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# ALIEN PROPERTY CUSTODIAN

## PROCESS OF CONSOLIDATING OR WATER-PROOFING MORTAR

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The present invention relates to a process of consolidating or water-proofing or tightening mortar, the expression "mortar" including lime mortar and cement mortar as well as mixtures of same which for instance are obtained if 3 to 5 parts of sand are added to a mixture consisting of 1 part by weight of cement to 2 parts by weight of quick-lime, and is a continuation-in-part of application Ser. No. 53,933, filed December 11, 1935.

It is the aim of the present invention to achieve the well-known good consolidating or water-proofing effect of the lime-soaps in the mortar itself by forming these lime-soaps in the finest possible distributed form so that on the one hand the maximum possible protective effect is obtained and on the other hand practically any scum formation is prevented. In accordance with the present invention this is effected by treating fatty acids of high molecular weight under application of heat with proteins or protein decomposition products and sulphite spent liquor in the presence of non-saponifiable oils and fats, whereupon emulsification with water is effected in an alkaline solution. Hereby the substances of protein products and sulphite spent liquor act as protective colloids in such a manner that the combination of the emulsion with the free lime of the mortar prevents precipitation of the line-soap in the form of coarse flakes. The effect of the protective colloid is shown by the fact that the protective lime-soap is formed in the mortar in a finely divided state and therefore with a high protective effect. Simultaneously this fine distribution prevents that scum films, otherwise formed in the mortar when using normal soaps, loosen the structure of the mortar by air inclusions and thereby impair the density and strength.

This is obtained in accordance with the present invention by the following facts: The protein products used as protective colloids and the sulphite spent liquor chemically react during the manufacture of the emulsion which may be proved by the xanthroprotein-reaction. According to the statements made for instance in Ullmann: "Enzyklopädie der Technischen Chemie" 2. edition, volume 4, page 336, the material to be tested is mixed with concentrated nitric acid and heated. In the presence of protein yellow coloring occurs. When carrying out the process according to the invention the presence of protein cannot be proved which again is a proof for the fact that in the course of the reaction the protein, probably due to condensation with the ingredients of the sulphite spent liquor, has changed to gluco-proteides or similar condensation products.

Oleic acid, stearic acid, abietic acid, linoleic acid and so on are suitable as high molecular fatty acids. The effect of preventing scum or foam formation is increased by small additions of non-saponifiable oils and fats, for instance mineral oils.

It is hitherto not known that lime-soaps could be formed in mortar in the finest state of subdivision, because hereby high molecular fatty acids momentarily react with formation of coarse flakes. This formation of lime-soaps in mortar in the finest state of subdivision was first rendered possible by the invention which disclosed the fact, that by the use of protective colloids and means preventing scum or foam formation an emulsion could be obtained which in the presence of alkali hydroxide contains the high molecular fatty acids in a free non-hydrous form. That this is the case is proved by the following test: 8 grams of oleic acid are heated to about 90° to 100° and a solution of 3 grams of potassium hydroxide in 89 grams of water, heated to 90° and thoroughly stirred, are added. This solution of hydrous potash soap is allowed to stand for 24 hours in a closed vessel, whereupon the viscosity is determined at a temperature of 20°. The solution intended to show the effect of the new method is prepared as follows: 5 grams of animal glue and 12 grams of sulphite spent liquor (50%) are heated with 15 grams of water until all particles are thoroughly mixed. Then 8 grams of oleic acid are added under stirring and heating is continued until a bond results. The solution is then allowed to cool down to 80° and 3 grams of potassium hydroxide, solved in 3 grams of water, are added. The mixture thereby is colored brown. After ten minutes 60 grams of water, having a temperature of about 70°, are stirred into the mixture and after standing for 24 hours the viscosity is again determined at a temperature of 20°. Hereby a viscosity of 4,4 centipoises results, while the soap solution shows a value of 4957 centipoises. This high value is due to the fact, that in the soap solution the soap molecules, owing to their high hydration (emulsion colloid), have molecules of large size. The low value of 4,4 centipoises in connection with the emulsion according to the invention proves that with equal high oleic-and potassium hydroxide-concentration the system has changed to a suspension colloid in which the emulsifiers are not the hydrated soap molecules, but the combined protein sulphite spent liquor-emulsifier is the carrier of the emulsion, and the fatty acid with simultaneous presence of alkali hydroxide is to be considered as disperse phase. If these two solutions (or their dilutions with water 1:20) are shaked, a stiff scum or foam is formed upon the solution of potash soap which is produced by the hydrated soap molecules, whereas with a solution according to the invention the scum instantaneously breaks on standing. (In this connection see Wo. Ostwald: "Die Welt der vernachlässigten Dimensionen" 9th and 10th edition, pages 80 and followings; Fischer-Hooker "Die lyophilen Kolloide" 1935, pages 6 and followings.)

