THE BULBS

A conceptual artwork cast in porcelain

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Abstract

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The aim of this thesis is to create a porcelain artwork by using slipcasting. The work explains what *slip* means, what it is composed of and how it is produced; further on, it studies surface decoration applications such as *glazes;* and finally, it presents the created cast porcelain artwork variations. The thesis consists of a knowledge base and an implementation part.

In the theoretical part, a porcelain slip, high-fire glazes, the principles of creating them, and what happens to the compounds in an electric kiln during firings, are studied. The target of this research is to build a theoretical platform supporting the making process.

The practical part demonstrates the process of creating the artwork, which is a combination of cast porcelain bulbs of various shapes and sizes. The porcelain slip is created and used for casting, and the glazes are made and used for the surface decoration, the porcelain bulbs are finalized. Some bulbs are glazed partially, and some are left unglazed – to show the beauty of the contrast of a stunningly white porcelain and bright glazes. The final artwork variations are multi-colored and the parts within them – all have an original look.

The artwork theme presented in this work is only one of possible variations. Depending on the number of bulbs, and the means of their attachments, they can be easily re-assembled into new artistic installations. This concept offers a very creative playground for an artist.

Keywords Porcelain, slip, slipcasting, glaze, ceramics.
Pages 70 pages and appendices 2 pages

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1 Introduction

The aim of this thesis is to research porcelain slip as a material, a slipcasting method, high-fire matte glazes as a decorative final element, and to create a certain product: a conceptual artwork. After the theoretical foundation has been built, it is followed by the practical implementation. The outcome of the research study and the practical realization is the conceptual artwork called “the Bulbs”, presented in various art installation forms in an outdoor theme. As a matter of fact, the title only describes the individual multiple parts of the final installations. It is done intentionally. I envision many ways of later possible re-assembling, re-installing, re-attaching, and re-grouping of the bulbs into new artworks.

The bulbs, in whichever form they are arranged together into one composition, should give diverse, but a uniform look to the artwork, which, in its turn, should have no practical purpose, but only the artistic value.

I believe that art is important for human beings. Someone needs to make, others – to observe, but in any case, while art is not a necessity that humans need to survive, yet I believe it is important for psychological health of people. There are many art forms available, but what combines them all is their potential effect on people: therapeutic, healing, thought evoking, and imagination stimulating.

This work is based on the theoretical research about materials and my personal work process. It is a practice-based thesis; therefore, the given knowledge base only supports the implementation part. As an outcome, background knowledge is brought into practice, and hence, practical professional skills are gained.

1.1 Reasoning of the chosen subject

Interest in researching the material properties. I am interested in working in slipcasting technique and making casting molds. The aim of this thesis is to depict the process step-by-step, and thus to offer guidelines to those willing to get the required skills for working with slipcasting and high-fire glazes.

Inspiration received from nature-made organic forms. I became inspired by organic shapes that can be seen all around us in nature, and, feeling experimental, I wanted to imitate the nature and to create an artwork of an organic form, using non-organic materials.

Interest in making a creative artwork. I am a visualist who gets easily inspired. I see beauty in everything that surrounds me: in every little thing, color, shape, texture. I am quite curious and am always willing to try myself in something new and experiment with new materials and techniques.

Artist style transition. The chosen artistic style is an outcome of my long transition from the urban esthetics to the organic forms' beauty. It shows my willingness to depict the non-man-made beauty all around us in a man-made way.

1.2 Thesis structure and objectives

The first section of this thesis discusses what are the objectives of the given work. It explains what subjects are going to be researched, why specifically these topics where presented, and how the research will be carried out.

The second and the third sections are dedicated to a theoretical research and to collecting the subject-related background information that supports the creation process. The aim is to study the materials' properties and the techniques for making the required items. The research on the following was done: porcelain slip making, plaster molds building, slipcasting process, glaze compounds, and the suitable firing settings selecting.

The fourth section shows the planning process that I went through. It presents my sources of inspiration, with the detailed planning process after that.

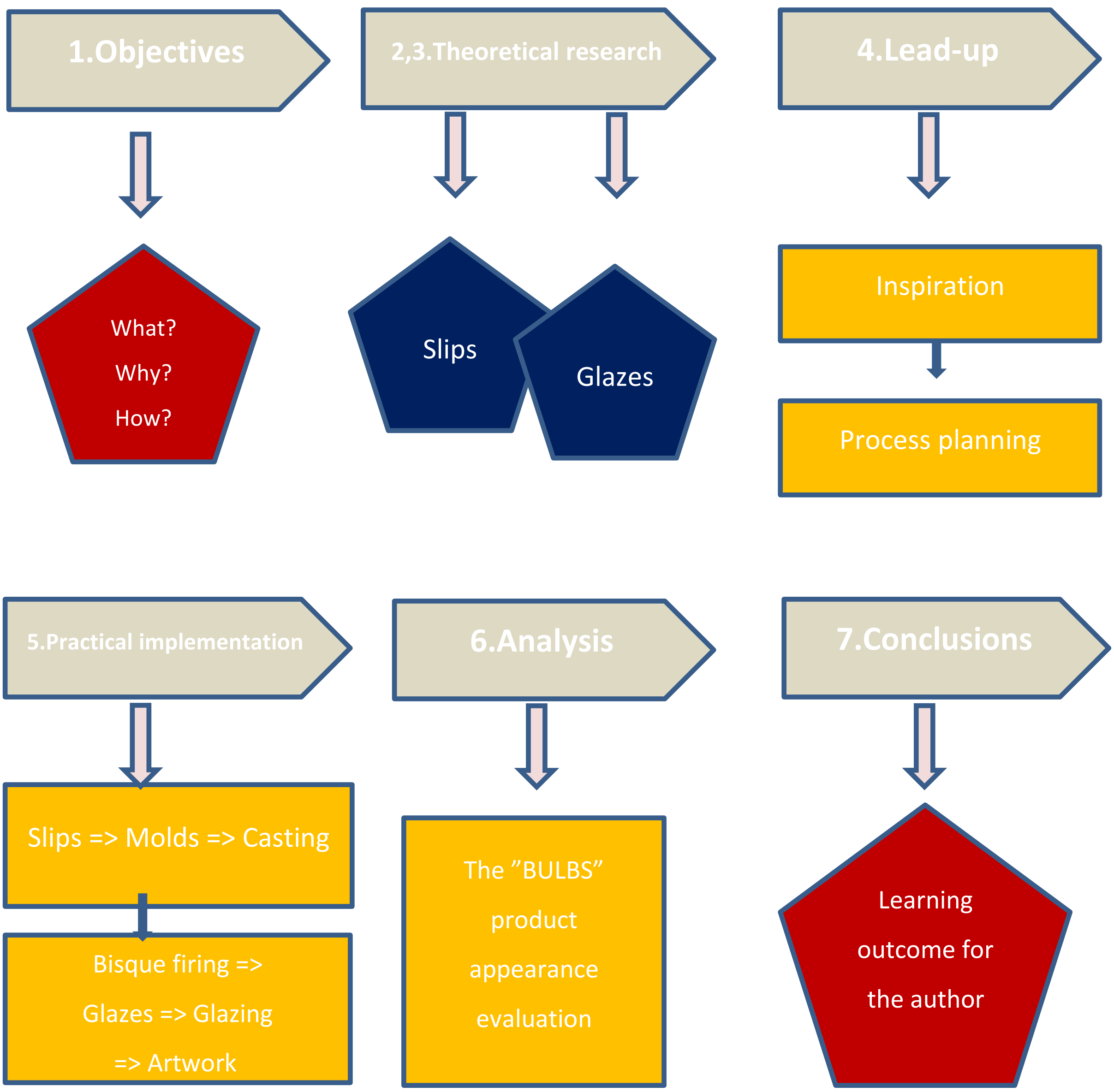
The fifth section describes the physical process of the creation. It has two subsections, devoted to slip- and glaze- making. Firstly, a step-by-step process of how I created the slip, the plaster molds, and how I made the slipcasting overall is shown. Secondly, the process is followed by creating my own high-fire glazes to the chosen recipes (appendices 1,2).

In the sixth section, I analyze the product appearance and the process, how the practical implementation was aligned with the theoretical foundation, and whether the execution process went smoothly, or were there any possible technical challenges or deviations met.

In the seventh and the final section, conclusions on the materials, techniques, the making process, and the experience overall, are made, with the reference to the future possible professional use. Here I am analyzing the relevance of such a work for me as a future professional independent ceramics' entrepreneur.

The entire process structure of the thesis is shown in the diagram below:

Image 1. Process structure of the thesis



1.3 Research questions and research methods

The main research question of the thesis is:

How is a cast and glazed conceptual artwork implemented?

The refining questions are:

What is porcelain slip and how is it cast? What does the slipcasting process consist of?

What is a glaze? What does it contain and how does it work?

In this thesis, various research sources have been used. The given subjects have been examined through the field-related literature, e-books, the Internet, professionals' insights, industry professionals' articles, and educational videos.

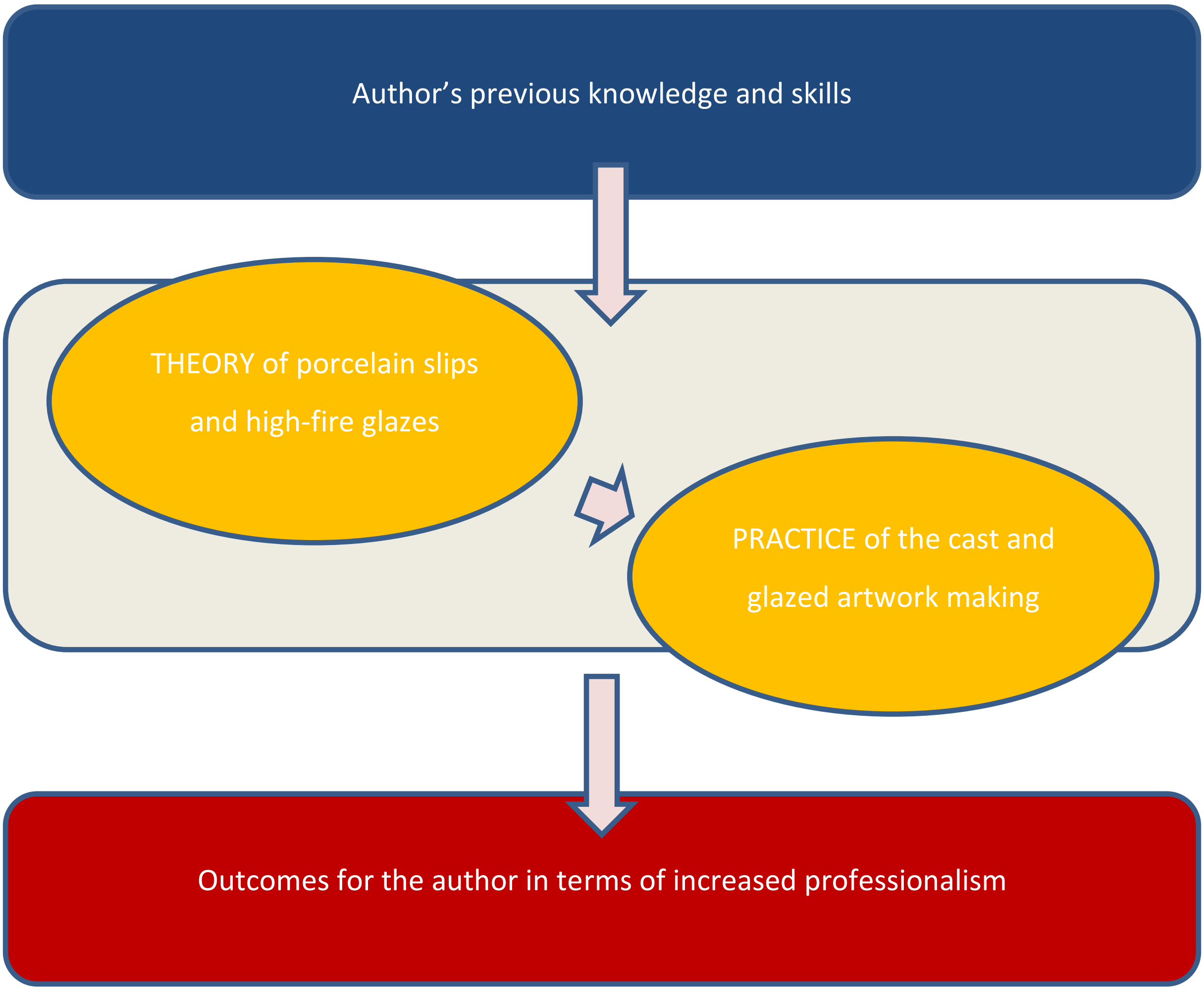
1.4 Framework

The framework of this thesis summarizes all the aspects of the process. It includes my knowledge, experiences, and a personal artistic style. There was a long profession-related journey that I have been through before starting to write this final study work. That is why the aspects that led me to this stage cannot be overlooked. The entire study experience has led me to the research conducted for this subject.

On top of the previously gained knowledge and experiences, the given thesis took me further in my professional growth by concentrating on a very specific topic, deeply researching it, and executing it in practice, going from phase to phase further up, to the full completion of the project.

