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Alternatif Hammadde Olarak Pegmatitin Sırlı Porselen Karo Ve Yer Karosu Massesinde Kullanılması

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Anahtar kelimeler
Atık, CO_2 salınımı; Karo üretimi.

Özet

Yer karosu ve sırlı granit üretimleri düşünüldüğünde proses başlangıcında uygun hammaddelerin seçilmesi, bu hammaddelerin öğütülmesi, daha sonra püskürtmeli kurutucudan geçirilip granül haline getirilmesi, şekillendirilip pişirilmesi ya da sırlı uygulamalarda şekillendirme esnasından sonra bisküvinin kurutulması, sırlanması ve daha sonra pişirilmesi adımlarını kapsamaktadır. Bu proses adımlarına baktığımızda oldukça fazla enerji tüketmekte ve çevremize oldukça büyük miktarlarda CO_2 vererek kirliliğe neden olmaktayız. Bununla birlikte prosesi oluşturacak en önemli adım olan hammaddelerin sevkiyatı esnasında da aslında ciddi bir CO_2 salınımı söz konusu olmaktadır. Bu çalışmada, yer karosu ve sırlı granit masse reçetelerinde oldukça büyük oranlarda kullanılan ve Aydın Çine'den getirilen feldispatın yerine Söğüt'ten getirilen pegmatit kullanılmıştır. Çine ve Bozüyük arası yaklaşık olarak 540 km iken, Söğüt-Bozuyük arası yaklaşık olarak 55 km uzaklıktadır. Dolayısıyla karayolu nakliyesinde kısa mesafeli taşıma gerçekleştirilmiştir. Ayrıca, Söğüt bölgesinden farklı yapıda 3 değişik pegmatit harmanlanarak reçeteler oluşturulmuştur. Reçetelerde Çine feldispatı Sırlı Granit massesinde tamamen çıkartılmış, yer karosu massesinde ise azaltılarak ve yerine Söğüt bölgesinden tedarik edilen pegmatitler konulmuştur. Reçeteler hazırlanırken, ilgili tüm Ar-Ge çalışmaları yapılmış, kompozisyonel olarak oluşan fazlar incelenmiş, hazırlanan çamurların kontrolleri yapılmış, pişirilen ürünlerin özellikleri standart bünye kompozisyonları ile (su emme, boyut, renk, vb.) karşılaştırılmıştır. Yapılan çalışmalar ve hesaplamalar sonucunda Söğüt feldispatının yer karosu ve sırlı granit massesinde kullanılması ile maliyetler azaltılmış, CO_2 salınımı düşmüştür, çevre dostu üretim anlayışımız hedefine ulaşmıştır.

Use Of Alternative Pegmatite İn The Floor Tile And Glazed Porcelain Tile Body Formulations

Key words
Waste; CO_2 emission; Tile production.

Abstract

In this study, pegmatite brought from Bilecik region was used in the floor tile and glazed porcelain tile bodies instead of feldspar. Distance between Çine and Bozuyuk is longer than Bilecik and Bozuyuk. Therefore, the short-local haul was carried out. In addition, 3 different pegmatite from Bilecik region was mixed for preparation new recipes. Feldspar from Çine was completely removed from the standard glazed porcelain body and partially reduced in standard floor tile body. However, pegmatite from Bilecik region was increased both floor and porcelain tile bodies. For preparation of the recipes, R&D works has been done considering 3-component phase diagram. The effects of pegmatite from Bilecik region on sintering, water absorption, colour variation and deformation of prepared compositions and the optimum entry to recipes identified according to analysis result. As a result of the studies, recipe costs decreased with pegmatite from Bilecik region and CO_2 emission reduced that was because of transporting decreased.

