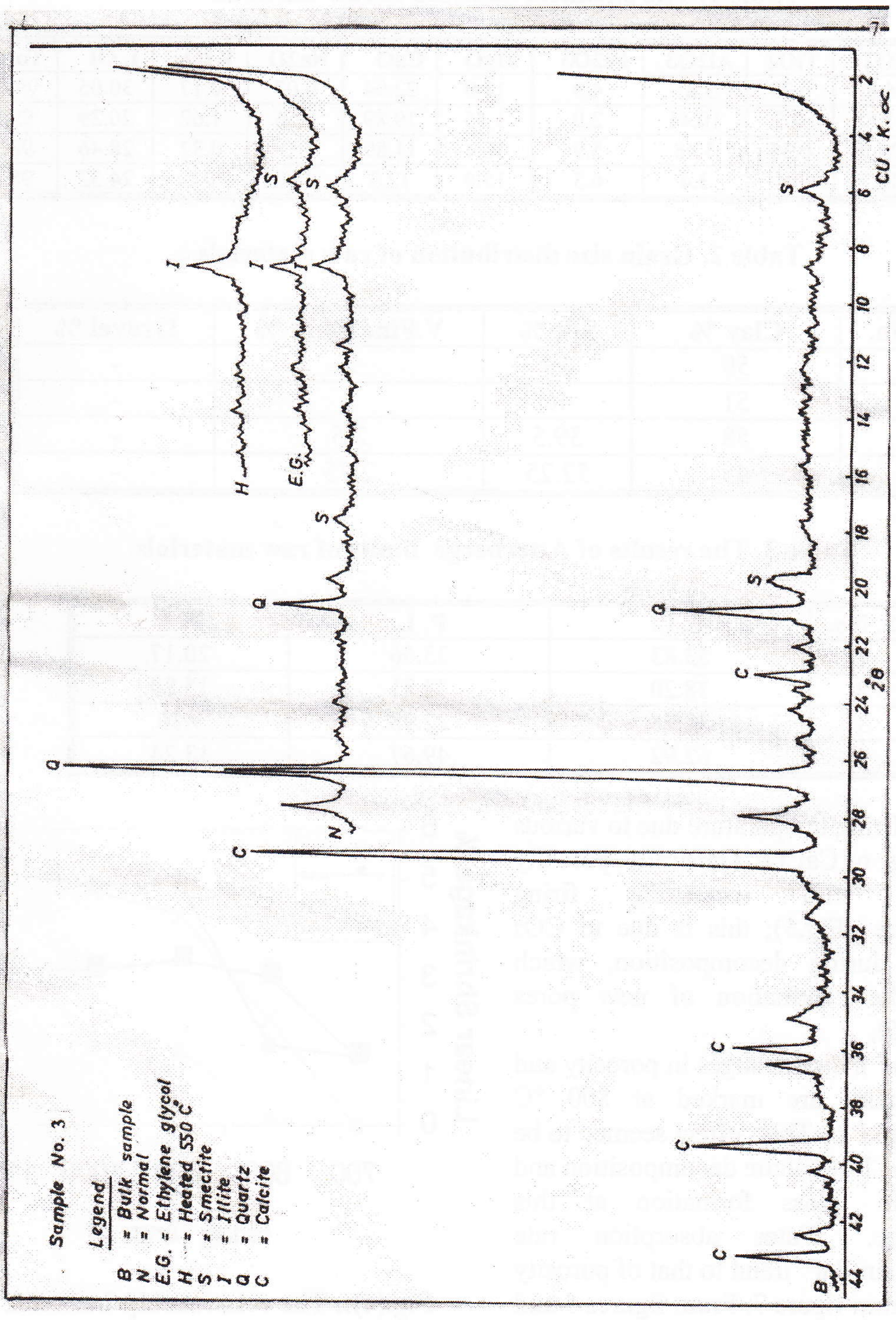

Fig.(3): results for clay mineral identification before firing.

Table 1. The chemical analyses of raw materials .

S.No.	SiO2	TiO2	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	L.OI	Total
1	24.82	0.25	3.83	4.9	12.9	22.94	0.07	0.17	30.05	99.93
2	41.88	0.5	10.41	2.9	1.45	19.89	0.56	1.62	20.29	99.5
3	29.9	0.35	5.48	5.9	16.4	11.89	0.2	0.32	28.46	98.9
4	36.7	0.4	3.4	6.3	15.0	12.3	0.08	0.2	24.32	98.7

Table 2. Grain size distribution of raw materials .

S. No.	Clay %	Silt %	V.Fine Sand %	Gravel %
1	59	39	2	-
2	51	46	3	-
3	58	39.5	2.5	-
4	45	52.25	2.75	-

Table 3. The results of Atterberge limits of raw materials.

S. No.	L. L.	P. L.	P. I.
1	53.83	33.66	20.17
2	38.20	22.31	15.89
3	32.78	22.98	9.80
4	62.92	49.67	13.24

rising of firing temperature due to various containing of $CaCO_3$. Generally, porosity increases with increasing firing temperature (Fig.5); this is due to CO_2 libration during decomposition, which caused the formation of new pores (14, 15, 16).

