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Effect of Addition Waste Wood in Physical Property of Ceramic

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Abstract:

Waste of wood was used as additive materials to enhance the porosity and physical properties of ceramics. The experimental laboratory work documented in this research involved four stages: the first involved preparing ceramics from kaolin at 1100°C, by Molding Process. The second stage required further development of the ceramic composition by adding wood waste (1,2,3, and 4%wt). Sections 3 and 4 required studies of the physical and mechanical properties of ceramics after and before modification and that were done by using scanning electron microscopy, apparent porosity, water absorption, bulk density, the linear shrinkage and the fracture strength. According to the results have shown that waste wood succeeded in increasing the porosity of synthesized ceramic.

Keywords: Ceramic, Kaolin, Waste wood, Molding process, Porosity.

Introduction:

The ceramic material is inorganic, consisting of metallic oxide, nitride, or carbide for some elements, mostly it could exist as pristine elements with a specific structure, such as carbon or silicon. However, ceramic behavior is hard, strong in compression, and weak in shearing and tension [1]. Ceramics according to porosity include two types, which are porous ceramics, which have microscopic pores within their structure, and those responsible for altering their properties. The second type, nonporous ceramics, is dense and exhibits properties like high strength, corrosion resistance, and electrical insulation, while the first is typical for filtration, insulation, or enhanced surface area applications [2].

Porous ceramics can also be classified into Microporous, Mesoporous, and Macroporous materials according to the size of their pores, when shown as 2 nm, 2-50 nm and over 50 nm respectively. Methods and Techniques for Fabrication of Porous Ceramics generally include four methods: Partial sintering, Sacrificial fugitives, Replica templates, and Direct foaming [3].

Ceramic porous materials are commonly used in many technical and industrial applications due to their specific properties. Thus, a lot of attention was done to make more benefit from these materials. The attention was reported by many types of modifications with different materials which shown influenced by a variety of factors such as the raw material, manufacturing process, and sintering conditions.

The primary continent of ceramics is Kaolin ($Al_2Si_2O_5(OH)_4$), characterized by a very fine grain size, and good bonding strength during sintering, which are responsible for the porosity of the final ceramic product [4]. Many attempts deal with modifying creaming by changing conditions of the synthesizing process [5], such as temperature heating for the reactions with specific controls for specific production for applications. The other studies that are concerned with developing ceramics used natural resources, such as corn leaf ash, Banana Frond Powder, and poppy (Papaver rhoeas L.). The additives were particularized with large size, narrow size distribution, shape, density, density, and they are available in the environment at low cost [6]. The addition of corn leaf ash with alumina (Al2O3) material heated by a furnace at 600 0C with different ratios of 100%: 0%, 90%: 10%, 80%: 20% and 70%: 30% of alumina using the dry pressing method [7]. This clay and banana frond powder with a grain size of 200 mesh by employing the dry-pressing method which is heated to a sintering temperature of 1000°C with a holding time of 3 hours [8]. Commercial poppy seed was added to Porous alumina ceramics have available poppy seed in combination with a new ceramic shaping technique called starch consolidation casting. The heating reaction was 1570 °C with a heating rate of 2 °C/min which formed a bimodal distribution, corresponding closely to the original size of the pore-forming agents [9]. In this work, the effect of additions of different ratios of waste wood WW on some physical and structural properties was reported, which are enhanced by characterizing specific technical to explain the change in behavior of new ceramics after modification.

Experimental:

1. **1.Raw Materials:**

Three raw materials were used in this work, which are waste of wood, kaolin and polyvinyl alcohol as shown in figure 1. Wood as waste WW was supplied from the local market. Three raw materials were used in this work, which are waste of wood, kaolin and polyvinyl alcohol. Wood as waste WW was supplied from the local market, which was milled to particle size (150 mm). Polyvinyl alcohol – PVA was supplied by Zibo Aiheng New Material Co., Ltd. China with 98.6% in purities. The sieving process for the raw materials was carried out by using a sieving shaker type (Retsch GMbIH 5657HAAN), by using sieves (150) µm. Dwaikhla kaolin clay is supplied by the Iraq Geological Survey in natural-sized rocks, which contain SiO_2, Al_2O_3, Fe_2O_3, K_2O, Na_2O, MgO, CaO, and L.O.I with percent weight wt% 61.15, 22.23, 1.11, 4.0, 4.01, 4.01, 4.32, and 13.9 respectively.

Figure (1) : Photo of waste wood on the left and Kaolin on the right.

