Bone China Used in the Production of Tableware

ONE CHINA USED IN THE PRODUCTION OF TABLEWARE products industrially has high level of whiteness, smoothness and light translucency properties. This porcelain is used also in artistic applications today because of the aesthetic opportunities it presents. Body composition of bone china is provided by bone ash, felspar and kaolin in its composition. Its recipe known today was developed by Josiah Spode II in England on 1794 and the production of bone china begun at the Spode factory in Staffordshire at that time. The bisque firing temperature of bone china is between 1220ºC – 1280ºC according various factors such as the firing speed and body composition.

Production of industrial bone china, preparation of the clay raw materials, and composition of its clay as well as the formation, firing, glazing and decoration of the product require a special production processes. “Production of bone china is similar to traditional porcelain production. But it requires a sensitive control in the preparation of its raw materials and production steps because it has a lower plasticity and a narrower vitrification range.” (Erkalfa 1990: 16)

Bone ash in its composition specifies the white and semi-transparent characteristics of bone china. Bone ash is usually obtained from cattle bones which have a lower iron content. Bone flour is produced by separating the gelatin

Beyza Ozgundogdu researches bone china artistic production in Turkey


Singer and Singer (1963) define traditional bone china bodies in their book Industrial Ceramics as follows.

Bone ash 50 per cent
Kaolin 25 per cent
Felspar 25 per cent
content after scalding the bones in a suitable solvent and cleaning them from their flesh and oil coverage. Bone flour is a raw material used in the production of glues and animal feeds. The accuracy in the calcinations process of the bone flours that will increase the plasticity and give the whiteness characteristics in the bone china production determines the quality of the bone ash. Calcination is performed in electrical furnaces at a temperature of about 800° – 1000°C. The ash obtained is then passed through grinding, ageing and drying operations successively.

Cornish stone is a type of felspar used in the production of bone china. It is a felspathic sodium and potassium rock that is partly kaolinised containing felspar, quartz, kaolin, mica and a small amount of fluorspar. This felspar occurs in the Devon–Cornwall region in England and there is also a similar mine in Carolina region of the US. Plasticity values of the bone ash and Cornish stone existing in the body of bone china are low and this property is added to the composition by kaolin (china clay). Increasing the plasticity will mean an increase the workability and green strength of the composition. Bentonite and ball clay can be added to the body at a rate of 1 - 5 per cent for this purpose.

The mixture prepared in the industrial production process is ground in a watery environment in ball mills. The clay is then pressed by using a selected method of formation or shaped at a template lathe. Bone china is suitable for mould formation because of its low plasticity. Selection of electrolyte type and its rate is important in this process. The products that are shaped can be deformed easily because of their composition as they do not have plastic properties. For this reason, bone china products are dried inside the controlled drying chambers with hot air jets called ‘dobbins’. Dried products are then placed into the biscuit kilns inside special saggers.

Despite some negative aspects, bone china has a prestigious statue with the aesthetic opportunities it provides. Its aesthetic characteristics have made bone china a special genre in the art of ceramics although its use is not common because of the technical difficulties associated with its use. Bone china is whiter, thinner and more transparent than other porcelain types.

The whiteness of bone china enables us to obtain good quality colour in glaze applications on the surface. But, colour applications are generally avoided in artistic bone china applications because it is mostly preferred to emphasise its pure whiteness. White is the most suitable colour for artists who like to use light in their work. The clean and white colour of bone china facilitates the perception of its smooth and glasslike texture. The surface of bone china is porous when touched compared with a surface having a bright glazed layer. But this composition is at a level that cannot be perceived visually. A bone china body absorbs the light to a certain degree and gives a satiny half-opaque appearance to the surface.

It is a well known fact that bone china has the highest translucency property in standard product thicknesses among all the porcelain types. The artists working with bone china prefer to give attention to the translucency by thinning the surface in a controlled manner in order to emphasise the semi-transparent effects.

Ceramic artists working with clay bodies having plastic and technical diffi-
cultures such as bone china have developed various methods for clay preparation, formation and firing. Body recipes have been created, formation techniques have been developed and various firing schedules have been experimented with for the purpose of artistic applications during this research.

I have experimented with various firing schedules have been tried for the calcination of the bone ash in electric furnaces during the body formation phase. The ash obtained from the calcination process made with a speed of 100°C per hour and a soaking period of 1 hour at 900°C was ground afterwards in a ball mill with ash:ball:water ratio of 1:1:2 for a duration of 12 hours. The ground bone ash was passed through a 100-mesh sieve and stored in water for a period five weeks to improve its plasticity. The ash was then dried in a furnace after this ageing process. It was decided that, after this process, suitable ventilation conditions should be provided in the environment for calculations to be performed under studio conditions.

Five per cent of gum arabic was added to the mixture and then it was ground in the ball mill for a further six hours at a rate of 40 per cent. Various electrolytes were tried in the preparation of the slip clay and it has been determined that the best result was obtained with sodium dispex of three per cent.

I chose to add gum arabic to assist in the workable properties of my bone china. However because the slabs were very thin and the wet strength of the clay was low, the slab cracked while bending it. To overcome this I laid the slab down on a thin piece of cloth and then it was possible to lift the slab with the help of the cloth. These technical limitations determined the character and the artistic application for my work.

In shaping works, it was observed that the dry strength is low after the controlled drying process. Thus, a preliminary firing process of 1000°C was applied for retouching and thinning certain parts; and retouching may easily be achieved afterwards by using sandpaper.

The relation between the body firing speed and translucency of bone china is another factor that should be taken into consideration. Firings made at slow speeds increase its translucency. Another determining factor is soaking. Deformations were detected related to the structure of formation (especially when saggars were not used) at the degree where the body became viscous. Thus, it has been observed that firing with saggars at 125°C/hour speed with a soaking period of one hour and sintering at 1260°C gave positive results with regard to translucency and strength.

These conclusions were made in my study examining the aesthetic characteristics and usability of bone china, for artistic applications; and the following results have been obtained: Characteristic aesthetic properties like whiteness, smooth texture and translucency differentiates bone china from other traditional porcelain used in ceramic art.

Production of bone ash for the formation of bone china body that may be used in the direction of artistic targets require a further series of personal research activities.

Pureness of kaolin and felspar are needed for the white colour of the porcelain.
Recipes recommended in the previous studies were tried and the following recipe has been created with good plasticity:

- Ash/Tri-calcium phosphate: 45 per cent
- Potassium felspar: 22.8 per cent
- Grolleg kaolin: 30 per cent
- Quartz: 2.2 per cent

Additives like gum arabic and CMC are able to increase the workability of the non-plastic bone china clay to a limited degree for the purpose of forming artistic works.

Loss of shape increased with the increase in sintering. For this reason, the balances between firing speed, firing temperature and sintering duration should be controlled. Design of suitable saggers is required to protect the shapes of bone china products.

I have tried to bring the characteristic properties of bone china to the foreground through artistic applications. Aesthetic concepts supported by the language of the composition like whiteness, feeling of thinness and translucency have been examined in the shapes formed. It was determined that technical and aesthetic characteristics are giving direction to the language of the designs; and searches in the designs are aimed at pure styles.

It is not possible for the art of ceramics to avoid dynamic scientific processes because its background is based on technology. Basic knowledge of raw materials and production technology is a tool required for a ceramic artist for exhibiting his/her artistic proficiency. Development of this information will also develop the language of the material while also enlarging the field of expression for the artist.

It has been observed that it will be possible to create further industrial opportunities and gain new dimensions in the expressive language of the artists with further studies to be made in the future on bone china.

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