The major changes in porosity and bulk density are marked at 800 °C (Figs. 5 and 6).This effect seemed to be caused by low calcite decomposition and appreciable glass formation at this temperature. Water absorption rate followed similar trend to that of porosity as seen from figure 7. From figures 5 and 7 it can be noticed that reducing in

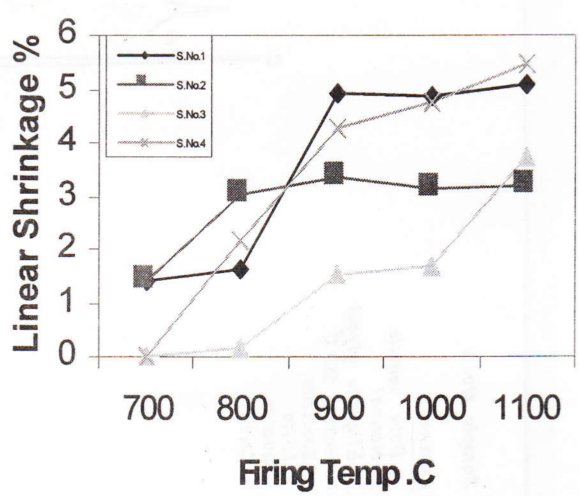

Fig.(4):. The relationship between Linear Shrinkage % and firing Temperatures.

porosity and water absorption and increasing of bulk density with rising firing temperature.

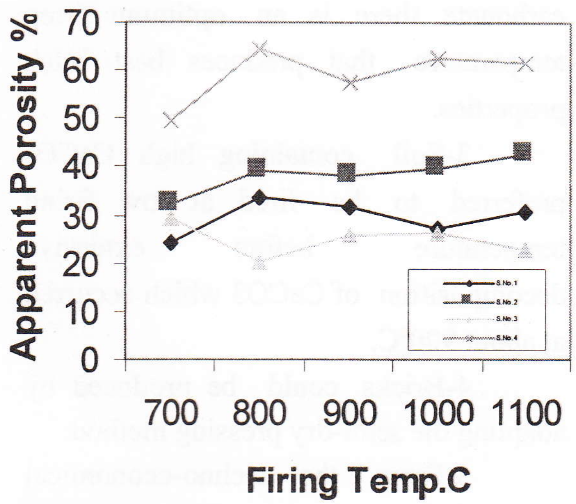

Fig.(5): The relationship between apparent porosity and firing temperatures.

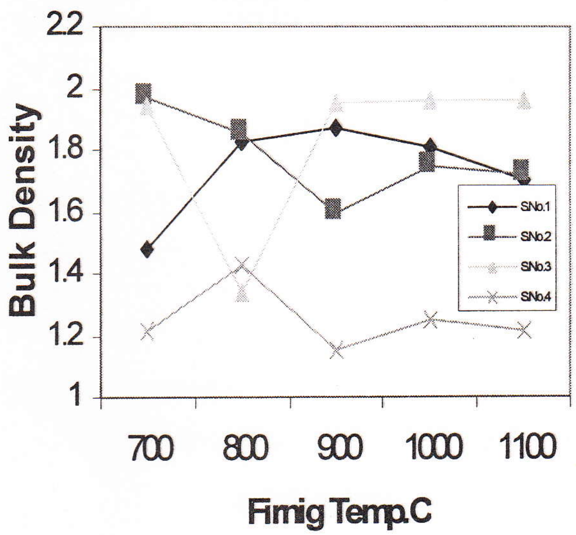

Fig.(6): The relationship between Bulk Density and Firing Temperatures.

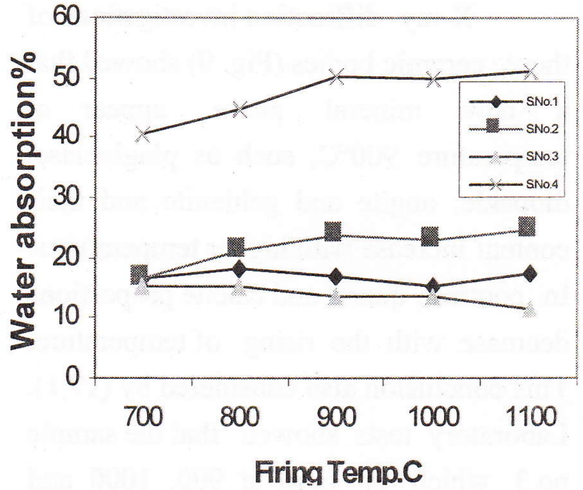

Fig.(7): The relationship between water absorption % and firing temperatures.

Drastic compressive strength reduction observed (Fig. 8) with higher CaCO3 content at all firing temperatures. This is attributed to decreasing of density and microcracks, which might be created by increasing CO2 pressure. Also the increasing in compressive strength observed with rising firing temperatures, as shown in figure 8.

