Ton/A

United States Patent

Horvitz

[15] 3,668,150
[45] June 6, 1972

[54] CONCRETE FLOOR WITH GROUND METAL AGGREGATE AT THE WEAR SURFACE

[72] Inventor: **Howard J. Horvitz,** 21800 Shaker Blvd., Shaker Heights, Ohio 44122

[22] Filed: **Nov. 16, 1970**

[21] Appl. No.: **90,040**

[52] **U.S. Cl.** **106/90,** 106/314, 106/97, 252/513

[51] **Int. Cl.** **C04b 7/02,** H01b 1/02

[58] **Field of Search** 252/511; 106/315, 314, 97, 106/99, 90

[56] **References Cited**

UNITED STATES PATENTS

3,166,518	1/1965	Barnard	252/511
3,210,207	10/1965	Dodson	106/315

Primary Examiner—Douglas J. Drummond
Attorney—Fay, Sharpe and Mulholland

[57] **ABSTRACT**

A dry mix for making concrete comprising approximately 28 to 38 percent cement, approximately 62 to 72 percent powdered ferrous metal and approximately 0.01 to 0.80 percent sodium nitrite.

A method of making a substrate which includes forming a base of a conventional concrete mix and screeding and floating the base to form a substantially flat surface. The base is allowed to set until the bleed water disappears and then a dry mixture of approximately 28 to 38 percent cement, approximately 62 to 72 ground ferrous metal and approximately 0.01 to 0.80 percent sodium nitrite is deposited in a uniform manner on the flat surface by shaking. After the dry mixture absorbs adequate water from the base, it is floated and trowelled to the desired finish.

10 Claims, No Drawings

Portland Cement
Powdered Ferrous Metal
$NaNO_2$

CONCRETE FLOOR WITH GROUND METAL AGGREGATE AT THE WEAR SURFACE

BACKGROUND OF THE INVENTION

This invention is concerned with providing flooring with a high resistance to wear, to be installed in areas of high traffic usage.

Concrete floors are the traditional flooring for most industrial plants. When a particularly hard wear surface is desired, the builder often resorts to "topping" floors to provide a hard aggregate at the surface to resist wear; it is also well known to apply dust coats of metallic aggregate to a concrete floor to harden the wear surface. The latter are often referred to as iron plated concrete floors and such are the subject matter of the instant invention.

One other reason for incorporating iron filings in a concrete floor is to provide an electrically conductive flooring. Such an application is discussed in U.S. Pat. No. 3,166,518 to Earl H. Barnard. The electrical conductivity of such a floor deteriorates over a period of time and for reasons which are unrelated to wear per se.

Comparisons between various aggregates, finishing methods and curing methods were reported in a research paper RP 1252, published in the Journal of Research of the National Bureau of Standards, Volume 23, November, 1939, entitled, "A Portable Apparatus for Determining the Relative Wear Resistance of Concrete Floors" by Louis Schuman and John Tucker, Jr. The statement, "Slab 37, coated with 0.9 lb. of metallic aggregate mixture per square foot of surface, showed the least wear of all slabs tested." appears at page 566. Because of this fact known in the art and the fact that such floors tend to deteriorate rather quickly for reasons other than wear, the problem confronting the industry is how to improve the life of concrete floors with a ground metallic aggregate at the wear surface. In other words, what can be done to retard the deterioration of iron plated concrete floors due to factors other than surface abrasion?

The deterioration problem with floors using ground metal as an aggregate stems from the rather quick corrosion of the metal. The fact of corrosion creates a problem because the wear-ability of corroded metal is much lower than that of the pure metal in its uncorroded state.

Another aspect of this problem is with white concrete floors which are becoming more important in various aspects of industry. Clearly, when corrosion starts in a white concrete floor the inherent color change will quickly dissipate the light reflectivity of the white flooring and since this in one of the prime reasons for having a white floor it quickly loses its effectiveness.

Thus, the isolated problem is to minimize the corrosion of the metallic aggregate mixture for the purpose of maintaining a longer lasting floor and in some instances a resulting floor which is "whiter" for a longer period of time.

Customarily the initial pH in a concrete substrate is approximately 12. However, over a period of time carbon dioxide from the air permeates the matrix and reduces the pH below about 9. With a pH of about 9, chlorine within the matrix accelerates corrosion and oxidation of the ferrous metallic particles embedded therein. Additionally, at a pH of about 11 there is a tendency toward corrosion of the metal but, the reason for this is not known with certainty.

It was discovered that the addition of sodium nitrite to concrete retards the corrosion of embedded iron. Thus, to minimize the corrosion of the ground metal aggregate, sodium nitrite is added to dry mixtures of cement and ferrous metal aggregate. Preferably, this dry mixture is applied as a topping to a freshly laid concrete base by the well known dusting or shaking method. No elaboration on the details of "shaking" appear necessary as such is well known in the art.