After having researched the topics and having executed the full process, I have made the conclusions that will help me in my future professional journey. All the sections of the framework complement each other. In the same way, all the phases of the given work, including personal conclusions, add to my professional growth. This thesis framework is shown in the following diagram:

Image 2. The framework of the thesis



1.5 Key concepts

Ceramics are heat-resistant, nonmetallic insulators, corrosion-resistant, hard, but brittle (like glass), inorganic solids made from clay that has been fired to high temperature. Once the clay is fired to high temperature, its chemical composition permanently changes and becomes *ceramic,* which will never dissolve in water again. The following terms fall under ceramics: pottery, china, porcelain, stoneware, earthenware. (Lakeside Pottery, n.d.-a)

Porcelain - the name comes from the old Italian *porcellana* (a shell) because of its resemblance to the surface of the shell. The earliest forms of porcelain originated in China around 1600 BC and this association popularized the term ‘*fine china*’, or ‘*bone china*’ when porcelain had ground animal bone added to the clay, to create an even more durable

material. Properties of porcelain are: low permeability, elasticity, high strength, hardness, whiteness, translucency, resonance, resistance to thermal shock. (Rado, 1988)

Slip is an aqueous suspension of a clay body, which is a mixture of clays and other minerals such as quartz, feldspar, and mica. (Osborne, Harold, 1975)

Slipcasting or **slip casting** is a ceramic forming technique for shapes not easily made on a wheel. A liquid clay body slip, mixed in a blunger, is poured into plaster molds and allowed to form a layer, the cast, on the inside walls of the mold. The process usually takes at least 24 hours per piece. It gives very precise and consistent shapes. (Osborne, Harold, 1975)

Plaster Mold is a self-hardening casting mold made of plaster solutions by pouring. A well-done mold cast cleanly, but sloppy molds cost more in terms of time and trouble. A well-done mold lasts through many cycles of casting. (The American Ceramic Society, 2021-a)

Greenware is a stage in the production of ceramics where an item is going through the drying process necessary before it can be safely fired. (Lakeside Pottery, n.d.-a)

Bisque firing or **biscuit firing** is the first firing of an item before it is glazed. Most pottery goes through a bisque firing and is then fired again to melt the glaze and fuse it to the clay body. Raw firing is not as robust as glaze firing and is best suited to decorative pieces because it is not food safe. (The Spruce Crafts, 2018-a)

Ceramic glaze is an impervious layer or coating of a vitreous substance which has been fused to a ceramic body through firing. Glaze can serve to color, decorate, or waterproof an item. (Wikipedia the Free Encyclopedia, 2021)

Glazing is dipping in- or painting a fired ceramic item with the glazing slurry. Glazes can be colored by the addition of specific transition-metal or rare-earth elements to the glaze glass or by the suspension of finely divided ceramic particles in the glaze. (Britannica, n.d.)

Vitrification is the formation of glass, accomplished through the melting of crystalline silicate compounds into the amorphous, non-crystalline atomic structure. As the formed

item is heated in the kiln, the clay component turns into progressively larger amounts of glass. (Britannica, n.d.)

Glaze firing is the second firing of clay. After the first firing, liquid glaze is applied to the bisque fired pottery that is then fired for the second time and the glaze melts to form a glassy layer on the item. It is sometimes called *glost firing*. (The Pottery Wheel, n.d.)

Conceptual art emerged as an art movement in the 1960s (Tate, n.d.) In it, the idea or concept is the most important aspect of the work. When an artist uses a conceptual form of art, it means that all the planning and decisions are made beforehand, and the execution is a perfunctory affair. (LeWitt, 1967)

2 Porcelain and slipcasting

This chapter contains research of porcelain as a material with paying special attention to porcelain slip. It presents a detailed examination of the porcelain slip's content and properties, the slipcasting as a process, the drying stages that a cast product undergoes before been bisque fired, and the bisque firing process itself.

2.1 Porcelain: definition, nature, and properties

Porcelain is a vitrified clay body with low Fe_2O_3 contamination. Porcelain comes from a refined clay which is fired at very high temperatures of approximately 1,200°C – 1,450°C. The result is an extremely hard, shiny material often white and translucent in appearance. It can be divided into three main categories: hard-paste, soft-paste, and bone china. Unlike with glazes, the chemistry of porcelain is usually not considered. Instead, the physical properties present interest. Porcelain has low permeability and elasticity, but high strength, hardness, whiteness, translucency, resonance, resistance to chemical attack and thermal shock. Porcelain is composed of tiny particles that offers optimum qualities of smoothness. It can be worked with even when extremely thin to achieve translucent, delicate forms. (Digitalfire Reference Library, n.d.-n) These properties gave me interest to work with this material.

Porcelain raw base materials include kaolin, feldspar, ball clay, silica. Each compound has its very special purpose. *Kaolin / Ball Clay* passes on plasticity and drying hardness to the wet materials and transforms into a mesh of crystals during firing, which gives porcelain its strength. *Feldspar* fills the gaps between the silica and clay particles and cements them into a strong mass when melting. *Silica (Quartz)* provides a foundational framework for the fired substance, like gravel in concrete does. (Digitalfire Reference Library, n.d.-n) These ingredients can be mixed in various ratios giving different results in properties. The ratio that has been used for this work is shown in the *implementation* section 5.1.1.

Clays used for porcelain are generally of lower plasticity and are shorter than many other clays. They wet very quickly, meaning that small changes in the content of water can produce large changes in workability. (Oxford English Dictionary, n.d.) It is difficult to *throw* because of its low plasticity. However, it is not applicable to porcelain slip and casting.

It cracks and deforms easily during the drying and firing stages, because its optimum density is not achieved until nearly the melting point of the clay. (Digitalfire Reference Library, n.d.-n) This is a property that applies to both solid porcelain and porcelain slip.

2.2 Porcelain slip created for the thesis

There are few criteria of choosing a clay body for each specific purpose and work. (Lakeside Pottery, n.d.-a) These criteria were considered when selecting porcelain slip for this work: the size and form of the work, the surface texture, the making processes, the firing temperature and type, the end product usage, and the color glaze effect. The formula and the making process is shown in the *implementation* section (chapter 5.1.1.).

2.2.1 Porcelain slip chemistry

The porcelain slip that was chosen and created for this work, has the following ingredients in its content formula: *Kaolin Superb Porcelain, Ball Clay Hywhite Superb, Potash Feldspar, Silicon Dioxide (Silica, Quartz), and Calcium Carbonate (Whiting, Chalk).* The substances that contain several composition elements are presented with their content formulas.

Kaolin (China Clay)

Kaolin's composition includes the elements that are shown in this table:

Table 1. Kaolin content formula (Digitalfire Reference Library, n.d.-b)

Oxide	Content
Al2O3	40.21 %
SiO2	47.29 %
LOI	12.50 %

Kaolin is the primary material from which porcelain is made. (Lakeside Pottery, n.d.-a) It is the purest clay, which is close to the idealized clay mineral *kaolinite*. It contains very little iron impurity and is high in aluminum oxide content, therefore it is white. (Laguna Clay Company – FL., n.d.-b)

Kaolin has limited plasticity, which limits the workability of throwing or modeling porcelain. For casting porcelains, to improve this property, part of kaolin is replaced with ball clays. (Digitalfire Reference Library, n.d.-n) Kaolinite mineral has a much larger particle size than ball clays, so blending them can produce a good cross section of ultimate particle sizes, which in its turn improves working and drying properties. Another advantage of the larger particle size of kaolins is that they are much more permeable to the passage of water. Thus kaolins, speed up casting rates in slurry bodies and drying rates in all bodies. (Digitalfire Reference Library, n.d.-b)

Ball Clay

Ball Clay's composition is shown in the table below:

Table 2. Ball clay content formula (Digitalfire Reference Library, n.d.-c)

Oxide	Content
CaO	0.30 %
K2O	0.90 %
MgO	0.30 %

Oxide	Content
Na2O	0.40 %
TiO2	1.00 %
Al2O3	25.00 %
SiO2	59.00 %
Fe2O3	1.00 %
LOI	12.00 %

The term *ball* traces to historic mining in England where large chunks of the clay were cut from the bank in ball shapes for transporting further. Commercial ball clay mining deposits are common and are typically created by slowly moving water with an acidity that tends to flocculate and settle the clay. (Digitalfire Reference Library, n.d.-c)

A typical ball clay powder is light grey from lignite, particles of which can produce glaze imperfections. Ball clays contain mineral impurities. They can have ten times the amount of brown-firing iron oxide that kaolin has, and many have heavy soluble salts that produce a dark colored layer on the burned surface. So, were it not for the impurities, and hence, the harmful effect on fired whiteness, ball clays would be ideal ceramic materials. (Digitalfire Reference Library, n.d.-c)

Ball clays are employed to achieve desired plasticity as they are very plastic. They even tend to be too fine and slippery for use, but additions of sand, grog, coarser and less plastic clays improve workability. (Laguna Clay Company – FL., n.d.-c)

Since ball clay has a much smaller particle size than kaolin does, even a small test bar can take a very long time to dry. (Digitalfire Reference Library, n.d.-c) Also, it gives excessive shrinkage during drying and firing. (Lakeside Pottery, n.d.-a) That is why it can not be used alone, without kaolin.

If ball clay percentage is high in a recipe, it is possible to use less silica powder since ball clays contain quartz. However, the quartz grains in the ball clay are finer, so they will dissolve into the feldspar glass more readily. (Digitalfire Reference Library, n.d.-c) Ball clay vitrifies at 1100°C - 1200°C. (Laguna Clay Company – FL., n.d.-c)

Potash Feldspar

Feldspar's composition is presented in the table below:

Table 3. Feldspar content formula (Digitalfire Reference Library, n.d.-a)

Oxide	Content
K2O	16.92 %
Al2O3	18.32 %
SiO2	64.76 %

Feldspars have cooled and crystallized from a molten magma. Due to their content, they can be called natural frits or glazes. It is a mineral , which is used up to 25% in bodies and up to 100% in glazes. The value of feldspar is that it introduces alkalis (potassium oxide) into a body or glaze without recourse to fritting. (Laguna Clay Company – FL., n.d.-a)

Feldspar contains fluxes - the oxides that help develop fired maturity by liquefying and slowly dissolving some of the clay and silica. The iron content impurity in them can vary significantly, depending on a producer. Additionally, some can have flocculation problems due to slight solubility (Digitalfire Reference Library, n.d.-n)

Calcium Carbonate ($CaCO_3$, Whiting, Chalk)

Whiting is a fine grind of chalk (aragonite - marine shell deposits). The purest sources are located in England, France, and Belgium. The material sources include marble, calcite ores, and seashells. (Glazy, 2015)

It is more widely and in larger amounts used in glazes, thus more glaze-related information will be provided in the glaze section of the thesis (section 3.5.1.).

Silica oxide (SiO_2, Silica, Quartz)

Silica is a consistent and inexpensive material. Quartz grains act as a framework structure in the formula. (Digitalfire Reference Library, n.d.-n) It is a hard glassy substance which

melts at 1710°C to a transparent glass. This temperature is too high for a potter's kiln, so some way of melting silica at a lower temperature is used in order to make a glaze – using fluxes. They are mixed with the silica, which results in bringing down the melting temperature to within range of the potter's kiln. The resulting melt is a mixture of silica and other oxides which link together on cooling to form a glass. Silica is the necessary component of this glass. It increases the thermal expansion in clays and decreases thermal expansion in glazes. (Laguna Clay Company – FL., n.d.-d)

When cooled from molten to solid, silica powder transforms into its mineral form – quartz. Its volume and form changes when fired through 573°C. Quartz sand is often used in bodies as grog for texture and to increase thermal expansion. (Digitalfire Reference Library, n.d.-e)

Deflocculant

Deflocculant is a chemical substance, addition of which to the clay slurry affects it so that the clay particles begin to repel each other and the clay slurry becomes more fluid, i.e. the viscosity decreases. The need for sludge water is reduced, and low viscosity is achieved with less water than without deflocculant. (Jylhä-Vuorio, 2003)

2.3 Slipcasting process

Slipcasting is a ceramic forming technique for the mass-production of pottery and other ceramics, especially for shapes not easily made on a wheel or by hand. It is the most common commercial method. In slipcasting, a liquid clay body slip, usually mixed in a blunger, is poured into plaster molds, and allowed to form a layer, the cast, on the inside walls of the mold. (Dodd & Murfin, 1994)

In a solid cast mold, ceramic objects such as handles, and plates are surrounded by plaster on all sides with a reservoir for slip and are removed when the solid piece is held within. For a hollow cast mold, for objects such as vases and cups, once the plaster has absorbed most of the liquid from the outside layer of clay the remaining slip is poured off for later use. The cast piece is removed from the mold once it is leather-hard, that is, firm enough to handle without losing its shape. (Dodd & Murfin, 1994)

The casting technique is suited to the production of complex shapes, relief decoration, thin walls, limited edition, one off objects, reproductions. Quantitative production of factory porcelain items is usually made by this technique. (Dodd & Murfin, 1994)

2.4 Drying stages of the cast product before bisque firing

Once the cast piece is leather-hard, that is, firm enough to handle without losing its shape, it can be removed from the mold. It is then "fettled", or trimmed neatly, and allowed to dry out further, usually overnight. This produces a greenware piece that is then ready to be decorated, glazed, and fired in a kiln. According to Dodd & Murfin (1994), the terminology of each drying phase goes as follows:

Leather-hard phase is the stage in the drying process when a clay object can be carefully handled without danger of the shape being deformed, but the clay is still pliable enough so alterations can be made if desired.

Greenware phase is the stage when a vessel is going through the drying process necessary before it can be safely fired. The water which is bound to the clay minerals is not removed during drying. The drying result and consequently also the shrinkage during drying are determined by the composition of the mass, the size of the grains and the densification, the moisture content, the sherd thickness, the drying temperature, and drying speed.

Bone dry phase is the stage when clay is completely air-dry, at its most brittle state, and is ready for firing.