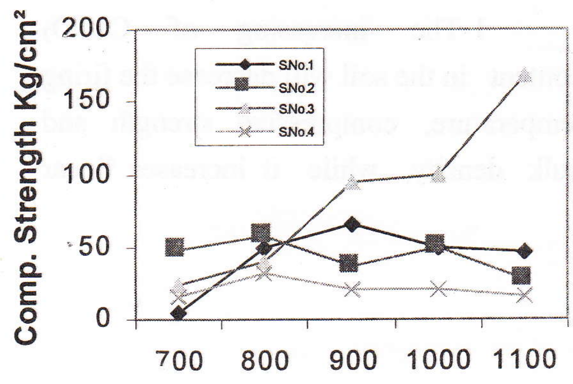

Fig.(8): The relationship between compressive strength and firing temperatures.

X-ray diffraction investigations of these ceramic bodies (Fig. 9) showed that a new mineral phase appear at temperature 900°C, such as plagioclase, diopside, augite and gehlenite and their content increase with higher temperatures. In contrast, quartz and calcite proportions decrease with the rising of temperature. This conclusion also considered by (17,1). Laboratory tests showed that the sample no.3 which is fired at 900, 1000 and 1100°C is useful in brick manufacturing. According to (18) bricks should not exert water absorption more than 25% and should have compressive strength in the range of 90-110Kg. /cm².

Conclusions

On reviewing the proceeding experimental results the following conclusions could be derived:

1-The increasing of $CaCO_3$ content in the soil will decrease the firing temperature, compressive strength and bulk density, while it increases linear shrinkage, apparent porosity and water absorption.

2-For specimens rich in calcium carbonate there is an optimum firing temperature that produces best brick properties.

3-Soil containing high $CaCO_3$ preferred to be fired at low firing temperature before extensive decomposition of CaCO3 which occurred at about 900°C.

4-Bricks could be produced by adapting the semi-dry pressing method.

5-From the techno-economical point of view, it is recommended that the raw material of sample number 3 in the studied area should be used as extending materials for the manufacture of bricks.

Fig.(9): XRD results for clay mineral identification after firing.

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هەڵسەنگاندنی هەندێ لە نیشتووە قوڕی یەكانی پێكهاتووی جركس (ایوسین ناوەڕاست) بۆ پیشەسازی خشت ناوچەی سلێمانی /باكوری ڕۆژهەڵاتی عێراق

تۆڵە احمد میرزا

بەشی جیولۆجی / كولیژی زانست/ زانكۆی سلێمانی

هەرێمی كوردستان- عێراق

پوختە

ئەم لێكۆڵینەوەیە دەربارەی بەردە قوڕیەكانی بەشی سەرەوەی پێكهاتوی جیركس ە (ایوسینی ناوەڕاست)لە باكوری ڕۆژهەڵاتی عێراق كە هەڵسەنگێنراوە بۆ بەكار هێنانی لە پیشەسازی خشت دا.

شیكردنەوەی قەبارەی دەنكۆڵەكان و سنووری ئەتەر بیرگ بۆ ئەو نمونانە دیاری كراوە شیكردنەوەی كیمیائی پیشانی ئەدات كە نمونەكان دەوڵەمەندن بە $CaCO_3$ و ڕێژەی SiO_2 و AL_2O_3 تیایدا كەمە .چل نمونەی سیرامیكی ئامادەكراو بە ڕێگەی كەبسی نیمچە ووشك (٢٥٠ كگم /سم^2 و ڕێژەی شێ ٨٪)پاشان ئەم نمونانە سوتێنران بە پێ ی بەرنامەیەكی دیاری كراو بۆ پلەی گەرمای ١١٠٠،١٠٠٠،٩٠٠،٨٠٠،٧٠٠ م°.لە ژێر ڕۆشنایی ئەنجامەكانی شی كردنەوەی تاقیگەی دەركەوت كە هەندێك لەو نموونانە دەتوانرێت بۆ پیشەسازی خشت دروست كردن بەكار بهێنرێت.

تقيم بعض الاطيان من تكوين جركس (أيوسين الاوسط) لصناعة الطابوق / منطقة السليمانية / شمال شرق العراق

تۆڵە احمد میرزا

قسم الجيولوجي / كلية العلوم/ جامعة السليمانية

إقليم كردستان - العراق

الخلاصة

البحث يتناول فحص نماذج من الترسبات الطينية في الجزء العلوي لتكوين جركس (اليوسين الاوسط) من شمال شرق العراق ،و كذلك تقييم هذه الاطيان لصناعة الطابوق .تمت دراسة التوزيع الحجمي للعينات و حدود تربيك للمواد المستخدمة في البحث .التحليل الكيمائي اظهرت تواجد نسبة قليلة من اكاسيدSiO_2 وAL_2O_3 و نسبة عالية من $CaCO_3$.تم تشكيل اربعون عينة سيراميكية بطريقة كبس شبه جاف (٢٥٠ كغم/سم^2 و حوالي نسبة رطوبة ٨٪)ثم حرقت تلك العينات بحسب برنامج حرق معين لدرجات الحرارة ,٨٠٠٧٠٠,٩٠٠,١٠٠٠,١١٠٠ م° . على ضوء نتائج الفحوصات المختبرية لنماذج قيد الدراسة تبين امكانية استخدام بعض العينات لصناعة الطابوق المصنوع من الطين.

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