

Description

Background of the Invention:

The present invention concerns a method for rehabilitating concrete layers where a formation of carbonate has occurred, especially in connection with reinforced concrete and brick wall constructions, such as buildings, pilings, docks and supporting brick walls.

In these and also in other types of concrete constructions reinforcement steel is used in order to increase the strength. The concrete protects the steel against corrosion through the high alkalic environment that exists in the concrete. Absorption of acidic gases, mainly carbon dioxide, and in a lesser degree sulphur dioxide and sulphur trioxide from the atmosphere, leads to an acidifying of the concrete, and the alkalinity will be reduced. When the pH of the concrete has reached about 9.5 the imbedded steel is no longer protected, and corrosion starts. If at the same time chlorides are present, the corrosion starts at higher pH-values than 9.5.

This change in the concrete, that is called formation of carbonate, may lead to the fact that corrosion on the reinforcement steel creates breaking or blasting of the outer layer of the concrete. This implies a certain risk of accident, especially in connection with buildings. It will also weaken the concrete construction.

Such damages on concrete constructions are on the point of being a serious economical and technical problem. Traditional repair is based on sandblasting and/or removal of the concrete layer where formation of carbonate has occurred by cutting it away, cleaning and optionally an anti-corrosion treatment of the steel followed by casting or applying of new concrete or mortar.

There exist materials, that when they are applied to concrete surfaces contribute to reduce the rate of formation of carbonate in that the concrete's diffusion resistance against gases is increased. However, such materials cannot rehabilitate concrete where formation of carbonate has occurred.

The main object of the invention is to create a method for rehabilitating of concrete layers where formation of carbonate has occurred. A special object is to find a method that can be accomplished without extensive building works and without considerable disturbance of the activities that are going on in and near by the concrete construction that is concerned.

According to the invention rehabilitating of concrete layers where formation of carbonate has occurred is obtained in that the surface of the concrete layer that is exposed to air is coated with a gas and water tight layer and that the concrete

layer where formation of carbonate has occurred and the adjacent concrete is supplied with water during a period of re-alkalization.

By accomplishing this method for a relatively short period, preferably from two to six weeks, a satisfying rehabilitation can be obtained.

The method gives the following effects:

1. The sealing layer cuts off the access of the atmosphere to the concrete surface and thus stops further absorption of acidic gases (CO₂).
2. The sealing layer also stops the water transport through the concrete. By supplying water to the layer where formation of carbonate has occurred, via the concrete adjacent to this layer, where no significant formation of carbonate has occurred, both will in a short time be saturated with water without any water flow right through the concrete.
3. When the concrete is saturated with water alkalic materials from the inner part of the concrete where formation of carbonate has not occurred are allowed to diffuse through the rest of the concrete area. When this diffusion has reached equilibrium the pH in the part where formation of carbonate earlier had occurred is raised to a level where reinforcement steel again is protected against corrosion. By this diffusion the concrete where formation of carbonate has occurred will be re-alkalized by transferring of alkalic materials from the inner parts of the concrete.

When the re-alkalization is accomplished (recorded by sampling), the water supply can be stopped. The sealing layer on the concrete surface which is exposed to air however will be retained in order to avoid re-formation of carbonate due to carbon dioxide or the like.

Other advantageous features of the invention are mentioned in the sub-claims.

The invention will in the following be described by reference to the drawings, where

Fig. 1 schematically shows a section through a concrete construction with an outer layer where formation of carbonate has occurred.

Figs. 2 to 4 in the same way show schematically sections through different concrete constructions, where the method in accordance with the invention is shown accomplished in different ways.

In Fig. 1 is shown a horizontal plate formed concrete construction 11 which is exposed to water pressure on the upper side and which is exposed to air on the underside. Due to the penetration of carbon dioxide from the air there is on the underside created an acidic part 12 where formation of carbonate has occurred, beyond the reinforcement steel 13. Due to the water pressure a transport of water will occur through the "unspoiled" part 14 of the concrete 13 and through the part 12 where

formation of carbonate has occurred.

In Fig. 2 a gas and water tight film or coating 15 is applied to the side of the concrete construction 11 that is exposed to air. Due to the water pressure the concrete will in short time be saturated with water without evaporation or loss of water in other ways to the atmosphere.