1. Introduction

In recent years scientific issues related to environmental preservation have acquired great importance and a major challenge to be met is the is the recycling of materials discarded by various productive sectors. Alternative materials discarded by various productive sectors. Due to the damage caused to the environment by technological development , this study seeks to evaluate the possibility of using alternative raw materials in the production of ceramic tiles. It is often overlooked that alternative raw materials are similar in composition when compared to main raw materials, containing materials that are not only compatible, but beneficial to the manufacture of ceramics. The fabrication of products from

alternative materials is an advantage that may give the manufacturer a highly competitive position in the market due to economic issues involved and the opportunity of marketing this principle particularly with regard to the ecological aspect. Ceramic raw materials is collected in two groups such as (clay+kaolin group) and (quartz+feldspar) group. Raw materials which are used in floor and porcelan tile body formulations can be divided into defferent mineral groups and each one has its own specific funtion. Chemical composition of the ceramic tile bodies changes depend on the type of the fluxing agent. In this study pegmatite was used as alternative fluxing agent. Pegmatite, consists of mainly potassium feldispar minerals as well as other economic minerals such as quartz feldispar. Pegmatite brought from Bilecik region was used in the floor tile in standard body formulation instead of feldispar. Distance between Çine and Bozuyuk is longer than Bilecik and Bozuyuk. Therefore, the short-local haul was carried out. In addition, 3 different pegmatite from Bilecik region was mixed for preparation new recipes. It is in this context that the use of phase diagrams becomes a useful tool to guide preparation of the recipes and also to assist in making good choices of composition and processing parameters.

Natural raw materials (whether plastic, fluxing, or inert) contain, as major components, silica (SiO_2), alumina (Al_2O_3) and lime (CaO). Minor amounts of other components may be present, which will mostly affect the colour of the fired product (Fe_2O_3, MnO, TiO_2, Cr_2O_3) but should not play such an important role during ceramic processing in air at low temperatures. Other minor components (MgO, K_2O, Na_2O) will act as fluxes and may have a strong effect during sintering . The phase diagrams provide a clear and concise method of graph representation of the equilibrium state for a given composition, temperature and pressure, and this may provide a valuable estimate of the phase proportion present during and after sintering, i.e. the presence of liquid phase at sintering temperature and the resulting crystalline phases. Stable phase equilibrium diagrams represent phases that may be expected from reactions occurring under equilibrium conditions and, therefore, provide a basis for making predictions of the material behaviour under various conditions of service or processing. Not all reactions reach complete equilibrium, and consequently, the phases which are present in a given system may not be the equilibrium phases. Although in normal industrial operating conditions thermodynamic equilibrium is usually not reached, the equilibrium phase diagram of the relevant system ($Na_2O/K_2O/SiO_2$ phase diagram) can still be used to foresee the reactions' tendency to completion and be of great assistance for making appropriate choices of compositions and processing parameters. This work aims to formulate new ceramic tiles from pegmatites from Söğüt from Bilecik, based on phase diagrams, allowing the withdrawal of those residues from the environment and giving them a nobler destination.

2. Materials and Methods

In this study, floor body composition was prepared by using pegmatite from Söğüt/Bozüyük region instead of Aydın/Çine feldispar. Chemical analyses of the pegmatite from Söğüt/Bilecik (P1) and Aydın/Çine feldispar (P2) represented in Table 1.

Table 1. Chemical compositions of feldispar and pegmatite.

Compositions	P1	P2
Al_2O_3	15.63±2.0	14.00±1.0
SiO_2	74.30±3.0	70.30±3.0
Na_2O	2.59±0.7	2.00±0.7
K_2O	3.20±0.5	3.35±0.5
MgO	0.31±0.1	0.28±0.1
CaO	0.78±0.1	0.65±0.1
TiO_2	0.16±0.05	0.10±0.05
Fe_2O_3	0.74±0.05	0.60±0.05
L.O.I[a]	2.26±1.0	2.50±1.0

[a]; L.O.I. is loss on ignition.

In this study, porcelain stoneware body composition was prepared by using industrial raw materials. A formulation, used for the industrial production of floor tiles, was chosen as a standard body mix. Starting from the standard body composition, different amounts of sodium and potassium feldispathic sands were added into the system. The new composition were denoted as N1.

Seger formulation was applied to prepare new compositions and Na_2O/K_2O molar ratio was chosen as the main variable parameter to prepare the compositions and amount of total molar alkali oxides ($Na_2O$and K_2O) was kept constant in the compositions. New compositions were prepared by wet grinding (Table 2). Slips were dried at 110 ◦C. The powders obtained were moisturised with 5 wt% water. The pellets with 50mm diameter and 6mm thickness were prepared by uniaxial pressing at a forming pressure of 44 bar.

