Production of ceramic tiles with a salt glaze by industrial production methods

Assist. Prof. Dr. Nawal Ahmed Ibrahim
Assistant Professor, Department of Ceramics Faculty of Applied Arts Helwan University
dr.nawalibrahem@yahoo.com

Research Summary:

Salt glaze is one of the distinctive glazes with its special aesthetic effects, and the researcher has done a number of researches to obtain salt glaze with its various effects by traditional methods first and then by non-traditional methods secondly, and that was in several previous studies, and the fire was done in the traditional kiln to fire sewage pipes, to obtain Salt glaze in traditional ways, then fire in the tunnel kiln, then fire in the rolls kiln (fast firing), and the previous study was about the possibility of obtaining the effects of salt glaze on ceramic tiles by application methods different from the traditional known methods, and this was done by more than one method, for application, but in the laboratory and not on production lines, and given the importance of the method of application of salt on ceramic tiles to obtain the effects of salt glaze because the resulting salt effects differ according to the method of salt application, so the study completed the topic of applying salt on ceramic tiles, and this study deals with how to produce ceramic tiles with salt glazing by industrial methods of production and application, and an attempt to solve its problems on the production line. Therefore, in this research, the same methods of application are used on the production line. Production lines such as silkscreen printing of dry milled salt, but due to the tendency of table salt (NaCl) to become saturated with moisture in the air, after a short time, salt hydration and agglomeration occur, so another method of application was tried, which is grinding salt with water in certain proportions until we reach to a density suitable for spraying (as an emulsion), which is a method corresponding to the method of application by disc on the production line, as well as applying the same emulsion with increasing water percentages to adjust the density to be suitable for application by silkscreen printing decoration, and each of them had a special aesthetic character and special results as a result of the different temperatures, the time of the fire cycle and the different method of application**.**

Key words:

Salt glaze, roller kilns, ceramic tiles, disc application, silkscreen application.

Research problem:

How can a salt glazing be obtained on ceramic tiles by the known industrial application methods on production lines?

Search objectives:

- Using the means of applying glazes on ceramic tile production lines to apply salt glaze on tiles.

- Obtaining results for a salt glaze on the tiles by fire in the fast firing and the decoration kiln (the difference in temperatures and the time of the fire cycle between the two kilns).

Research hypotheses:

The researcher assumes that:

- Salt glaze effects can be obtained by applying it by industrial methods (disc and silk screen printing).
- It is possible to obtain distinctive results for salt glazing through fire in the production (fast firing) and decoration kiln.

Search limits:

The experiments were carried out in the Royal Factory for Ceramic Tiles, and the fire was in the production kiln (fast firing) and the decoration kiln. The factory's pre-prepared glazes, as well as the factory's linings and colorants, were used with the use of table salt (sodium chloride) and borax, which are local raw materials.

Research Methodology:

Experimental method

Research results:

1- Application of ground salt emulsion with water, by spraying in the lab, is equal to the application by disc on the production line, and it is a type of application of glaze on tiles production lines (the application of glazes or salt in the tiles of a spray towards the surface of the tile until it is completely covered and the coverage is homogeneous).

2- Applying salt dry by silk screen method, and burning in the production kiln gives results with distinctive aesthetic effects and strong textures, but there are some obstacles to its use, which is that salt tends to absorb moisture greedily from the surrounding atmosphere, and when it absorbs moisture, it clumps and is somewhat difficult in silkscreen printing or even prose, a method must be thought for making the salt dry constantly before and during application on the production line, and this can be achieved by making the salt storage place on the production line a dryer with constant stirring to prevent salt from clumping.

3- The application of dry salt scattering on a layer of glue on the surface of the tile cannot be carried out on the tile production line, but it can be carried out on the decoration line.

4- The time cycle of the fire affects the results greatly. The longer the fire cycle time, the more it gives an opportunity for the salt to interact with the body, the lining and the glaze underneath it better, and thus strong color and contact effects appear, and crystallization in the salt glaze is clearly visible, especially in the production kiln (fast firing) , and this difference appeared in the experiments that were burned at 1170 degrees Celsius in a time of 70 minutes and the experiments that were burned at the same temperature but in a time of 38 minutes.

