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Tile adhesive production by Inorganic materials

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ABSTRACT: In modern construction, ceramic tile and mosaic which are used for finishing and decoration are attached to the surface by using tile adhesives. It was a long way for tiling technology to arrive at the current cement based modified adhesive. The development in additives and modifier are the paramount factor to improve workability, higher flexibility, and better adhesion. In this document tile adhesive has been produced for economical and high performance formulation. These products have been produced by considering the effect of aggregate. These two products with different size of aggregate have been compared and tested. The test made was slip, bending, and compression test. Economical formulation consists of components like cement, quartz sand, cellulose ether and tartaric acid. But high performance consists of limestone and cellulose fiber in addition to these components. The modifier added has enhanced the final product resistance to sliding, bending and compression strength. In terms of compression strength test about 17.27% high performance is stronger than economical formulation. And in addition high performance is stronger than economical formulation by about 16.89% in terms of bending strength. The other thing is the effect of grain size, the component that has low grain size have shown great strength and resistant to slide.

KEYWORDS: Aggregate, Compression, Formulation, Modifier, Strength.

1 INTRODUCTION

An adhesive is a material that is applied to the surfaces of articles to join them permanently by an adhesive bonding process. Substance capable of forming bonds to each of the two parts when the final object consists of two sections that are bonded together. [1]. Adhesive or glue is a material, usually in a liquid, semi liquid and solid state that adheres or bonds items together. It is a substance capable of holding material together by surface attachment [5]-[6]. Cement-based mineral adhesives were exclusively produced and applied by so-called job-site mixing technology. Job-site mixing means transportation of the individual raw materials to the job-site and then mixing on site in the appropriate ratio. Thus, cement, the most common mineral binder, is mixed with fillers (sand) before water is added to create the wet adhesive for application. Adhesives are produced in specially designed dry-mix mortar plants in which mineral binder(s) and aggregates (sand) are mixed together in the appropriate way [2]. This factory-based process also allows different additives and admixes to be added to these adhesive to improve significantly their technical performance. Based on this technology individual dry mortars for specific applications can be produced according to formulations developed and pretested in the laboratory. Because of there is a fast-growing demand in the construction industry for new building materials and technologies, it resulted shortage of skilled workmen, the need for shorter construction times together with cost reduction, increasing labor costs, the diversification of building materials suitable for specific applications, new materials, and an increased demand for better quality of construction. Job-site mortar technology was not able to adequately meet all these requirements. [3].

The majority of the adhesive used in the construction industry is concerned with fastening decorative finishing materials to the insides and outside of building. For instance, the attachment of ceramic tiles and mosaics to floors and walls, wooden and flexible floor coverings, ceiling tiles, thermal insulation materials, wall veneers, covings, nosing, and so on, accounts for the usage of large amounts of a variety of adhesive materials. Tile adhesives are used for fixing tiles on various substrates [8].

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They are powder based on cement as a binder and require the application of water prior to the application. Pre-packed polymer modified tile adhesives are widely used in the modern building industry, e.g. as adhesives for fixing tiles and the installation of thermal insulation materials, as tile grout mortars, mineral decorative finishes and stuccos, self-leveling screeds and underlayment, waterproofing sealing slurries, repair mortars, jointing compounds, key-coats, masonry adhesives etc [9]. Due to the high diversification of modern building materials, these mortars must meet various technical requirements like good adhesion on all kind of substrates, high deformation ability (flexibility) and excellent durability even under extreme climatic conditions all over the world [4]. The Production of tile adhesive uses local mineral resources and industrial polymers, the raw material composition is usually as follows: cementing material made of Portland cement; the main aggregates are silica sand or quartz sand, limestone; minerals admixture mainly industrial products [7]. This thesis focuses on the production of tile adhesive and investigating the effect of modifiers. And as well it studies the additives added, whether it is selected depending on the climatic condition of the environment. After producing this adhesive, its strength is checked using strength testing machine. The production of tile adhesive has its own quality and performance, so in this thesis the task accomplished is to make quality product for given environment. The aim of the work is to determine the effect of aggregates and additives, preparation of standard tiles adhesive, and determining the best composition of tile adhesive

2 METHODS

2.1 MATERIAL REQUIRED

Jaw crusher, rotor mill, rotor disk mill, mixer, sieve, ceramic tile, heat oven balance, hammer, wood, nails, and universal tensile- compression testing machine. Portland cement, sand (quartz), limestone, fibers (e.g. cellulose fibers), cellulose ether, calcium chloride (calcium formate or lithium carbonate), citric acid or tartaric acid.