The figure illustrates the situation that has occurred when the alkalic materials have been allowed to diffuse from the "unspoiled" concrete part 14 and into the part 12 where formation of carbonate has occurred and thus have re-alkalized this part. This means that the reinforcement steel 13 no longer is exposed to corrosion as it is surrounded by an alkalic environment. This situation can take place in tunnels, rocks, cellars and in bridges, dikes and water towers.

In Fig. 3 is illustrated an embodiment of the invention that is relevant for a concrete construction 11' that stands free, such as facades, pavings, chimneys, silos and so on. A tight film or coating 15' also in this case is applied to that side of the concrete where formation of carbonate has occurred. The concrete is humidified with water from a tube 16 on the upper side. The concrete must be supplied with water in such a way that the concrete humidity is higher than about 90% relative humidity, preferably higher than 95%. The part of the concrete where formation of carbonate has occurred is given reference Number 12', the reinforcement bar is given reference number 13' and the acidic concrete part is given the number 14'.

Fig. 4 illustrates an alternative to the embodiment in Fig. 3, where both sides of a vertical plate formed concrete construction are exposed to air and where formation of carbonate has occurred. A sealing film or coating 15'' is applied to both sides. For water supply a hole 17 is drilled in the concrete that is connected to a pipe system 18 for filtering in or injecting water. In this case a complete water saturation can be obtained in the concrete volume.

As a sealing layer or film any material can be applied that can be bonded to the concrete surface in liquid condition, and that solidifies or hardens and becomes a gas and water tight coating with sufficient adhesion to the concrete.

Especially suitable materials are thermoplastics with a low content of solvent, such as epoxies and polyurethanes. In some cases it is also possible to use bituminous mixtures and diffusion tight paints.

The supply of water to the concrete construction can be carried out in other ways than those described above. For example a terminal surface of a concrete construction that is coated on both sides with sealing films or coatings can be supplied with water, holes optionally being drilled down into the concrete.

As an alternative to the sealing films or coat-

ings plates can be used that are fastened to the concrete in a way such that loss of water content is avoided. This can be relevant in connection with architectural rehabilitation of facades. Then tight facade plates can be used and be mounted side by side, the space between the concrete and the plate optionally being filled with an adhering, filling and/or sealing substance, for example a mortar.

The water that is supplied may contain useful additive materials, for example materials that make the water alkalic, such as solutions of alkalic substances or lime, and materials that increase the penetrating ability of the water.

Claims

1. Method for rehabilitating concrete layers where formation of carbonate has occurred, especially in connection with reinforced concrete and/or brick wall constructions, such as buildings, pilings, docks and supporting brick walls characterised in that the surface of the concrete layer (12) that is exposed to air is coated with a gas and water tight layer (15) and that the concrete layer (12) where formation of carbonate has occurred and the adjacent concrete (14) is supplied with water during a period of re-alkalization.
2. Method in accordance with Claim 1, characterised in that the water supply (16) is carried out by sprinkling or injection.
3. Method in accordance with Claim 1 or Claim 2, characterised in that the water content is kept at a level of at least 90%, preferably higher than 95% relative humidity.
4. Method in accordance with any of the Claims 1 to 3, characterised in that an alkalic material is added to the water.

Revendications

1. Méthode pour la réhabilitation de couches de béton où s'est manifestée la formation de carbonate, notamment dans le cas de constructions de murs en béton et/ou brique renforcés, tels que pour des bâtiments, pilotis, bassins et murs de soutènement, la méthode étant caractérisée en ce que la surface de la couche de béton (12) qui est exposée à l'air est recouverte d'une couche (15) imperméable au gaz et à l'eau et en ce que la couche de béton (12) où s'est formé le carbonate ainsi que la partie



formation of carbonate has occurred.

In Fig. 2 a gas and water tight film or coating 15 is applied to the side of the concrete construction 11 that is exposed to air. Due to the water pressure the concrete will in short time be saturated with water without evaporation or loss of water in other ways to the atmosphere.

The figure illustrates the situation that has occurred when the alkalic materials have been allowed to diffuse from the "unspoiled" concrete part 14 and into the part 12 where formation of carbonate has occurred and thus have re-alkalized this part. This means that the reinforcement steel 13 no longer is exposed to corrosion as it is surrounded by an alkalic environment. This situation can take place in tunnels, rocks, cellars and in bridges, dikes and water towers.

