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(54) Title: RECIPE OF HIGH SCRATCH-RESISTANCE FOR PORCELAIN TABLEWARE

(57) Abstract: The invention relates to a recipe of high scratch-resistance for porcelain tableware and a method of production for porcelain tableware manufactured so as to have a minimum hardness of 6.5 Mohs by use of this recipe.



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RECIPE OF HIGH SCRATCH-RESISTANCE FOR PORCELAIN TABLEWARE

Technical Field

The invention relates to a recipe of high scratch-resistance for porcelain tableware
5 and a method of production for porcelain tableware manufactured so as to have a minimum hardness of 6.5 Mohs by use of this recipe.

Prior Art

The word porcelain is derived from the word porcella, the Italian name of a mussel
similar to a porcelain. As far as is known, the term "porcella" was used for the first
10 time by Marco Polo for these products from China. Different expressions can be used to describe the porcelain.

Technically speaking, porcelain is one of the most successful products obtained by the ceramics and it is a ceramic material which semi-light transmittance and also durability is provided on and can be used with or without glazing for technical or
15 artistic purposes. In other words, it is a mass of two parts, the biscuit (body) and the glaze. Biscuit is the name given to ceramic products that have been shaped, dried or fired but not yet glazed. The various substances, glass or other crystals combined with glass in the finished product is only compounded by being fired. The porcelain glaze is similar to glass in its composition. Biscuits, a more meaningful expression by
20 its body or its fired form, are made up of glass in which other very small crystals are added at the ratios of 70-80%. The glass-like paste is also the cause of the porcelain being transparent (light transmittance). The properties that distinguish porcelain from ceramic or soil based materials include light transmittance, low porosity, water absorption with less than 1%, hardness and strength. However, the most important
25 problem in the current situation is the scratches which may occur as a result of the intensive use of porcelain tableware especially in the hotel, restaurant and cafe sector and the customer complaints caused by these scratches. The most important reason for the occurrence of these scratches is that the hardness value of porcelain products used in the current situation is around 5.5 Mohs and this hardness value

cannot be increased. The hardness value of TSE 10850 Porcelain Tableware Standard was determined as 5,5 Mohs. However, this hardness value determined by the standard falls short of preventing the scratches occurring as a result of intensive use of porcelain tableware.

- 5 When existing products are examined, it is observed that there is no porcelain tableware with a minimum of 6.5 Mohs hardness. In the conducted patent search, no technical information such as a method or a recipe developed for achieving this hardness value has been found.

Although there is no similar patent in the patent search, the patent application
10 TR2018/03956 relates to a porcelain material-made plate, the underside of which a relief is applied to, and a method of its production for increasing the resistance of particle breakage, rising the fracture resistance, and making an aesthetic appearance.

The patent application TR2018/03898 relates to a method of coating with nano PVD
15 titanium increasing the color variety of porcelain without disturbing their surface shapes and preventing the product color from fading when being contacted with water and detergent in a dishwasher or by hand washing unless the product colour is exposed to impact and is not scratched during cleaning, characterized by comprising the process of washing and cleaning of porcelain with an ultrasonic washing
20 machine, wiping and drying porcelain with gasoline and then wiping with ethyl alcohol, placing the cleaned porcelain on the hanging apparatus in the coating machine, vacuuming of the internal oxygen to open all the pores on the porcelain, coating of porcelain with argon, nitrogen, acetylene and oxygen gases sprayed to the internal environment alone or together at certain rates with a certain pressure and
25 duration in order to obtain silver, copper, gold, rainbow colours and other colours after vacuum.

Objective of the Invention

The invention relates to a recipe of high scratch-resistance for porcelain tableware and a method of production for porcelain tableware manufactured to have a minimum
30 hardness of 6.5 Mohs by use of this recipe.

An object of the invention is to prevent customer complaints by preventing scratches on porcelain tableware due to intensive use, especially in hotels, restaurants and cafes.