2.2 EXPERIMENTAL WORK

This document tries to address the issue of tile adhesive production. And it relies on cement-based tile adhesive because of it has some advantage and availability of chemicals and raw material. The work of this project depends on literature review on tile adhesive and related products. The final goal of this thesis is also dependent on laboratory work on tile adhesive from mineral resource.

2.2.1 PREPARING OF ECONOMICAL FORMULATION TILE ADHESIVE

This is an adhesive prepared for cost minimization and need minimum numbers of raw materials [10].

Table 1. Raw material for economic formulation with composition

No.	Raw material	Grain size	Composition (%)
1	Quartz	0-0.5mm	74.25
2	Portland cement	As prepared by the supplier	25
3	Cellulose ether	As prepared by the supplier	0.5
4	Tartaric acid	As prepared by the supplier	0.25

For the purpose of meeting this, raw materials are ground using grinding machine that exist in the laboratory. After these raw materials are prepared with appropriate ratio and then mixed [6].

2.2.2 PREPARING OF HIGH PERFORMANCE FORMULATION TILE ADHESIVE

This product has been produced using modifier and chemical additives with regard to environmental condition. And it has been prepared with different grain size [10].

Table 2. Raw material for high performance formulation with composition

No.	Raw material	Grain size	Composition (%)
1	Quartz sand	0 – 0.5mm	55
2	Ground limestone	0-20 µm	5
3	Portland cement	As prepared by the supplier	38
4	cellulose fibers	As prepared by the supplier	1
5	Carbomethyl cellulose	As prepared by the supplier	0.5
6	Tartaric acid	As prepared by the supplier	0.25

2.2.3 STRENGTH TEST FOR THE PRODUCTS

Using universal tensile strength test machine the strength of the product has been tested [7].

1. For the purpose of this test, the specimens have been prepared in mold form.
2. After seven days the samples have been tested.
3. After this the samples have been inserted in heater to make it dry around 70^0C.
4. Universal strength test machine has been used for test of compression and bending strength of specimen.

2.2.4 SLIP TEST

A tile adhesive should have a good slip resistance mainly for the following two reasons: for tiling with heavy tiles like marble tiles, and second for countries where the tiling of a wall starts from the top [8].

3 RESULTS AND DISCUSSION

After accomplishing the experiment, the anticipated results that were proposed have been found. The production of high performance and economical formulation was done. The next step is testing the products. From experiments the following result has been found.

3.1 SLIP TEST RESULTS

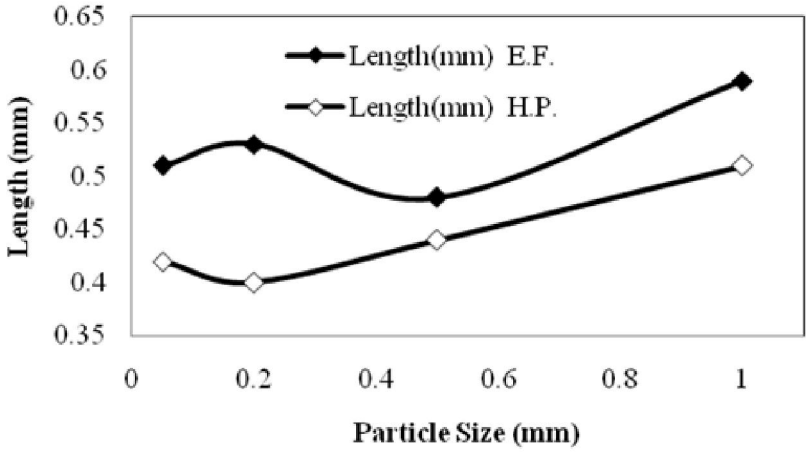

Fig. 1. Graphical representation for economic formulation and high performance

For the two data, the graph has been noticed that when the fineness changes the length travelled by tile is changed. And for the middle product was good relatively as compared to the other. The other thing is high performance have shown better result than the economic formulation.

