Effect of Fire Clay Powder on The Properties of Ceramic Materials Produced by Using Kaolin

Hazim Falih / Assis Lecturer
Department of chemical Industries
Institute of Technical / Anbar
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Abstract

Fire clay are directly into kaolin with different weight percent. Density, shrinkage , water adsorption properties were studies at ($1000C^0$) and ($1200C^0$) . All samples pressed under (10 tan) . The results showed that the fire clay increase density , at the same time decrease the shrinkage and water adsorption .

Keywords: Fire Clay, Ceramic Materials, Linear Shrinkage, Water Adsorption Refractory

1. Introduction

Kaolin has a low shrink-swell capacity and a low cation exchange capacity (1-15meq/100g) .It is a soft, earthy, usually white mineral (decahedral phyllosilicate clay),produced by the chemical weathering of aluminum silicate minerals like feldspar. In many parts of the world, it is colored pink-orange-red by iron oxide, giving it a distinct rust hue. Lighter concentrations yield white, yellow or orange colors.[1] Kaolin is a clay mineral with chemical composition $AL_2SiO_2O_5(OH)_4$.It is a layered silicate mineral, with one tetrahedral sheet linked through oxygen atoms to one octahedral sheet of alumina octahedral. [2] Rocks that are rich in kaolin are known as china clay or kaolin. Fire clay is a specific kind of clay used in the manufacture of ceramics, especially fire brick. The fire attribution is given for its refractory characteristics. There are two types of fire clay: flint clay and plastic fire clay.[3] It is resistant to high temperatures, has a fusion point higher than 1,600°C, and therefore it is suitable for lining furnaces, as fire brick, and manufacture of utensils used in the metal working industries, such as crucibles, sag gars ,retorts , and glassware. Because of its stability during firing in the kiln, it can be used to make complex items of pottery such as pipes and sanitary ware. Its chemical composition consists of a high percentage of silicon and aluminum oxides, and a low percentage of the oxides of sodium, potassium, and calcium .Unlike conventional brick-making clay, it is mined at depth, usually found as a seat earth associated with coal measures.[4]

2. Experimental

Kaolin powder (mesh No.300 μm) and density 1.46 gm/cm^3) were milled Then mixed with fire clay powder (62-67 μm diameter). Take constant weight of all type of mixture (10 gm) and pressed into disc (40 mm) at(10 Ton) to form compact, by using different weight percentage we obtain different samples. Compact samples drying at ($110C^0$) shown in **table (1)**. Then the specimens were fired in two stages, the first stage held at a temperature of ($1000C^0$) for two hours . Finally, they were fired at ($1200C^0$) kept at this temperature for two hours.

3. Result and discussion

3.1 Linear Shrinkage and height

Fig (1), Demonstrate the linear shrinkage and height decrease when fire clay increase in composite because the fire clay has low porosity , also when fire the specimens the linear shrinkage and height decrease when increasing firing temperature due to decrease in the apparent porosity which effect by sintering process, this shown in **table (2),(3) and Fig(1)** .

3.2 Density

It is clear that density composite increase with increasing fire clay percent due to decrease in porosity. The increment in firing temperature causing presence of low porosity through sintering process , due to bind the particles together , this is shown in **Fig (2)** .

3.3 Water adsorption

It is found that the level of linear shrinkage decrease with increasing fire clay ,that leads to decreasing of porosity. Water adsorption is a property which depend on the level of porosity present in composite, **Fig (3)** shows the water adsorption decrease with increasing fire clay and firing temperature.

4. References

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Table(1): Effect of fire clay percent on the height

Drying 11 0±5 C°			
No.	**Kaolin%**	**Fire clay%**	**Height(mm)**
1	**100**	**Zero**	**11.58**
2	**97**	**3**	**11.9**
3	**95**	**5**	**11.85**
4	**93**	**7**	**11.78**
5	**90**	**10**	**11.6**
6	**85**	**15**	**11.55**

Table(2): Effect of fire clay percent on Properties of ceramic

Drying 11 0±5 C°				**Firing at1000 C°**			
No.	**Kaolin**	**Fireclay %**	**Height (mm)**	**Linear Shr. %**	**ρ (g/m^3)**	**Water adsorption %**	**Apparent porosity %**
1	100	Zero	11.27	6.32	1.51	4.21	12.7
2	97	3	11.23	6.72	1.52	4.19	12.3
3	95	5	11.19	6.32	1.52	3.9	11.85
4	93	7	11.15	4.92	1.54	3.72	11.61

Table(3) : Effect of fire clay percent on Properties of ceramic

Drying 1 10±5C°			**Firing at 1200C°**				
No.	**Kaolin %**	**Fireclay %**	**Height (mm)**	**Linear Shr.%**	**ρ (g/m^3)**	**Water adsorption %**	**Apparent porosity %**
1	100	Zero	10.8	11.01	1.62	3.16	10.2
2	97	3	10.6	11.2	1.62	2.95	9.64
3	95	5	10.54	8.29	1.65	2.77	9.13
4	93	7	10.5	8.28	1.65	2.63	8.33
5	90	10	10.5	14.28	1.67	2.45	7.77
6	85	15	10.5	8.01	1.69	٢.٣	6.35

