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RECLAMATION OF THERMAL SHOCK STRENGTH OF KINIK (PAZARYERİ-BİLECİK ,TURKEY) POTTERIES BY ADDING SEDIMENTER SEPIOLITE

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In this study, it is aimed to increase the thermal shock strenght of terra cotta products by adding sedimenter sepiolite. In the course of the study, Kınık's village pots were tested. In (+250 µm, -250µm - +125 µm and -125 µm) was added to Asanlar clay which has been utilized by the potters. It was determined that sepiolite addition has drastically increased the thermal shock strenght of the pots. Furthermore, the previous studies that have been done for this matter were criticized and analysized for compiling. At the end ofthe previous studies, the researchers have determined that the additives have relatively increased the thermal shock strength of Kınık (Pazaryeri-Bilecik) pots.

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Keywords: Sepiolite, thermal shock strength, Kınık potteries.

1. Introductıon

Pots are the materials that are formed of non-organic compounds and obtained on a turning lathe by hand shaping then dried and fired till it reaches sufficient hardness. The most archaeologists have found in surveys and excavations are potteries. A region's cultural characteristics and their place in time are evaluated by architectural remains, graves and pottery bowls occured in the excavations. In this respect potteries are the basis of archaeological knowledge. It is not exactly known how human being has discovered the pottery. Generally accepted assumption is that man has incidentally found out that soil has gained strength after burning in the fire. Whatever discovering the pottery is, the beginning and development of pottery depends on turning of nomadic tribes to settled life. It is known that the first potteris produced in Anatolia belongs to Neolithic period, about BC 7000. Almost for ten thousand years Anatolian people are shaping the soil transforming it into mud by mixing with water. The first products have been shaped by wrapping and winding technique, and the firing has been done on open fire. By BC 3000 the potter found out the lathe and begun to shape patteries on it [1-13].

Pottery in the village of Kınık was initiated by the master potter Şakir who has emigrated from Bulgaria in 1877. Since that time the citizens of the village of Kınık have carried on pottery until today according to changing of pleasure and need. The village of Kınık which is also known as Pottery Research-Development and Practice Village is representing the opportunity of studying and having experince about pottery for the students. There are approximately 40 workshops producing ceramic, ewer, jug, earthenware jar, noodle, teapot, yogurt and meal casserole by using the soil of this region. The mud onwhich the most perfect front lining that has the tone of ivory being the most important fact for quality ceramic can be applied exists only in the village of Kınık. In order to access the best layer of soil it is required to dig to a depth of four meters from the surface and samples are taken from deeper layers when necessary. So a hard and heavy soil is

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obtained and then it is carefully purified in order to use in production. The potteries and ceramics of Kınık which are processed by a common technique in Anatolia called underglazing can be designed by beige, dark green and purple, dark blue, cobalt blue, orange and brown linings onto background including cream or ivory colors [6,10,11,12,13,14,"15,"16,17]. However the cracks occured when potteries are used for cooking could not be stopped. It is estimated that the reason of those cracks is related to the low thermal shock resistance of the potteries. Prevention of cracks will increase both competitiveness and market share of pottery manufacturers. This is the main purpose of this study , briefly; it is aimed to improve the thermal shock resistance of the Kınık potteries by addition of different grain-sized dolomitic sepiolite and thus to resolve the marketing problems of manufacturers. Sepiolite with its catalytic and rheological properties including high surface area, fiber structure, porosity, crystal morphology and composition, surface activity has the ability of providing responsive suspensions with high viscosity at low concentrations. The structure of sepiolite is sensitive to heat treatment so that zeolitic and adsorbed water molecules move away from the structure with the increasing of temperature. In engineering applications, the case of sudden heating or cooling of a material with large temperature differences is called "thermal shock", and the resistance against this thermal shock is called "thermal shock resistance". Rapid heating or cooling of a ceramic structure causes cracks and other defects in the structure. Thermal shock may be associated with some basic features common to ceramic materials. These materials do not ragularly get hot or cold by sudden temperature changes by means of their low thermal conductivity. Therefore some internal thermal stresses that can not be removed by changing material's shape ocur [1-17].