2.5 Bisque firing

During the complete cycle of clay firing in a kiln, the clay goes from totally fragile substance (clay) to stone like substance (ceramic), nearly impervious to water and time. It is important to understand what are the transformations that clay mass goes through in a kiln during the firing process. This knowledge helps a ceramicist to get involved in the process and make alterations, if needed. The stages are outlined in the table 4:

Table 4. Firing process (LaKe teaching material archive, HAMK)

Phases of a ceramic firing process
100-200°C - water evaporates from the clay
200-500°C (226°C) - quartz crystal form changes (200-300 - important when cooling)
300-800°C - organic matter burns off
573°C - clay turns into ceramics (500-600 - important when the furnace cools)
400-600°C - the crystal water evaporates
900-1000°C - decomposition of carbonates into oxides. The clay begins to sinter, i.e., it turns into a solid porous material without liquefaction
1000-1400°C – vitrification. At different temperatures for different clay types:
1000-1050 - red clay
1100-1300 - stoneware clays
up to 1400 – porcelain
About 200°C - quartz crystal changes occurred, and a cooled furnace is safe to open
The bisque firing lasts about 6-10 hours
A kiln cools for about 12-24 hours

Burn off carbon and sulfur. Clay bodies all contain carbon, organic materials, and sulfur which will burn off between 300°C and 800°C. (Bormans, 2003)

Chemically combined water driven off. After the clay is air dried, it still contains about 15% of water, which is chemically bonded. Chemically, clay is defined as being a molecule of alumina and two molecules of silica bonded with two molecules of water. The chemically combined water bond loosens when heated during the same time as the carbon and sulfur burn off. The chemically bonded water escapes from the clay body between 350° C and 800° C. The item will become substantially lighter with no physical shrinkage. It is critical that during this stage, the temperature rise is slow to prevent rapid steam escape which can result in explosion. At temperature of 400°C and higher the crystal water is removed from the kaolinite. After that, the mass can no longer be plasticized by absorbing moisture. (Bormans, 2003)

Quartz inversion. Quartz (silica oxide) has a crystalline structure that changes at a temperature of 573°C. This change, the quarts inversion, will cause the pottery to increase in size by 2% while heating and loose these 2% when cooled. The ware is fragile during this change and kiln temperature must be raised. (Bormans, 2003)

Sintering. Starting at about 900°C the clay particles begin to fuse. This process is called sintering that when completed, the clay has become ceramic. Once temperature reached between 960°C to 1050°C, it is bisquied, and the material acquires its strength. At this stage, the ceramic porous, somewhat fragile, not yet vitrified and is called earthenware or bisque. The bisque allows wet, raw glazes to adhere to the pottery before glaze firing. (Bormans, 2003)

Vitrification. It is the progressive fusion of clay that makes the finished product harder and more durable. As vitrification proceeds with temperature increase, the proportion of glassy bond increases and the porosity of the fired ceramic becomes lower. It is also during this stage that mullite or aluminum silicate crystals are formed that act as a binder strengthening the clay body even further. Stoneware is semi-vitrified and would not be impermeable without glaze. Porcelain, however, is among the most vitrified ceramic is impermeable even without glaze. It can be fired at a higher temperature than earthenware, thus the body vitrifies and becomes non-porous. (Lakeside Pottery, n.d.-b)

Cooling. The crystalline form of silica, as it cools past 220°C, must be cooled slowly to avoid cracks. Therefore, this temperature is critical when cooling. At about 200°C, quartz crystal changes occur. (Lakeside Pottery, n.d.-b)

Bisque porcelain is unglazed porcelain treated as a finished product, mostly for figures and sculpture. Unlike their lower-fired counterparts, porcelain wares do not need glazing to render them impermeable to liquids and for the most part are glazed for decorative purposes and to make them resistant to dirt and staining. (Lakeside Pottery, n.d.-b)

3 Glazes

This chapter thoroughly examines glazes nature with the focus on the high-fire range of glazes with the matte surface. It describes the glazes' typical components and the specifics how glazes get their colors. The deep research of the oxides used for the given glazes is presented. Further, what glaze undergoes in firing is shown in an easy generalized diagram.

3.1 Glazes: nature, and properties

Glaze protects and seals a ceramic body, making it both functional and beautiful. This vitreous compound can transform a porous ware into a food-safe and stain-resistant, and a tougher surface item as it is an impervious coating that has been fused to a ceramic body through firing. (The Spruce Crafts, 2017) Once a glaze is applied and the piece is fired—causing a chemical reaction and, hence, a transformation in color—the outcome is magical. Glazes can form a variety of surface finishes, such as glossy or matte finish and colors. Glazes may also enhance the underlying design or texture. (Wikipedia the Free Encyclopedia, 2021) To show the power of the color transformation, this work includes creation of the variously-glazed bulbs.

Compounds. What makes every glaze unique is its special formula - a mixture of the base-forming and additional compounds. The additional compounds are the elements that vary from glaze to glaze. However, the core base-founding ingredient are the same, with only variation in their amounts. The core compounds that typically form the main body of color glazes, according to Salmenhaara (1983), include the following:

Silica: Quartz. The material that forms the glass. The more quartz there is in the glaze, the more glassy or less opaque the glaze is.
Alumina: Kaolin (and ball clay, functions similarly in glazes*).* A refractory and stiffener that allows the glass to stick to vertical and even overhanging surfaces while it is molten. It is what makes glass into the glaze. It raises the melting point of the glazing, durability, hardness, and opacity.

Flux: Feldspar. The substance that makes silica melt at a lower temperature than it would otherwise.

Glaze influencers. Glazes come in a huge array of colors, which are the result of minerals and inorganic compounds used. The most commonly used *colorants* are the iron oxides, cobalt oxide, chromium oxide, copper oxide and copper carbonate. Additionally, a glaze's color is affected by the firing process. If the atmosphere in the kiln has plenty of oxygen, it is called an *oxidation firing*. If the atmosphere has very little oxygen, it is called a *reduction firing.* The oxygen amount in the kiln changes colors. (The Spruce Crafts, 2017)

Glaze modifiers. They are opacifiers, - those that add opalescence, or those that encourage crystal growth. Glazes can be transparent or opaque. Most opaque or partially opaque glazes derive their effect due to either tiny particles or trapped air bubbles held in suspension within the glaze. Many white glazes are white due to opacity rather than an actual colorant. (The Spruce Crafts, 2017)

Temperature. Glazes do not all melt at the same temperature. Most glazes have quite specific melting ranges. Too little heat, and the glaze will not fully melt. Too much heat, and the glaze will become too fluid and may even run off the item onto the kiln shelf. (The Spruce Crafts, 2017)

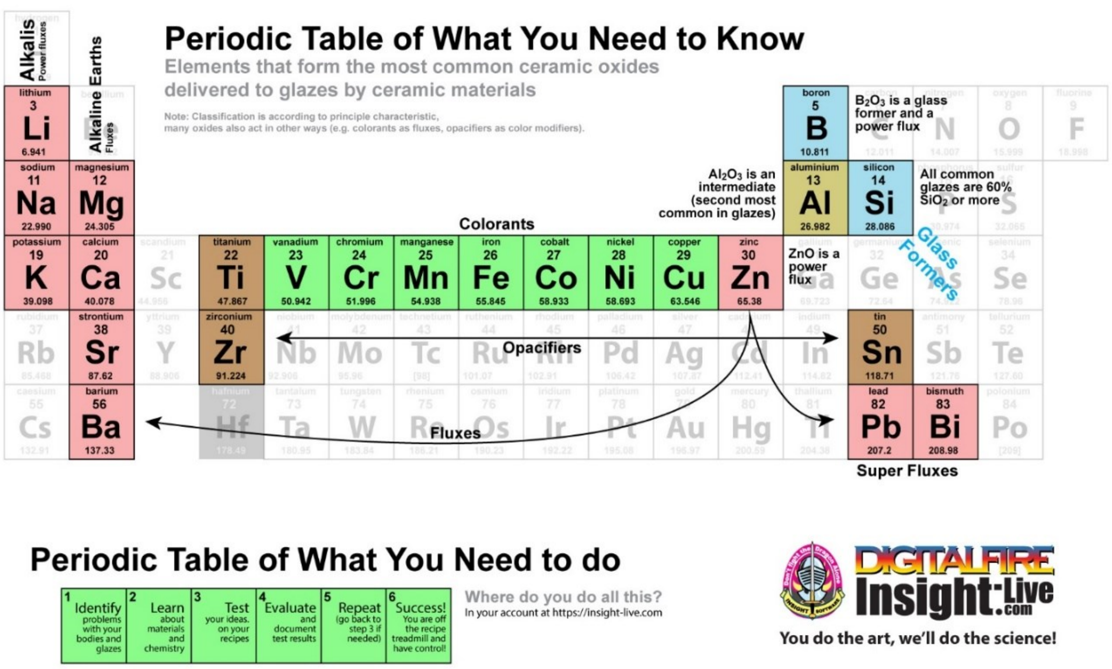
3.1.1 Coloring glazes with oxides

To achieve the wide range of hues, that makes decorating pottery with glazes so rewarding, ceramic colorants are used. Most of them are made from metallic oxides as they must be able to withstand high temperatures without burning off. Metallic oxides are also the medium that can affect the melting point of the glaze. Raw metal oxides usually bear no resemblance to the color they produce in the glaze. The knowledge of the chemical foundation of oxides and other compounds is required to be able to predict the approximate and desired outcome. In addition, understanding of firing operations, of one’s kiln’s features, and other technical specifications of the process is required. (The Spruce Crafts, 2019-b)

Oxides form crystals in the glaze that can be seen when examining the glazing under a microscope. (Green, 1963, p.75) Dyeing glaze with oxides requires testing, as there are innumerable factors that affect the color tones and other properties of the glaze. For practical implementation, it is important to remember that metal oxides should be ground carefully when making the glaze so that the glaze becomes smooth and not speckled, unless the goal is precisely a speckled effect. (Clark, 1983, p.92)

All common traditional ceramic base glazes are made from a dozen of elements (plus oxygen). They can be seen from the *Ceramic Oxide Periodic Table* below (Table 5). Materials decompose when glazes melt, sourcing these elements in oxide form. Each of these oxides contributes specific properties to the glass. So, one can look at a formula and make a good prediction of the properties of the glaze. (Digitalfire Reference Library, n.d.-g) One can know what specific oxide to increase or decrease to change a glaze property in a given direction (e.g., melting behavior, hardness, durability, thermal expansion, color, gloss, crystallization), and predict how they interact affecting each other. (Digitalfire Reference Library, n.d.-g). RO2 and RO analyses and empirical formulas are needed if one wants to research this subject deeper and modify formulas. Marked in green in the Periodic Table are the most commonly used in ceramics coloring elements.

Table 5. Ceramic Oxide Periodic Table (Digitalfire Reference Library, n.d.-g)



3.2 What makes glaze matte

Raw materials. Matte glazes are often named after the raw material that causes the matte surface. Examples of these are barium, calcium, magnesium, and lithium opaque glazes with oxides that belong to the RO group in the empirical formula of glazes. In addition, tin, titanium, zirconium, and zinc oxides belonging to the RO2 group form matt glazing surfaces. The more oxides from the RO or the RO2 groups are, the dimmer the glaze is. (Salmenhaara, 1983, p.75)

Saturation with flux. For a given firing temperature, whether a glaze comes out glossy, matte, or somewhere in between depends on whether the glaze is saturated with flux. Matte glazes are flux-saturated. Glossy glazes are not. That is why the matte glazes precipitate from the cooling glaze and form flux aluminum-silicate crystals. A glossy glaze instead solidifies as a shiny glass. A satin glaze is between the two and is just a matte glaze that is only saturated by a small amount of flux. When fully melted glazes cool and harden to a matte surface, crystals have formed. The crystals are made up of flux elements plus alumina and silica. Because there is more of that flux element than the glass can keep dissolved, the crystals of a particular flux form a glaze during cooling. If there were not such an excess, which is termed '*flux saturation*', the glaze would be glossy. (The American Ceramic Society, 2021-b)

Saturation temperature points. Different flux elements may have different saturation points. The proportions of glass formers and modifiers can also change the saturation point for given flux elements. (The American Ceramic Society, 2021-b)

Cooling rate. Formation of a matte glaze surface can be affected by the rate at which the ware is cooled. Allowing the kiln to quickly cool 93°C –149°C below the peak firing temperature, then holding or cooling slowly from there until the glaze solidifies can improve matte surfaces. The extended cooling cycle allows time for crystals to grow at the glaze surface. It is necessary to cool the glaze a bit to permit some crystal formation in some glazes. Precisely how much cooling is necessary is a matter of trial and error. Some crystals form at peak firing temperature and slow cooling is not necessary. It depends on the glaze. (The American Ceramic Society, 2021-b)

3.3 Some typical glazing agents for matte glazes

Matte glazes are often named after the raw material that causes the matte surface. Examples of these are *barium, calcium, magnesium, and lithium* opaque glazes with oxides that belong to the *RO group* in the empirical formula of glazes. In addition, *tin, titanium, zirconium, and zinc* oxides belonging to the *RO2 group* form matt glazing surfaces. The more oxides from the RO or the RO2 groups are, the dimmer the glaze is. (Salmenhaara, 1983, p.75)

Barium oxide (BaO) is a slightly capricious raw material and the oxides, and their amounts affect sensitively the glazing results. Barium oxide glazes must therefore be tested very carefully at different temperatures. In copper-containing alkali glazing, the BaO introduced by barium carbonate strengthens the colors. Note: barium carbonate is toxic, so it should not be used in the glazing of utensils such as food containers. (Salmenhaara, 1983, p. 44)

Calcium oxide (CaO) and Magnesium oxide (MgO) are produced in glazes by the natural mineral *Dolomite*. The higher the amount of dolomite, the more opaque the glazing will come. Dolomite is therefore well suited as a raw material for matte glazes. (Salmenhaara, 1983, p. 44)