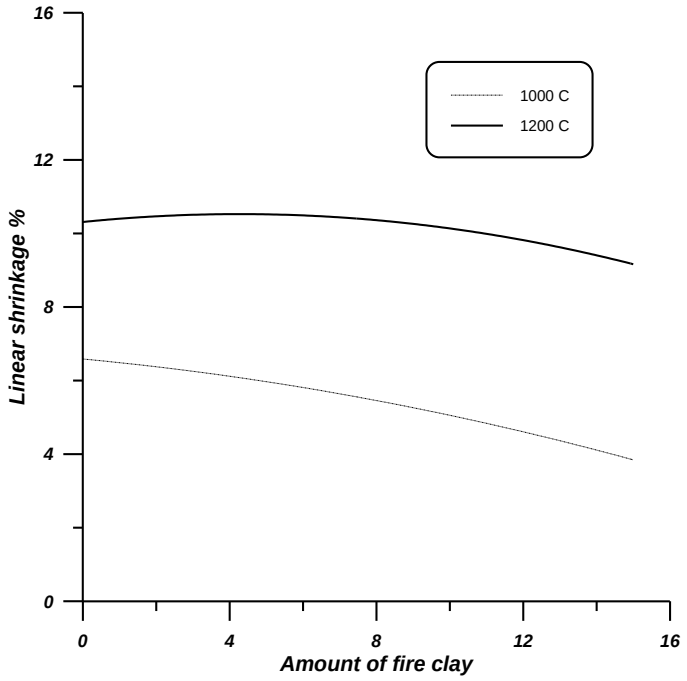

Fig. (1) : Effect of fire clay on linear shrinkage

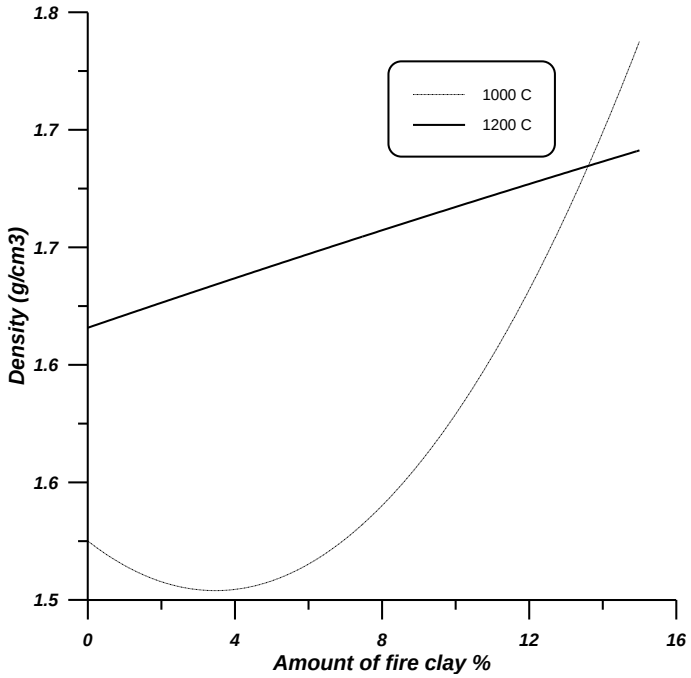

Fig. (2) : Effect of fire clay on density

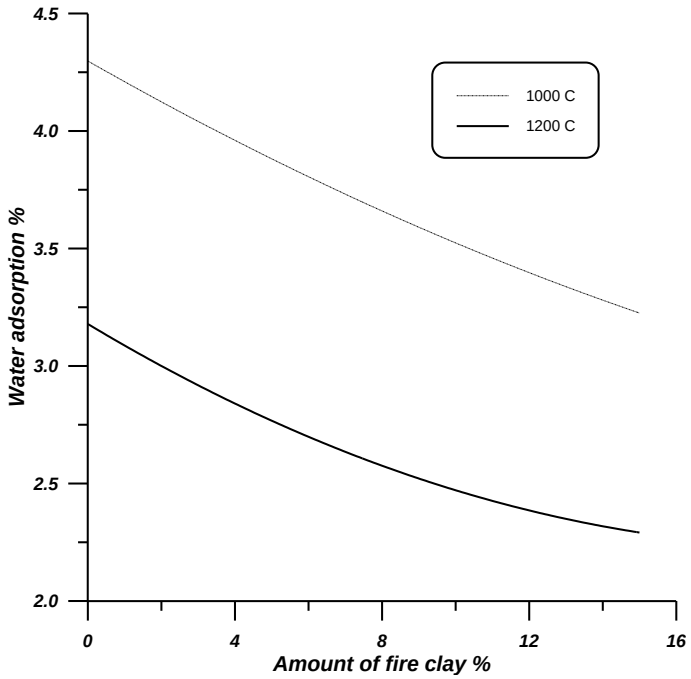

Fig. (3) : Effect of fire clay on water adsorption

تأثير مسحوق الطين الناري على خصائص المواد الخزفية المنتجة باستخدام الكاؤولين

المهندس حازم فالح حسن
مدرس مساعد
المعهد التقني /الانبار..قسم الصناعات الكيماوية

الخلاصة:

تم في هذا البحث دراسة تأثير إضافة مسحوق الطين الناري الى الكاؤولين بنسب وزنيه مختلفة ودراسة خصائص الكثافة ، نسبة التقلص وامدصاص الماء للنماذج ،التي تم كبسها تحت حمل (١٠ طن). النتائج أشارت إن مسحوق الطين الناري يؤدي إلى زيادة الكثافة للمواد السيراميكية المكبوسة في الوقت الذي يؤدي إلى نقصان في التقلص وامدصاص الماء للنماذج.

الكلمات المفتاحية :**الطين الناري، مواد سيراميكية،انكماش خطي،امدصاص الماء،الحراريات**.