Increasing the Setting Time of Local Gypsum (Joss) by the Use of TGP additive

Ahmed S. D. AL-Ridha¹; Ali A. Abbood¹; Essam H. Elaiwi¹; Hussein H. Hussein²; Layth Sahib Dheyab³

1Department of Civil Engineering, Engineering College, Mustansiriyah University, Baghdad, Iraq.
2 Department of Petroleum Engineering, Engineering College, Baghdad-University, Baghdad, Iraq.
3Civil Engineer, Iraqi Engineers Union, Baghdad, Iraq

Email: ahmedsahibdiab@yahoo.com

Abstract: This research presents a study of using an additive for the objective of increasing the setting time of a material used in several aspects in the constructional field, this material is “Local-Gypsum” which is locally called “Joss”, and the additive used in this study is “Trees Glue Powder” denoted by “TGP”. Nine mixtures of Local-gypsum (joss) had been experimented in the current study to find their setting time, these mixes were divided into three groups according to their water-joss ratios (W/J) (0.3, 0.4 and 0.5), and each group was sub-divided into three sub-groups according to their TGP contents (0.0%, 0.3% and 0.6%). It was found that, when TGP is added with the two contents (0.3% and 0.6%), the setting time of local gypsum (joss) is increased, and the percentage of this increase at (TGP content = 0.6%) is doubly multiplied as compared to the percentage at (TGP content = 0.3%). Moreover, when TGP content is increased from (0.0% to 0.6%), the percentage of increase in the setting times of joss is reduced with the increase of (W/J) ratio from (0.3 to 0.5). It was also found that, when (W/J) ratio is increased, the setting time of joss is increased, and this behavior is applicable for all TGP contents (0.0%, 0.3% and 0.6%). While, when (W/J) is increased from (0.3 to 0.5), the percentage of increase in the setting times of joss is reduced with the increase in TGP contents from (0.0% to 0.6%).

1. Introduction

In the latest years, gypsum products had been extremely utilized as interior finishing. Homes in the United States and Europe, are either constructed from or mostly contain gypsum-based products which are preferred by architectural engineers for their outstanding characteristics, such as reachable obtainability of inexpensive raw materials, volumetric stability, acoustic and thermal insulation, fire resistance, very low toxicity and the comparatively low energy and temperatures required in its manufacture [1]. Gypsum is also utilized in numerous implementations beyond the constructional field.
In the current study, ordinary potable water was utilized for mixing all local-gypsum (joss) mixtures.
Nine mixtures of Local-gypsum (joss) had been experimented in the current study to find their setting time, these mixes were divided into three groups according to their W/J ratios (0.3, 0.4 and 0.5), and each group was sub-divided into three sub-groups according to their TGP contents (0.0%, 0.3% and 0.6%). The constituent materials: (Joss, TGP and water) of all mixes were weighted quantities. The mixes details are illustrated in table (1). The experimental work plan and the specimens groups are shown in the flow chart of figure (1).

Figure (1) : Experimental Work Plan
Table (1) : Details of mixes .

| Mix No. | TGP contents by weight(%) | (W/J) ratios | Components for (100g) of Local Gypsum (Joss) |
|---------|---------------------------|--------------|---------------------------------------------|
| Mix 1   | 0.0                       | 0.3          | (100g) Joss + (0.0g) TGP + (30g) water      |
| Mix 2   | 0.3                       | 0.3          | (100g) Joss + (0.3g) TGP + (30g) water      |
| Mix 3   | 0.6                       | 0.3          | (100g) Joss + (0.6g) TGP + (30g) water      |
| Mix 4   | 0.0                       | 0.4          | (100g) Joss + (0.0g) TGP + (40g) water      |
| Mix 5   | 0.3                       | 0.4          | (100g) Joss + (0.3g) TGP + (40g) water      |
| Mix 6   | 0.6                       | 0.4          | (100g) Joss + (0.6g) TGP + (40g) water      |
| Mix 7   | 0.0                       | 0.5          | (100g) Joss + (0.0g) TGP + (50g) water      |
| Mix 8   | 0.3                       | 0.5          | (100g) Joss + (0.3g) TGP + (50g) water      |
| Mix 9   | 0.6                       | 0.5          | (100g) Joss + (0.6g) TGP + (50g) water      |

3.3. Testing program

The experimental work of the current study was carried out in the laboratory of constructional materials in the College of Engineering at Mustansiriyah University, the aforementioned laboratory is an integrated laboratory that contains many testing machines, and the several tests of many researches such as [17-24] was carried out in that laboratory.
3.3.1. Setting Time

One of the most shortcomings of all gypsum composites, specifically in preparing the paste is that its setting time is small (i.e. in comparison with cementitious or concrete pastes) and this shortcoming doesn't provide enough comfort for the craftsmen to do their work freely, this encourages us to assess the effectiveness of our additive (TGP) in increasing the setting time of local-gypsum (joss) [10].

Setting time is often measured by a device called (Vicat apparatus), which consist of a 300gm movable rod ended with a (50mm) long and (1mm) in diameter needle, fixed by a holder with a graduated plate and a cylindrical pan of (70×40)mm dimensions, the apparatus is shown in figure (1), and the test is performed according to ASTM : C472-99 [25].

