ABSTRACT

A device for accelerating the setting of concrete elements wherein as well as heating the surface of the concrete, water is supplied to said surface with a view to obtaining a suitable degree of humidity in contact with said surface during setting, for which purpose a blanket is used which covers all or part of the surface of the concrete, said blanket having an internal electrical heating element, porous material linings and water conduction means which pass through the interior and supply water to the blanket which distributes the water, in liquid or vapor form, over the surface covered.

6 Claims, 7 Drawing Figures
DEVICE FOR ACCELERATING THE SETTING OF CONCRETE

The present invention refers to a process and corresponding device for accelerating the setting of concrete elements.

It is known that the reactions proper to the setting of concrete are favored by increasing, within certain limits, the temperature at which they take place. Based on this fact there are known processes and devices for accelerating the setting of concrete pieces by heating these pieces by means of electrical heating elements submerged in the concrete mass which is to set. These heating elements, when connected to an external source of energy, provide the desired temperature to the mass and accelerate its setting. Nevertheless, experience has shown that this internal heating accentuates the shrinkage phenomenon by accelerating the drying, creates a state of imbalance between the internal and surface setting, with the appearance of cracks which spoil the quality of the concrete, and with its drying action produces the natural water losses which originate close to the surface of the piece an atmosphere derived of humidity when, as is known, a good set needs excess water and a saturated atmosphere. At the same time the heating elements submerged in the concrete are lost in its interior, something which is not always of economic interest.

In order to avoid these disadvantages there were devised thereafter processes and devices for heating the surface of the concrete by means of a protective electric blanket which increased the surface temperature and, therefore, accelerated the setting. Nevertheless, this method also produces unsatisfactory results since this heating produces a quick surface drying and the water vapor produced moves away from the proximity of the surface being concreted, since the blanket cannot retain it.

This invention has been conceived to accelerate the setting of concrete pieces by maintaining throughout said setting suitable humidity conditions so that the pieces obtained may have the required quality of appearance and strength. Essentially it consists of a process for accelerating the setting of concrete members of the type consisting of the application of thermal treatment means which cover at least part of the surface of the concrete members, insulating it from the exterior, heating it electrically and maintaining it at a temperature above the ambient temperature whilst simultaneously providing water for the concrete member through the surface which is covered by said thermal treatment means.

The device used to perform the process consists, in the invention, of an electric heating blanket which comprises a metallic cloth, acting as electrical heating element, aid metallic cloth being situated between a rear covering sheet and a front covering sheet applied on the surface of the concrete member, and conduction means allowing the provision of water to the interior of the heating blanket, there being in the interior of the blanket some porous material linings occupying a substantial part of the blanket and being suitable for impregnation with water, the rear covering sheet being impermeable whilst the front covering sheet is suitable for allowing the water to pass from the interior of the blanket to the concrete member.

Preferably laminar strips of synthetic foam are used as the porous material linings. When the front covering sheet in contact with the concrete surface is impermeable, it is provided with a plurality of perforations which allow the water or water vapor retained in said porous material linings to pass to the concrete surface protected by the blanket.

In a further embodiment, the front covering sheet is water permeable and therefore it is not necessary to make holes for the passage of the water.

In one embodiment of this invention, in order to provide the blanket with the necessary handleability and ease of carriage and storage, said blanket is subdivided into a plurality of parallel sections with their electrical heating element metallic cloths connected in parallel and the water conduction means consist of at least one transverse conduit disposed over the different parallel sectors and in communication therewith.

In a further preferred embodiment of this invention, the blanket, subdivided as in the previous embodiment in several parallel sectors having their corresponding metallic cloths connected together in parallel, has the water conduction means consisting of at least one transverse conduit which, passing through the middle part of said parallel sectors and in communication therewith, crosses each of said parallel sectors in zig-zag in order to ensure a perfect distribution of the water in said porous material linings, without impairing the handleability of said heating blankets which allows for their easy carriage and storage.

For a better understanding of the scope of this invention, we now describe some illustrative but not limiting embodiments of said invention, with reference to the accompanying drawings in which:

FIG. 1 is a plan view of one embodiment of the blanket according to the invention;
FIG. 2 is an enlarged, cut-away view of part II of FIG. 1;
FIG. 3 is a cross section along the line III—III of FIG. 1 in one embodiment;
FIG. 4 is a cross section along line III—III also of FIG. 1 in a further embodiment;
FIG. 5 is a cross section along line V—V of FIG. 2;
FIG. 6 is a plan view, partly in section, of a third embodiment of the invention; and
FIG. 7 is a cross section along VII—VII of FIG. 6.

In FIG. 1, the blanket 1 is seen subdivided into a plurality of parallel sectors 2 with separating spaces 3 where the blanket 1 may be folded for storage and carriage purposes and with water conduit 4 having an inlet 5. The blanket 1 also has terminals 6 and 7 for connection to an electric power source.

The blanket itself is constituted by a stainless steel metallic cloth 8 situated between a rear covering sheet 9 and a front covering sheet 10. Both sheets are constituted basically and preferably of an electrically insulating fiber glass fabric capable of withstanding high temperatures, said fabric being given a greater consistency by being impregnated with PVC whereby it is made impermeable and direct rubbing of the glass fabric with the surfaces in contact with the blanket is avoided. The synthetic foam spongy material 11 is also situated between both sheets 9 and 10. The water conduit 4 which supplies said water to the plurality of parallel sectors 2 of the blanket 1 is limited externally
by the plastic sheet 12 also of PVC bonded to the sheet 9 in regions 13 and 14. Portion 15 of sheet 9 included between the regions 13 and 14 thus constitutes the bottom of the conduit 4 and said portion 15 has the perforations 16 which allow for the passage of the water circulating along the conduit 4 towards the interior of the blanket 1 where it is retained by the spongy material 11. This vaporized water passes through the front covering sheet 10 through the plurality of perforations 17 and comes into contact with the protected surface of the concrete.