Calcium oxide (CaO) is also brought into a glaze by *Calcium Carbonate (whiting, $CaCO_3$).* Therefore, it is an important raw material for the so-called in lime-glazed glazings. Accurate tests must be carried out on colored glazing, as chromium oxide (Cr_2O_3), for example, forms calcium + magnesium glazing brown in color. (Salmenhaara, 1983, p. 44)
Lithium oxide (Li_2O) (Lithia) is sourced by *Spodumene* - a silicate mineral often referred to as lithium feldspar. (Digitalfire Reference Library, n.d.-m)

Tin oxide (SnO_2) acts as a dimming component in the glaze and provides a white tint to the glaze. It can also be used in conjunction with other color oxides to soften or lighten shades. (Digitalfire Reference Library, n.d.-m)

Titanium dioxide (TiO_2) (Titania, Rutile) by itself is quite refractory. But when other oxides are present in the melt, TiO_2 becomes much more complex: it opacifies, variegates, and

crystallizes glazes. It also modifies existing colors from metals like Cr, Mn, Fe, Co, Ni, Cu. (Digitalfire Reference Library, n.d.-m)

Zirconium dioxide (ZrO_2) (zirconia) (not to be confused with zircon) is extremely refractory, even more so than alumina. It is primarily used as an opacifier in glazes, it does not easily go into solution in the glaze and so does not participate in the chemistry. It is normally used in the form of zirconium silicate. (Digitalfire Reference Library, n.d.-m)

Zinc (ZnO) Zinc generally promotes crystalline effects and matteness / softness in greater amounts. If too much is used, the glaze surface can become dry and the heavily crystalline surface can present problems with cutlery marking. Other surface defects like pitting, pin holing, blistering, and crawling can also occur because its fine particle size contributes to glaze shrinkage during drying and it pulls the glaze together during fusion. (Digitalfire Reference Library, n.d.-m)

Potash feldspar produces a crystalline phase (leucite) that contributes to opacity. Thus, it is often used for matte glazes while soda feldspar is used for glossy glazes. (Digitalfire Reference Library, n.d.-m)

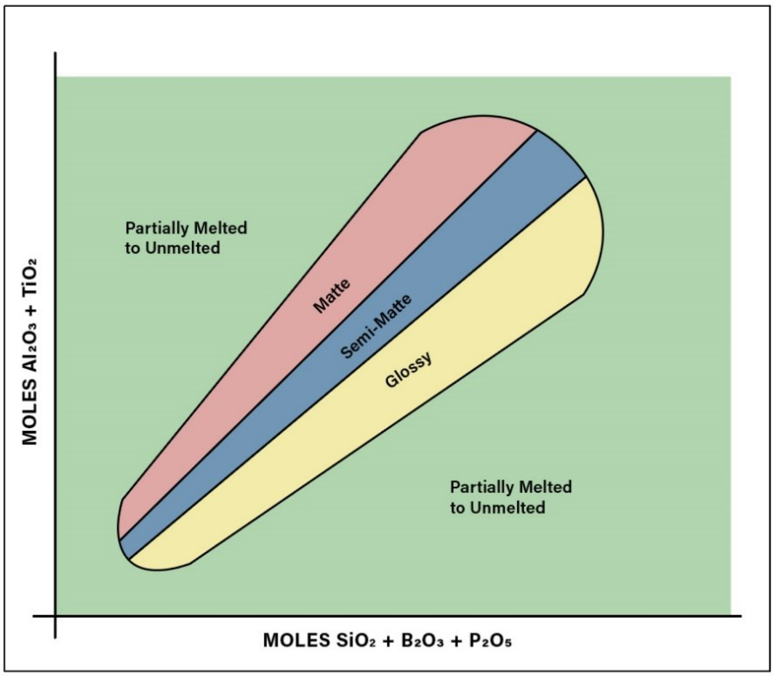
3.4 Glazes and range of temperatures

Each ceramic glaze has to be fired at a specific temperature range. If fired at too low temperature, the glaze will not mature, if at too high, the glaze will become too melted and run off the surface of the pottery. The range of glazes varies by temperatures like so: (according to The Spruce Crafts, 2018-b)

- Very low-fire range: 605^oC - 850^oC
- Low-fire range: 882^oC - 1120^oC
- Lower mid-fire range: 1110^oC - 1145^oC
- Mid-fire range: 1165^oC – 1210^oC
- High-fire range: 1240^oC - 1390^oC

The following diagram suggests that a high-fire work with porcelain may be viewed more globally as an island of fully-melted glazes within a plot of glass forming oxides. Besides silica, oxides of boron and phosphorous are glass formers and should be included on the horizontal axis. Titania is included with alumina on the vertical axis. In the lower left corner, there are not enough glass formers for a glaze to melt. At the upper right, glazes will not melt because the refractory properties of silica and alumina overwhelm the fluxes. This generalization applies for any family of glazes of a specific ratio of fluxes matured to a specific firing temperature.

Image 3. A generalized diagram for a high-fire glaze work with porcelain (The American Ceramic Society, 2021-b)



For this thesis work, I am researching the high-fire glazes, so I am going to concentrate on them. High-fire range of glazes: 1240°C - 1390°C. This range includes the stoneware and porcelain. Glazes and clay bodies are dense and durable; however, the color range is limited. Because of the varying effects of oxidation and reduction on glaze colorants, the few coloring oxides that are viable at this range can still produce a rich, if much more limited, palette. (The Spruce Crafts, 2018-b)

3.5 High-fire matte glazes created for the thesis

Some of the foundation compounds have already been discussed in the porcelain slip section. They are presented here only as glaze agents. All the names are presented with translation to Finnish. The nature of the given ingredients is presented in this chapter, while the formulas and the making process will be shown in the *implementation* section.

3.5.1 Foundation compounds chemistry

The core foundation compounds for the two high-fire matte glazes that were chosen and created for this work, are: *Potash Feldspar, Kaolin Grolleg, Spodumene, Silicon Dioxide (Silica, Quartz), Calcium Carbonate (Whiting, Chalk), and Zinc Oxide.* The substances that contain several elements in their composition are presented with their content formulas.

Potash Feldspar

Feldspar is a melting agent consisting of flux. Fluxes play the key role in lowering the melting point of silica, making it usable in ceramic glazes. And, like silica, fluxes also promote vitrification, or transformation into glass. (The Spruce Crafts, 2019-b)

A feldspar is typically referred to as *potash* if there is significantly more potassium than sodium. Potash feldspars are often not as pure and white as *soda* spars. (Digitalfire Reference Library, n.d.-a) Potassium feldspar melts at around 1200^{o}C, which is higher than soda feldspar, therefore, producing a more viscous melt. It can also produce a crystalline phase (leucite) that contributes to opacity. Thus, potash feldspar is often used for matte glazes while soda feldspar is used for glossy glazes. (Digitalfire Reference Library, n.d.-a)

Kaolin Grolleg

Kaolin is a refractory and a stiffening agent, and the primary source of alumina oxide for glazes. Almost all glazes contain alumina, or aluminum oxide as without it, the glaze would simply slide off the surface of any vertical piece. By adding alumina as a clay (kaolin, ball clay, or fireclay) or as alumina hydrate (a white manufactured powder), the glaze can stick to the pottery's surface without coming off. (The Spruce Crafts, 2019-b)

Alumina helps disperse fine gas bubbles that can form in the firing process. (The Spruce Crafts, 2019-b). Additionally, it is used in glazes to keep the silica, feldspar, frit, and other particles from settling out. (Digitalfire Reference Library, n.d.-b)

Spodumene

Spodumene's composition is shown in the table below:

Table 5. Spodumene content formula (Digitalfire Reference Library, n.d.-l)

Oxide	Content
Li2O	8.01 %
Al2O3	27.41 %
SiO2	64.59 %

The name Spodumene comes from the Greek word *spodos*, meaning 'burnt to ash'. Spodumene is a silicate mineral often referred to as *lithium feldspar* as it is used in ceramics as a source of lithium. Lithium (lithia) is a very powerful flux. It reduces thermal expansion, melting temperature and viscosity of the glaze melt. As one of only a few natural lithium source materials, spodumene is a valuable component in ceramic glazes and glass. Since spodumene is a natural combination of silica, alumina and lithia, it melts better than a chemically equivalent mixture of silica, kaolin, and lithium carbonate. (Digitalfire Reference Library, n.d.-l)

Some types of spodumene do contribute to the formation of bubbles in the glaze slurry. To alleviate this issue, spodumene can be washed before use by mixing it well in plenty of hot water, allowing to settle overnight, pouring off the water the next day, and drying it. (Digitalfire Reference Library, n.d.-l)

Silicon Dioxide (SiO_3, Silica, Quartz)

Silica can be obtained naturally from quartz, sandstone, sand, or flint, or it can be manufactured as silica oxide. Silica, or industrial sand, is the key ingredient in glass, raw clay, and ceramic glazes. (The Spruce Crafts, 2019-b) It is the glass former**.** If it is hot

enough, silica forms glass all by itself. However, silica's melting point is approximately 1710ºC, which is hotter than can be obtained by any ceramic kiln. Therefore, silica cannot be used on its own as a pottery sealer. (The Spruce Crafts, 2019-b)

Calcium Carbonate ($CaCO_3$, Whiting, Chalk)

Whiting is also often called a quicklime or burnt lime in raw glazes and glass. However, whiting and limestone are not necessarily the same thing. Whitings typically contain some dolomite as a contaminant, while limestone may contain considerable amounts of magnesium (i.e., dolomite). Some suppliers do not distinguish, so, special attention must be paid. (Digitalfire Reference Library, n.d.-d)

Whiting has traditionally been a source of calcium oxide in raw glazes and glass. It is generally inexpensive (Digitalfire Reference Library, n.d.-d) and it is a high temperature flux that gives durability and hardness to glazes. (Glazy, 2015)

It produces a very large volume of gases while decomposing and loses more than 40% by weight. These gases usually evaporate before 1100ºC and do not affect the glaze melt. (Digitalfire Reference Library, n.d.-d)

Zinc Oxide (ZnO)

Zinc oxide is soluble in strong alkalies and acids. It is thermally stable on its own to high temperatures, however in glazes it easily dissolves and acts as a flux. Due to its fine particle size, it pulls the glaze together during fusion, and contributes to glaze shrinkage during drying. (Digitalfire Reference Library, n.d.-m)

Zinc generally promotes crystalline effects and matteness when used in larger amounts. If too much is used, the glaze surface can become dry, the heavily crystallized, and having such defects as pin holing, blistering, and crawling (Digitalfire Reference Library, n.d.-m)

The use of zinc in glazes is limited by its price, its affect on certain colors and its tendency to make glazes more leachable in acids. However, it is also widely used in glass, frits, and enamels. (Digitalfire Reference Library, n.d.-m)

3.5.2 Metal oxide chemistry

The oxides, or the *‘coloring agents’* for the two chosen and created for this work high-fire matte glaze bases are the following: *Copper Carbonate, Manganese Dioxide, Titanium Dioxide, Copper Oxide, Iron Oxide, and Chrome Oxide.*

What needs to be taken into consideration when adjusting ceramic glazes is: what each oxide contributes, how they interact, and their proportions in the formula. Materials are ‘warehouses’ that supply these oxides to the glaze melt. Oxides within this model are not the same as those outside of it. Sometimes textbooks will provide data on the properties of individual oxides. For example, melting behavior might be quoted as a reason for firing in a certain way. However, it is important to realize that oxides are "packaged" within materials that we use in ceramics, those materials are normally sourcing other oxides along with them. While an individual oxide might melt at a certain temperature, the individual particles of that material may not release the oxide to participate in the chemistry until a much higher temperature. Or they might release it even lower. Additionally, interactions between it and particles of other materials will affect the manner of melting and dissolving. (Digitalfire Reference Library, n.d.-f)

It is difficult to draw relationships between the chemistry of vitreous bodies and their physical fired properties. Bodies are not melted during firing as are glazes, normally firing creates conditions of crystal growth in the body. Thus, bodies of similar chemistry can develop completely different crystalline formations and different physical properties, depending on firing and mineralogy of elements. (Digitalfire Reference Library, n.d.-f)

Copper Carbonate ($CuCO_3$)

The color range of copper carbonate is: green, turquoise, and red tones, depending on firing conditions and glaze formulation. Suggested concentrations of copper in the preparation of glazes and slips are as follows: in glazes < 5%, in slips 2 - 8%. If concentrations above 5% are used, glazes often change to a metallic pewter. It can also be applied by brushwork as a wash on bisqueware. Copper should not be used as a

component in soluble glazes that will come in contact with food or drink, as it is likely to leach. (The Ceramic Shop, n.d.)