Another object of the invention is to increase the scratch resistance of the porcelain tableware by increasing the hardness of the porcelain tableware to a minimum of 6.5 Mohs or higher.

Another object of the invention is to develop a production process for making the recipe, which is developed for increasing the scratch resistance of porcelain tableware, into the final product

10 Detailed Description of the Invention

The invention relates to a recipe of high scratch-resistance for porcelain tableware and a method of production for porcelain tableware manufactured so as to have a minimum hardness of 6.5 Mohs by use of this recipe.

In the production of porcelain tableware, glaze application is required which ensures the surface quality. In this case, reactions occur during the glaze firing, and each raw material used in the glaze recipe has different reactions during firing. This brings the formation of our surface quality.

The glazing process is applied after the biscuit production in our porcelain tableware production process according to the invention. The final porcelain product is formed after glaze firing.

The recipe for the porcelain tableware according to the invention comprises the following raw materials:

- 22% to 50% by weight of feldspar derivatives ($K_2O \cdot Na_2O \cdot Al_2O_3 \cdot 6SiO_2$),
- 3% to 12% by weight of Kaolin derivatives ($Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$),
- 3% to 12% by weight of Aluminum oxide derivatives (Al_2O_3),
- 15% to 45% by weight of Quartz (SiO_2) derivatives,

- 15% to 45% by weight of Calcium derivatives (CaO)

As a result of the use of raw materials (Kaolin, Feldspar, Quartz, Alumina, CaO derivatives etc.) in various proportions, the products that are transparent, bright, matte, compliant with the standards, impact resistant, suitable for water absorption, stain resistant and having scratch resistant surface are produced.

The scratch resistance is increased with the addition of heat-treated quartz (SiO_2) at elevated temperatures, which is used in different proportions in the recipe of the present invention as a novelty compared to the available recipes, and raised to a minimum of 6.5 Mohs or higher. The ratio of heat-treated SiO_2 derivatives is between 1% and 20% by weight.

The quartz (SiO_2) is enabled to have resistance to abrasion during the firing reaction and its scratch resistance is increased. The scratch resistance is increased due to the recipe developed by supplementing the quartz (SiO_2) kept subject to the heat treatment in the high temperatures by keeping the quartz (SiO_2) ratio fixed in total. While these works are performed, they are performed without disturbing the rheology balance in the glaze recipe. For this reason, the values of density, viscosity, Gallenkamp (thixotropy) and particle size, which are among the parameters affecting the Rheology, are kept the same as the standard glaze.

The process steps of the method of production performed from the recipe to the final product are also described in the following.

- Hard raw materials, which have been micronized in dry before, (22% to 50% by weight of feldspar derivatives ($\text{K}_2\text{O} \cdot \text{Na}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 6\text{SiO}_2$), 3% to 12% by weight of Aluminum oxide derivatives (Al_2O_3), 12% to 45% by weight of Quartz (SiO_2) derivatives, 1% to 12% by weight of Calcium derivatives (CaO)) are blended and subsequently loaded and grinded on a mill or other equipment,
- The particle size and surface area of raw materials grinded in the mill or in a different equipment are determined,
- The micronized and grinded hard raw materials are mixed with kaolin derivatives and made into mud condition at appropriate values,

- The product groups are shaped by the compression of the granules, which are obtained by drying the prepared mud in a spray drier with the addition of binder, with the pressure within the mold by isostatic presses,
- 5 - The biscuit firing of the products of the desired humidity is done at approximately 980 - 1010 °C in a kiln after the shaped raw product has been taken out of the dryer and the water in its body has been evaporated.
- 10 - It is passed to the glazing application after biscuit firing and the raw materials [Kaolin ($\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$), Feldspar derivatives ($\text{K}_2\text{O} \cdot \text{Na}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 6\text{SiO}_2$), Calcium derivatives (CaO), Quartz (SiO_2), Aluminum Oxide (Al_2O_3)] are homogeneously blended by milling, and the biscuit-fired products are glazed by the dipping method at the desired standard weight and intensity,
- 15 - The final products are obtained by firing the glazed products in the tunnel kiln at 1210-1225 °C,
- 20 - The final products coming from the tunnel kiln are delivered to the quality control band for making them discerned as the first quality, the second quality, the defected and the fractured.
- 20 - The foot grinding is done to eliminate the hardness in the feet of the products discerned as the first quality and second quality after their quality control.
- 20 - The products are made ready for delivery in proper packaging after their foot grinding.

