> Ceramics can be classified as hand-made art, and one should pay close attention to the adjective—hand-made. A prerequisite for being able to make art from clay will, for 99% of those who try, be that they have sufficient ability in the craft itself. Only when this has been mastered, and you know what both the materials and you yourself are capable of, can you start to add your own artistic ideas.[1]

This quote is from the last part of the introduction in the *Keramisk håndbog (Ceramic Handbook)* written by the Danish ceramicist Finn Lynggaard[2]. I have taken this book and another even older reference book on ceramics[3] from my bookshelf because I am looking for chapters on glaze chemistry. The oldest of the two books has a technical thoroughness that takes the reader back in time and history. The newest book belongs to a craft tradition that reminds me a lot about the education I received at the Design School in Kolding[4]. Lynggaard's book was first published in Danish in 1968, and a Norwegian edition was published in 1972. It quickly became an important reference book in ceramic education, also in Norway, because it was both

comprehensive and educational and because it had been translated into Norwegian[5].

> Glaze can succinctly be described as a mixture of various crystalline minerals which, by a melting process and subsequent cooling, forms a glassy, non-crystalline covering on a clay item. Depending on the composition of the glaze, and the addition of smaller or larger amounts of, for example lead, feldspar, quartz or coloured oxides, the result achieved can be either matt, glossy, opaque, transparent or coloured. [...] As the word suggests, glaze is related to glass. The production of the two things has significant similarities, but whereas glass itself is a product that can be shaped and used for one purpose or another, glaze is intended to cover a clay surface and serves the purpose of sealing the surface or making the surface smooth or just pretty. [...] As far back as 4000 years BC, the Egyptians are believed to have had knowledge of glaze production. Only over the last hundred years, and with the increasing industrialization we now, thanks to scientific investigation, have a comprehensive knowledge of the chemical processes that affect and determine the entire glaze making process. [...] Whereas the Chinese and Japanese potters were forced to work with instructions handed down from generation to generation to make a variety of glazes from the various naturally occurring raw products, we can,

today, by careful calculations, calculate the compositions of our glazes.[6]

I acquired my knowledge of the development of my own glazes and silicate chemistry[7] from glaze lessons with Lisbeth Voigt Durand[8]. With curriculum texts from «Lisbeth's glaze guide», a thick ring binder with photocopied pages, we learned about the properties of, and what you could do with, ceramic materials during the first three years of the education. The education consisted of both academic theory and workshop practice. The school's glaze archive played a central role in the learning, and it was the students themselves who were responsible for the production of new samples as part of the compulsory course. The archive grew in pace with the years that passed by, and the scale of it was so large that the size was described in the number of tall cabinets. They were stacked in lines and rows in the classroom and formed a large library. If you opened a cabinet, it was tightly packed with trays consisting of hundreds of small glaze samples attached in rows and recorded on charts.

A successful glaze sample contains a lot of information. It has to give an idea of the colours of the glaze and the melting points, but it has to give an idea of other properties as well. For example, how it flows on both a vertical and horizontal surface, how it draws to edges and flows, settles into recesses, whether it forms undesirable blemishes on the surface, such as cracks, pin holes, bubbles or anything else like that. In addition to the actual information on the glaze, there must also be room to write the formula or other characteristics of the sample. Supplementary information about the glaze's recipes, the firing temperature, the atmosphere and which

types of clay the glaze has been tested on is stored in a paper archive. Many large and small factors affect the results, and a sample without precise information cannot be reproduced.

For a complete beginner, it could seem unmanageable, almost impossible, to find a way through the school's glaze archive. It was not filed according to visual results, but by formulas and recipes. If you found glaze samples you could use for your own work, you then had to go to the paper archive. In practice, the glaze samples were worthless without the information contained in the ring binders. The ring binders were in Lisbeth's office, and she had been the driving force behind the archive's development over the last 40 years. It was a life's work.

> In ceramics, glaze and glaze recipes are some of the most versatile and, to some extent, confusing… [things to work with] that can be imagined, since all manner of permutations from the simplest clay and salt glazes to very complex and intricate compound glazes can be found. It was therefore of the utmost significance that the exemplary German ceramicist, Seger, at the end of the last century, brought some order to this confusion with his glaze formulas which, to some degree, led to the confusing glaze recipes being brought over on to scientific, chemical ground, in so far that attention is moved away from the seemingly rather random raw materials used to the content of the substance of the finished glaze.[9]

When the basic recipe of the glaze had been found and the glaze sample had been put back in place in the cabinet, the work then took on a practical nature. Then, I could put on overalls, find a dust mask and plastic gloves and go to the lab. Turning on the ventilation fan, it would quietly fill the room with a constant hum over the long, brushed steel table, which always had to be kept clean. When you took out the sensitive laboratory scale that had to be fine-tuned by gently turning the rearmost weight, it was like tuning into your own concentration. With the glaze recipe that had been written down and converted to percent and quantity ratio, you could then start weighing the ingredients. They were kept in containers with lids labelled with chemical designations. Glazes could contain anywhere from three to many different raw materials, and it was important to keep a record so that nothing was overlooked or repeated. Powdered raw materials are difficult to distinguish from one another: white, grey, brown-red earth tones with very few characteristics. If the substances were mixed, it could not be reversed. The precious pure cobalt could, in a moment of absent-mindedness, become worthless waste if mixed. Carelessness is not acceptable in a laboratory. A glaze sample must be weighed precisely. If it leads to good results, all the information must be accurate, otherwise the chemical processes and the interactions of the various substances will remain unknown phenomena, and what honestly can you learn from that?