1.2. Synthesized pristine ceramic by Molding Process

15 g of kaolin was mixed with 2 ml of PVA as a binding agent, then poured the batter into a mold which was prepared for this purpose, then pressed at 10 tons. After drying overnight, the matrix was heated to 1100 C by Nabertherm Muffle Furnace with the rate of ascent of 7 C /min. for an hour.

1.3. Modifying ceramic with different ratios of WW

In the second part of preparation, different ratios of waste wood WW (1, 2,3, and 4%) were added to kaolin using the same steps of synthesis which are mentioned above. Figure 2 refers to the steps for modifying kaolin with WW to forming modifying ceramic with new porosity.

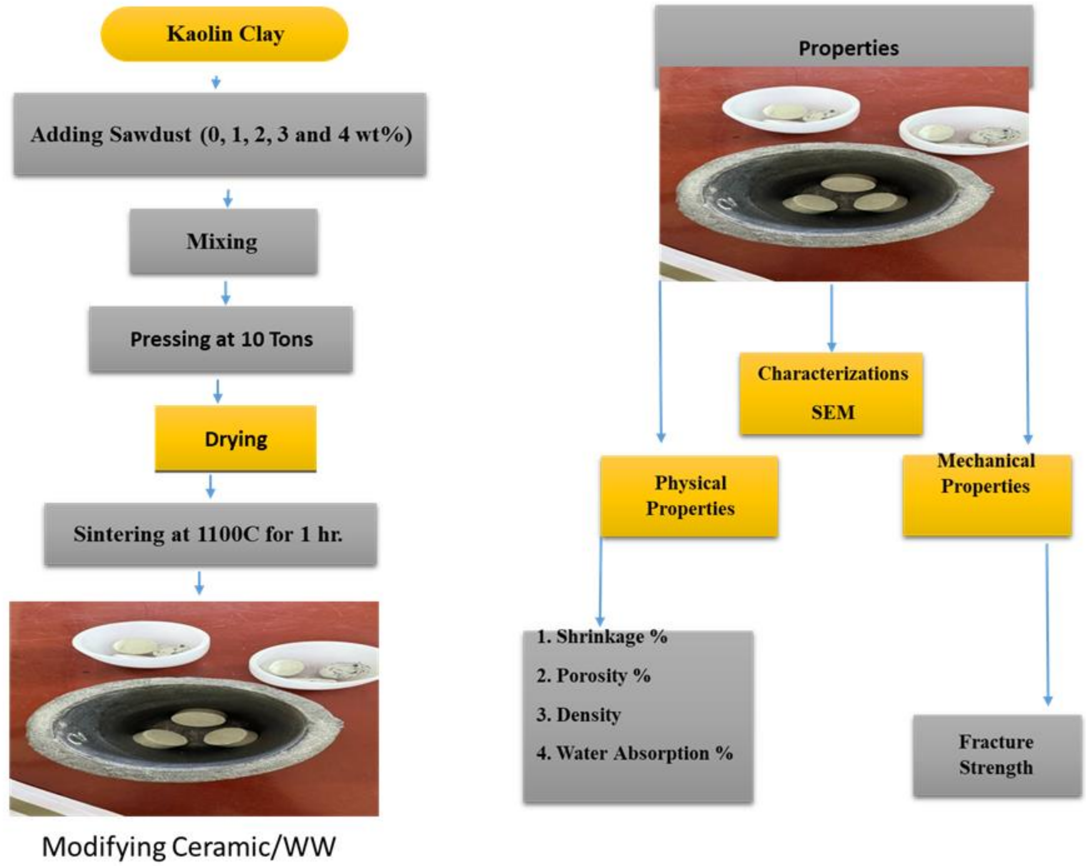

Figure 2: Skim for synthesized Kaolin/MM in the left and characterization with studding physical properties in the right.

2.Characterization:

2.1 Apparent Porosity and Water Absorption

Figures (3, a) present the effect of different additions WW on the apparent porosity and water absorption of the kaolin. It has been shown that the apparent porosity and water absorption of the kaolin clay specimens are increased with increasing sawdust due to the additions. It will fire during the sintering process and release large amounts of CO and CO2 gases resulting from the decomposition of these materials. Therefore, these gases generate pores and thus decrease the densification of kaolin clay particles[10]. 2.2 Bulk density

Figure (3b) reported the results of pristine and modifying ceramic with different ratios of WW. The bulk density of the kaolin clay specimens is decrease with increasing the additions contents; this is due to decreasing in the apparent porosity.