CLAIMS

1. A recipe of high scratch-resistance for porcelain tableware having a minimum hardness of 6.5 Mohs, characterized in that it comprises:

- Kaolin derivatives ($\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$),
- Feldspar derivatives ($\text{K}_2\text{O} \cdot \text{Na}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 6\text{SiO}_2$),
- Calcium derivatives (CaO),
- Quartz (SiO_2),
- Aluminium oxide (Al_2O_3).

2. A recipe according to claim 1, characterized in that it comprises quartz (SiO_2) which is kept subject to the heat treatment in the high temperatures.

3. A recipe according to claim 1, characterized in that said recipe comprises

- 22% to 50% by weight of feldspar derivatives ($\text{K}_2\text{O} \cdot \text{Na}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 6\text{SiO}_2$),
- 3% to 12% by weight of Kaolin derivatives ($\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$),
- 3% to 12% by weight of Aluminum oxide derivatives (Al_2O_3),
- 15% to 45% by weight of Quartz (SiO_2) derivatives,
- 15% to 45% by weight of Calcium derivatives (CaO).

4. A method of producing porcelain tableware having a minimum hardness of 6.5 Mohs, characterized in that it comprises the following steps:

- hard raw materials, which have been micronized in dry before, (22% to 50% by weight of feldspar derivatives ($\text{K}_2\text{O} \cdot \text{Na}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 6\text{SiO}_2$), 3% to 12% by weight of Aluminum oxide derivatives (Al_2O_3), 12% to 45% by weight of Quartz (SiO_2) derivatives, 1% to 12% by weight of Calcium derivatives (CaO)) are blended and subsequently loaded and grinded on a mill or other equipment,

- the particle size and surface area of raw materials grinded in the mill or in a different equipment are determined,
 - the micronized and grinded hard raw materials are mixed with kaolin derivatives and made into mud condition at appropriate values,
 - 5 - the product groups are shaped by the compression of the granules, which are obtained by drying the prepared mud in a spray drier with the addition of binder, with the pressure within the mold by isostatic presses,
 - 10 - the biscuit firing of the products of the desired humidity is done at in a kiln after the shaped raw product has been taken out of the dryer and the water in its body has been evaporated.
 - 15 - it is passed to the glazing application after biscuit firing and the raw materials [Kaolin ($\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$), Feldspar derivatives ($\text{K}_2\text{O} \cdot \text{Na}_2\text{O} \cdot \text{Al}_2\text{O}_3 \cdot 6\text{SiO}_2$), Calcium derivatives (CaO), Quartz (SiO_2), Aluminum Oxide (Al_2O_3)] are homogeneously blended by milling, and the biscuit-fired products are glazed by the dipping method at the desired standard weight and intensity,
 - the final products are obtained by firing the glazed products in the tunnel kiln.
- 20 5. A method of production according to claim 3, characterized in that the biscuit firing of the products of the desired humidity is done at approximately 980 - 1010 °C in a kiln after the shaped raw product has been taken out of the dryer and the water in its body has been evaporated.
- 25 6. A method of production according to claim 3, characterized in that the final products are obtained by firing the glazed products in the tunnel kiln at 1210-1225 °C.
7. A method of production according to claim 3, characterized in that the final products coming from the tunnel kiln are delivered to the quality control band

for making them discerned as the first quality, the second quality, the defected and the fractured.

- 5 8. A method of production according to claim 3, characterized in that the foot grinding is done to eliminate the hardness in the feet of the products discerned as the first quality and second quality after their quality control and the products are made ready for delivery in proper packaging after their foot grinding.