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# Clayey material analysis for assessment to be used in ceramic building materials

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**Abstract**

Ceramic building materials, like bricks and blocks, are a modern choice. However, the production of ceramic materials is complex process, therefore, principal element, clay, research is very important. Clay from Latvian biggest quarry was used in this study. Grain size distribution was determinate using the pipette method. Quarry soil is available in various grain size compositions from clay and clay alerolites to sandstone. Mineralogical composition was determinated by XRD. Mixing very plastic clay with sand may be very important to obtain optimal proportion of clay, silt and sand size particles for qualitative ceramic building material manufacturing.


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*Keywords:*brick; clay; grain size distribution; XRD; pipette methode.

## 1. Introduction

Ceramic building materials are modern and environmentally-friendly solution for buildings. Materials, such as bricks and blocks, have high strength, durability and the ability to control humidity, creating a healthy indoor microclimate. The main raw material for the creation of ceramic building materials is all period sediments occurring in clayey soils. In Latvia these are the Devonian and Quaternary, and to a lesser extent Triassic and Jurassic clayey soils. The most important quarry in Latvia consists of Devonian clayey terrain. Field covers a whole different set of

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soil - from clay and clay alerolites to sandstone, but mostly they are different shades of red, no carbonate clayey aleirolites[1,2].

The grain size distribution in quarry varies within a wide range. It is very important to determinate appropriate grain size distribution, because it influences considerably the behavior of ceramic bodies during the technological process, like behavior of the material during the shaping and drying processes. It has effect on the microstructure and the mechanical properties of fired materials as well [3]. Raw materials with high percentages of clay size particles experience difficulties in the drying process as consequence the high moisture required in the molding one. However, the firing temperature can be decreased due to the fact that the vitrification process, which initiates on the specimen surface, can occur more easily [4].

Based on German experience, suggested grain size distribution limits for solid bricks, perforated bricks and tiles are illustrated in triangular diagram (Fig. 1). It includes three main clayey soil grain distribution – clay (<2μm), silt (2-20μm) and sand (>20μm)[5]. Diagram is divided into four parts: unsuitable – all type of products liable to shrinkage during firing; roofing tiles; perforated bricks; solid bricks only.

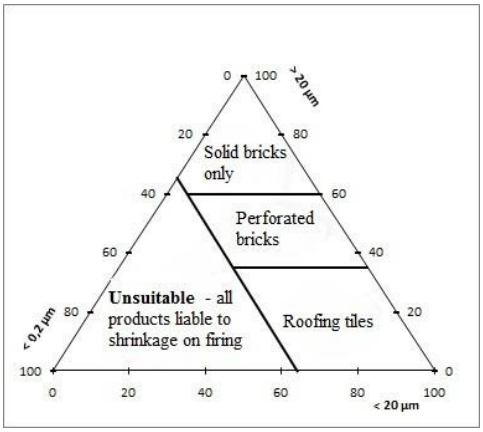


Fig. 1. Suggested grain size distribution for bricks an roofing tiles [5].

As the goal is to have solid bricks it is important to investigate granulometry of available quarry clay and to made proportion of soil grain distribution that confirm "Solid bricks only" part. It consists0 – 35% of clay (<2μm), 65 – 100 % of silt (2-20μm) and 60-100% of sand (>20μm). Very small percentage of coarser fraction up to 10 mm can be included to improve mixing and aesthetic reasons. Most common used is grog (pre-fired clay). Particles in the size range 50μm to 1, 2 mm is used as filler fraction, usually sand-size quartz. High sand-size particle content may be used also for aesthetic reason to obtain attractive texture, ore to balance very plastic clay. Silt-size and clay-size particles is used as plastic fraction for good forming properties [5]. However general requirements for brick making materials are:

- Plasticity of brick making mass: Mass should be plastic enough to extrude, shape or press it into a mould;
- Shrinkage and cracking must be limited: Formed materials shrinkage and cracking must be controlled during drying and firing process;
- Sufficient dry material strength: Dry material strength must be enough to during technological process quarry firing it will not be damaged and will have adequate strength after firing [5].

## 2. Materials and methods

Four basic types of clayey soil from quarry were used – Grey, Red, Composite and Sand. Composite clay is colorful mottled, no carbonate clayey aleirolites and in them occurring like intermediate state - light gray, refractory