The results reported that 4% of WW was causing largest digresses in behavior [11-12].

2.3 Linear shrinkage and fracture strength

Figure (3c) reveals the effect of different additions of WW. The linear shrinkage of the kaolin clay specimens is decreasing with increasing the addition's contents; this is due to a decrease in the apparent porosity and water absorption. Figure (3d) shows the effect of different additions of WW on the fracture strength. It has been shown that the fracture strength of kaolin clay specimens has decreased with the increase of the additions contents due to because the strength values are highly correlated with density and porosity, so reducing the number of defects in a specimen is a common way of increasing its fracture strength [13].

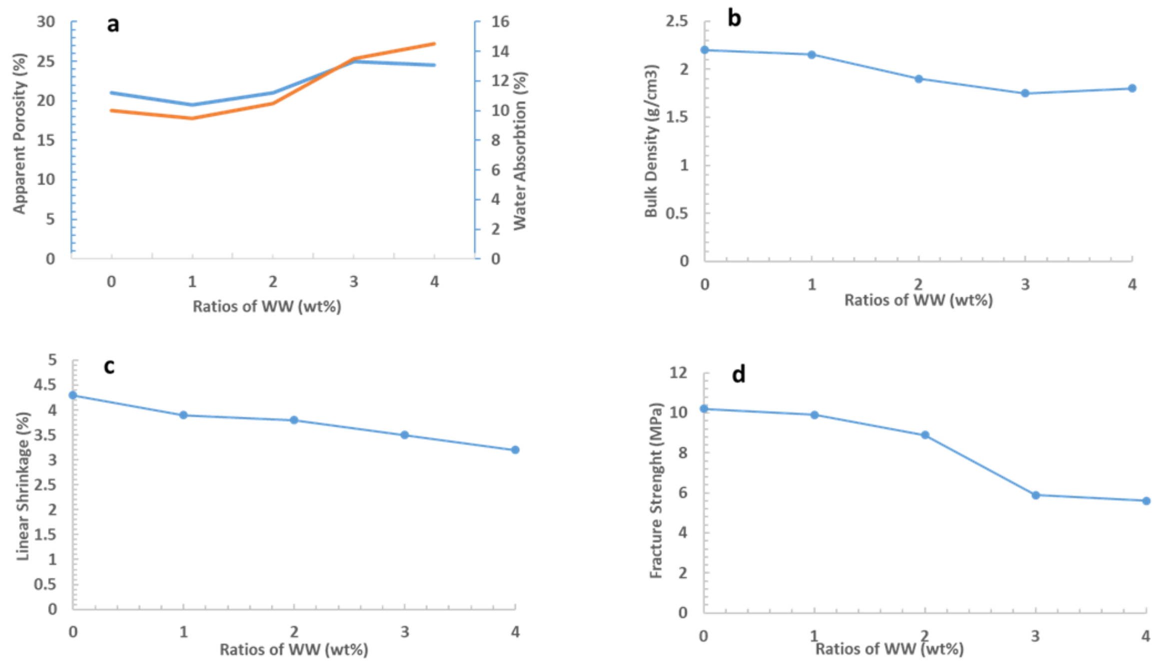

Figure (3): Effect of WW additions on the(a) apparent porosity, water absorption (b) bulk density (c) the linear shrinkage (d) and the fracture strength of kaolin clay samples after modification.

2.4 **SEM Characterization**

The SEM micrographs for the fracture surface of kaolin samples were taken for pristine kaolin and modified with 3% WW, which is reported in Figures 4 and 5, respectively. The SEM microstructure displays a regular and smooth fine-grain microstructure of the kaolin sample with the smooth phase appearing as it is uniformly distributed on all the sample surfaces. Figures (5) show the SEM micrographs of the fracture surfaces of kaolin samples containing 3 wt% of WW, which are shown to become more porous, due to an increase in the porosities of partials from WW.