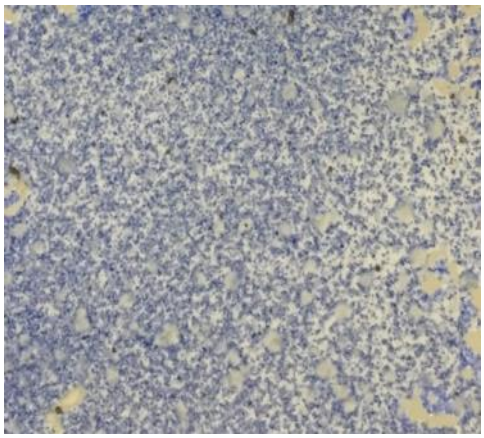
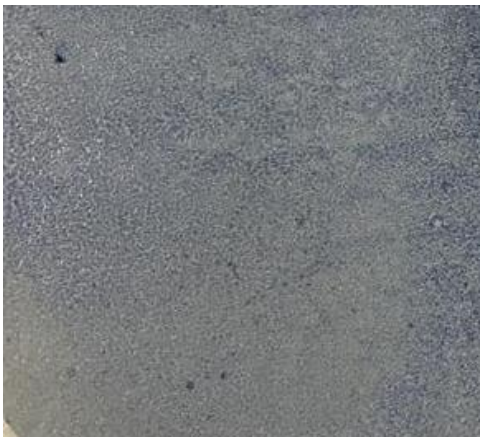
5- The salt glaze firing in the production kiln (fast firing) produces effects and texture, which are not produced by the fire in the decoration kiln, due to the fact that the firing temperature in the production kiln is 1170-1180, and the decoration kiln is 1020-1050, and the salt glaze is leveled in high temperatures above 1150 with the addition of a percentage of smelters to the

salt to reduce the degree of its settlement, because salt evaporates at a temperature above 1400, and salt reactions take place strongly at this temperature, but it is reduced by adding a little borax to the salt.

6- When printing designs with slightly fine areas with salt glaze, the application should be light, because heavy application melts outside the design limits.

Analyzing the results of practical experiments:

1.The larger the size of the applied salt granules, the more the resulting effects (spotting or dripping) will have different areas according to the size of the applied salt granule.

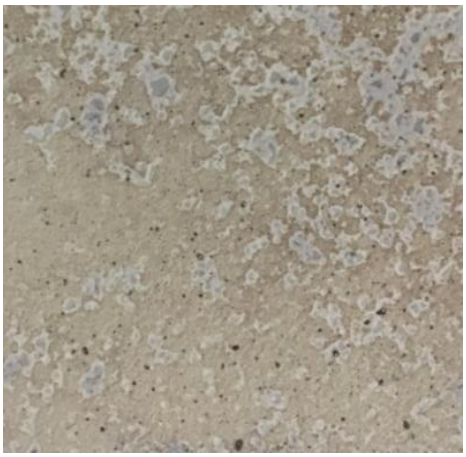



B A

A. Slab Porcelain Fire at 1180 Time 70 Minutes (Previous Experience) Application of colored, dry, unground salt.

B. Slab Porcelain Fire at 1180 Time 38 minutes (Experiment Application) by spraying as an emulsion of ground salt with water.(١٦)

2. Grinding salt with water to make an emulsion and then spraying application made the effect of the salt glaze (orange peel effect) smaller and the texture softer, compared to the same experiment with spready salt on the same slab, which gives an effect with a very rough texture and the effect of orange peel or staining of different sizes (fire in the production kiln and the same temperature).

