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POTENTIAL OF ELWADI ELGEDID SHALES FOR USE IN BRICK PRODUCTION

امكانية استخدام طفلة الوادى الجديد فى صناعـــــة الطــوب

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خلاصة – نظرا لاهتمام البلاد فى الوقت الحاضر بالبحث عن بدائل الطمى للاستخدام فى صناعة الطوب دار كثيرا من مراكز البحث العلمى تسعى للوصول لأفضل خامات مناسبة وأن أهمية ايجاد بدائل للطمى فى صناعة الطوب لها هدفان رئيسيان الأول هو المحافظة على الطمى اللازم لزيادة غلة الرقعة الزراعية المحدودة فى الدلتا والحفاظ على جودتها الانتاجية والثانى هو امداد البلاد بالبديل المناسب من الطوب الجيد واللازم للنهضة العمرانية الموجودة فى خطة الدولة الخمسية الحالية . وانطلاقا من هذه الأهداف تم اعداد هذا البحث وذلك بتحليل وبحث امكانية استغلال ستة عشرة نوعا من الطفلة الموجودة فى أماكن مختلفة فى منطقة الوادى الجديد وهى مناطق أبوطرطور والداخلة والخارجة . وقد تم اختيار هذه الأماكن لتوافر خامات الطفلة بها وتوسطها فى منطقة عمرانية مما يتيح الفرصة لاقامة مصانع للطوب الطفلى قادرة على تحقيق الاكتفاء الذاتى لمنطقة جنوب البلاد . وتتلخص خطوات هذا البحث فى عرض الخواص الكيماوية والفيزيائية والتركيب المنرالوجى لهذه العينات وتحديد التدريج الحبيبى والخواص الريولوجية لكل خامة وذلك باستخدام حدود أتربرج المعروفة فى علم ميكانيكا التربة . من المعلومات السابقة تم اعداد عجائن من كل خامة عند المحتوى المائى المناسب وهو المحتوى الذى يعطى سهولة فى تشغيل الخلطة وفى نفس الوقت لا يسمح بالتغير الحجمى للطوبة بعد الحرق . كذلك فقد تم اعداد عينات لاختبار الضغط لعينات مشكلة يدويا أو آليا لتحديد مقدار تحمل العينات المصنعة من الخامات المختلفة لاجهادات الضغط قبل وبعد الحرق تحت ظروف محددة . وقد أثبتت الدراسة المعملية وتحليل النتائج أن هناك العديد من الطفلة الجيدة المتوفرة بمنطقة الوادى الجديد والصالحة لانتاج طوب ذو خواص ممتازة وصالحة للاستخدام فى البلد .

ABSTRACT- The use of shale in the production of bricks is now getting high momentum in all construction research institutes as a replacement of the Delta clays. It is well known that many types of shales, when molded and burned under controlled conditions, can produce good and comparative bricks.

A research project was initiated in Mansoura University jointey with Abou-Tartour phosphate project to study and evaluate the shale materials available in Elwadi-Elgedied as raw materials for bricks manufacture. Sixteen different shales were sampled from three areas : Abou-Tartour, Eldekhla and Elkharga.

This study is presenting the laboratory evaluation of these sixteen shale samples and the potential of their use in bricks production. The geological, chemical, physical and minerological properties of all samples were determined as well as the plastic characteristics of water mixed specimens. Following this, specially molded specimens were tested to determine their strength and volume change before and after controlled burning.

The results of the study have revealed a very high potential of many shales found in Elwadi Elgadied for use in the bricks industry. High strength, nonshrinking and moisture resistant bricks can be produced using these materials. A factory of 10 million units annual production can be initiated to supply the area with bricks for at least one hundred years.

INTRODUCTION

Bricks constitute an important componenent in the construction of buildings in Egypt. Specially in the Egyptian villages where one or two storey buildings are prevailing, the need for a strong and light weight brick is warranted for constructing bearing wall type structures. Our ambitious 5- year plans together with the rule released by the people council in 1985; prohibiting the use of any clay in the Nile delta region for brick production, has forced many interested authorities to investigate other alternatives.

