The Development of the Plaster Coating Materials Operated Structure by Processing Waste Recovery

A V Kramarenko¹, A M Mustekova¹
¹Togliatti State University, Ushakova St. 59, Togliatti, Russian Federation, 445020

E-mail: kramarenkoav@mail.ru, alsu.mustekova@mail.ru

Abstract. In present work there are main plaster coating materials mentioned, also as main materials being base for plaster coating materials operation do. There were complex research realized, which included theoretical, practical, experimentally theoretical scientific cognition methods to apply possibly processing waste (partically, eggshell) for final coating operating. The manufactures monitoring was set and done with eggshell waste. There was plaster coating arrangement technology using eggshell was developed. There was the choice of test equipment and binding material done. As the result of experiments series there was data of the strengthening parameters while binding material added, obtained; also there was definitive strengthening parameters while different kinds of binding material added, analyzed. All of the satisfying consuming parameters of such final coating were detected.

1. Introduction
The plasterwork seems to be one of main techniques by final coating of the different municipal buildings inner walls. The construction and consuming markets coating stuff need analysis shows that requests and amount of the plaster fine stuff is going to be multiplied every year since. The plaster possesses a lot of advantages comparatively to other final coating; that is possible to admit some satisfying consuming parameters, such as simple coating, lesser labor costs, high operating abilities, possibility to increase and boost some definitive characteristics. Here it is appropriate to mark such advantages like the structured shape high variety got in due to plaster mix ingredients and coating technology special events.

2. Urgency
The possibility to apply processing waste in fine stuff arrangement, allows to obtain unique impressive shape with the usual cost of simple plaster. Also that solves partly the ecological manufacturing problem of waste recovery; in that case, there is not direct funds assignment to be needed.

3. Problem
To detect the composition, to obtain all imperative ingredients, to develop and implement the plaster coating materials arrangement structure by processing waste recovery.
4. The main plaster coating forms analysis

4.1. The main forms of plaster coating

**Fine stuff.** It is appeared to be the final coating with added colorants. It can also be applied with the high-silica sand and additive supplement in forms named "bark beetle", "grain".

**French stuc.** That is a ductile mixture the stones are formed of. Granite chips are mainly applied as a filling material.

**Terrazite plaster.** It is using for the rock formation imitation. It possesses great binding parameters and weight. High-silica sand and stone chips are applied as a filling material.

**Scratchwork.** That form of plaster coating is performed by several coloured sheets applying; after their setting there is sheets scalping by definite depth provided accordingly to chosen outline. As a result, the relief coloristic painting is coming out.

**Venetian plaster.** The base of venetian plaster is marble powder added to material composition. As a binding material, acryl or lime fits. It is necessary to coat much of sheets with their own structure for the venetian plaster arrangement.

4.2. The plaster coating main forms base analysis

**Lime base.** The most widely used material it is; to create it, there are slaked lime (calcium hydroxide \( \text{Ca(OH)}_2 \)) and mainly coarse particled fluvial sand applied.

**Acryl base.** It provides highly leveled plasticity, adhesion and resistance to atmospheric agents.

**Polymer-cement base.** That base is merely porous for air and gives the "breathing wall" effect. The composition includes modified polymers that allows to improve plastered sheet attributes.

**Silicate resin.** That base allows to improve resistance to different types of mechanical damage.

5. Practical research

5.1. The development of the plaster coating materials applying by processing waste recovery

The following main ingredients were used in this experimental research: lime-based dry plaster mixture, ground eggshell allowing to create an impressive shape.

The eggshell seems to be the waste of bakery, confectionary, poultry (since usual egg crush gives 10% of all amount) manufactures. The eggshell has density of 2,14–2,17 g/cm³; its composition includes calcium bicarbonate (\( \text{Ca(HCO3)}_2 \)) mainly (92,8%) which makes eggshell durable and resistant to chemical influence.

The eggshell implementing during the coating arrangement does not seem to be harmful for the men's health; besides, it meets sanitary standards nowadays.

The results obtained on present stage, provides possibility to apply eggshell for the buildings inner final coating.

5.2. The development of the plaster coating materials arrangement technology with the processing waste applying

The first stage in experimental development of the plaster coating materials arrangement structure with the eggshell applying is the plaster coating shape preparation. As the base, it would be concrete, brick, wood, metal. The choice of present research is concrete. The plaster coating shape preparation contains the following: cleaning, dust removal, lining coating, drying.

The eggshell is main ingredient for fine stuff production; it allows to create structured plastered shape. There was cleaned and ground eggshell, relatively coloured, applied in the fine stuff production. The eggshell thickness does range 0,34–0,4 mm; that simply allows to obtain required fraction during the cleaning. As a result, recommended fraction must does range 0,5–2 mm.

As experimental equipment there were the following ones applied: construction tools for the plaster sheet coating, compressed-air spray pistol with the 3 mm of jet diameter. The obtained fine stuff was coated by compressed-air spray pistol either on plastered shape until the strengthening peak, or after
the plaster sheet got fasten. In second case, there is a binder required for the binding of fine stuff with plastered shape.

There were plastic sheet made patterns applied for the different drawing creation while fine stuff is coating.

There was fluorescent paint applied to colour the ground eggshell for the luminescence effect during the 5-6 hours at night.

The fine stuff flow under the different powers of operated shape coating is ranged in Table 1.

Table 1. The fine stuff flow under the different powers of operated shape coating.

| % of coating shape for 1 sq.m | Amount, g |
|------------------------------|-----------|
| 90                           | 1050      |
| 50                           | 583       |
| 25                           | 292       |
| 10                           | 146       |

There was the fine stuff quantity and operated shape coating powers relation diagram was generated (follow Fig. 1); it was based on the table 1 results.