When the front covering sheet 18 (FIG. 4) is permeable, the perforations 17 are not needed since the water vapor passes directly to the contact surface of the concrete through this sheet 18.

Some strips 19 of plastic material are bonded to the metallic cloth 8 and the sheet 10 or 18 to fix said metallic cloth 8 to the front covering sheet 10 or 18 in contact with the concrete.

FIG. 5 affords a detailed view of the shape of the conduit 4, particularly where it passes through the separation spaces 3 of the sectors 2 of this blanket.

The operation of the device is obvious. The blanket 1 is spread over the concrete surface the setting of which it is wanted to accelerate, with the covering sheet 10 or 18 in direct contact with said surface. Inlet 5 of the water conduit 4 is connected to an external water source and at the same time terminals 6 and 7 of the blanket are connected to an external electric power source. The water, which is distributed by the conduit 4 throughout all the parallel sectors 2 of the blanket, passes through the perforations 16 of the sheet 9 to the spongy area 11, comprised between the sheets 9 and 10 (or 9 and 18 in the variation) where it is retained and heated by the electrical heating element constituted by the metallic cloth 8. On being heated the water evaporates and the water vapor passes through the orifices 17 to enter in contact with the concrete surface which is setting and saturates with humidity the space comprised between the blanket and the concrete surface, placing this concrete surface in optimum setting conditions since it is surrounded by a heated, humidity saturated atmosphere.

Since the metallic cloth 8 which acts as electrical heating element for the blanket 1 has to be in contact with the water impregnated synthetic foam 11, it is preferably constituted by an 18/8 stainless steel wire cloth and the connections to the power source are of the same material. Since the temperatures to be reached are relatively low, a very high temperature impairing the setting, the voltage applied to the electric heating element of the blanket is low.

In the embodiment shown in FIG. 6, the blanket is likewise divided into several parallel sectors 2 separated by the spaces 3. The water supply conduit 4a, represented in broken lines in FIG. 6, is connected to a cock through a pipe adapted to the inlet 5a. The conduit 4a, as shown in FIG. 7, is located between the spongy material 11 and the upper covering sheet 9a. The other end 20 of this conduit 4a is plugged up and the conduit has orifices 21 along the whole of its length and around the whole of its periphery. These orifices 21 have been shown in FIG. 6 in vertical orientation, but, as may be seen in FIG. 7, they also exist on the median plane of the conduit 4a. In this way the orifices 21 distribute the water uniformly in the spongy material 11 covering the metallic cloth 8.

As has been said before, this metallic cloth 8 is made from stainless steel and thus it can withstand without rusting contact with the water or water vapor which reaches it through the spongy material 11, before said water reaches the lower sheet 10 through which it passes by way of the orifices 17.

On checking the operation of this blanket with a consumption of 300 W/m² over 12 hours, it provides about 1.2 kg water to the concrete with which it is in contact by saturating the intermediate air. Obviously these details are subject to variation according to the blanket consumption and, in the long run, to the voltage applied to its terminals according to the acceleration of the setting desired.

The use of the blanket according to the invention sensibly reduces the water losses from the concrete pieces which are setting. Multiple tests have been performed in test samples which were provided with the afore mentioned devices, that is, with electrical heating element submerged in the concrete mass, with natural setting, with dry blanket and with the blanket according to the invention. The results obtained in these tests have shown that the water losses in setting in the test samples provided with blankets according to the invention are much lower than in the other test samples, being around one-third of the water losses in the test samples with submerged wire and less than half of the water losses in the test samples with natural setting. This proves the advantages afforded by this blanket since it not only accelerates the setting by elevating the temperature surrounding the concrete piece and the temperature of the concrete itself, but it also maintains a humidity saturated atmosphere in the region immediate to the surface of the setting concrete to afford setting in optimum conditions.

What I claim is:

1. In a device to accelerate the setting of concrete members by the application of thermal treatment means consisting of an electric heating blanket having a metallic cloth acting as electrical heating element situated between a rear covering sheet and a front covering sheet applied over the surface of the concrete member, the improvement comprising, the combination therewith of conduction means allowing for the supply of water to the interior of the heating blanket, porous material linings situated inside the blanket occupying a substantial part of its extension and suitable for being impregnated with water, an impermeable rear covering sheet and a front covering sheet that is suitable for allowing the water to pass from the interior of the blanket to the concrete members.

2. Device according to claim 1 wherein the porous material linings consist of laminar bands of synthetic resin foam.

3. Device according to claim 1 wherein the front covering sheet has orifices.

4. Device according to claim 1 wherein the front covering sheet is made from water permeable material.

5. Device according to claim 1 wherein the heating blanket is subdivided into a series of parallel sectors and the water conduction means consist of at least one transverse conduit which crosses the different parallel sectors and is in communication with the porous material linings in said sectors.
6. Device according to claim 5 wherein said water conduction means are arranged following a zig-zag route allowing said conduits to cross each of said parallel sectors lengthwise in the mid portion of each of said sectors and wherein the corresponding lengthwise portions of each said conduits communicate respectively with the porous material linings in said sectors.