Table 2. Ratio of (wt %) used body mix and wastes in the recipes

Compositions	Standart Body	N1
Standart body mix	76	76
P2	34	17
P1	0	17
Na_2O/K_2O	4.510	4.102

Water absorption was determined by water saturation under vacuum (ISO 10545-3) by using related equation (Eq. (1)).

$$\%\, Water\ absorption\ (w_a) = \frac{w_w - w_d}{w_d} \times 100 \quad (1)$$

The colour of fired body samples was measured using a UV-Vis spectrophotometer (Minolta 3600d, Japan) and the chromatic co-ordinates as L*, a*, b*. The sample microstructures were examined by scanning electron microscopy (SUPRA-Zeiss-50). In addition, as a function of the compositional changes firing shrinkage, water absorption and chromatic co-ordinates variations of floor tile were compared and discussed.

3. Results and Discussion

Table 3 presents some of the important properties of the investigated bodies fired under industrial conditions. A comparison of the standart floor tile Body and N1 was made according to the main technological properties measured.

Table 3. Technological properties and chromatic co-ordinates of the tile bodies

Formulation	Firing Shrinkage (%)	Water absorption (wt%)	L*	a*	b*
Standart body	7.2	1.3	62.55	2.90	14.65
N1	7.2.	1.7	61.94	2.95	15.01

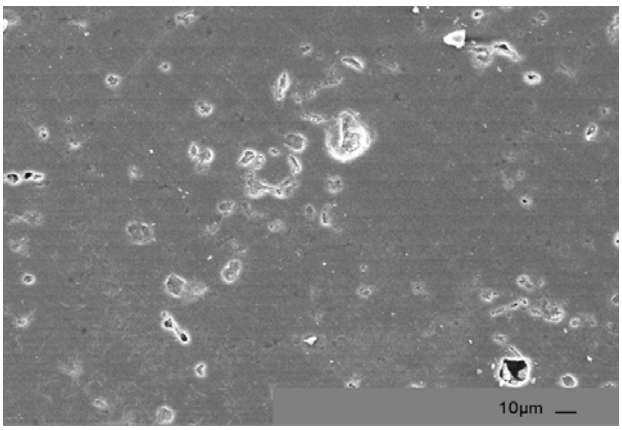

Fig. 1. SEM micrograph of the standard floor tile.

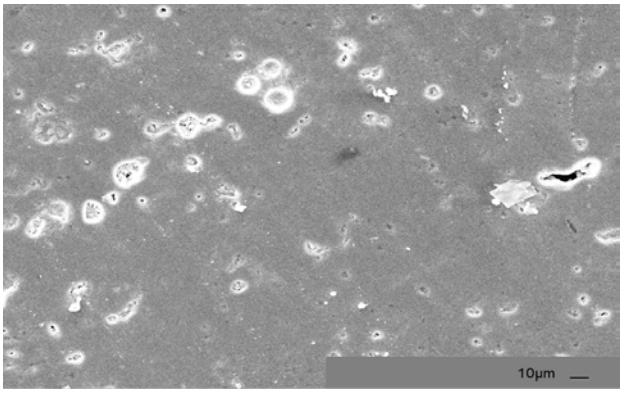

Fig. 2. SEM micrograph of the floor tile with N1 composition.

Fig. 1 shows that the standard floor tile body an Fig. 2 also shows the floor tile body with N1 compositon. In this study, using of alternative raw materials as pegmatite provided decreasing of CO2 emission. Formerly, 125.614 kg/mount CO_2 emitted to the atmosphere during tile production. With this study, this emission value decreased 77.086 kg/mount. These results also indicates that how much importance is given by Eczacıbaşı VITRA Tile Cor. to environment and human health.

4. Conclusions

In this study, it has been shown that pegmatite from Söğüt-Bilecik region can be successfuly utilized to prepare tile compositions. This alternative material decreasing of CO2 emission. Formerly, 125.614 kg/mount CO_2 emitted to the atmosphere during tile production. With this study, this emission value decreased 77.086 kg/mount. These results also indicates that how much importance is given by Eczacıbaşı VITRA Tile Cor. to environment and human health.

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