Manganese Dioxide (MnO_2)

Manganese is an element in many volcanic rocks, and thus occurs in many clays weathered from these parent rocks. The color range of manganese dioxide is: black, brown, and purple tones. Manganese is a color contributor in many traditional slip glazes. Smaller amounts are easily dissolved in most glaze melts, however, around the 5% threshold, the manganese will precipitate and crystallize. In large amounts of about 20% in a glaze, metallic surfaces are likely. (Digitalfire Reference Library, n.d.-o)

Titanium Dioxide (TiO_2, Titania, Rutile)

Titanium dioxide is considered an impurity in ball clays and kaolins used for making porcelain as it can react with any iron present to form rutile crystals which negatively affect body color and tranlucency. (Digitalfire Reference Library, n.d.-h) By itself, it is quite refractory, but when other oxides are present in the melt, it becomes much more complex: it opacifies, variegates, and crystallizes glazes. Titania is oxygen-hungry, it quickly oxidizes from its reduced state if given a chance. (Digitalfire Reference Library, n.d.-h)

In amounts below 1% titanium dioxide can dissolve completely in a glaze melt. At 1% it can alter and intensify existing color and opacity the glaze. Above 2% it begins to significantly alter the glaze surface and light reflectance properties through the creation of tiny crystals. These crystals give soft colors and pleasant opacity, break up and mottle the surface. In the 2-6% range, it increasingly variegates the glaze surface. As amounts increase above 5%, the opacity and matteness accelerates. As much as 25% can be absorbed by some lead glazes. Glazes containing titanium dioxide are phototropic thermotropic - they can slightly change color by the action of light and when heated. (Digitalfire Reference Library, n.d.-h)

Copper Oxide (CuO)

The color range of copper oxide is: green and blue tones. The shade of copper greens can vary with firing rate and soaking changes. The best colors are generally obtained with fast firing and little soaking. Copper and titanium together can produce beautiful blotching and specking effects. (Digitalfire Reference Library, n.d.-j)
Copper oxide melts at the lowest temperature of non-ferrous metal oxides. It is a strong flux and even 2% can considerably increase melting of a glaze, so it can affect the matte surface. When added to low lead solubility glazes, copper can much increase the solubility of the lead, or leaching. (Digitalfire Reference Library, n.d.-j) That is why copper oxide-stained glaze is not suitable for utensils. (Salmenhaara, 1983, p.82, Clark, 1983, p.94)

Iron Oxide (Fe_2O_3, Ferric Oxide)

The color range of iron oxide is: amber, yellow, tans, and brown tones. Up to 4% of it in glazes produce amber to yellow, around 6% - tans, bigger amounts – brown tones, in the 20% range, matteness is typical. Iron compounds are the most common coloring agents in ceramics. On one hand, they are undesirable impurities staining white clay or glaze and turning bright colors muddy. At the same time, iron has so many sides with different kiln atmospheres and temperatures; and with different glaze chemistries that it is among the most exciting of all materials. (Digitalfire Reference Library, n.d.-i)

Most glazes dissolve more iron in the melt than they can incorporate in the cooled glass. Thus, extra iron precipitates out during cooling to form crystals. This behavior is true both in oxidation and reduction. (Digitalfire Reference Library, n.d.-i)

Iron oxide behaves as a refractory anti-flux material in a glaze melt. Iron-red glazes, for example, can have very low alumina contents yet do not run off ware because the iron acts like alumina to stabilize and stiffen the melt. However, these glazes tend to have reduced durability. On contrary, in a reducing atmosphere, it acts as a flux in both bodies and glazes at high temperatures. Since the breakdown of carbon or sulfur compounds in body and glaze so easily reduces iron, a slow oxidizing atmosphere is critical through 700°C - 900°C to assure that it remains in its anti-flux oxidized form. (Digitalfire Reference Library, n.d.-i)

Chrome Oxide (Cr_2O_3)

The color range of chrome oxide is: green; and also, possibly orange, red, brown, and yellow tones; pink (with tin oxide), and blue - green (with cobalt). (Salmenhaara, 1983, p.82, Clark, 1983, p.94) However, the green is its 'main' color. It produces its characteristic green in slow or fast and oxidizing or reducing firing. It is also used in paints and dyes. The green color produced by chrome is generally a drab army-helmet green. It is also used in the glass industry to make green glass (up to 1%). (Digitalfire Reference Library, n.d.-k)

Chromium is not very soluble in glass and does not form silicates or combine with fluxes readily unless compounds are finely ground (e.g., ball milled) and dispersed and amounts are not excessive. Since it does not dissolve well in the melt, amounts above 1% are increasingly likely to opacify the glass rather than color it more. Amounts up to 3% in a glaze recipe gives greyish green coloration. (Digitalfire Reference Library, n.d.-k)

3.6 Glaze firing

The process in the kiln, as described by the Lakeside Pottery (n.d.-b), undergoes the following stages:

Heating up. Glaze firings can be faster than bisque firings because most of the water has already been driven out of the clay. Some glazes will look better when fired fast, and some - when fired slow. This requires experimentation. If unsure, one should start with slow firing in particular if the glazed ware has been recently glazed and is still wet.

Soaking. Having a soak (also called holding temperature or holdup time) can be very useful at the end of firing. A soak may last from 10 minutes to an hour or more. This helps even out the temperatures throughout the kiln and ensure all the pieces have achieved the right temperature. This is particularly useful if the kiln is densely packed. Soaking for too long can overfire ware, glazes might run and end up on the kiln shelves.

Cooling down. Mid- to high-fire glazes often look better if they are cooled slowly.

4 Preparation

This chapter demonstrates what preparation has been done after the theoretical knowledge was obtained, and before moving on to the project accomplishment. It includes the idea search and my sources of inspiration, how they transformed my ideas and eventually brought me to the idea of this work. The ideation process is followed up by the process planning phase, when sketching and material collection was done. The full progress diagram is shown in this section.

4.1 Inspiration, idea search

The chosen artistic style is an outcome of my long transition from the urban esthetics to the organic forms' beauty, conceptual art- driven inspiration and eventually, - personal fascination in the driftwood art and the art of organic shapes made of inorganic materials.

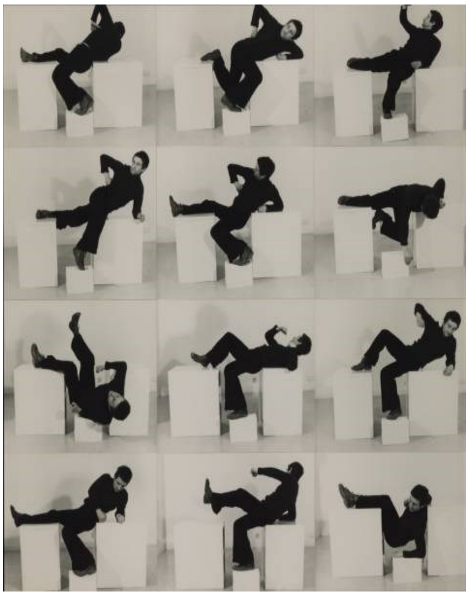
The very original inspiration came from the **urban esthetics** ideation. As an artist, I was thinking creatively, but from the somewhat practical aspect of exhibiting in indoor spaces, such as art galleries (some interest evoking ideas are in the images 4 and 5). I wanted to bring some soft forms into typical plain gallery spaces, with frequently used rigid concrete elements. There, the Bulbs could be arranged for example in an urban theme, being compiled in an installation with other, unpredictable materials such as robes, metal wires and meshes, concrete pieces, hanging down or pocking sidewise or upwards, as wall-, floor, table, - or ceiling installations… There are unlimited creative usage possibilities available. I am sure I will use them for this purpose one day too. However, for this work I drifted away from that idea and was thinking of other presentational styles.

Image 4. Still Life (bouy) (Hicksdave, 2007)

Image 5. Gift From Above (Naoko Okabe, 2014)

At that time, one of the directions in art, **the conceptual art** as a presentational style, caught my attention (great examples are in the images 6 and 7). The trend had already been developed in the 6os, and in a sense, it frees the artist and the art itself from being too serious, clear, or meaningful. The concept interpretation can come in front of the traditionally considered beautiful presentation.

Image 6. Jannis Kounellis. Untitled. 1969 (Tate, n.d.)
Image 7. Bruce McLean. Pose Work for Plinths. 1971 (Tate, n.d.)



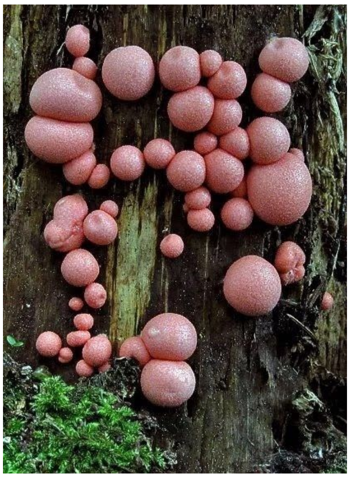
In search of forms, I began to be inspired by nature. The nature itself is the greatest inventor and creator of everything – the glory and the ugly, the good and the bad. Nature is

an endless source of inspiration on its own (the images 8 - 10 are a perfect proof of that). To study the **products of nature** can be a life-time research. All sorts of funguses can be found from the nature. They do usually live on and co-exist with fallen trees and brunches, some of them being, practically, tree diseases that slowly kill the stems. So, I realized that I wanted to show the intriguing beauty of those parasitic organisms in an artistic way!

Image 8. Porcelain fungus (Woodland Trust, n.d.)

Image 9. Lycogala Epidendrum, ”Wolf’s Milk Slime” (Bio-Occulist, n.d.)

Image 10. Coral Tooth Fungus (Blackmomba, 2014)



So, that was only logical that I arrived at my final source of inspiration - **the driftwood art** (the images 11 and 12). I have been for long fond of combining man-created with nature-created elements, to show the beauty of the contrast, so to say to “combine un-combinable”. I got strongly influenced by the idea and the endless creative opportunities that rise within it.

Image 11. Wooden Lamp (Tossart, n.d.)

Image 12. Woodworking (ID Lights, n.d.)

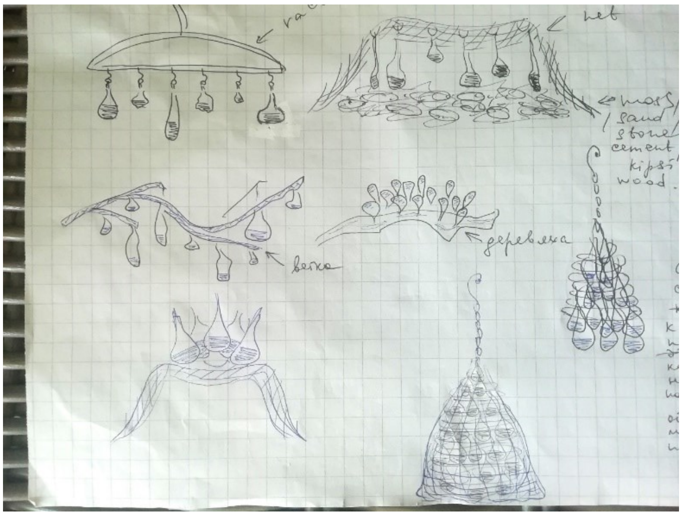
Being driven by the organic shapes ideas in art, I have previously made the **glass artworks** called “Let it drip” that depicts the dripping water drops (the images 13 and 14). I was very satisfied with the result, with the flow of the material, and I wanted to continue this line in my ceramic artwork. Moreover, in the future, the glass and the ceramic Bulbs can be combined in one piece to show the beauty of both materials together.

Image 13. Let It Drip. Glass sculpture (Siukola, 2019-a)

Image 14. Let It Drip. Glass sculpture (Siukola, 2019-b)

After the idea was formed, and the name was thought of, I moved on to the sketching and designing the individual bulb elements as well as a few general installation ideas. The points to consider were the sizes and the color pallet of the bulbs, and the ways of assembling and presenting the elements altogether, in one group, as a piece. Here there are several ways to make a maneuver with – to make a hanging, standing, laying, etc. installation; indoor or outdoor. The concept suggests that there would be other materials employed for the installation, whichever way would be selected. Among the suggested additional materials, such items as a driftwood, a metal mesh, a thick robe, or a soft net are considered (see the image 15).

Image 15. Sketching ideas



4.2 Planning the process

The planning started from making the work timetable. This phase cannot be overlooked as working with ceramics involves many time- and labor-consuming phases, such as creating the slip, making plaster molds, slipcasting, making the additional bulbs support base, letting dry, arranging access to the shared kilns, raw – firing, creating glazes, glazing the bulbs, glaze – firing, and making the outdoor installations with a professional photoshoot. Several days' time was allocated for the photoshoot considering the risk of a bad weather. All of these needed to be taken into consideration when setting the work schedule. This process requires a lot of self-discipline from an artist. Being well-collected during the entire process, is crucial for a ceramicist.

The next step was to select my materials. All the needed materials for the porcelain slip making, the plaster molds building, and the glazes creation, were found from the university storage. The possible additional materials for various installation versions, were searched for in stores and in forests and parks (see the images 16 and 17 below). All the needed professional equipment for a high-quality photoshoot was arranged.

Images 16,17. Material ideation (Own images)

5 Implementation

A detailed description of the overall work process is shown in this chapter. It is divided into two subsidiary parts: creating the porcelain bulbs with the help of plaster molds and creating and applying the decorative glaze on them. All the previously collected information is put here into practice. The outcome, resulting from the obtained theoretical knowledge and thorough pre-planning, and been followed up by the practical experience, - leads to the strongly enhanced professional skills.

5.1 Porcelain bulbs making

The creation process has been carried out in several stages. Firstly, porcelain slip itself was made. Then, the plaster molds for slipcasting were built. Altogether, three molds were created for this project. After the "Bulbs" had been cast, trimmed, and dried, they were bisque-fired.

5.1.1 Porcelain slip making

The porcelain slip named "Massa 3B" has been done according to the recipe by A. Hortling. This recipe is one of the several commonly used at HAMK. The content of the slip was discussed in the chapter 2.2.1. It has the following ingredients in its content formula: *Kaolin Superb Porcelain, Ball Clay Hywhite Superb, Potash Feldspar, Calcium Carbonate (Whiting, Chalk) and Silicon Dioxide (Silica, Quartz).* When mixing up the dry ingredients, a protective mask must be used. The ingredients that form a slip are health hazardous when in their dry form, i.e., inhaling the dust particles must be prevented. The amounts of the ingredients and the making process are displayed in the following tables:

Table 6. The porcelain slip recipe (Jylhä-Vuorio, 2003)

A. Hortling, named Massa 3B	
Kaolin Superb Porcelain	35%
Ball clay Hywhite Superb	10%
Feldspar FFF	25%
Chalk	5%
Quartz FFQ	25%
In total	**100%**
Water	36%
Deflocculant Dispex	0,18%

Table 7. Porcelain slip making process (Jylhä-Vuorio, 2003)

Porcelain slip making process
1. Measure warm water into the mixing bowl
2. Weigh the deflocculant and add it to the water. Stir
3. Weigh the clays (kaolin and ball clay) and add them to the water. Stir
4. Weigh the non-plastic raw materials (feldspar and quartz). Mix them into the mass
5. Allow to rotate in the mass mixer for about 1 hour, at the slowest speed
6. Sift the pulp with a 50 Mesh sieve to break down any lumps
7. Stir from time to time for about 2 hours. Check the viscosity of the pulp
8. When the viscosity of the pulp is good and there are no air bubbles in the pulp, it is ready for use

Images 18,19. Slipcasting process

The slip has been created in a large amount. However, since I am not making a mass production with many molds, naturally, the slip was not meant to be used all at once. When I later had to return to the bulbs making, I had to make the slip smooth again and all the ingredients to fully blend-in, without forming a residue. I did the stirring and removing the residue that had already formed. For mixing it up, I used an electric high-speed propeller mixer. After that, the slip was again left aside for few hours so that the trapped-in air bubbles would free from the mass. Then the slip mass was ready to be used again.