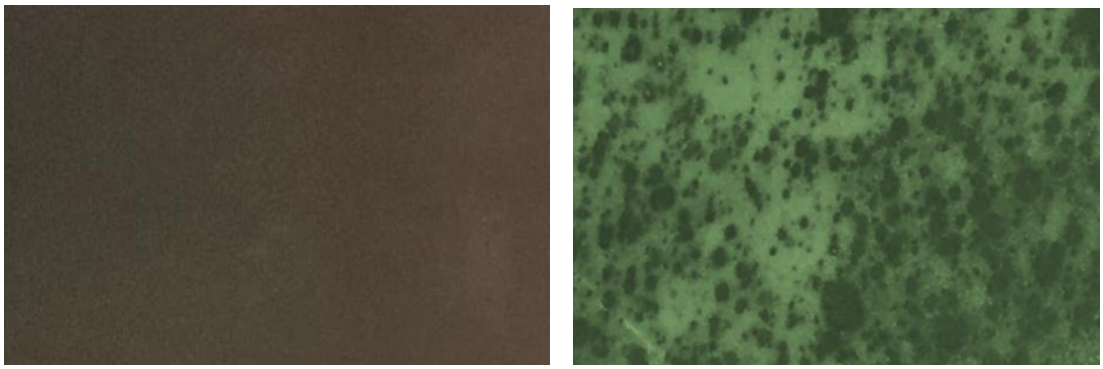



B A

A. Application on porcelain slab by spreading salt (previous experience)

B. Experiment No. (15) applying salt as an emulsifier by spraying.

3. The effects and textures resulting from applying the salt emulsion by spraying on the body of the slab, or applying the dry salt by spreading on it, the emulsion has very small particles, and is applied by spraying, covering the entire surface of the slab with salt homogeneously, resulting in a homogeneous color with a clear orange peel texture as in figure (A). In Figure (B), the application of dry salt by spreading on the body of the slab, the effect appears as spots or dots of different shapes and sizes, and this effect could be due to the lack of homogeneous distribution of the salt grains on the slab, due to the non-distribution of glue (as a layer under the salt) homogeneously on the slab, or the salt clumps due to the absorption of moisture.



A B

(A)Application of salt emulsion by spraying on the body of wall slab and fire in the production furnace Experiment No. (10).

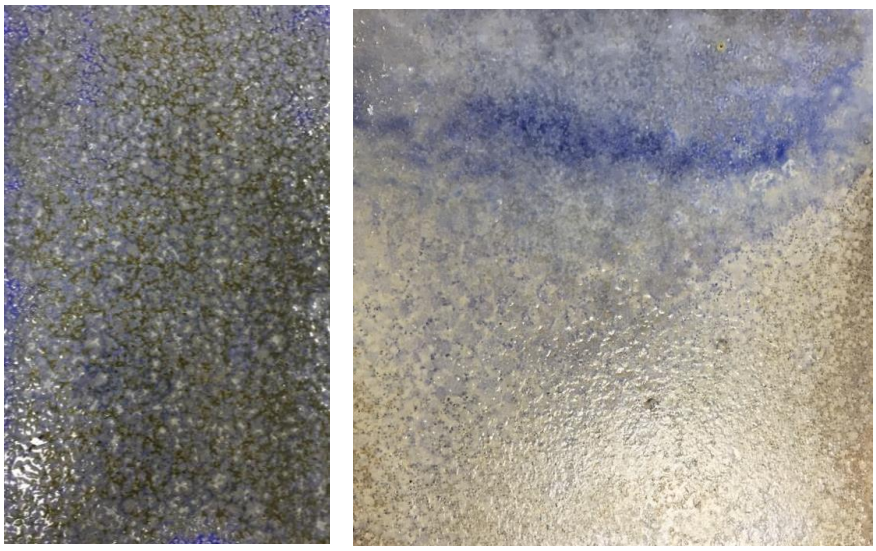
(B) Application of dry salt by scattering on the body of wall slab and fire in the production furnace (previous experiment).

٤. Applying a salt-water emulsion by spraying on a printed design using an ink jet method and the fire in the production furnace produces an effect like orange peel and texture etched in the salt glaze strongly, and the color of the lining appears under it, as if there was corrosion in the glaze as a result of the interaction of salt with the colors under it, and the glaze appears shiny, as for applying the same salt by spray method under the ink jet printed design. It produces smooth matte color and the orange peel texture is calmer and more accurate than the application over printing (Figure A), and the color volatilizes in a certain way that appears as if the color has the effect of obsolescence.

A. Application by spraying the salt emulsion over the printed design by the ink jet method.

B. Application by spraying the salt emulsion under the printed design by the ink jet method.

5. The colors vary when mixing dry salt with the color in the ball mill for a short time, so the color is homogeneous in form (A), while the form (B) is mixed manually without a mill, so the color is not homogeneous.