Another test is as follows: 5 grams of a solution of potash soap (8% oleic acid) are diluted with water to 100 cm$^3$ in a 100 cm$^3$ measuring cylinder. After an addition of 10 grams of Portland cement, the mixture is shaked 20 times. After standing for 15 minutes, the sediment formed is read off. 40 cm$^3$ of coarse flaked particles are precipitated from the soap solution and a portion forms a stiff scum or foam upon the upper surface. In connection with the emulsion the sediment consists of 14 cm$^3$ of very fine particles, whereas the liquid on top thereof contains a turbid milk of cement with emulsion particles. The scum upon the upper surface is broken or decomposed.

This shows that in spite of the presence of free fatty acids and a free alkali hydroxide in the emulsion, the stability cannot be dependent on the presence of soap, but only on the protective colloid formed by the combination of protein products and sulphite spent liquor. Hereby it is, moreover, proved that the free lime of the cement at once forms with the soap solution very coarse lime-soaps and a stiff scum, whereas with the emulsion the lime-soaps are produced in the finest possible distribution and without the formation of scum.

As with the known process, in this case also it is highly desirable to add lime-soaps to the mortar as well as to effect this in the finest possible distribution. If the ingredients are separately added, this is extremely difficult owing to the high reaction speed of the lime-soap formation. If finished lime-soaps are added to the mortar this is possible in the form of coarse dispersions in which the size of the particles amounts to more than 10 microns, whereas the size of particles of clear or only faintly turbid emulsions is below 0.1 micron. Inasmuch as the degree of the protective effect rapidly increases with the reduction of the particle size, it is quite evident that the present invention is accompanied by a substantial advantage.

It is generally known that a fine dispersion often is highly desired, particularly if an intensive effect is expected, however, the solution of the problem in the present case has nothing whatever to do with a dispersion such as is obtained by the Plausen-colloid mill. It has, moreover, been proposed to avoid the formation of scum in connection with colloid substances in the mortar by adding small amounts of salts of high molecular fatty acids or their sulfonating products, acting as scum or foam destructing agents, to relatively large amounts of protein substances. In this case the water-proofing is not effected by the lime-soap formed, as in the case of the present invention, but the effect is based upon the protein substances which, however, are more or less soluble in water. In connection with the present invention the water-proofing effect requires a genuine or true emulsion which for the purpose of preventing scum or foam formation contains not only non-saponifiable oils and fats, but the combined protein-sulphite spent liquor-emulsifier. The water-proofing effect in the mortar is based chiefly upon the formation of hydrophobic lime-soaps. In this case the aim is to prevent the formation of scum.

The improvement obtained by the new method may be seen from the following table. Mortar plates of dimensions of 4x20x20 cm were produced from a mortar composition of 1 part by weight of Portland cement, 3 parts by weight of sand of mixed grain sizes and 10% of water calculated on the dry mortar. The water-proofing agents were mixed with the water and calculated to 2% based upon the weight of the cement.

| Substances added | Weight of the volume of the mortar | Water-tightness of the mortar |
|---|---|---|
| None | 2,01 | Permeable. |
| Emulsion according to the invention. | 2,01 | Satisfactorily water-tight. |
| Insoluble soaps without soluble soaps. | 2,01 | Somewhat permeable. |
| Insoluble soaps with alkali soaps. | 1,95 | Satisfactorily water-tight, reduced strength. |
| Puro alkali soaps with and without soluble additions. | 1,80–1,90 | Satisfactorily water-tight, strongly reduced strength. |