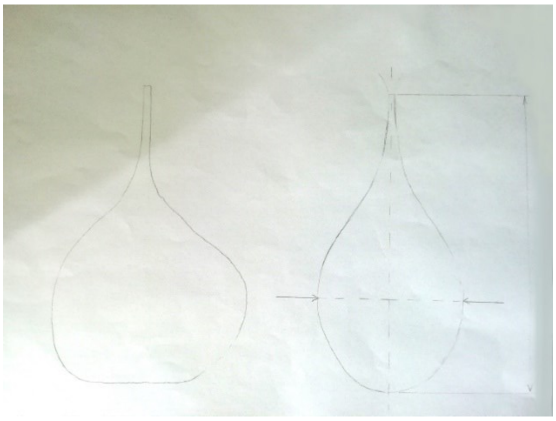
5.1.2 Plaster molds for slipcasting

In search of the desired shapes, I have made several plaster molds. After having tried them out, I have decided which ones suit the most for this project. The three of them were selected. Here is the step-by-step process of the plaster molds making for the three selected shapes. The main starting point for thinking of prototypes was looking for an organic shape. Due to the bulbs' forms, all the molds are made of two parts.

Step 1: Designing the prototype models

The first prototype for the shape was sculpted out from clay. I hand-built a free-style form reminding of a bulb, or a drop of some liquid or semi liquid substance, a lot of which can be found in nature. The shape was made deliberately to be not perfectly symmetrical, but quite polished anyways. This form has the middle size among all the three prototypes. This prototype was first sketched by hand, in search of a satisfying shape and size.

Images 20,21. Model prototype N1



For the second form, I used an old wooden tool, which perhaps, originally was meant to be used for making mashed potatoes or crushing spices. Not being sure about the initial purpose of the tool, I, however, saw the potential for getting an intricate and truly natural and organic looking shape out of it. The shape itself is quite challenging for casting due to its very curved and elongated form. This form resembles something biogenic, derived from a living organism, having a biological origin. The surface is by design slightly rougher and is more textured than the one of the first prototype. This is the biggest form from the three.

Image 22. Model prototype N2

The third shape was created using an old light bulb. This time I was looking for a perfectly round and symmetrical shape. It was a bit of a challenge to find such a light bulb as they are not commonly used any more in the times of led lamps. The shape is the smallest in size, just like some perfectly faultless product of nature, and it has an absolutely smooth surface.

Image 23. Model prototype N3

To add even more variety, after all the shapes have been cast, I polished some of them to perfection, while deliberately leaving the joint marks from the molds on, and even sometimes emphasizing on them, while sanding and finalizing the casted bulbs. Any deliberately left possible roughness, unevenness, exposed joints - add to the texture, as the textured glaze will also do when applied.

Step 2: Preparing materials

Before starting to create the molds, all the necessary materials should be prepared. Materials needed for making a plaster mold are the following:

1. Plaster, water, scale, clay, pine soap slurry, shellac, separative medium, 4 cottle boards, 4 clamps

2. Dust mask and safety goggles, 2 clean buckets, something to mix with, paper towels, a clean, flat, and non-porous surface to work on

Step 3: Preparing the models for use

Firstly, I made the parting lines. As all the three of my molds are 2-part molds, they open either right in the middle of the model vertically, or in its widest place horizontally. To know the precise opening places, I determined and marked the parting lines on the model.

Secondly, I created a gate. That is where the slip is poured into the mold. That way, the top of the casted items has some extra clay that can easily be trimmed away, leaving a clean edge. I made the gate by building up a clay extrusion on the top parts of my ingots.

Thirdly, I brushed on the protection to all the accessible to plaster surfaces so that plaster can be detached easily when formed into a mold. The protection has three layers, which must be applied in the given order:

1. Shellac – apply, let dry

2. Whisked, foamy pine soap slurry - spread-on, let dry

3. Separative medium - brush-on, let dry

Lastly, I made a clay bed. The ingot prototype must rest on it perfectly horizontally and be aligned with the parting lines.

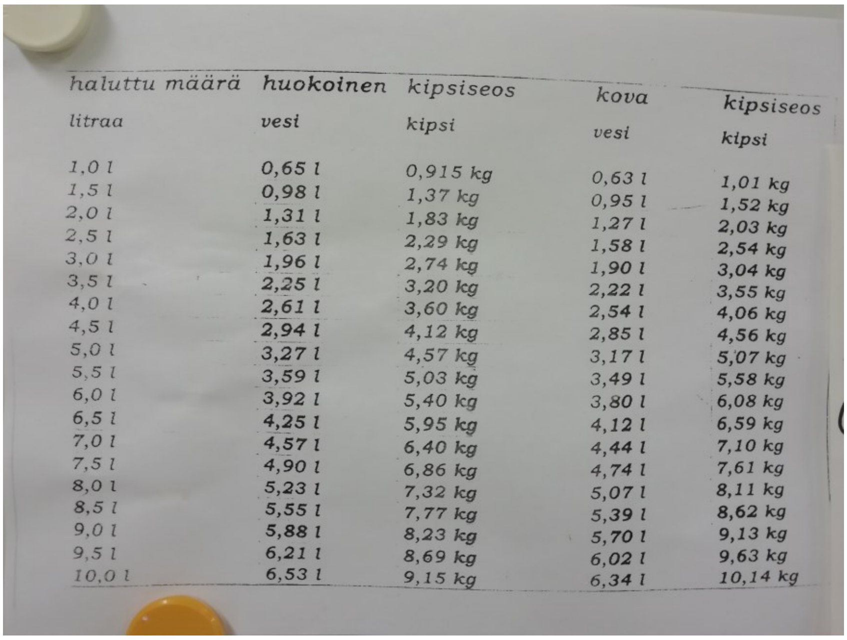
Step 4: Making the 1st part of the plaster molds

I prepared the frame from cottle boards. First, I set up the cottle boards on a clean work surface to achieve my desired dimensions, allowing about extra 3 cm of extra space in each direction from the model towards the boards for the mold to have strong thick walls. Then I clamped the boards in place and sealed all edges and cracks with clay. Next, I coated the cottle boards with a detaching agent by brushing a light coat on inner sides of the boards. This will help them stay clean and seal them from sticking to the plaster.

Next is the time to make plaster. For my references, I followed the table of plaster expenditure from HAMK materials. There were several molds made all together, of which three were eventually selected for the core thesis artwork. The sizes and shapes of the

molds were different, so multiple calculations and various volumes of plaster slurries were used. In the presented table there are two types of plaster calculated. I used the porous plaster for my mixtures.

Image 24. Table of plaster expenditure for plaster mixtures (LaKe teaching material archive, HAMK)

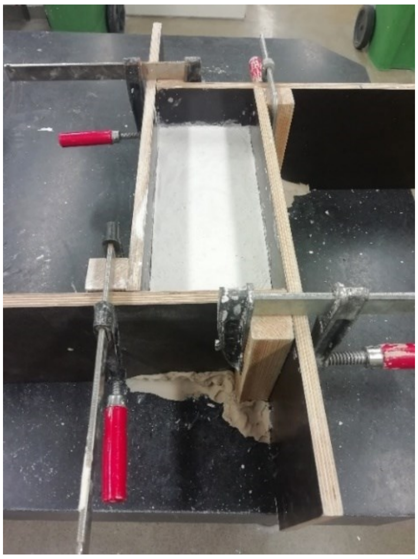


haluttu määrä litraa	huokoinen vesi	kipsiseos kipsi	kova vesi	kipsiseos kipsi
1,0 l	0,65 l	0,915 kg	0,63 l	1,01 kg
1,5 l	0,98 l	1,37 kg	0,95 l	1,52 kg
2,0 l	1,31 l	1,83 kg	1,27 l	2,03 kg
2,5 l	1,63 l	2,29 kg	1,58 l	2,54 kg
3,0 l	1,96 l	2,74 kg	1,90 l	3,04 kg
3,5 l	2,25 l	3,20 kg	2,22 l	3,55 kg
4,0 l	2,61 l	3,60 kg	2,54 l	4,06 kg
4,5 l	2,94 l	4,12 kg	2,85 l	4,56 kg
5,0 l	3,27 l	4,57 kg	3,17 l	5,07 kg
5,5 l	3,59 l	5,03 kg	3,49 l	5,58 kg
6,0 l	3,92 l	5,40 kg	3,80 l	6,08 kg
6,5 l	4,25 l	5,95 kg	4,12 l	6,59 kg
7,0 l	4,57 l	6,40 kg	4,44 l	7,10 kg
7,5 l	4,90 l	6,86 kg	4,74 l	7,61 kg
8,0 l	5,23 l	7,32 kg	5,07 l	8,11 kg
8,5 l	5,55 l	7,77 kg	5,39 l	8,62 kg
9,0 l	5,88 l	8,23 kg	5,70 l	9,13 kg
9,5 l	6,21 l	8,69 kg	6,02 l	9,63 kg
10,0 l	6,53 l	9,15 kg	6,34 l	10,14 kg

In one clean bucket, I measured out the appropriate amount of water for the plaster-to-water ratio. Then in a separate bucket I measured out the dry plaster. I pour the plaster into the water (always dry into wet) and allowed it to sink and absorb into the water. I allowed the plaster to soak and remove air bubbles by hitting the sides of the bucket. Once the plaster has set enough to create a soft visible peak on the top of the bucket, I mixed the slurry with a hand mixer and poured it into the cottle boards up until the drawn line. Then I let the plaster set for about 30 minutes or until the plaster feels cool.

When this part of the mold was ready, I added the keys. This step is fairly easy to forget, yet it is a crucial one. I screwed 4 holes of about size of a coin on sides. The keys will help the 2nd part to lock in. The depth of the keys is important. If they are too deep, the 2nd part can get stuck to them and will not detach, so a key can get broken when ripping off the part. If they are too shallow – the mold parts risk to slide away and not to have precise and tight connection. The first part is ready.

Images 25,26. Making the 1st part of the plaster molds




Step 5: Making the 2nd part of the plaster molds

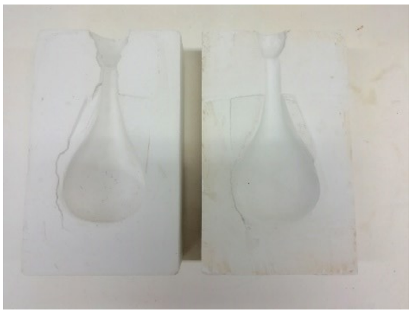
I soaped up the first mold part and repeated the process for the second mold part, paying extra attention to always clean and soap each part so that the new plaster would not stick to them. Then I mixed the measured amount of plaster and poured it into the new boards . After about 30 minutes, I removed the boards and separated the new plaster mold part from the prototype and the clay. A rubber mallet helped sometimes. The first part is ready.

Images 27,28. Making the 2nd part of the plaster molds


In the end, I cleaned up the edges of the molds with a file and sandpaper to avoid cracking and to make it easier to handle. I put the molds into a dry cupboard for a few days to allow them to dry out completely before slipcasting.

Images 29-31. Two-part plaster molds





5.1.3 Slipcasting process

When I started the pouring process, I realized that even though I followed the formula precisely, the slip was too thick and not very fluid. Not to add water, I added an extra spoon of deflocculant to the entire 10l barrel. It worked instantly. Now the solution was nicely fluid that made the setting time much shorter – from 20 to 10 min.

Images 32-34. First cast bulbs



5.1.4 High-bisque firing

It is important to remember that ceramics go through a small shrink in the scale (about 10-12%) during firing. However, it is of no importance for this artwork. The high bisque firing was performed in an electric kiln at the peak temperature of 960^{o}C. like so:

Table 8. High bisque firing temperatures (LaKe teaching material archive, HAMK)

High bisque firing		
Ramp **(Temp. per hour)**	**Temp** **(Peak temp.)**	**Time** **(Soak)**
1. 100’C/h	600’C	0
2. 150’C/h	960’C	0
END		

Images 35,36. Perfectly white bisque-fired bulbs

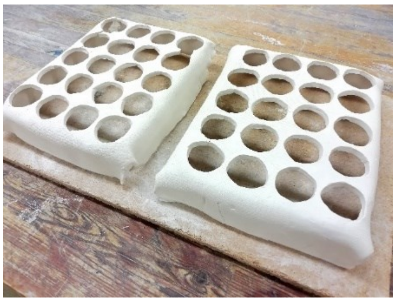

5.1.5 Additional supportive structure building

At this stage, before I moved on to working with the glazes, I needed to build a supportive structure. It was needed because the bulbs were intended to be glazed on their bottoms. As the glaze cannot touch the kiln shelves, they would need to be glaze-fired in an upwards position, and due to their shapes and long narrow necks, they cannot stand like that by themselves. Since the “necks” of the bulbs are meant to be left un-glazed, the bulbs are fired upside down, sitting in the base.