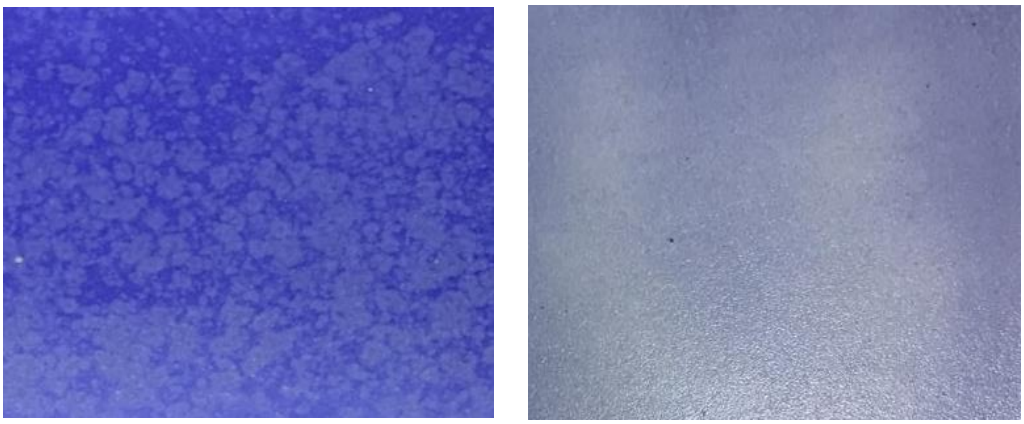


A B

B. Printing with silk screen of (5 mesh) the color is added manually, Experiment (1).

A. Printing dry salt with silk screen of (5 mesh) salt and color are ground, experiment (2).

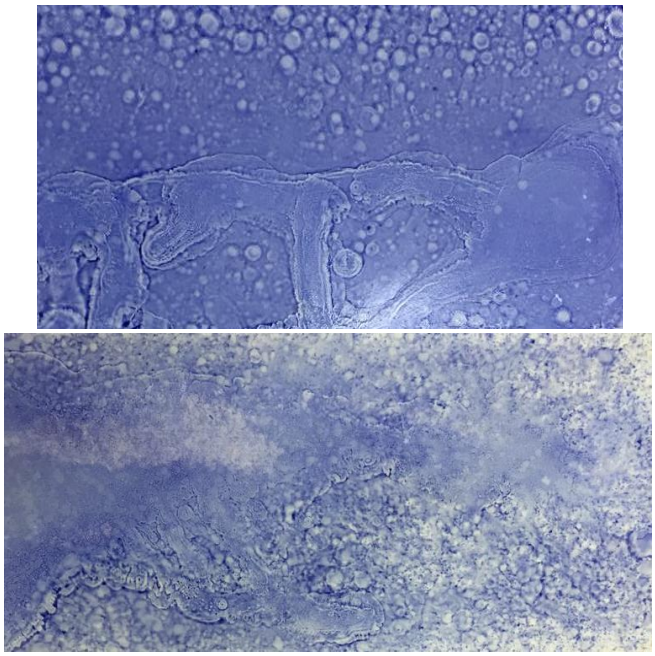
6. The effect resulting from the spray application of the emulsion of milled salt with color with water on the lining, makes the resulting color homogeneous in the form (A), and it differs from the effect resulting from spreading the colored dry salt on the lining as in figure (B), which appears as different spots.