3.2 COMPRESSION TEST RESULT

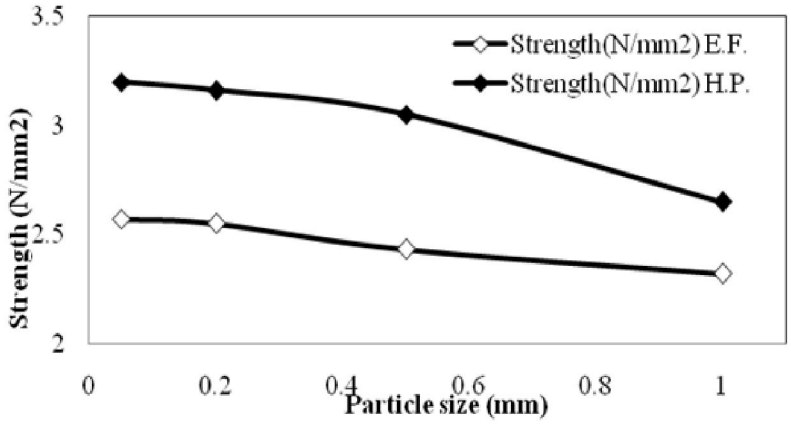

Fig. 2. Graphical representation for economic formulation and high performance

The graphs above shows that fine particle have high compressive strength. And the other thing is, in percentage high performance is stronger than economical formulation by about 17.27%.

3.3 BENDING TEST RESULT

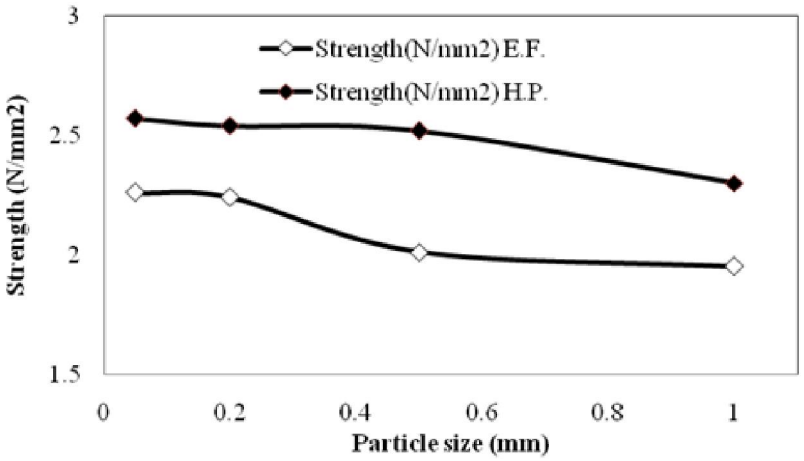

Fig. 3. Graphical representation for economic formulation and high performance

In the test of tile adhesive bending strength we have get the data shown in the graph above. From the graph we noticed that finer particle has good bending strength. And in percentage high performance is stronger than economical formulation by about 16.89%.

4 CONCLUSION

Tile adhesive have been produced with two different formulations. These two formulations are economical and high performance. Economical formulation is a product produced from components like cement, sand, cellulose ether and tartaric acid. While high performance is produced from cellulose fiber, limestone in addition to the components mentioned above. The work done in this thesis is production of tile adhesive as per the standard which is comfortable for our environment. Additives were added to enhance and inhibit the rate of drying and hydration. For acceleration chemicals like Calcium chloride, calcium formate and lithium carbonate were added for wet climate region. For retard and slow down of the rate of hydration chemicals like citric acid and tartaric acid are good for hot climate. Cause of these it was possible to produce tile adhesive suitable for our environment.

Tile adhesive which prepared from different modifiers for high performance and without modifier for economical purpose has difference in terms of strength. In terms of compression strength test about 17.27% high performance is stronger. And in addition high performance is stronger than economical formulation by about 16.89% in terms of bending strength. The two products have difference in terms of composition and content. Because the modified product has cellulose fiber, and limestone it has a characteristic like good workability, long open time, high anti slip resistance, high compression and bending strength. The economical formulation has shown slip resistant which greater than the standard as was indicated in the result except medium size product. For the case of high performance the two products, (fine and medium) have shown less than maximum requirement. Because of these, fine size of economical formulation is an acceptable product. And fine and medium size of high performance formulation have shown good result. The other thing is the bending and compressive strength test results of economical formulation were unable to satisfy the minimum requirement. But high performance formulation, (fine and medium size) have satisfied minimum requirement but that is not sufficient strength. This might have resulted because of raw material quality and absence of redispersible powder which enhance the strength of the product.

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