2. Materıals and methods

This study was conducted in three stages including laboratory, pottery business trip and office work as well as literature researches. As laboratory studies; grinding, sifting, phephercorne test, masse preparation, chemical and physical analysis have been made. With the trip to the pottery manufacturers. At the trip to the pottery manufacturers, the informations about production have been received and environment conditions have been seen on-site. At the office work, datas of the first and second steps were gathered then compiled and written. The clay whose required grain size was particularly determined for this composition was supplied from Asanlar A.S. and was grinded by a laboratory type rolar mill till the particle size below 500µm. Grinding process was carried out between 30-second time. The grinded clay has been dried in a drying oven, sieved to the grain size of 500 µm and then stored in an air-proof plastic bowl. Sepiolite used as adjunct was also grinded in the rolar mill in order to achieve the grain sizes of -125µm, +125µm – 250µm and +250µm in accordance with the study. The grinded sepiolite was oven-dried and then sieved respectively as -125µm, +125µm – 250µm and +250µm. Finally the classified sepiolite was stored in an air-proof plastic bowl. The prepared raw material and additions were mixed in order to make the samples. Accordingly, %20 sepiolite additions and %80 Asanlar clay were mixed forming a total weight of 3kg. According to applicable rates, totaly 3 kg combinations were achieved by mixing 2400g of clay and 600g of sepiolite. For this purpose, three groups of mixture were prepared. To obtain the structure water was added and amount of water was determined by the plasticity test done for each group. Phephercorne plasticity measurement technique was used fort his purpose. In the thermal shock experiments standard sized specimens were suddenly cooled in the water after a careful process of heating. For this purpose, prepared samples have been waiting for 30 minutes on the fire and in the meantime, the water level related to the time was recorded. Then the samples were immersed in cold water to observe if there are any cracks and other problems or not. The reason for using this method is to determine if any defects occured or not on the cooking potteries during and after firing[4-17].

3. Results and dıscussıon

The chemical analysis of sedimenter sepiolite is as follow (Table 1-2; Figures 1-9):

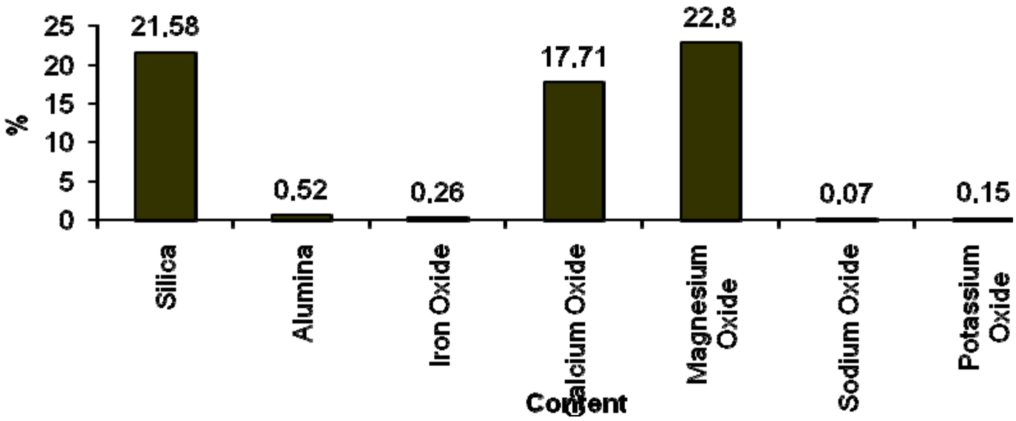

Table 1 . The chemical analysis result of sedimenter sepiolite.

The chemical analysis of Asanlar clay is as follow,

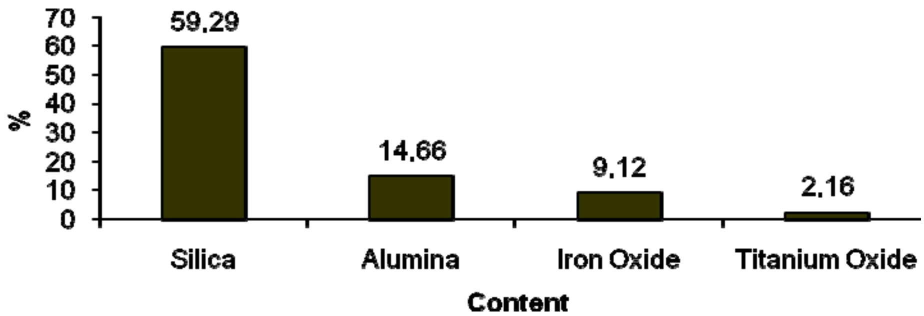

Table 2 . The chemical analysis result of Asanlar clay.