B A

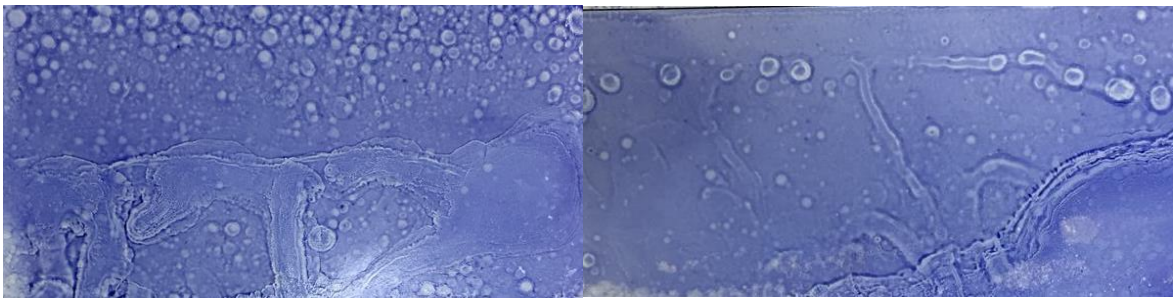
A. Printing by spraying colored salt emulsion on the lining Experiment (12).
B. Printing by scattering hand-colored, dry salt on the lining (previous experience).

7. The salt glaze fire in the decoration kiln is at a temperature of 1020-1050 and this temperature makes the salt glaze reactions somewhat superficial without strong textures.



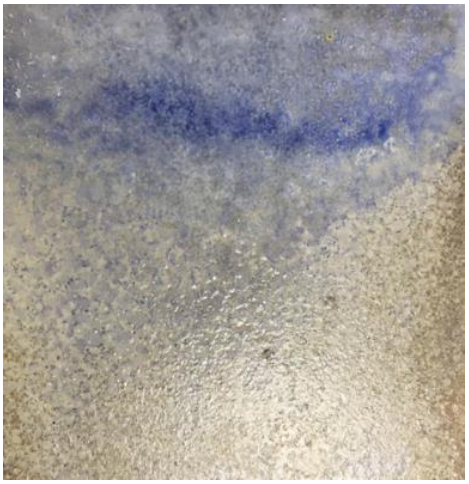
Application of salt as an emulsion by spraying Experiment (9) Application of salt dry course spraying Experiment (6).

8. The grinding medium can be replaced instead of water, a type of oil that is used as a medium for printing in decoration, such as turpentine oil.

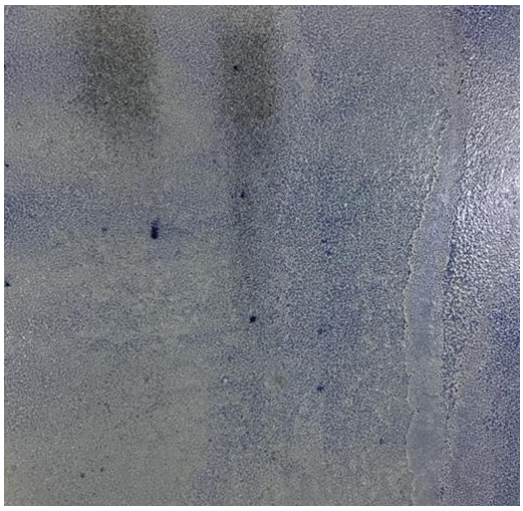


Experiment (9) grinding media is oil Experiment (8) grinding media is water

9. The cycle of the fire greatly affects the results of the fire, as it gives an opportunity for the salt glazing to interact and the emergence of strong effects and contacts and the emergence of crystallization clearly, especially in the production kiln (fast firing).



Firing at a temperature of 1180, cycle of 70 minutes and application with dry salt by silk screen Experiment.(١)



The firing at 1170 and the fire cycle 38 minutes and application with salt-colored emulsion by spraying Experiment (16).

Recommendations:

1. Choosing the distinguished results that were achieved in the field of applying salt paint on industrial ceramic tiles, focusing on them and solving their problems on the production line, in order to obtain an industrial product with an aesthetic and human nature that competes with the industrial product.
2. Encouraging the quality of research that achieves the aesthetic effects resulting from ceramic techniques on the industrial product, so that the industrial product has a human and aesthetic character.
3. Encouraging research cooperation that deals with industry problems or adds new ones.
4. Attempting to create cooperation protocols in the research field between our college and the various factories, and to legalize the quality of research conducted in this field, so that these researches are actually beneficial to the industry, as well as the academic study.
5. Encouraging research in salt glaze in the field of architectural cladding, especially exterior, because its specifications withstand climate change factors such as rain, heat, etc., and also it is an economic glaze that once fire, and is inexpensive in terms of the materials required because it is only table salt.

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