In Fig. 3 is illustrated an embodiment of the invention that is relevant for a concrete construction 11' that stands free, such as facades, pavings, chimneys, silos and so on. A tight film or coating 15' also in this case is applied to that side of the concrete where formation of carbonate has occurred. The concrete is humidified with water from a tube 16 on the upper side. The concrete must be supplied with water in such a way that the concrete humidity is higher than about 90% relative humidity, preferably higher than 95%. The part of the concrete where formation of carbonate has occurred is given reference Number 12', the reinforcement bar is given reference number 13' and the acidic concrete part is given the number 14'.

Fig. 4 illustrates an alternative to the embodiment in Fig. 3, where both sides of a vertical plate formed concrete construction are exposed to air and where formation of carbonate has occurred. A sealing film or coating 15" is applied to both sides. For water supply a hole 17 is drilled in the concrete that is connected to a pipe system 18 for filtering in or injecting water. In this case a complete water saturation can be obtained in the concrete volume.

As a sealing layer or film any material can be applied that can be bonded to the concrete surface in liquid condition, and that solidifies or hardens and becomes a gas and water tight coating with sufficient adhesion to the concrete.

Especially suitable materials are thermoplastics with a low content of solvent, such as epoxies and polyurethanes. In some cases it is also possible to use bituminous mixtures and diffusion tight paints.

The supply of water to the concrete construction can be carried out in other ways than those described above. For example a terminal surface of a concrete construction that is coated on both sides with sealing films or coatings can be supplied with water, holes optionally being drilled down into the concrete.

As an alternative to the sealing films or coat-

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The water that is supplied may contain useful additive materials, for example materials that make the water alkalic, such as solutions of alkalic substances or lime, and materials that increase the penetrating ability of the water.

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2. Method in accordance with Claim 1, characterised in that the water supply (16) is carried out by sprinkling or injection.
3. Method in accordance with Claim 1 or Claim 2, characterised in that the water content is kept at a level of at least 90%, preferably higher than 95% relative humidity.
4. Method in accordance with any of the Claims 1 to 3, characterised in that an alkalic material is added to the water.

Revendications

1. Méthode pour la réhabilitation de couches de béton où s'est manifestée la formation de carbonate, notamment dans le cas de constructions de murs en béton et/ou brique renforcés, tels que pour des bâtiments, pilotis, bassins et murs de soutènement, la méthode étant caractérisée en ce que la surface de la couche de béton (12) qui est exposée à l'air est recouverte d'une couche (15) imperméable au gaz et à l'eau et en ce que la couche de béton (12) où s'est formé le carbonate ainsi que la partie

adjacente de béton (14) sont alimentées en eau pendant une période de ré-alkalinisation.

2. Méthode selon la revendication 1, caractérisée en ce que l'alimentation en eau (16) est effectuée par aspersion ou injection. 5
3. Méthode selon l'une quelconque des revendications 1 ou 2, caractérisée en ce que la teneur en eau est maintenue à un niveau d'au moins 90 %, et de préférence supérieur à 95 %, d'humidité relative. 10
4. Méthode selon l'une quelconque des revendications 1 à 3, caractérisée en ce que une matériau alcalin est ajouté à l'eau. 15

Ansprüche

1. Verfahren zum Sanieren von Beton, bei dem Karbonatbildung stattgefunden hat, insbesondere bei bewehrten Beton- und/oder Mauerwerkstrukturen, wie Gebäuden, Pfählen, Docks und tragenden Mauerwänden, dadurch gekennzeichnet, daß die der Luft ausgesetzte Oberfläche des Betons (12) mit einer gas- und wasserdichten Schicht (15) versehen wird, und daß dem Beton (12), bei dem Karbonatbildung stattgefunden hat, und dem angrenzenden Beton (14) Wasser während einer ReAlkalisierungsphase zugeführt wird. 20
2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die Wasserzuführung (16) durch Berieselung oder Injektion erfolgt. 25
3. Verfahren nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß der Wassergehalt auf wenigstens 90 %, vorzugsweise höher als 95 %, relativer Feuchtigkeit gehalten wird. 30
4. Verfahren nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß dem Wasser ein alkalisches Mittel zugesetzt wird. 45



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