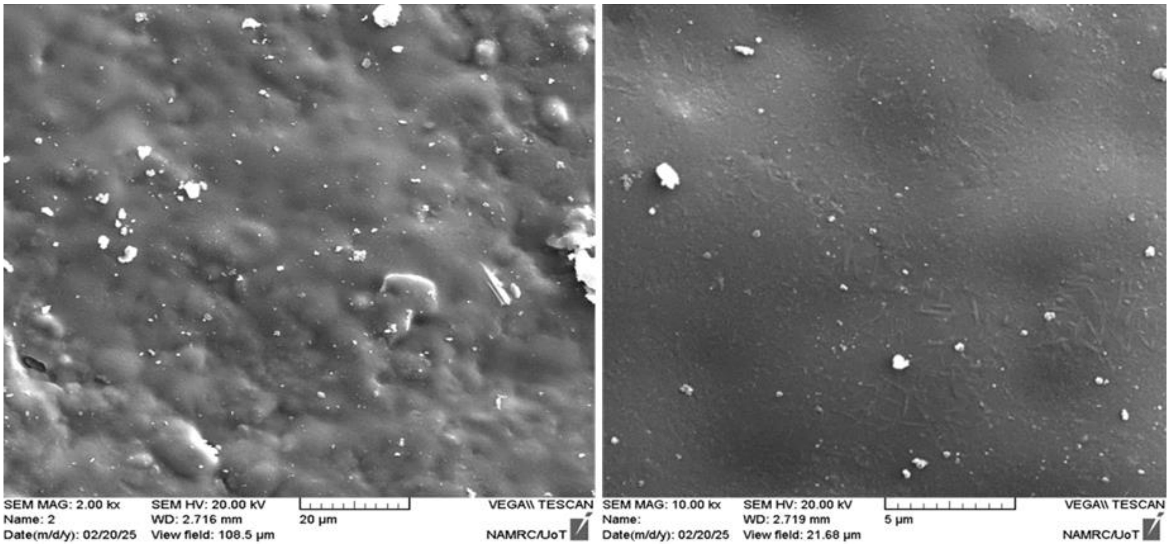

Figure (3) SEM micrographs for pristin Kaolin samples with different magnifications

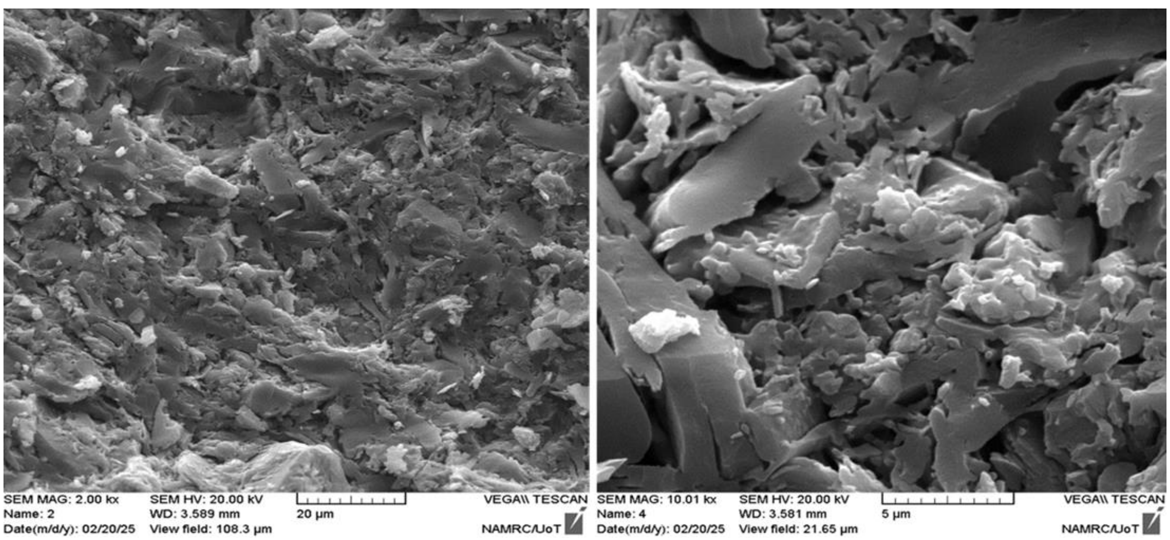

Figure (4): SEM micrographs for Kaolin/WW (3%) with different magnifications

Conclusions:

The main conclusions obtained from the present work can be summarized as succeeding additive materials to make changes in the behavior of kaolin. Maybe the change is not enough to cause variance in properties, but it’s good for making more modifications and research. The waste of wood WW as additives to kaolin specimen have different behavior for pore-forming agents and that shown changes in the physical and mechanical properties of ceramics after modifying. The results of modification generally give increased total water absorption and apparent porosity. The results may show enhancement in low value according to the conditions of preparation, but changing the conditions could produce more and more change to a new porosity with higher value.

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