[Second Edition.]

PATENT SPECIFICATION

554,863

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PROVISIONAL SPECIFICATION

Improvements in or relating to Concrete.

I, GEOFFREY HERBERT CHEESMAN, a British Subject, of 9, Compton Road, Wimbledon, London, S.W.19, do hereby declare the nature of this invention to be as follows:—

This invention is for improvements in or relating to concrete.

Concrete is usually made by premixing portland cement and an aggregate with water and placing the premixed material wherever it may be required and allowing it to set.

This invention has for an object the making of concrete by first putting the aggregate or coarse stones into the required position and then filling the voids between the stones with portland cement mortar in the form of a grout and allowing it to set.

It is common knowledge that if portland cement, sand and water, prepared as a grout without any other treatment, is poured into the interstices of stones, previously laid, with the object of filling the voids, and thereby making a solid mass, partial separation of the constituents takes place, which results in the voids being only partly filled and the resultant concrete being honeycombed with a consequence that the strength is less than that of concrete made by normal methods.

It is also known that if such a slurry or grout is passed through what is termed a colloidal mill and is then poured into the voids between the aggregate or stones already laid to receive such mortar or grout such mortar or grout will penetrate the voids and provided the aggregate or stones are not too small the mortar so prepared will readily flow into the voids and fill them with the result that solid mass is formed without the constituents separating out and a good concrete will be formed.

I have found that concrete made by the use of a cement mixture prepared in accordance with my invention provides an improvement or advance over untreated cement mortar or mortar passed through a special colloidal mixing machine as already described, since it renders it possible ~~to prepare~~ a suitable slurry or mortar in ordinary concrete mixers or even by hand mixing without the necessity of using a special colloidal mixer or any other special type of mixer.

According to the present invention a cement mixture or slurry for use in grouting is prepared by admixing cement and water and if desired sand or fine aggregate with a small proportion of a dispersing or wetting agent (such as sulphonated oil, of which the sulphonated octyl alcohol sold under the Registered Trade Mark "Sulphonated Lorol" is an example). The cement mixture or slurry thus obtained can then be simply poured over and into the interstices between the aggregate in the position in which the final concrete is desired and in due course, the product is a uniform concrete of good quality.

The following is a description of an experiment which illustrates the effect of using a cement-mortar in accordance with my invention:

A vertical cylinder 12 inches in diameter and 3 feet high was packed with a coarse aggregate consisting of crushed shingles graded to a size of ½ inch to ¾ inch and over the top of the vertical cylinder there was poured a mixture consisting of 6 lbs. cement, 9 lbs. sand, 0.3 gram of the sulphonated octyl alcohol, sold under the Registered Trade Mark "Sulphonated Lorol", the whole being mixed with 1633 ccs. of water.

When the cement had set, the cylinder was opened and the contents was examined and it was found that the cement mixture had penetrated uniformly to a depth of eighteen inches down the column to form a solid column of concrete of good quality.

There were substantially no cavities in the column and consequently the column had a high strength.

A comparison test, in which the experiment was repeated precisely as above indicated, except for the omission of the dispersing or wetting agent, yielded a column in which penetration of the column was irregular and had extended in part only to a depth of eighteen inches, the interior of the column containing many cavities and the

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column therefore being of a low grade concrete having a low strength. Moreover, without the use of a sulphonated compound it was found that there was considerable settling out of the cement mixture and consequently it would be quite impossible to obtain the same uniformity of penetration as is obtained when operating according to my invention.

The method of my invention is applicable to the manufacture of concrete in any shape or form provided the smallest particle size of the largest aggregate employed is such that the mortar or slurry will penetrate and fill the interstices between the aggregate to make a solid mass.

Dated this 8th day of January, 1942.

For
GEOFFREY HERBERT CHEESMAN:
Stevens, Langner, Parry & Rollinson,
Chartered Patent Agents,
5—9, Quality Court, Chancery Lane,
London, W.C.2, and at
120, East 41st Street, New York City,
New York, U.S.A.

COMPLETE SPECIFICATION.

Improvements in or relating to Concrete.

I, GEOFFREY HERBERT CHEESMAN, a British Subject, of 9, Compton Road, Wimbledon, S.W.19, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention is for improvements in or relating to concrete.

Concrete is usually made by premixing portland cement and an aggregate with water and placing the premixed material wherever it may be required and allowing it to set.