Sodium nitrite is known as a corrosion inhibitor under certain specialized conditions and has been used to inhibit the corrosion of reinforcing bars in concrete structures where a calcium chloride accelerator is used to shorten the setting time for the portland cement. An example of this is described in U.S. Pat. No. 3,210,207 to Vance H. Dodson et al. The prime function of Dodson's corrosion inhibitor is to counteract the effect of the calcium chloride accelerator. That, of course, is never a problem with a dry shake application of a cement coating as described in this invention because calcium chloride is not an ingredient.

What is not known and what is extremely important in the instant invention is that the combination of a small amount of sodium nitrite in a surface coating which is applied dry to a freshly laid concrete base will inhibit corrosion of the surface exposed metallic aggregate. This combination has been found to be effective in minimizing the pH change caused by the permeation of atmospheric carbon dioxide; thus, it is speculated that the "buffered" environment is not conducive to corrosion of the metal. However, it may be that the buffering action is not the reason for the inhibition of corrosion. The exact reasons for the results are not certain but, the observed result is inhibited corrosion.

PREFERRED EMBODIMENTS

The concrete of this invention is particularly adapted for use in industrial flooring where there is a large volume of traffic, where the load is heavy or the concrete is required to have a relatively high compressive strength. In other words, where the wearability of the surface of the floor is extremely important.

An improved floor is the result of designing an improved dry mix for shaking on a freshly laid concrete base and an improved method of applying it. The completed floor consists of a conventionally laid concrete base which is coated at its top with a layer of mixed cement and ground ferrous metal, for example, one-sixteenth to one-eighth inches thick.

The basic dry coating mix includes approximately 28 to 38 percent cement, 62 to 72 percent powdered ferrous metal and 0.01 to 0.80 percent sodium nitrite.

Cement in this case is the binder for holding the aggregate in the hardened matrix. The cement used in this invention is conventional and is usually Type I cement although it is not limited to Type I cement.

As is known to those in the industrial concrete floor covering industry, cement itself does not have a strong wearability characteristic. Cement is merely the binder. The ability of a concrete floor is resist wear is based on the aggregate itself and it is preferable to have a very dense wear surface with as much of the aggregate exposed at the surface as possible. The cement in the interstices will tend to wear away slightly which will allow the aggregate to perform its function as the wearing surface of the flooring. Experimentally it has been determined that a ratio of approximately 2:1 of metallic aggregate to cement is preferable.

The aggregate in this particular invention is powdered or ground ferrous metal. It could be any of various types of steel but it is contemplated that ground cast iron will be used.

The main problem found in the prior art with powdered ferrous metal aggregate is the resulting corrosion. Increased chlorine in the concrete is one contributor to this problem. It is known that the amount of chlorine found in the mixing of water has increased over the past few years because of a greater percentage of chlorine treated drinking water and other factors. Whether this increased chlorine content be from regular purification treatment by municipal water plants is unknown but clearly part of it comes from the increased salting of highways to melt snow and ice in the winter.

Clearly one way to minimize oxidation is to minimize the contact of the iron aggregate and oxygen and this is partially accomplished by providing a dense surface layer of the aggregate. This of course, minimizes the permeation of air.

Corrosion and oxidation takes place as carbon dioxide permeates the concrete and lowers the pH from an initial 12 to below 9. Chlorine, water and oxygen are inherently present and because the powdered metal topping is at the surface and exposed to the atmospheric carbon dioxide, it very quickly becomes subject to such corrosion. Reinforcing steel buried deep in the concrete may not be subject to such a pH change for an extended period of time.

Experimentally it has been determined that a small amount of sodium nitrite (0.01 to 0.80 percent of the dry mix) is adequate to greatly inhibit the corrosion of the ferrous metal. The reasons for the improved result are not known but the result is less corrosion over a given period of time.

As is well known, corroded or rusted metal is weaker in compression or tension than the pure metal or alloy and thus, inhibition of the corrosion factors will tend to maintain a stronger floor for use over a longer period of time. This appears to be the prime cause of failure in metal aggregate floors currently in use. First the floor is strong, then the metal corrodes and the floor begins to check and crack.

In some more recent applications such as food manufacturing plants and other such diverse industrial applications as floors for hangers to house the large Boeing 747 jet aircraft, the need for white concrete floors has been felt. White cement is used to prepare white floors for such areas for two reasons. The first is the light reflectivity of the white floor which minimizes the need for electrical power. It is conventional to have light fixtures suspended from the ceiling. As is obvious, when a hanger of the size necessary to house the Boeing 747 aircraft is involved, the light fixtures will be a substantial distance from the floor and greater numbers of bulbs of high wattage are needed. White flooring as prepared by the method of this invention produces up to 60 percent greater light reflectivity than conventional gray floors prepared from the usual gray cement.