These chemical analysisses are made using atomic adsorption methods in Kutahya Porcelain research and development laboratories. As seen from the results, Asanlar clay and sedimenter sepiolite have a high percentage of silica. There is a very small amount of Al_2O_3 and instead of that more calcium and magnesium oxides are included. The amount of iron is also very little. The amount of excess iron in the clay is more than substantial amount. In the study of first group over 250µm grain sized sepiolite, in the study of second group between 250µm and 125µm grain sized sepiolite and in the study of third group under 125µm grain sized sepiolite was mixed with the Asanlar clay having a ratio of %20 (weight). And then the changes were investigated [5-17].

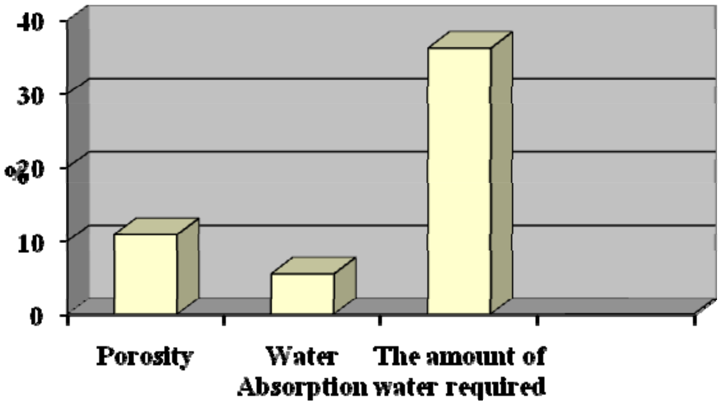

Fig. 1.Diagram representation of porosity, water absorption and phephercorne test results of pottery sample which includes %20 (weight) and +250μm grain sized sedimenter sepiolite.

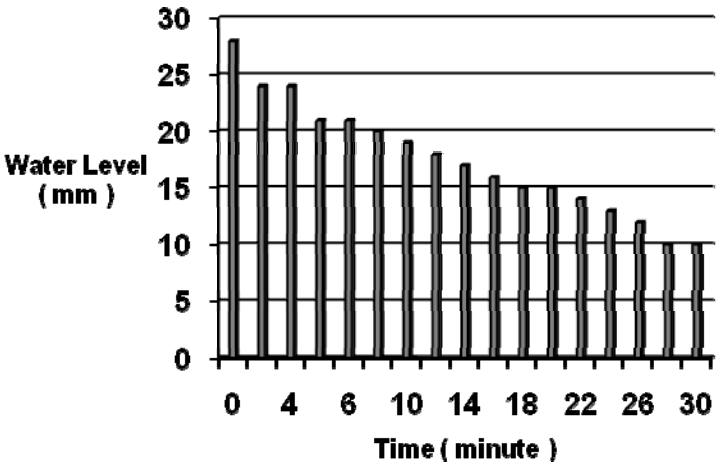

Fig. 2. Graphic that shows the time-dependent water level in the pottery sample when it is on the fire. Containing %20 (weight), +250μm grain sized sedimenter sepiolite and %80 (weight), maximum 500μm grain sized Asanlar clay.

Fig. 3. Sample image after thermal shock test.

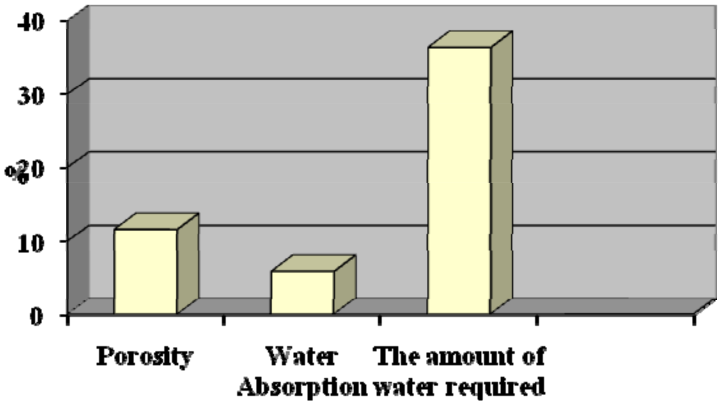

Fig. 4. Diagram representation of porosity, water absorption and phephercorne test results of pottery sample which includes %20 (weight) and +125µm -250µm grain sized sedimenter sepiolite.