This invention has for an object the making of concrete by first putting the aggregate or coarse stones into the required position and then filling the voids between the stones with portland cement mortar in the form of a grout and allowing it to set.

It is common knowledge that if portland cement, sand and water, prepared as a grout without any other treatment, is poured into the interstices of stones, previously laid, with the object of filling the voids and thereby making a solid mass partial separation of the constituents takes place, which results in the voids being only partly filled and the resultant concrete being honeycombed with a consequence that the strength is less than that of concrete made by normal methods and various expedients for example, the use of a pressure grouting process have been employed with a view to overcoming this effect.

It is also known that if such a slurry or grout is passed through what is termed a colloidal mill and is then poured into the voids between the aggregate or stones already laid to receive such mortar or grout, such mortar or grout will penetrate the voids and, provided the aggregate or stones are not too small, the mortar so prepared will readily flow into the voids and fill them with the result that a solid mass is formed without the constituents separating out and a good concrete will be formed.

I am aware that various proposals have been made for the addition of a wetting or dispersing agent to cements and concretes at various stages in their manufacture. In prior specification No. 466,229, for example, it has been proposed to add a cement peptising or dispersing agent to cement clinker to facilitate the grinding thereof; in prior specification No. 361,094 it has been proposed to add albumenous material (which tend to induce frothing) and a salt of a higher fatty acid or a sulphurisation product thereof either during the manufacture of cement or to finished cement powder or during the mixing of a cement mixture whilst in prior Specification No. 431,679 it has been proposed to improve the plasticity of a mixture of cement, water and coarse aggregates by the addition of a cement peptising agent. In none of these prior specifications, however, has there been any suggestion that concrete free from voids can satisfactorily be made by a grouting process.

I have, however, found that concrete can successfully be made by the use of a cement mixture prepared in ordinary concrete mixers, or even by hand mixing, without the necessity of using a special colloidal mixer or any other special type of mixer whilst in addition, by the use of a cement mixture or slurry containing a wetting or dispersing agent, it is possible to prepare the cement mixture or slurry and pump it over long distances, for grouting placed coarse aggregate, without separation of the ingredients occurring.

According to the present invention a method of forming concrete structures, articles, roads, carriage-ways, paths and the like comprises placing a coarse aggregate *in situ* or in forms and grouting the coarse aggregate with intimate admix-

ture of cement and water, with or without sand or fine aggregate, with a stable wetting or dispersing agent as hereinafter defined in an amount of between 0.001% and 0.5% by weight of the cement, the smallest size of the particles in the coarse aggregate being such as to permit the cement grout to penetrate and fill substantially all the interstices therein; preferably the wetting or dispersing agent is used in the amount of about 0.01% by weight of the cement. Where sand or fine aggregate is incorporated in the cement mixture or slurry, the maximum particle size thereof requires to be so selected that at least the major portion of it can pass through the interstices in the coarse aggregate or large stones; thus, with larger sized coarse aggregate, the maximum permissible size of the sand or fine aggregate is greater than where the coarse aggregate is smaller. The depth of the layer of coarse aggregate must also be taken into consideration as the size of the interstices between the particles in the coarse aggregate needs to be larger where deeper penetration is required and thus it may be necessary to limit the size of the sand or fine aggregate to smaller particles than would normally be used with a given coarse aggregate as an alternative to the use of larger sized particles in the coarse aggregate. The sand or fine aggregate should preferably not contain more than a small proportion of particles of a size greater than three sixteenths of an inch when used with a coarse aggregate whose particle size ranges from 2 inches down to ¼ inch. The preferred class of wetting and dispersing agents are the sulphonated or sulphated higher alcohols.

The concrete can be simply made by pouring the cement mixture or slurry over and into the interstices between the aggregate in the position in which the final concrete is desired and in due course, the product is a uniform concrete of good quality.

The following is a description of an experiment which illustrates the effect of using a cement-mortar in accordance with my invention:

A vertical cylinder 12 inches in diameter and 3 feet high was packed with a coarse aggregate consisting of crushed shingles graded to a size of ½ inch to ¾ inch and into the top of the vertical cylinder there was poured a mixture consisting of 6 lbs. cement, 9 lbs. sand, 0.3 gram of the sulphonated octyl alcohol, sold under the Registered Trade Mark "Sulphonated Lorol", the whole being mixed with 1633 ccs. of water.

When the cement had set, the cylinder was opened and the contents examined when it was found that the cement mixture had penetrated uniformly to a depth of eighteen inches down the column to form a solid column of concrete of good quality.