The second reason for having the white flooring is its cleanliness. A white floor makes it easier to locate any dirt or droppings and in addition it looks cleaner.

Conventional white portland cement purchased on a commercial basis is used by this invention is preparing the white flooring necessary. In addition, white calcium aluminate or combinations of white portland cement and white calcium aluminate can serve as suitable binders to fix the powdered metal aggregate in position in a white floor.

As is well known in the art of floor making the use of white cement to make a, so called, white concrete floor does not always result in a floor that is substantially whiter than one prepared with conventional gray cement. In spite of its supposed nonstaining characteristics the white cement is really not so white as the name would imply and it rather quickly "-grays out", particularly if the aggregate used is subject to chemical reaction of any kind.

To increase the whiteness of the floor and to help it maintain its whiteness for a sustained period of time, approximately 1 to 5 percent titanium dioxide is added to the dry topping mixture when necessary. When less than 1 percent titanium dioxide is added to the mixture it does not contribute greatly to the whiteness of the floor and when more than 5 percent is added it tends to weaken the concrete excessively in compression. As a practical matter, about 2 to 3 percent titanium dioxide is added to the dry mix.

The corrosion inhibiting additive, sodium nitrite, is particularly important when powdered ferrous metal aggregate is used in the manufacture of a white floor. Clearly, rusting and corrosion of any kind will quickly destroy the light reflective characteristics of the floor. The use of sodium nitrite in the dry mix applied to the top of the concrete flooring is particularly unique in this aspect and has contributed greatly to the success of long standing white flooring.

The method of applying the cement-powdered ferrous metal aggregate to the surface of the floor is very important, particularly the proportions of material and the timing of the method steps. The area where the floor is to be laid is first prepared in the conventional manner and a mixture of conventional cement, aggregate and water is deposited on it to form a base. The base is screeded and floated in a conventional manner to provide a substantially flat surface. After floating the base is allowed to set until the bleed water disappears. At that time a mixture of the cement, powdered ferrous metal and sodium nitrite is deposited on the flat surface as a uniform layer by shaking. Such other necessary additives should be included in the dry shake mixture prior to the shaking.

"Shaking" is a well known method of applying a surface coating to a concrete substrate and no particularly detailed discussion appears necessary to describe the same. The shake method of applying is performed in a two step sequence whereby, the first shake of approximately two-thirds the desired thickness of the upper surface is applied and allowed to absorb water from the previously laid concrete base. After adequate water is absorbed it is floated. Then the second layer of approximately one-third of the total is applied by a second shake. After the second shake has absorbed water from beneath, it is floated and trowelled to the desired finish.

Clearly the two step method of applying the surface coating is very important with the white cement because the absorption of water from the gray base up through the white cement will tend to gray the surface to some extent. Applying the coating as a double layer tends to screen out some of the gray permeation from beneath.

It is equally clear that the dry mixture could be applied by a monolithic application and the usual trowelling. In such an application the dry mix is combined with water where approximately a 94 lb. bag of the dry mix is combined with 10 to 12 pints of water to prepare a smooth mixture. The plastic mixture is then trowelled onto a previously laid concrete base with the topping being about one-eighth to one-fourth inches thick.

Sometimes in the process of laying the instant topping it is preferable to use a plasticizing material in the mix to enhance its spreadability during the floating and trowelling operations. Diatomaceous earth for example, is a suitable plasticizing material and occasionally it is added to the dry mix in amounts approximately in the range 0.1 to 0.4 percent.

Similarly a dispersing agent is useful in some mixes and 0.03 to 0.10 percent calcium ligno sulphonate is often added to the dry mix.

The floor prepared by any of the above described methods of preparing the same will provide a hard upper surface with good wearability characteristics capable of withstanding long years of hard use with rolling weighted wagons and vehicles of various kinds.

THE INVENTION CLAIMED IS:

1. A dry mix for making concrete comprising, approximately 28 to 38 percent cement portland, approximately 62 to 72 percent powdered ferrous metal and approximately 0.01 to 0.80 percent sodium nitrite.

2. The dry mix of claim 1 including approximately 0.1 to 0.04 percent plasticizing material.

3. The dry mix of claim 2 wherein the cement is white cement.

4. The dry mix of claim 1 wherein the cement is white cement.

5. The dry mix of claim 2 including approximately 1 to 5 percent titanium dioxide.

6. The dry mix of claim 3 including approximately 1 to 5 percent titanium dioxide.

7. The dry mix of claim 4 including approximately 1 to 5 percent titanium dioxide.

8. The dry mix of claim 1 including approximately 0.03 to 0.10 percent calcium ligno sulphonate.

9. The dry mix of claim 2 including approximately 0.03 to 0.10 percent calcium ligno sulphonate.

10. The dry mix of claim 3 including approximately 0.03 to 0.10 percent calcium ligno sulphonate.

* * * * *