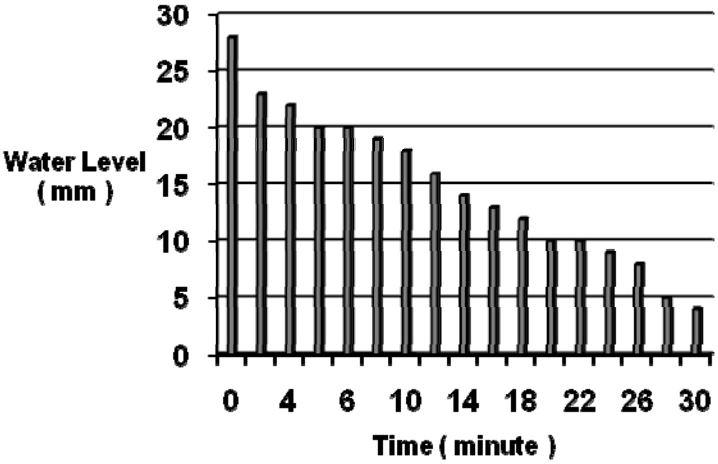

Fig. 5. Graphic that shows the time-dependent water level in the pottery sample when it is on the fire. Containing %20 (weight), +125µm -250µm grain sized sedimenter sepiolite and %80 (weight), maximum 500µm grain sized Asanlar clay.

Fig. 6. Sample image after thermal shock test.

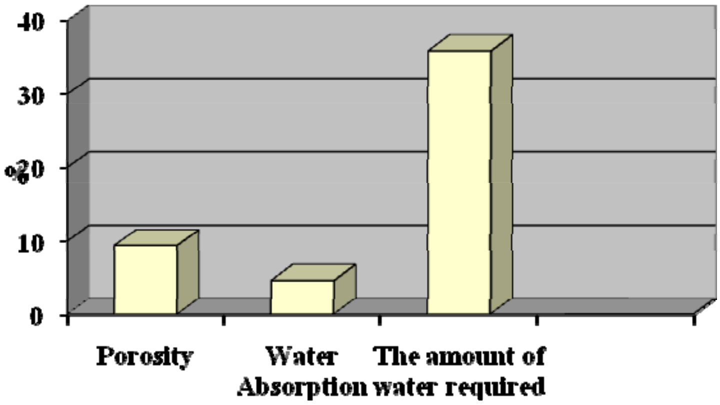

Fig. 7. Diagram representation of porosity, water absorption and phephercorne test results of pottery sample which includes %20 (weight) and -125µm grain sized sedimenter sepiolite.

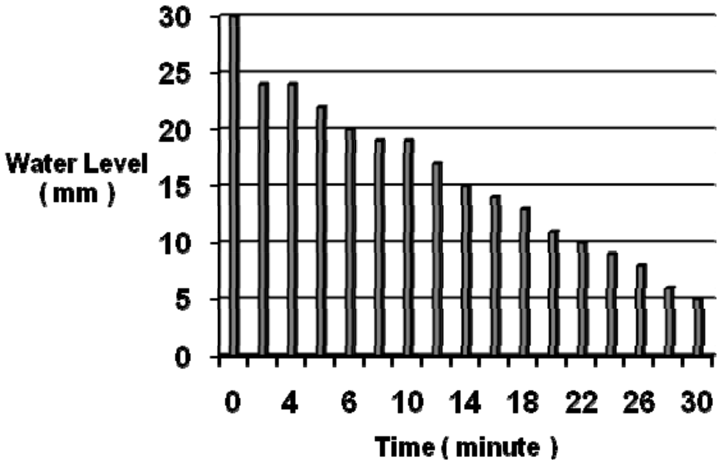

Fig. 8. Graphic that shows the time-dependent water level in the pottery sample when it is on the fire. Containing %20 (weight), -125µm grain sized sedimenter sepiolite and %80 (weight), maximum 500µm grain sized Asanlar clay.

Fig. 9. Sample image after thermal shock test.

When results are examined it is obvious that sepiolite can be used as alternative and / or additional material in potteries and also in ceramics with its surface area, absorption and water absorption properties. After thermal shock resistance test applied to the potteries which contains %20 (weight) sedimenter sepiolite added with grain sizes of -125µm, +125 -250µm and +250µm and %80 (weight) Asanlar clay having grain size of -500µm, there was no split or breaking, furthermore it is determined that by the increase of temperature only water has moved away from the sample by evaporating and did not cause any harm to the pottery. Thus, this consequence shows us that addition of sedimenter sepiolite to the pottery body heals the thermal shock resistance of the pottery products. And the visual controls applied to the samples has also supported this result so that there were not any crack, split or breaking seen on the patterns [4,14-17].

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