There were substantially no cavities in the column and consequently the column had a high strength.

A comparison test, in which the experiment was repeated precisely as above indicated, except for the omission of the dispersing or wetting agent, yielded a column in which penetration of the column was irregular and had extended only in part to a depth of eighteen inches, the interior of the column containing many cavities and the column therefore being a low grade concrete having a low strength. Moreover, without the use of the sulphonated compound it was found that there was considerable settling out of the cement mixture and consequently it would be quite impossible to obtain the same uniformity of penetration as is obtained when operating according to my invention.

The following is a description of a field trial of the process in which the invention was applied in connection with the construction of a 12 foot carriage-way six-inches thick.

The site for the carriage-way was laid with an appropriate depth of aggregate consisting of stones varying in size from 2 inches to ½ inch. The cement used was an ordinary portland cement and this was mixed with clean washed sand of a size ranging from ⅛ inch down in the proportion of one volume of portland cement to 1½ volumes of dry sand.

The actual quantities used were 1.4 cubic feet of cement and 2.1 cubic feet of dry sand the whole being admixed with 8¼ gallons of water containing a dispersing of wetting agent known under the Trade Mark "Cheecol" in the proportion of approximately 0.01% by weight of the cement.

The mix was charged into a conventional mixer of the tilting drum type and when the mixing had been completed the cement grout was pumped through a 2-inch rubber hose to the site of the carriage-way, where it was poured over the whole surface which was to form the carriage-way, and was then allowed to set.

The completed carriage-way was found to be completely successful and to have an adequate strength and uniformity throughout its whole width and depth. The actual construction of the carriage-way was carried out faster than it can be done in the ordinary method by mixing the cement, water, sand and large aggregate in a mixer of the same capacity since the mixer, when the method of my inven-

tion is used, does not have to cope with the large weights and volumes of coarse aggregate but only the cement and any sand or fine aggregate used in the formation of the grout. There is, moreover, less power used in driving the mixer, and less labour is required for conveying the cementitious mixture to the site.

The surface of the carriage-way was finished off in the conventional way by means of a tamper.

The method of my invention is applicable to the manufacture of concrete in any shape or form provided the smallest particle size of the large aggregate employed is such that the mortar or slurry will penetrate and fill the interstices between the aggregate to make a solid mass.

By "stable wetting or dispersing agent" is meant a wetting or dispersing agent which is not rendered ineffective, precipitated or destroyed by the alkali or any calcium or magnesium compounds present in or liberated by the cement or which remains effective, in the presence of such compound, for a period of time sufficient to enable the cement mixture or slurry containing it to be poured over and penetrate the coarse aggregate; it will be appreciated that so long as the wetting or dispersing agent remains effective for a period of time sufficient to enable the penetration of the grout to take place throughout the whole of the aggregate or stones laid *in situ*, it will have fulfilled its function satisfactorily.

The wetting or dispersing agents sold under the Trade Mark "Cheecol" consist of alkali salts of higher sulphated alcohols and are eminently satisfactory materials since their calcium and magnesium salts are readily water soluble and, therefore, the wetting or dispersing effect of the agents persists even though the sodium salts initially applied or the wetting or dispersing agent itself may have been converted into the calcium or magnesium salts thereof.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A method of forming a concrete structure or article which comprises placing a coarse aggregate *in situ* or in forms and grouting the coarse aggregate with an intimate admixture of cement and water, with or without sand or fine aggregate, with a stable wetting or dispersing agent as hereinbefore defined in an amount of between 0.001% and 0.5% by weight of the cement, the smallest size of the particles in the coarse aggregate being such as to permit the cement grout to penetrate and fill substantially all the interstices therein.

2. A method according to Claim 1 wherein the coarse aggregate is graded to between two inches and half an inch in size.

3. A method of forming roads, carriage-ways, paths and the like which comprises placing a coarse aggregate *in situ* or in forms and grouting the coarse aggregate with an intimate admixture of cement and water, with or without sand or fine aggregate, with a stable wetting or dispersing agent as hereinbefore defined in an amount of between 0.001% and 0.5% by weight of the cement, the smallest size of the coarse aggregate being such as to permit the cement grout to penetrate and fill substantially all the interstices therein.

4. A method according to any of the preceding Claims wherein the wetting or dispersing agent is present in an amount of about 0.01% by weight.