4. Results & Discussions

4.1. Effect of (TGP) content on Setting Time of Joss with various (W/J) ratios.

Table (2) and figure (3) present a study of the effect of adding TGP with two contents (0.3% and 0.6%) on the setting time of joss for the three (W/J) ratios (0.3, 0.4 and 0.5). It is noticed that the setting time is increased with increasing TGP content, and this behavior is applicable for all (W/J) ratios (0.3, 0.4 and 0.5) as compared with the reference mixes that are free of TGP (Mix1, Mix4 and Mix7) respectively. This behavior might be attributed to the emulsifying nature of (TGP + water) solution coating some of gypsum particles with a thin film of it and hence isolating them from their contribution in the hydration process, and this outcome is in line with that stated by Hatim et al.[26].

It can also be noticed from the above mentioned table (2) and figure (3), that when TGP is added with (0.6%) content, the percentage of increasing in the setting time (as compared with the reference mix) is doubly multiplied in comparison with the percentage of increasing in setting time when TGP is added with (0.3%) content (as compared with the same reference mix), and this matter is applicable for the three (W/J) ratios.

Moreover, one can realize that when TGP is added with content (0.3% and 0.6%), the percentage of increasing in the setting time of joss is reduced with the increase in (W/G) ratio from (0.3) to (0.5).

| Mix No. | (W/J) ratios | TGP contents (by weight) (%) | Setting Times (min.) | Percentages of Increasing (%) |
|---------|--------------|------------------------------|----------------------|------------------------------|
| Mix 1   | 0.0          | 1.9                          | 0.0                  | -----
| Mix 2   | 0.3          | 5.5                          | 0.3                  | 184.5
| Mix 3   | 0.6          | 14.8                         | 0.6                  | 667.4
| Mix 4   | 0.0          | 4.3                          | 0.0                  | -----
| Mix 5   | 0.2          | 12.3                         | 0.2                  | 190.2
| Mix 6   | 0.4          | 28.0                         | 0.4                  | 558.8
| Mix 7   | 0.0          | 6.1                          | 0.0                  | -----
| Mix 8   | 0.3          | 13.8                         | 0.3                  | 127.4
| Mix 9   | 0.6          | 35.3                         | 0.6                  | 480.8

Table (2) : Effect of TGP content on Setting Time of Joss with various (W/J) ratios
4.2. Effect of (W/J) ratios on Setting Time of Joss with various TGP contents.

Table (3) and figure (4) studies the influence of increasing (W/J) ratios (from 0.3 to 0.5) on the setting time of joss for the three contents of TGP (0.0%, 0.2% and 0.4%). They reveal that the setting time is increased when (W/J) ratio is increased as compared with the reference mixes (Mix1, Mix2 and Mix3), and this behavior is applicable for the three contents of TGP.

Table (3) and figure (4) also show that the percentage of increasing in the setting time is enlarged with the increase in (W/J) ratios (from 0.3 to 0.5) in comparison with the reference mixes which have (W/J = 0.3 : i.e. Mix1, Mix2 and Mix3), and this behavior is applicable for all contents of TGP.

In addition, it can be noticed that when (W/J) ratio is increased from (0.3 to 0.5), the percentage of increase in the setting time of joss is reduced when TGP contents are increased from (0.0% to 0.6%).

Table (3): Effect of (W/J) ratios on Setting time of Joss with various TGP contents.

| Mix No. | TGP contents weight (%) | (W/J) ratios | Setting Times (min.) | Percentages of increasing (%) |
|---------|-------------------------|--------------|----------------------|------------------------------|
| Mix 1   | 0.0                     | 0.3          | 1.9                  | -----                        |
| Mix 4   | 0.0                     | 0.4          | 4.3                  | 119.9                        |
| Mix 7   | 0.0                     | 0.5          | 6.1                  | 214.7                        |
| Mix 2   | 0.3                     | 0.3          | 5.5                  | -----                        |
| Mix 5   | 0.3                     | 0.4          | 12.3                 | 124.2                        |
| Mix 8   | 0.3                     | 0.5          | 13.8                 | 151.5                        |
| Mix 3   | 0.6                     | 0.3          | 14.8                 | -----                        |
| Mix 6   | 0.6                     | 0.4          | 28.0                 | 88.8                         |
| Mix 9   | 0.6                     | 0.5          | 35.3                 | 138.2                        |
5. Conclusions

1. When TGP is added with the two contents (0.3% and 0.6%), the setting time of local gypsum (joss) is increased, and the percentage of this increase at (TGP content = 0.6%) is doubly multiplied as compared to the percentage at (TGP content = 0.3%).

2. When TGP content is increased from (0.0% to 0.6%), the percentage of increase in the setting times of joss is reduced with the increase of (W/J) ratio from (0.3 to 0.5).

3. When (W/J) ratio is increased, the setting time of joss and the percentage of its increase are both increased, and this behavior is applicable for all TGP contents (0.0%, 0.3% and 0.6%).

4. When (W/J) is increased from (0.3 to 0.5), the percentage of increase in the setting times of joss is reduced with the increase in TGP contents from (0.0% to 0.6%).

6. References

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