![Figure 1. The diagram of relations between fine stuff quantity and operated shape coating power.](image)

The fine stuff flow while the patterns are applying, depends on the form dimensions; it is calculated in individual way.

5.3. The analysis of final coating strengthening parameters while adding the different types of binding material

During the experimental research it was precisely important to solve the problem of adhesion between fine stuff and plastered shape in case, when the fine stuff is coating after the plaster sheet strengthening. To solve the problem there were the following binding material types used: silicate cement, cement based on methylcellulose, alabaster binding material.
To determinate the applying binding material final form for its adhesion with plastered shape, these three samples were checked by constriction, stretching and bending. The results are presented in Tables 2, 3, 4.

**Table 2.** The strengthening characteristics of final coating by means of silicate cement.

| Additive, % | Strengthening characteristics |
|------------|-----------------------------|
|            | Rc, MPa | Rs, MPa | Rb, MPa |
| 1          | 0,738   | 0,376   | 0,781   |
| 2          | 0,744   | 0,398   | 1,232   |
| 3          | 0,751   | 0,454   | 1,523   |
| 4          | 0,756   | 0,487   | 1,648   |
| 5          | 0,761   | 0,496   | 1,734   |

**Table 3.** The strengthening characteristics of final coating by means of cement based on methylcellulose.

| Additive, % | Strengthening characteristics |
|------------|-----------------------------|
|            | Rc, MPa | Rs, MPa | Rb, MPa |
| 1          | 1,141   | 0,753   | 2,024   |
| 2          | 1,312   | 0,948   | 3,118   |
| 3          | 1,564   | 1,124   | 3,512   |
| 4          | 1,784   | 1,228   | 3,754   |
| 5          | 1,897   | 1,567   | 3,948   |

**Table 4.** The strengthening characteristics of final coating by means of alabaster binding material.

| Additive, % | Strengthening characteristics |
|------------|-----------------------------|
|            | Rc, MPa | Rs, MPa | Rb, MPa |
| 1          | 0,586   | 0,188   | 0,497   |
| 2          | 0,475   | 0,174   | 0,474   |
| 3          | 0,456   | 0,166   | 0,468   |
| 4          | 0,434   | 0,125   | 0,411   |
| 5          | 0,417   | 0,118   | 0,375   |

For comparative analysis of the present binding materials strengthening characteristics (based on Tables 2, 3, 4 data), there were the diagrams of relations between binding material addition ratio and final coating strength developed (tested by constriction, stretching and bending also; follow Fig.2).

![Figure 2](image-url)  
*Figure 2. The diagram of relations between binding material addition ratio and final coating strength.*
The binding material types strengthening characteristics analysis allows to understand that the greatest resistance parameter (by constriction, stretching and bending) can be reached by the mixing of fine stuff with cement based on methylcellulose.

The developed technology is happened to be implemented successfully on solid walls during the operation of built two-stage private dwelling house.

6. Conclusions

Hereby, the organic waste applying (eggshell, partically) in the coating operation is merely safe and reasonable, because that technological solution applies waste that is not need to be recovered; that waste is conscious enviromentally; its processing preparation is simple and free of great funds investment and any of complex processing units. The final coating possesses its distinction and infinite variety of forms and palette.

References

[1] Chernous G G 2017 Plastering Technology (Moscow: Academy)
[2] Chernous G G 2006 Facing work (Moscow : Academy)
[3] Shepelev A M 2008 Plastering (Moscow: High School)
[4] Gorchakov G I 2012 Building materials (Vladimir : Soyuzpoligrafprom)
[5] Begoonkov O I 2002 Testing of liquid adhesive materials (Khabarovsky. Methodical instructions)
[6] Khrulev V M 1991 Synthetic adhesives and mastics (Moscow: High School)
[7] Kardashov D A, Petrova A P 1983 Polymer adhesives. Creation and application. (Moscow : Chemistry)
[8] Zavrazhin N N 2006 Finishing works (Moscow: Academy)
[9] Volzhensky A V, Burov Yu S, Kolokolnikov V S 1979 Mineral binders (Moscow: Stroiizdat)
[10] Sulimenko L M 2005 Technology of mineral binding materials and products based on them (Moscow: High School)
[11] Nikitin, V M 2012 Chemistry of wood and cellulose (Moscow : Book on Demand)
[12] Prokofieva M V, Rodionov N A, Kozlov M P 1968 Chemistry and Technology cellulose derivatives (Vladimir)
[13] Korneev V I, Danilov V V 1996 Liquid and soluble glass (St. Petersburg : Stroiizdat)
[14] Toturbiev B D 1988 Building materials based on silicate-sodium compositions (Moscow: Stroiizdat)
[15] Zhuravlev I P, Lapshin P A 2005 Plasterer. Master of finishing construction work (Rostov on Don : Phoenix)
[16] Demyanova B C 2001 Effective dry building mixtures based on local materials (Moscow : DIA, Penza: PGASA)
[17] Ridges B M 2000 High-quality materials for dry building mixes (Moscow: Building materials)
[18] Smirnov V A, Efimov B A, Kulkov O V 2004 Materials for finishing construction works (Moscow: Academy)
[19] Boldyrev A S, Zolotov P P, Lyusov A N 2009 Building Materials: A Handbook (Moscow: Stroiizdat)
[20] Hayrapetyan L Kh, Zaika V D, Eletsksaya L D, Yanshina L A 1990 Handbook of adhesives (St. Petersburg : Chemistry)