5. A method according to any of the preceding Claims wherein the said sand or fine aggregate consists of particles of which the major proportion are of a size not greater than three-sixteenths of an inch when used with a coarse aggregate whose particles range from 2 inches down to ½ inch.

6. A method according to any of the preceding Claims wherein the wetting or dispersing agent comprises a sulphonated or sulphated higher alcohol or a water-soluble salt thereof.

7. A method according to any of the preceding Claims wherein the wetting or dispersing agent comprises a sulphonated or sulphated higher alcohol whose calcium and magnesium salts are readily soluble in water.

8. A method of forming concrete structures, articles, roads, carriage-ways, paths and the like substantially as described in connection with the experiment or field trial hereinbefore set forth.

9. Concrete structures, articles, roads, carriage-ways, paths or the like formed with the use of the cement mixture or slurry substantially in the manner hereinbefore described.

Dated this 7th day of January, 1943.

For
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Stevens, Langner

tion is used, does not have to cope with the large weight and volumes of coarse aggregate but only the cement and any sand or fine aggregate used in the formation of the grout. There is, moreover, less power used in driving the mixer, and less labour is required for conveying the cementitious mixture to the site.

The surface of the carriage-way was finished off in the conventional way by means of a tamper.

The method of my invention is applicable to the manufacture of concrete in any shape or form provided the smallest particle size of the large aggregate employed is such that the mortar or slurry will penetrate and fill the interstices between the aggregate to make a solid mass.

By "stable wetting or dispersing agent" is meant a wetting or dispersing agent which is not rendered ineffective, precipitated or destroyed by the alkali or any calcium or magnesium compounds present in or liberated by the cement or which remains effective, in the presence of such compound, for a period of time sufficient to enable the cement mixture or slurry containing it to be poured over and penetrate the coarse aggregate; it will be appreciated that so long as the wetting or dispersing agent remains effective for a period of time sufficient to enable the penetration of the grout to take place throughout the whole of the aggregate or stones laid *in situ*, it will have fulfilled its function satisfactorily.

The wetting or dispersing agents sold under the Trade Mark "Cheecol" consist of alkali salts of higher sulphated alcohols and are eminently satisfactory materials since their calcium and magnesium salts are readily water soluble and, therefore, the wetting or dispersing effect of the agents persists even though the sodium salts initially applied or the wetting or dispersing agent itself may have been converted into the calcium or magnesium salts thereof.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A method of forming a concrete structure or article which comprises placing a coarse aggregate *in situ* or in forms and grouting the coarse aggregate with an intimate admixture of cement and water, with or without sand or fine aggregate, with a stable wetting or dispersing agent as hereinbefore defined in an amount of between 0.001% and 0.5% by weight of the cement, the smallest size of the particles in the coarse aggregate being such as to permit the cement grout to penetrate and fill substantially all the interstices therein.

2. A method according to Claim 1 wherein the coarse aggregate is graded to between two inches and half an inch in size.

3. A method of forming roads, carriage-ways, paths and the like which comprises placing a coarse aggregate *in situ* or in forms and grouting the coarse aggregate with an intimate admixture of cement and water, with or without sand or fine aggregate, with a stable wetting or dispersing agent as hereinbefore defined in an amount of between 0.001% and 0.5% by weight of the cement, the smallest size of the coarse aggregate being such as to permit the cement grout to penetrate and fill substantially all the interstices therein.

4. A method according to any of the preceding Claims wherein the wetting or dispersing agent is present in an amount of about 0.01% by weight.

5. A method according to any of the preceding Claims wherein the said sand or fine aggregate consists of particles of which the major proportion are of a size not greater than three-sixteenths of an inch when used with a coarse aggregate whose particles range from 2 inches down to ½ inch.

6. A method according to any of the preceding Claims wherein the wetting or dispersing agent comprises a sulphonated or sulphated higher alcohol or a water-soluble salt thereof.

7. A method according to any of the preceding Claims wherein the wetting or dispersing agent comprises a sulphonated or sulphated higher alcohol whose calcium and magnesium salts are readily soluble in water.

8. A method of forming concrete structures, articles, roads, carriage-ways, paths and the like substantially as described in connection with the experiment or field trial hereinbefore set forth.

9. Concrete structures, articles, roads, carriage-ways, paths or the like formed with the use of the cement mixture or slurry substantially in the manner hereinbefore described.

Dated this 7th day of January, 1943.

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