Study of Efflorescence on Different Types of Bangladeshi Bricks and Relation between Degrees of Efflorescence with the Type of Bricks

Tanveer Ahmed Khan

1-Chemical Engineering Department, BUET, Dhaka, Bangladesh

Email: limon.buetbd@gmail.com

Abstract: The work presents a practical investigation on the degree of efflorescence on different types of bricks available in Bangladesh. A relationship between the type of brick and degree of efflorescence is observed. The study is performed on five different types of samples. For this purpose the general procedure for a brick production is followed by making two samples of customized brick from two different types of soil which includes black soil and red soil, besides the collection of readymade first-class, second-class and third-class bricks. The first-class brick is provided by the “Department of Chemical Engineering, BUET”, whereas the rest two samples are collected from two different brickfields in Gazipur. The black soil and red soil is collected from brickfields in Savar and Gazipur. The test of efflorescence was conducted on total eight samples according to Civil Engineering Standard. The degree of efflorescence is found lowest for first class brick, higher for second class and highest for third class. The customized two brick samples attained first class and second class property and showed efflorescence accordingly. The whole experimentation is conducted at “Corrosion Lab” in “Department of Chemical Engineering, BUET”.

Keywords: Study, Efflorescence, Brick, Bangladesh.

1. Introduction

The evaporation of water from the hydrated salt on the brick to the air and causing a powdery leftover or deposit on the surface is called the brick efflorescence. The general color of it is white although, yellow and greenish deposits are also common in many cases. Though it primarily considered as a simple surface abnormality, but with time and degree of severity it also can be a massive structural concern of weakness of the brick structure. The occurrence of efflorescence is on action when there is a water soluble salt present in the brick masonry. When the water enters the porous brick spaces the salts get dissolved and the solution migrates out of the brick containing salts. After evaporation the water goes away but the salts remain on the surface as a powdery deposit. The degree of efflorescence also depends on the salt content on the brick and the water solubility of that salt. Because brick is made from clay, the salt content of brick actually depends on the salt content of clay. Thus the degree of efflorescence is directly related to the type of brick and type of soil. Although while making bricks, proper firing has effect on the degree of brick efflorescence, the study only focuses the relation between degrees of efflorescence with type of brick. For this reason all the selected samples are ensured to be properly burnt brick. The temperature is ambient in all cases.

The three main types of brick found in Bangladesh are first class brick, second class brick and third class brick. The classification is due to the compressive strength of the brick and variation in type of clay. Pair of sample for each type of brick is collected from brick fields. Test of efflorescence is conducted on them.

The two basic type of soil used for brick production in Bangladesh are Red soil and Black soil in brickfields. Red soil has iron-rich salts and Black soil contains phosphate or ammonia-rich salts. Two soil samples are collected to make two customized brick and test of efflorescence is also conducted on them. The degree of efflorescence is found to be different on the different samples.

2. Methodology

2.1 Material Selection

Common building clay bricks are designated as BDS 208:2002 under the engineering products designated by BSTI. Following materials are used for the experimental study:

- Each Pair of Sample for 1st, 2nd and 3rd Class Brick
- Two customized Bricks
- Demineralised Water
- Custom Made Plastic Tray
- Custom Made Brick Frames
- Electric Furnace

2.1.1 Custom Made Plastic Tray
Four ploy-tetra-fluro ethylene based tray are made from Carpentry shop, BUET. The dimension is, 40cm × 40cm× 12.5cm.

Fig.1: Customized Tray for the Test of Efflorescence

2.1.2 Custom Made Brick Frames

Two wooden frames are made from Carpentry shop, BUET. They are used for the brick preparation from two different soil samples. The inner dimension is, 25cm × 12cm× 7.5cm. The wood thickness is 2cm.

Fig.2: Customized Wooden Frame for Making Two Custom Brick Samples

2.2 Making of Custom Brick Samples

Following Procedures are followed to make two custom bricks. (12)

PROPER CRUSHING AND GRINDING OF SOIL SPECIMEN

SEIVING OF THE GRINDED AND CRUSHED PARTICLES

SELECTION OF SMALLEST SIEVE SIZED PARTICLE

MIXING WITH APPROPRIATE RATIO OF WATER AND PARTICLE

FORMING STICKY CLAY AND PUT TIGHTLY ON THE FRAME

AIR DRYING OF THE CLAY OR UNBURNT BRICK

CONTINUOUS 24 HOUR BURNING ON THE FURNACE AT 800 DEGREE CELCIUS

COLLECTION OF BRICK SAMPLE

Fig.3: Preparation of Custom Bricks.