Shale is one, well known, alternative that when molded and burned under controlled conditions will produce good and comparative bricks and other products that are needed in the field of construction. A group of geologists in the Abou-Tartour phosphate project has performed a field study to investigate the presence of shale in three different areas, Abou-Tartour, Eldakhla and El-Kharga. Sixteen different shale materials were sampled and evaluated in laboratory to determine their physical, chemical, rheological and strength properties. This study is presenting the laboratory analysis performed to investigate the possibility of using these shales in brick manufacturing and the properties of brick specimens laboratorily made from each type of these shales.

A PRELIMINARY GEOLOGICAL STUDY OF SAMPLE SHALES

A geological survey was made in Elwadi Elgedid governerate to search for the presence of shale (1). It was found that large amounts of shale deposits were available in El-Kharga, Eldakhla and some other villages. The geological composition of shales in these areas was determined to be as follows :

1- Upper Noubian sand stone shale
2- Varisated shale
3- Eldakhla shale
4- Old lakes shale.

Table 1 presents estimates of the minimum amounts of shales that can be found in each of the sixteen samples sources.

Table 1: Estimates of Shales Amounts,

Region	Sample No.	Location	Area m^2	Layer thickness (m)	Volume m^3
Abou - Tartour	1	Abou - Tartour (Service station)	10^6	1.0	10^6
	2	Abou - Tartour (Electric tower)	2.5×10^6	2.0	2×10^6
	3	Abou - Tartour (North tunnel)	4×10^6	20.0	8×10^6
	4	Abou - Tartour (Mahdy square)	10^4	20.0	2×10^5
El - Dakhlah	5	El - Maghraby	10^6	3.0	3×10^6
	6	El - Ziat	6×10^6	1.0	6×10^6
	7	Balat	2×10^6	5.0	1×10^7
	8	Asmant	5×10^5	1.0	5×10^5
	9	El - Ouina (1)	5×10^4	3.0	1.5×10^5
	10	El - Ouina (2)	5×10^4	3.0	1.5×10^5
	11	WEST Elkosir	6×10^6	4.0	2.4×10^7

El-Khargah	12	Trwany mountain	1×10^5	4.0	4×10^5
	13	East of Elkharga town	2.5×10^5	1.0	2.5×10^5
	14	Asiout Highway	1×10^6	1.0	1×10^6
	15	Elkharga- Abou - Tartour (16-18 Km)	2.5×10^5	3.0	7.5×10^5
	16	Paris - Elkharga 7 Km.	1×10^5	3.0	3×10^5

Typical geologic cross-sections showing the layered position of some selected shales are given in figure (1). Table I shows that an absolute minimum amounts of shales of forty four million cubic meters can be drawn from Eldakhla, Three millions cubic meters from Elkharga and more than two millions cubic meter from Abou-Tartour. These estimates were considered encouraging for satisfying the construction needs of Elwadi Elgedid as a developing area.

CHEMICAL, PHYSICAL AND MINEROLOGICAL PROPERTIES

Chemical and Physical Properties:

Chemical analysis was performed in the laboratory of the Egyptian Authority for Geological survey and mining Projects. The results of the chemical analysis for each of the sixteen samples are given in Table II. Selected physical properties such as colour, hardness, specific gravity and natural moisture content were also determined. Table III summarizes these properties for the sixteen shale samples.

Table II : Chemical Components of Sampled Shales.