In total, I made two identical rectangular bases. Clay body with a high chamotte content was chosen for its higher durability and properties of withstanding multiple firings. They can be well re-used for other projects as well. The bases were made from a slab with use of hump molds and the slab roller. They were raw-fired at the same firing with the Bulbs.

Images 37-39. Supportive bases for glazing





5.2 Glaze making and glazing the bulbs

This process has included the three core phases. Firstly, the 6 glazes were created. Then, the double coated glazing was realized. For firing, the bulbs were positioned upwards into the pre-made support structures. Eventually, they were glaze-fired at the high-fire range.

5.2.1 Glaze making

When a ceramicist plans an artwork, they are free to choose whether to create their own glazes, to outsource the making service from a technician, or to purchase ready glazes. However, the process of creating glazes by yourself and waiting for miraculous

transformations as outcomes is very intriguing, so I undoubtedly wanted to have a personal impact on it. Since I had researched on the chemical compounds of glazes, I wanted to create my very own glazes, but using the existing recipes. Precautions were taken when mixing up the dry ingredients as they are health hazardous when in their dry form.

For this project I have created high-fire matte glazes. The bulbs have been covered partially – to show the contrast of the pure white porcelain body and the color glazes. Additionally, I coated them twice, second time dipping them into the glaze only half-way the first coating was – to give the gradual coverage effect. Some bulbs were with intention left unglazed.

The 6 different high-fire matte glazes that I have created and used are made of 2 bases, with 3 different coloring oxides formulas for each. The firing temperature is 1240^{o}C. Porcelain needs higher temperature than that in order to become translucent, but there were no available glaze recipes at the university's collection. Moreover, I specifically liked the chosen glazes for their appearance, so I had to compromise on the porcelain translucency for this project. The formulas for the given glazes were found from the HAMK study materials and the test pieces were made and tested out in an electric kiln by previous HAMK students. The appearances and the formulas can be seen from the tables and images below. For the glaze 1, I used the recipes for the samples N6, N12, and N14. For the glaze 2, the formulas for the samples N8, N10, and N15. The full diagrams for both glazes with the wide range of samples can be found from the appendices 1 and 2.

Table 9. Formulas for the two selected glazes' bases (LaKe teaching material archive, HAMK)

Glaze 1. The base ingredients:	
Feldspar FFF	24,6%
Kaolin Grolleg	22,9%

Whiting	17,7%
Quartz	13,3%
Spodumene	13,3%
Zinc oxide	8,2%
Glaze 2. The base ingredients:	
Feldspar FFF	45%
Kaolin Grolleg	22%
Whiting	33%

Coloring a glaze is typically done by adding either pigments or oxides to the glaze base. There are many variables in the process. The combination and the percentage, or concentration of the color agent defines the final color of the final ready glaze. Additionally, also the kiln type, the firing temperature and the clay body all make a tremendous impact.

I used oxides for my glazes for oxides give a rich variety of tones and undertones, when they react with one another during the firing, unlike the pigments, which normally give a solid coverage with very even coloring without gradations. My vision is that the bulbs would have organic-looking glaze covers with texture and flowing color transitions, just like in the nature, where everything is rich in color palette and having gradual shades.

I made in total 1kg of each base, which then was divided into 4 equal parts of 250 g for each sample. Three parts of each four parts of each base was used. One spare amount of 250 g from each base was left aside for potential alterations for later.

Image 40. Making six colorants: two glazes in three colors each

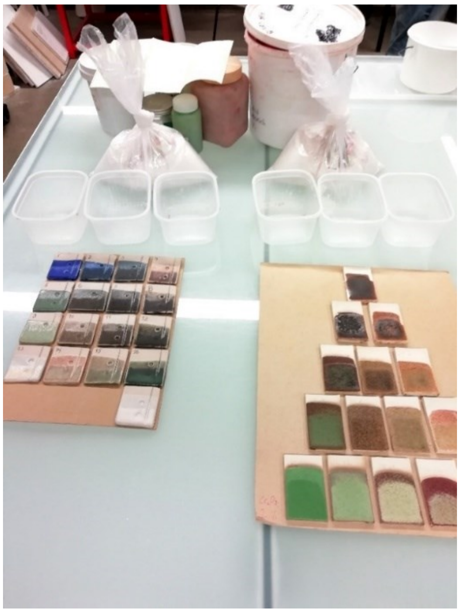
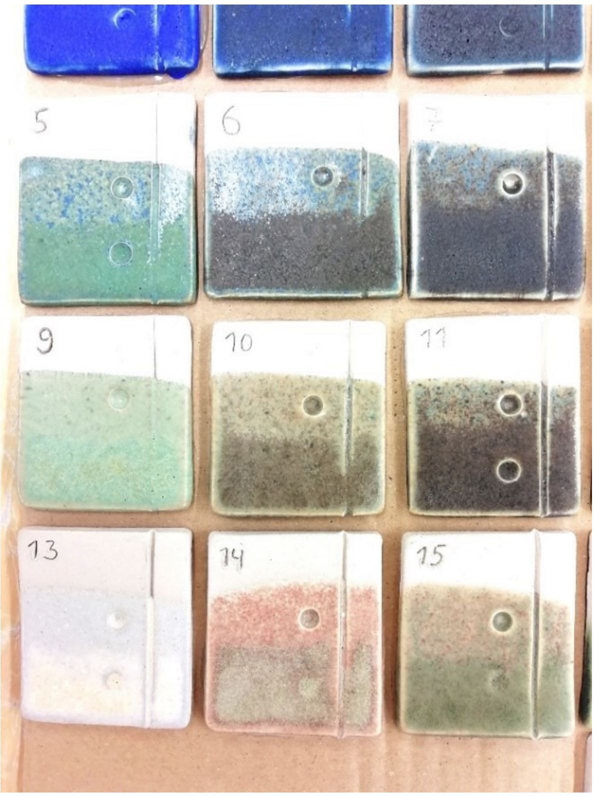


Table 10. Formulas for the 1st selected glazes' oxide content (Pulli, LaKe teaching material archive, HAMK)

Glaze 1. Oxides' content:			**Per sample** **Total sample weight:** **250g = 100%**
Sample N 6	CuCO3 Copper carbonate	0,89%	2,2 g
	MnO2 Manganese dioxide	0,89%	2,2 g
	TiO2 Rutile	1,33%	3,3 g

	CuO Copper oxide	0,22%	0,6 g
Sample N 12	CuCO3	0%	0 g
	MnO2	1,33%	3,3 g
	Rutile	0%	0 g
	CuO	1,33%	3,3 g
Sample N 14	CuCO3	0%	0 g
	MnO2	0%	0 g
	Rutile	4%	10 g
	CuO	0,67%	1,7 g

Image 41. Selected samples (Pulli, LaKe teaching material archive, HAMK)



Images 42,43. Creating glaze N1. Colours N6, N12, and N14

Table 11. Formulas for the 2nd selected glazes' oxide content (Kuusisto, LaKe teaching material archive, HAMK)

Glaze 2. Oxides' content:			**Per sample** **Total sample weight:** **250g = 100%**
Sample N 8	Fe2O3 Iron (III) oxide	2%	5 g
	Cr2O3 Chromium oxide	1%	2,5 g
	TiO2 Titanium dioxide	1,5%	3,8 g
Sample N 10	Fe2O3	2%	5 g
	Cr2O3	0%	0 g
	TiO2	4,5%	11,3 g
Sample N 15	Fe2O3	0%	0 g
	Cr2O3	0%	0 g
	TiO2	6%	15 g

Image 44. Selected samples (Kuusisto, LaKe teaching material archive, HAMK)

Images 45,46. Creating glaze N1. Colours N8, N10, and N15

As a result, I got 6 containers with the bases, 250g each, to which I added coloring oxides of about 10-15gr depending on the recipe, which gave me total of 260 – 265 g of dry content in each container.

To turn them into a ready glaze mixture, water must be added. For a general recipe it goes as following: 1,25l of water are mixed with 1kg of dry ingredients. So, I blended-in 0,33l of

water to each container. After the water was added, the final glaze slurries were thoroughly mixed and sieved through an 80 mesh to break down any small lumps.

Image 47. Ready glazes

The mixture was ready to be applied. However, I wanted it to have a little thicker and more viscous consistency. That is why I added a teaspoon of CMC agent to each glaze. Also, I double dipped the bottoms for even thicker coverage to get more robust effects. When glazes are applied in thick layers, they bubble up through one another and may generate widely ranging patterns. So, I wanted to give it a try.

5.2.2 Glazing the bulbs

Images 48-50. The bisque fired bulbs are on their way to be glazed



Glazing process imposes certain challenges onto a ceramicist. The glazed parts cannot touch each other, not the kiln shelves, as when the glaze melts, it becomes of a consistency of melted glass mass and permanently fuses into everything it touches. At this point, my pre-made and raw fired bases came in use. I have arranged the bulbs standing upwards in them, avoiding any contact. About one third of the Bulbs was left unglazed for creating the contrast in the final piece.

Images 51,52. The bulbs are ready to be glazed

The bulbs are glazed and resting in the holding bases, are now ready to be fired.

Images 53,54. The bulbs are glazed

5.2.3 High glaze firing

The high glaze firing was done in an electric kiln, at the peak temperature of 1240^{o}C. The soaking time at the peak temperature was set for 10 min as the items are not very big, and the kiln was not loaded very tightly. The firing phases can be seen in the table below.

Table 12. High-firing glazing temperature setting

High glaze firing		
Ramp **(Temp. per hour)**	**Temp** **(Peak temp.)**	**Time** **(Soak)**
3. 125’C/h	600’C	0
4. 150’C/h	1240’C	10 min
END		

The readily glaze-fired bulbs look like this:

Images 55,56. Ready glaze-fired bulbs (Own images)

5.3 The Bulbs. Conceptual porcelain art installations

The goal of this thesis's practical part has been to create the Bulbs - the individual cast parts that are then compiled into an artwork. I have created several designs of how and where the bulbs can be used, planning to use them later in other art projects as well. Here I am only showing the three installation variations within one outdoor theme, being inspired by the summer that has arrived, and by the awakening nature.

Additionally, I have made extra bulbs and deliberately left them unglazed – to alternatively complement the final piece and give me more variety of presentation. I am fond of the perfect whiteness and fragile appearance of porcelain, and I wanted to demonstrate it in a colorful and textured environment.

Here the *'outdoor theme'* is presented. It includes three locations in the forest, with three installations in those locations. Further, I would like to briefly open up the concepts of the installations, the ideas that led me to the creations, in a free artistic manner. I personally see the conceptual art's power in its presentational language, concept, and narrative.

The name of the theme is '*Life is time and food'*. The concept: 'The core things we humans need to exist and survive in life are Time and Food.'

The 1st porcelain art installation is called *'Timeless'*. The concept: 'Time inevitably goes forward and nature cycles within it timelessly keep on going around and around, repeating themselves year after year. The products of nature come and go… and come and go again. Nature gives us food, but will this cycle repeat forever?' (Images 57,58)

Images 57,58. Outdoor theme "Life is time and food". Porcelain art installation "Timeless". (Own images)

The 2nd porcelain art installation is called '*Shopping for Life'*. The concept: ' We go shopping for our food, but why wouldn't we rely much more on nature to get our food? The nature is self-sustainable, and so we can be, if we learn about the products that it offers to us. If we take good care of this planet, the 'shop', will stay 'customer-friendly' for us and for the next generations.' (Images 59,60)

Images 59,60. Outdoor theme “Life is time and food”. Porcelain art installation “Shopping for Life”. (Own images)


The 3rd porcelain art installation is called *‘Edible?’*. The concept: ‘We seem to have gone too distant from knowing the world around us. Are we too alien to the world of Nature? Can everything that looks beautiful and welcoming be consumed? And vice versa, is all unpleasant looking necessarily bad for us? Will the natural food sources be the same in the future, in the times of the drastic climate change?’ (Images 61,62)

Images 61,62. Outdoor theme “Life is time and food”. Porcelain art installation “Edible?” (Own images)


6 Analysis

In this chapter, I would like to discuss how the project went and discover whether there was a good relationship between the collected theoretical background information and the practical part, - the project implementation itself.

The theoretical knowledge obtained from the research on the materials and technics has well supported the practical implementation. Both the slips and the glazes are compounds that have certain formulas. To make one's own slips and glazes, one should know the recipe, in other words to follow the formulas, which have been already tested and proven to work. Of course, the other option is to experiment with ingredients' amounts, but the foundational rules of what slips and glazes are made of should be followed.

In general, the chosen formulars, recipes, and techniques, have functioned smoothly in practice. There were two minor drawbacks, however.

Firstly, I had to do a minor modification to the porcelain slip - to add a tiny fraction of the deflocculant Dispex as the slip occurred to be a little too thick and viscous for the bulbs. The challenge with the bulbs was in their shapes: they have rather narrow necks with the openings of about 1cm in diameter. So, the thick porcelain slurry would not flow out through the necks. After a little of deflocculant was added, the slip became thinner and more fluid, which removed the problem. Yet, no extra water was added, so the casting time was not extended. This was a great adjustment to this specific product. To my guess, if the cast items' form, and hence the plaster molds were more open, there should not occur any problem with the recipe. Porcelain has lower plasticity and is 'short', which means that it is less cohesive or sticky, so I did anticipate some technical challenges and I was ready to learn and try out different porcelain molding methods and tips on the way.

Secondly, the glaze did not turn out the way I wanted it to. All the bulbs do have different glaze coverage on them, and the textures are vivid. However, the colors are not as they should be according to the test pieces. Most of them turned out rather brown in shade. My intention was to show the absolute gorgeous beauty of porcelain in contrast with bright lively and 'runny' colors of the selected matte glazes. The glazes do not have so many colors, however, they do have many shadows of similar colors.