The results show that the scum formation of soluble alkali soaps strongly reduces the volume weight of the mortar and therewith the strength, while the insoluble, non-scuming soaps cause no decrease of the volume weight but, due to the slight dispersity of the hydrophobic particles, effect a slight water-proofing of the mortar. Other mortar compositions are as follows:

| | |
|---|---|
| Portland cement | 1 |
| Sand of mixed grain sizes | 4 |

| | |
|---|---|
| Portland cement | ½ |
| Hydraulic lime | ½ |
| Sand of mixed grain sizes | 4 |

| | |
|---|---|
| Iron Portland cement | 1 |
| Sand of mixed grain sizes | 3 |
| Gravel | 5 |

The excellent results obtained with the use of the emulsion according to the present invention are based on the fact that high molecular fatty acids are emulsified in an alkaline solution in the presence of non-saponifiable oils and fats under application of heat with protein substances or protein decomposition products and sulphite spent liquor as emulsifiers and protective colloids. Tests have shown that the scum preventing effect is primarily based upon the fact that the fatty acids are not present as hydrous and, therefore, as scuming alkali soaps, but that the combined protein-sulphite spent liquor-emulsifier is to be considered as emulsifier. Hereby it is of importance that a suitable emulsion may be obtained not by protein alone and also not by sulphite spent liquor alone. The addition of small amounts of non-saponifiable oils and fats serves the purpose of still improving the effect of preventing the formation of scum or foam.

*Examples*

(*a*) 5 kilograms of stearic acid are mixed with 6 kilograms of mineral oil and molten. Then 12 kilograms of sulphite spent liquor and 7 kilograms of protein (glue) are added which were treated with 20 kilograms of water, and the mixture is boiled at 100° until a bond has resulted. Thereupon, the whole is allowed to cool to 85° and 6 kilograms of potassium hydroxide (50%) are added and stirred until a uniform reaction product is obtained. Finally 44 kilograms of water, heated to 60°, are stirred into the mixture to finish same.

(*b*) 10 kilograms of oleic acid are heated to 105° with 5 kilograms of mineral oil and therewith are mixed 10 kilograms of protein decomposition products and 15 kilograms of sulphite spent liquor. The mixture is then heated at 100° until an homogeneous substance is obtained. Thereupon cooling down to 80° is effected and 4 kilograms of potassium hydroxide (50%) are added under thorough stirring until a uniform bond indicates the end of the reaction. Finally 56 kilograms of water heated to 80°, are added under stirring.

Suitable protein substances are: waste products of protein of bones, glue flesh or the like which by a treatment with steam under pressure have been decomposed until no gelatinisation occurs when cooled. Moreover, decomposition products of the glue- and gelatine production come into consideration which also may be obtained for instance by alkaline decomposition and which contain protalbine- and lysalbine acids.

Emulsions prepared in the manner described above dissolve in water either to a clear solution or with faint turbidity. If the emulsion is added to dry mortar with such an amount of water that 2 grams of emulsion are provided for each 100 grams of cement, the emulsion has excellent water-proofing effects without impairing the quality of the mortar. This being due to the fact that the active substances in the mortar are present in the finest possible distribution and that the formation of the hydrophobic lime-soaps is obtained, owing to the protective effect of the emulsifier, without the formation of scum films and in such finely divided form that maximum protection is ensured.

Another advantage of this emulsion consists therein, that it has a high wetting power and reduces the quantity of water necessary for the mixture of the mortar. If a mortar of 1 part by weight of Portland cement and 4 parts by weight of mixed sand is produced, then for obtaining a soft mortar, as is required for effecting plasterings, about 14% of water are required. If, however, the emulsion according to the invention is used for preparing the mortar only about 12% of water or liquid respectively are required to obtain the same mortar consistency. Generally, a reduction of the water, necessary to mix the mortar of about 1% results in an increase of the compressive strength of $^{20}/_{30}$ kg/cm$^2$. This means a substantial advantage when using the emulsion. Moreover, the plasticity of the mortar is increased, the mortar may more easily be formed, is prevented from breaking when dry, retains the water and is difficultly to separate which is of particular advantage for instance in connection with concrete for casting purposes which often must be fed or supplied over large distances without being separated.

CARL LETTERS.