> [...] and an enormous number of samples must be weighed and fired before achieving an acceptable result. But, when you finally succeed, it outweighs the many hours of trouble and hassle – and there may always be

> a hint of the alchemist remaining in you that you can't help but wonder that it can actually be done.[10]

By the time I had finished my education in Kolding, I had developed 800-1000 different glaze samples. They are now kept in cardboard boxes labelled «Glaze Samples 1999–2003». The archive was made as part of a learning process, an introduction to glaze chemistry, where I gained knowledge of thorough testing, error and the glaze material's potential. Making a glaze sample was a process of realizing a concept through theory and practice. The contrasts between the dry mathematics of the formulas and the seductive physics of the glaze were fascinating. The Seger formula was numbers that became reality in material and colour formation.

In the book *The Philosophy of Mathematics*, I have underlined the first sentence of the introduction:

> Already in ancient times, it was known how to describe reality with numbers.[11]

Drammen, 2018. In my studio, an emptied classroom in a disused school, the floor is currently covered with work: books lying open, A3 binders, photos printed out on photo-copy paper, a ceramic slab in a crate, some framed drawings leaned up against a wall, and on a large grey piece of material there are 46 drawings in A4. On the floor between all of this, there is also the glaze archive from Kolding. I have unpacked it and laid out a few hundred of the samples in a row. They cover an area of about four-square meters. The glaze archive has been laid out in this way for three months. I have heard

myself say to visitors who have curiously asked about the glazes: «It's an old archive, almost twenty years, and I'm in the process of examining what and how the glaze samples – especially the aspect of working with formulas – have meant and how it has affected my thinking in other contexts ... » When the conversations have become longer, I have picked up a glaze sample from one of the rows and explained what the inscribed numbers and letter codes mean.

Over the years I have looked after the archive and used it in different ways. And although it has not been used as it was originally intended, it has always been a recurring source of inspiration to revisit it. When I look at the archive today, I am amazed at how much of it there is? What drove me to make so many samples? To repeat the same system over and over again? The work is slow and demands patience, but I do not recall that the repetitions made me tired. On the contrary, because the amount increased, my fascination also grew. The significance of the level of detail became clearer and clearer. Only a tiny little adjustment was required to produce large fluctuations in a glaze, and with each new glaze I continued to discover something new.

It was the discoveries that drove my work. The road ahead was endless. Today, I would say that the work on the glaze archive was my introduction to the idea of working conceptually. I just didn't know it at the time.

The word concept comes from the Latin conceptus 'thought, concept', derived from concipere 'perceive, understand', and from con- and capere 'take, grab'.[12]

[1] Lynggaard, Finn (1976). *Keramisk håndbog [Ceramic Handbook]*. 2nd edition Copenhagen: J. Fr. Clausens Forlag. p. 84–85.

[2] Finn Lynggaard (1930–2011), Danish ceramicist and glass artists. He graduated from the Academy of Fine Arts in Copenhagen where he studied from 1951–56.

[3] Johs. Andersen, A.H.M Andreasen, Søren Berg P Bispeskov, Helge Finsen, Nathalie Krebs, Axel C, Kristensen, Erik Lassen, H.C. Leisner, H. A. L. Madslund, Therkel Mathiasen, Viggo Sten Møller, Vagn Poulsen, Emil Ruge, E. Tuxen, Kaj Uldall, E. Heikel Vinther (1946). *KERAMIK, Keramisk Teknik, Keramisk Kunst [CERAMIC, Ceramic Techniques, Ceramic Art]*. Copenhagen: Jul. Gjellerups Forlag.

[4] The Design School in Kolding (formerly the Art Crafts School) had a ceramics department from 1968–2007 where many of Denmark's ceramicists were educated. The department was closed on the back of a political decision and reorganization. I was a student there from 1999–2003.

[5] Information from Nina Malterud, Norwegian ceramicist educated at the National Crafts and Art Industry School from 1971–74.

[6] Lynggaard, Finn (1976), op.cit. p. 84–85.

[7] Silicate chemistry is the term used to calculate, develop or alter glaze based on chemical conditions.

[8] Lisbeth Voigt Durand (1946), Danish ceramicist. Educated potter in 1969. Was at the Institute for Science and Technology of Ceramics, Faenza, Italy from 1969-1971. Teacher and supervisor at The Design School ceramic department, Kolding from 1971–2007.

[9] Johs. Andersen et al. (1946). op.cit., p. 34 (The chapter on Seger continues with the quote, p 173) "... was a need for methodical research, and the introduction of such can in all likelihood be dated at around 1870, when the German Herman Seger (1839–93) put his life's work into this. In Seger, a rare degree of ceramic practice and scientific method were united in one individual, and his work is characterized by an unusual versatility. He has thus systematically dealt with topics such as the structure of clay types, glaze errors, Japanese porcelain and decoration techniques, and he is well remembered in particular for his grasp of the invaluable ceramic firing cone series."

[10] Lynggaard, Finn (1976). op.cit., p. 84–85.

[11] Pedersen, S. A. (2008). *Et Spadestik Dybere: Præsentation af 10 Filosofiske Disciplin-er, Matematikkens Filosofi. [Digging Deeper: Presentation of 10 Philosophical Disciplines, Philosophy of Mathematics]*. In V. Hendricks, & S. W. Pedersen (ed.), Copenhagen: Automatic Press. (pp. 74–107).

[12] Mikkel Bogh; concept art in Den Store Danske Gyldendahl *[The Great Danish Encyclopedia]*. http: denstoredanske.dk/index.php? sideId = 108811 (read 13th November, 2018).

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