Sample No.	Cmponent Weight %						
	SiO_2	AL_2O_3	Fe_2O_3	MgO	CaO	L.O.I.	M%
1	59.17	14.06	4.95	1, 45	4.55	13.03	3.77
2	55.82	14.58	5.35	1.55	4.76	13.35	4.50
3	37.36	9.88	11.67	6.10	7.35	21.95	7.82
4	48.98	11.78	6.88	4.40	5.32	16.00	6.19
5	59.65	20.05	6.15	0.95	0.35	9.28	2.67
6	51.46	15.77	6.23	1.45	3.92	16.25	5.69
7	52.99	15.53	8.55	3.00	1.12	12.30	7.12
8	59.03	9.22	5.45	1.85	6.86	12.85	3.31
9	51.56	14.92	6.79	3.60	0.70	15.52	8.64
10	59.66	14.25	3.83	2.40	0.21	14.40	6.87
11	52.02	15.25	6.23	1.95	3.57	14.74	6.10
12	46.87	24.13	4.48	1.65	0.49	19.25	7.86
13	50.09	11.69	4.48	1.60	8.19	14.32	3.59
14	39.46	15.49	5.99	2.70	10.86	21.48	6.21
15	55.18	21.52	4.23	0.95	0.49	13.43	4.19
16	49.24	10.69	16.06	1.85	0.49	13.01	5.43

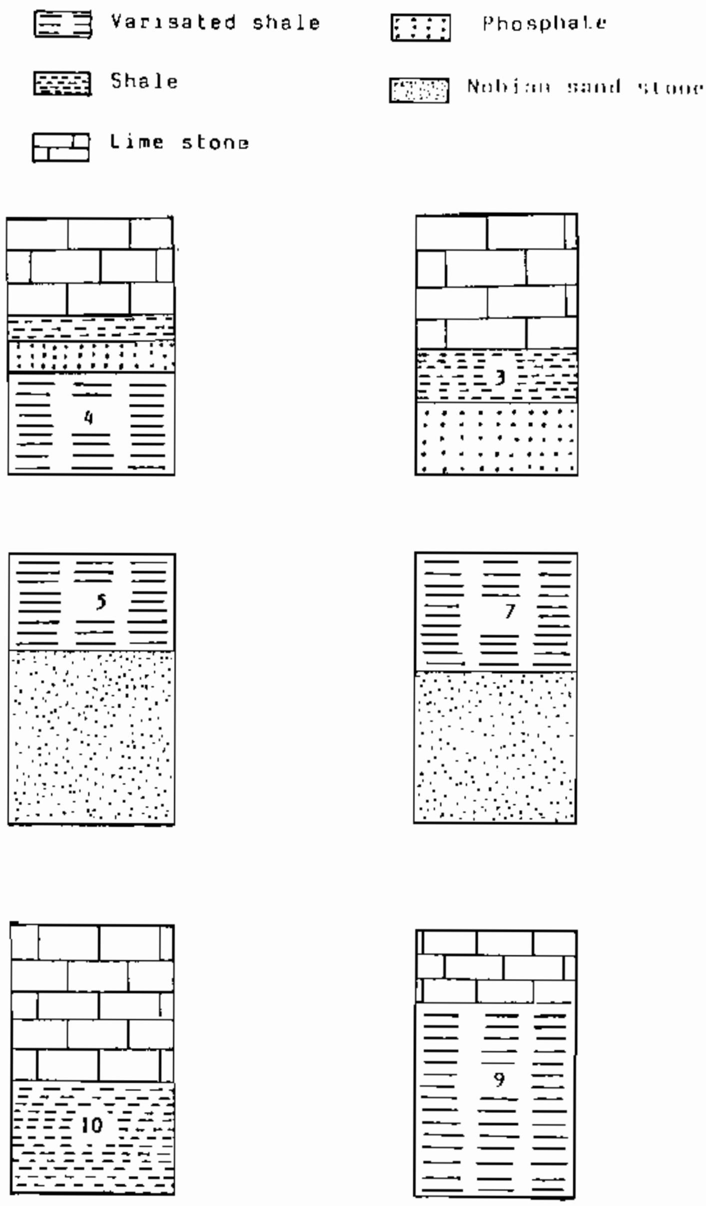


Figure (1): Typical Geological Cross Sections at Selected Locations.