2.3 Test of Efflorescence

On total eight brick samples, efflorescence test is conducted according to the standard testing method (20) followed by Department of Civil Engineering, BUET. The resulting procedure followed to the following format; (20)

<table>
<thead>
<tr>
<th>RESULT</th>
<th>OBSERVATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>NIL</td>
<td>NO PERCEPTIBLE DEPOSIT OF SALT</td>
</tr>
<tr>
<td>SLIGHT</td>
<td>NOT MORE THAN 10% OF THE AREA OF THE BRICKS COVERED WITH A THIN DEPOSIT OF SALT</td>
</tr>
<tr>
<td>MODERATE</td>
<td>A HEAVIER DEPOSIT THAN UNDER “SLIGHT” AND COVERING UP TO 50% OF THE AREA OF THE BRICKS SURFACE BUT UNACCOMPANIED BY POWDERING OF THE FLAKING OF THE SURFACE</td>
</tr>
<tr>
<td>HEAVY</td>
<td>A HEAVY DEPOSIT OF SALT COVERING 50% OR MORE OF THE BRICKS SURFACE BUT UNACCOMPANIED BY POWDERING OF THE FLAKING OF THE SURFACE</td>
</tr>
<tr>
<td>SERIOUS</td>
<td>A HEAVY DEPOSIT OF SALT ACCOMPANIED BY POWDERING OF THE FLAKING OF THE SURFACE</td>
</tr>
</tbody>
</table>

Fig.4: Efflorescence Result Writing Format.

2.3.1 Testing Conditions

The temperature and pressure maintained at ambient conditions inside the Corrosion lab, Department of Chemical Engineering, BUET.

3. Results and Discussions

The total duration for testing and observation was around 60 days. After completion of the tests; the efflorescence results in the bricks are found and compared as follows;

<table>
<thead>
<tr>
<th>TYPE OF BRICK</th>
<th>EFFLORESCENCE RESULT</th>
<th>TIME FOR STEADY STATE OF EFFLORESCENCE (DAYS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIRST CLASS</td>
<td>NIL</td>
<td>-</td>
</tr>
<tr>
<td>SECOND CLASS</td>
<td>MODERATE</td>
<td>25</td>
</tr>
<tr>
<td>THIRD CLASS</td>
<td>HEAVY</td>
<td>34</td>
</tr>
<tr>
<td>CUSTOM (RED SOIL)</td>
<td>NIL</td>
<td>-</td>
</tr>
<tr>
<td>CUSTOM (BLACK SOIL)</td>
<td>SLIGHT</td>
<td>22</td>
</tr>
</tbody>
</table>

Fig.5: Comparison of Degree of Efflorescence Among the test Samples.

3.1 Comparison of the Difference in Degree of Efflorescence

The first class brick shows no efflorescence as it is properly burnt (7), has most compressive strength (19) and the selected soil composition contains very negligible composition of salts (14) so the efflorescence is ‘Nil’ here. The custom (Red soiled) brick attained the property of first class brick and thus the result is also ‘Nil’ in this case. The reason for change in degree of efflorescence which is ‘Moderate’ and ‘Heavy’ for second class and third class brick respectively is for decreasing compressive strength and burning and
increasing salt content. It is noted that the custom (black soiled) brick attained the property closer to second class brick by showing ‘slight’ efflorescence, although it is provided all the same conditions that for custom (red soiled) brick, while preparation of them. This supports the fact that red soil is better for brick making as black soil promote more efflorescence and other problems.

3.2 Pictorial Illustration of Selected Specimens and occurrence of Efflorescence

Fig. 6: Selected Pair of First Class Brick showing ‘Nil’ efflorescence

Fig. 7: One Customized Brick Showing ‘Slight’ Efflorescence on Marked Area.

Fig. 8: Selected Pair of Second Class Brick Showing ‘Moderate’ Efflorescence on Marked Area.

Fig. 8: Selected Pair of Third Class Brick Showing ‘Heavy’ Efflorescence.

4. Limitations

Efflorescence has proven relationship with several other factors like; firing temperature, atmospheric temperature, humidity, and many other facts. The study only confined with the relationship between type of bricks and degree of efflorescence, considering all the other factors constant. The brick samples are confined in Bangladeshi bricks only.

5. Conclusions

In this work a physical relation between degree of efflorescence and type of Bangladeshi brick is developed. Brick is the mostly used construction material in Bangladesh. A proper brick will ensure a safe and well-built building structure. This work will act as a guideline for selection of brick for construction purposes especially in context of Bangladesh, considering the possible degree of efflorescence.

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References


Vitae

Mr. Tanveer Ahmed Khan was born in Dhaka, Bangladesh. He obtained a B. Sc degree in 2014 in Chemical Engineering department from Bangladesh University of Engineering and Technology (BUET). His research interest includes Simulation and Optimization, Brick Property Experimentation, Process Engineering, Petroleum Engineering, Coal Liquefaction and Gas Processing.