7 Conclusion

During this process, I have become even more interested in continuing mastering the slipcasting technique. I am fond of slip as a material, its properties and functionality. It is possible to make very thin yet detailed and intricated products from cast slip. Moreover, slipcasting grants the possibility of replicating products, or creating a line of identical objects, which can be a plus for some artistic or functional projects. Making plaster molds is time consuming, that is the fact. On the other hand, the slipcasting itself, if both the molds and the slips are of good quality, is rather fast, that is why this method is widely used by bigger manufacturers. An individual ceramicist can benefit from these properties as well.

Ceramic glazes are an intriguing science on its own. They offer a very creative medium, an experimental playground for an artist. The excitement of the moment of the kiln opening is very high due to the complex nature of glazes.

Creating an artwork from the bulbs has been a mesmerizing process. The 'Bulbs' that have been made as individual elements, have been put together in art installations. There are multiple options for arranging the elements into a total piece. The three selected versions to demonstrate in this thesis work however are the installations in the woods, i.e., the 'Outdoor' theme.

In my opinion, the conceptual art has the right to live. Does art have to have a message? A meaning? A purpose? A need? I believed not necessarily. Yet, I am sure that the creators always have some meaning put into their work. And so did I. The audience, however, is free to interpret creations in their own way.

I believe that during this process I gained in-depth knowledge of the given materials and techniques and improved my professional skills in the area. In addition, I have greatly expanded my technical vocabulary in English. Since the language of instruction during studies was Finnish, for this work I had to learn the related terminology in English, which expanded my personal linguistic technical database.

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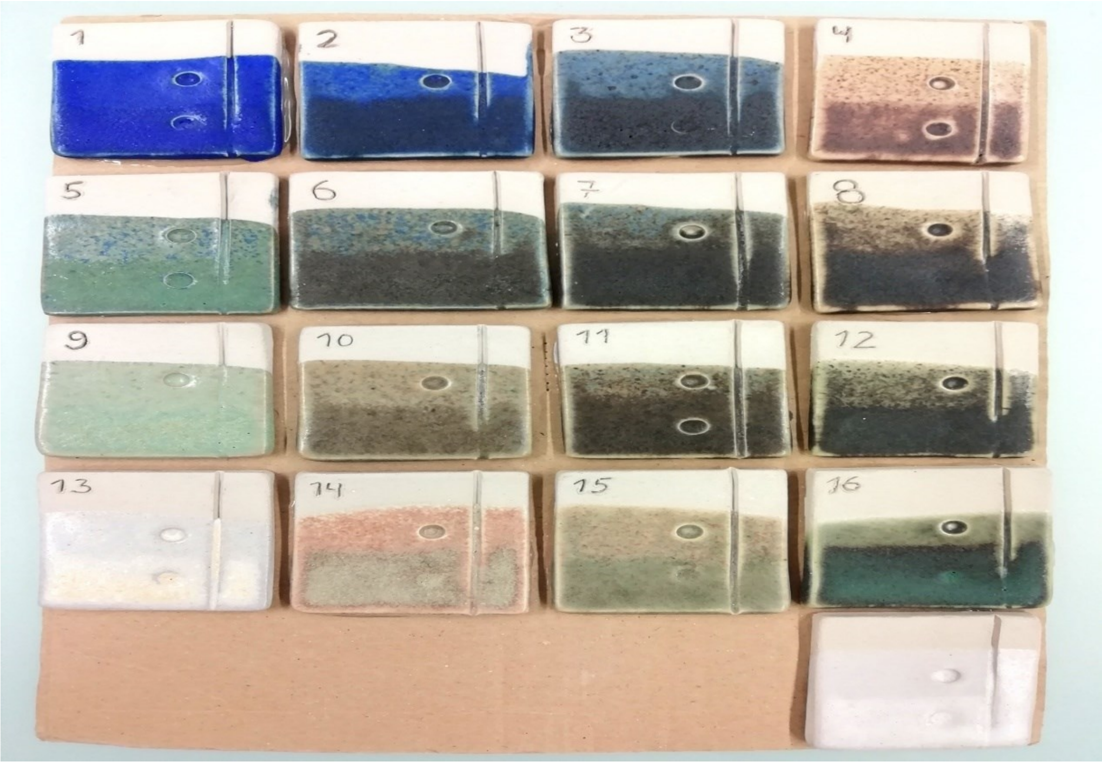
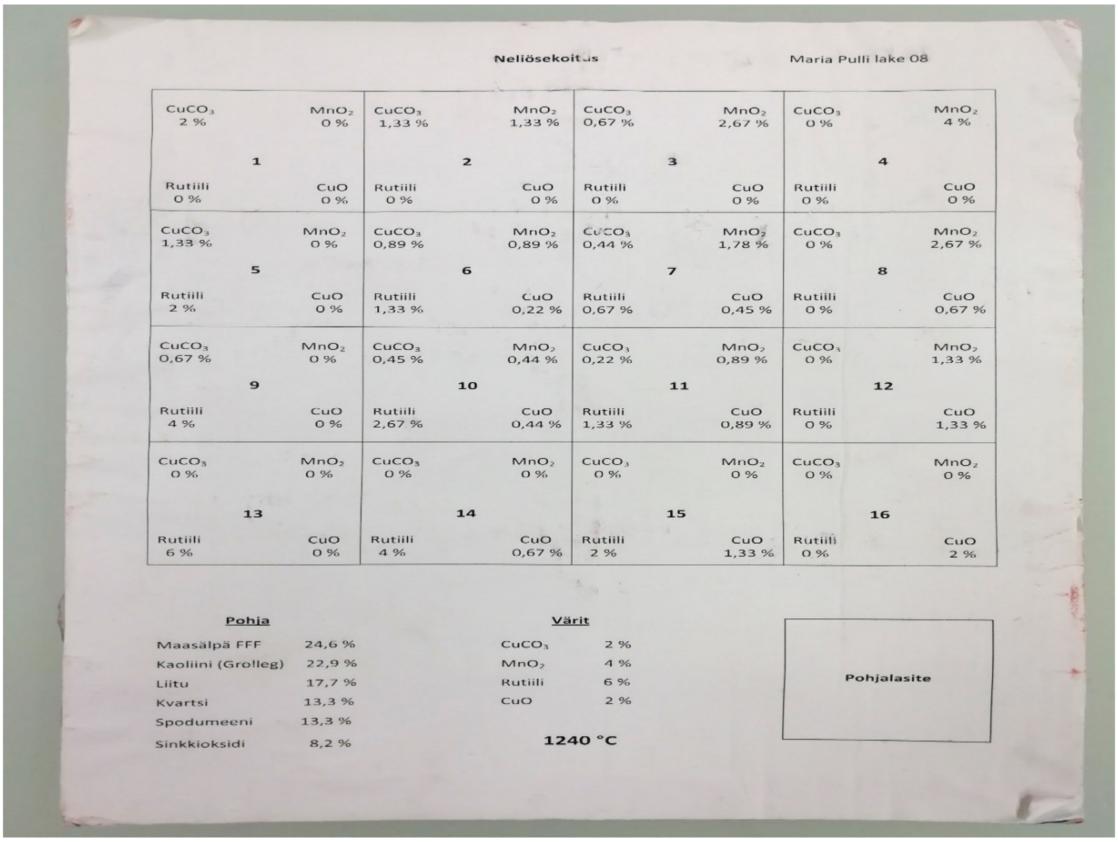
Appendix 1: Glaze 1. Test pieces. Pulli, LaKe teaching material archive, HAMK (n.d.)





Neliösekoitus Maria Pulli lake 08

$CuCO_3$ 2 % MnO_2 0 % **1** Rutiili 0 % CuO 0 %	$CuCO_3$ 1,33 % MnO_2 1,33 % **2** Rutiili 0 % CuO 0 %	$CuCO_3$ 0,67 % MnO_2 2,67 % **3** Rutiili 0 % CuO 0 %	$CuCO_3$ 0 % MnO_2 4 % **4** Rutiili 0 % CuO 0 %
$CuCO_3$ 1,33 % MnO_2 0 % **5** Rutiili 2 % CuO 0 %	$CuCO_3$ 0,89 % MnO_2 0,89 % **6** Rutiili 1,33 % CuO 0,22 %	$CuCO_3$ 0,44 % MnO_2 1,78 % **7** Rutiili 0,67 % CuO 0,45 %	$CuCO_3$ 0 % MnO_2 2,67 % **8** Rutiili 0 % CuO 0,67 %
$CuCO_3$ 0,67 % MnO_2 0 % **9** Rutiili 4 % CuO 0 %	$CuCO_3$ 0,45 % MnO_2 0,44 % **10** Rutiili 2,67 % CuO 0,44 %	$CuCO_3$ 0,22 % MnO_2 0,89 % **11** Rutiili 1,33 % CuO 0,89 %	$CuCO_3$ 0 % MnO_2 1,33 % **12** Rutiili 0 % CuO 1,33 %
$CuCO_3$ 0 % MnO_2 0 % **13** Rutiili 6 % CuO 0 %	$CuCO_3$ 0 % MnO_2 0 % **14** Rutiili 4 % CuO 0,67 %	$CuCO_3$ 0 % MnO_2 0 % **15** Rutiili 2 % CuO 1,33 %	$CuCO_3$ 0 % MnO_2 0 % **16** Rutiili 0 % CuO 2 %

Pohja

Maasälpä FFF	24,6 %
Kaoliini (Grolleg)	22,9 %
Liitu	17,7 %
Kvartsi	13,3 %
Spodumeeni	13,3 %
Sinkkioksidi	8,2 %

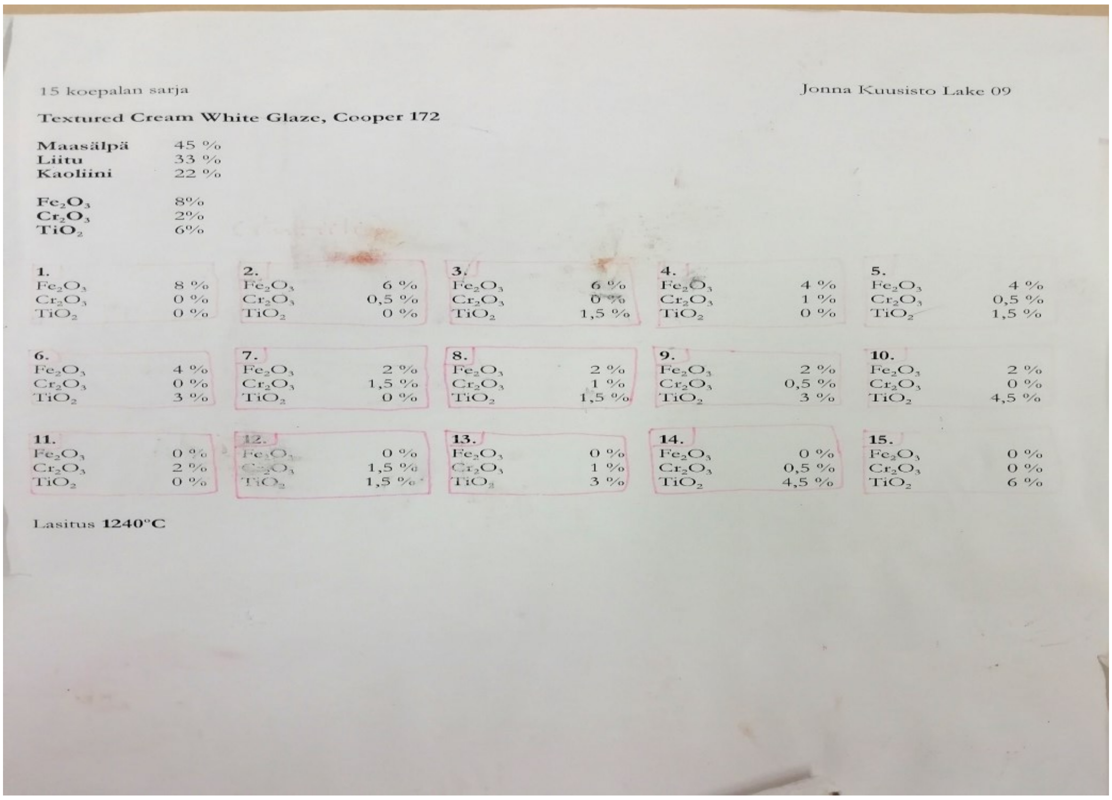
Värit

$CuCO_3$	2 %
MnO_2	4 %
Rutiili	6 %
CuO	2 %

1240 °C

Pohjalasite

Appendix 2: Glaze 2. Test pieces. Kuusisto, LaKe teaching material archive, HAMK (n.d.)



15 koepalan sarja

Jonna Kuusisto Lake 09

Textured Cream White Glaze, Cooper 172

Maasälpä	45 %
Liitu	33 %
Kaoliini	22 %
Fe_2O_3	8%
Cr_2O_3	2%
TiO_2	6%

	Fe_2O_3	Cr_2O_3	TiO_2
1.	8 %	0 %	0 %
2.	6 %	0,5 %	0 %
3.	6 %	0 %	1,5 %
4.	4 %	1 %	0 %
5.	4 %	0,5 %	1,5 %
6.	4 %	0 %	3 %
7.	2 %	1,5 %	0 %
8.	2 %	1 %	1,5 %
9.	2 %	0,5 %	3 %
10.	2 %	0 %	4,5 %
11.	0 %	2 %	0 %
12.	0 %	1,5 %	1,5 %
13.	0 %	1 %	3 %
14.	0 %	0,5 %	4,5 %
15.	0 %	0 %	6 %

Lasitus **1240°C**