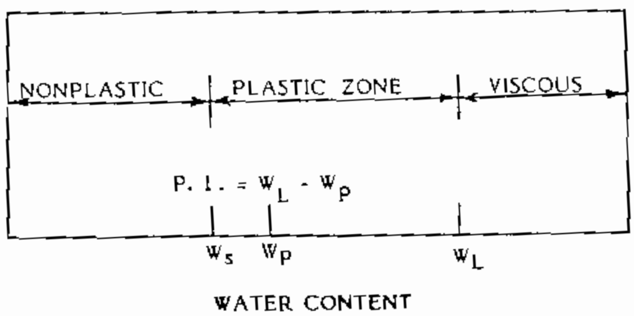


Figure (2) Relative position of consistency limits.

STRENGTH PROPERTIES BEFORE AND AFTER BURNING

The purpose of this section of study was to test the strength properties of specimens made from shale and water molded in special cylindrical molds. Specimens prepartion was designed to simulate the production process of bricks in field and to get data relative to the strength potential during and after burning.

Specimens Preparation and Evaluation

1- Mixing :

Shale samples were oven dried to constant weight at a temperature of 105 °C before they were cooled to room temperature. Each of the sixteen samples were mixed with water to have a moisture content at the plastic limit, Table IV, and mixed using a mechanical blender for at least 10 minutes or till uniform distribution of water is reached.

2- Molding :

For each shale type ten cylindrical specimens, 1.5-in diameter by 2.75 - in hight, were molded using a special static compactor under a pressure of 4 Kg/cm^2. Specimens were then extruded from molds and left on the lab table for sucessive evaluation.

3- Curing :

All specimesn, 160 specimens on the basis of 10 for each of the sixteen. shales, were air cured for four days . Half of the ten specimens, 5 specimens for each shale, were specarated for unconfined compression testing while the rest were prepared for burning following a special process.

4- Burning :

After air curing, the specimens prepared for burning are placed in an oven that is set at room temperature. The temperature in the oven is then raised gradually at a rate of 2°C per minute until a temperature of 600°C is reached. The oven temperature is then raised gradually at a rate of 6°C per minute till it reaches 950°C and is kept constant for a period of 12 hours. Specimens are then cooled in the oven at a gradual rate of - 2°C per minute till they reach room temperature. Figure (3), show a schematic representation of the burning and cooling process.

5- Testing :

Although other parameters might sound important, this research program concentrated on measuring two parameters, they are ; the percent shrinkage and the unconfined compressive resistance.

a) Percent shrinkage: the percent reduction in specimen volume due to burning was determined according to the following expression :

$$PS = \frac{V_b - V_a}{V_b} \times 100$$

where PS = Percent shrinkage
V_b = Volume of molded specimen before burning
V_a = Volume of molded specimen after burning.

b) Unconfined compression testing: the compressive resistance of all cylindrical specimens were determined using the unconfined compression testing machine. Ten specimens for each shale type were tested in which five of the specimens were tested before burning and the rest were tested after burning .

The results of the shrinkage and compression testing are given in Table V.

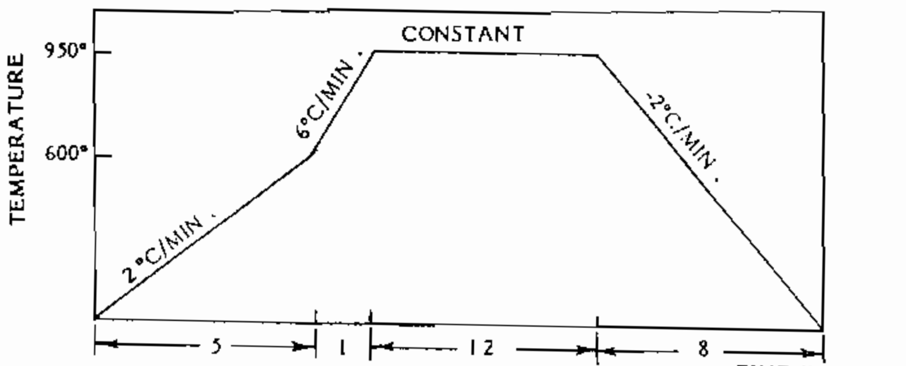
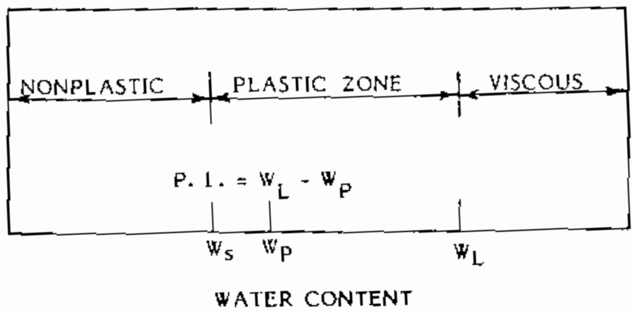


Figure (3) Burning Approach of Molded Shale Specimens.

Table V: Percent Shrinkage and Unconfined Compression Testing Results.

Sample Number	Percent Shrinkage	Unconfined Compression (qu) Kg/cm²	
		Before Burning	After Burning
Abou-Tartour Region			
1	1.7	26.0	108.0
2	0.8	17.0	56.0
3	3.0	24.0	59.0
4	2.0	17.5	19.0
El-Dakhlah Region			
5	0.7	27.75	121.0
6	0.0	22.57	31.0
7	10.0	19.75	58.0
8	1.0	18.75	60.75
9	0.0	32.00	88.0
10	--	--	--
11	--	23.00	46.0
El-Khargah Region			
12	4.0	16.13	31.22
13	3.0	26.00	46.00
14	-	--	--
15	2.0	17.00	57.00
16	--	--	--



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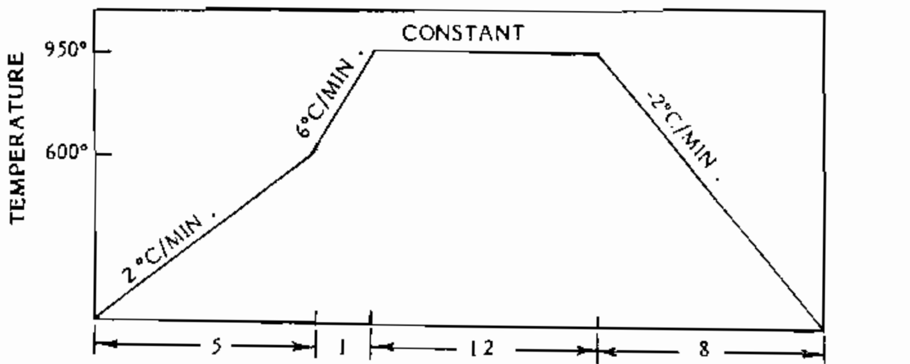

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2	0.8	17.0	56.0
3	3.0	24.0	59.0
4	2.0	17.5	19.0
El-Dakhlah Region			
5	0.7	27.75	121.0
6	0.0	22.57	31.0
7	10.0	19.75	58.0
8	1.0	18.75	60.75
9	0.0	32.00	85.0
10	--	--	--
11	--	23.00	46.0
El-Khargah Region			
12	4.0	16.13	31.22
13	3.0	26.00	46.00
14	-	--	--
15	2.0	17.00	57.00
16	--	--	--

CONCLUSSION

Based on both the field study and laboratory testing the following conclusion can be drawn :

1- The lab results has revealed the high potential of a respectable number of shales in Elwadi Elgedid for use in bricks production.

2- The amounts of shale materials that have proven high potential for bricks production in any of the three regions; Abou-Tartour, El-Dakhla and El-Kharge, are enough for a factory producing a minimum of 10 million bricks per year for one hundered years.

3- Based on the availability of basic facilities for constructing a brick industry, such as ; energy resources, water resources and location relative to transportation facilities, the Abou-Tartour shale has proven the highest potential followed by El-Dakhala and El-Kharga.

4- Bricks made from Elwadi Elgedid shales have proven high compression resistance. All samples except 4, 10, 11, 14 and 16 have a compression strength greater than that allowed in the codes of practice (4).

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