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[54] **PROTECTIVE SURFACES OR LINERS FOR SUBAQUEOUS STRUCTURES**

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[51] Int. Cl. A61l 13/00, C04b 31/12

[58] Field of Search 52/517; 21/61, 58; 61/54; 106/15, 98; 43/124

[56]

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[57]

ABSTRACT

A concrete slab or a tubular concrete pipe is provided with a wall surface or liner to protect the concrete member from marine-fouling organisms. The surface or liner incorporates an expanded shale aggregate, which aggregate has been impregnated with chemicals toxic to marine organisms. The toxic material will leach out very slowly over a long period to provide the desired protection. Such protective surfaces or liners are readily removable and can easily be replaced when the toxic chemicals are completely leached out.

6 Claims, 3 Drawing Figures

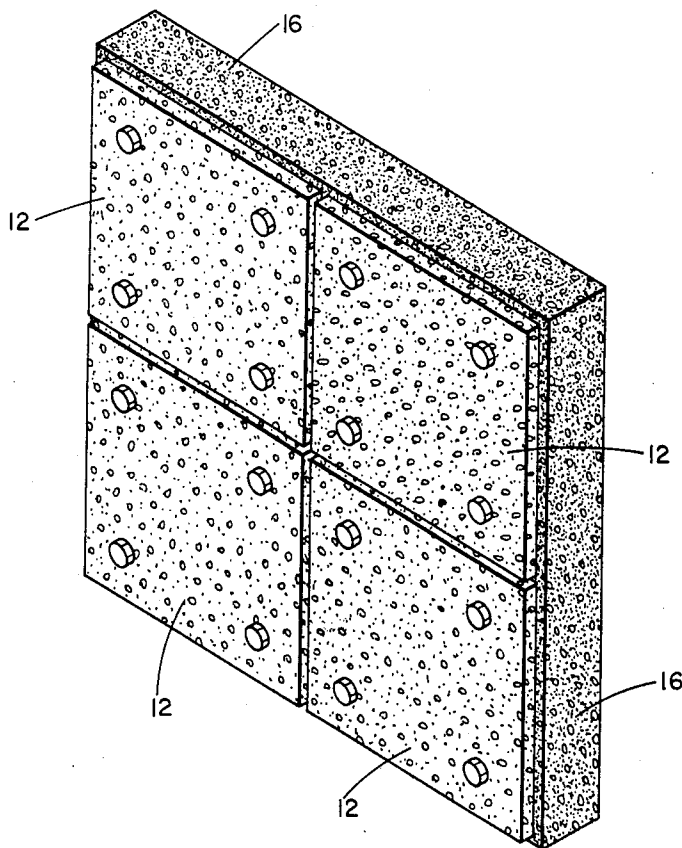


Fig. 1.

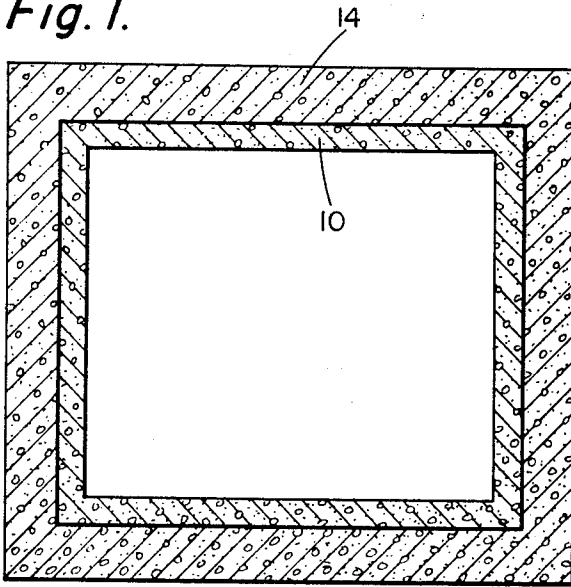


Fig. 2.

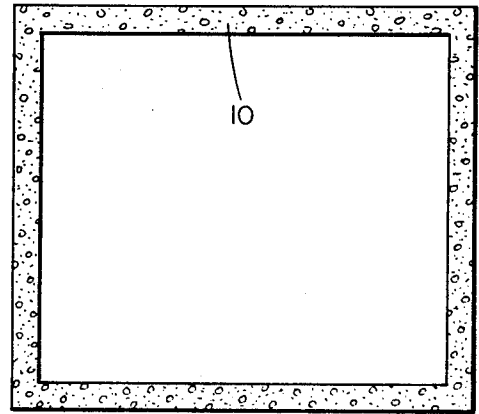
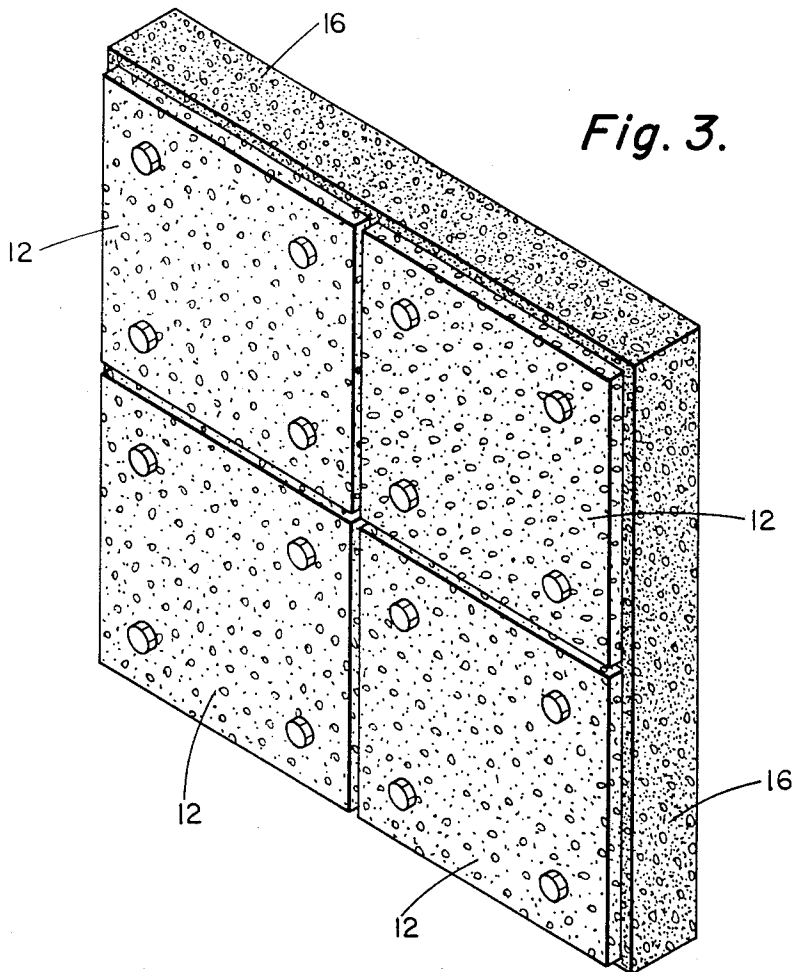


Fig. 3.



PROTECTIVE SURFACES OR LINERS FOR SUBAQUEOUS STRUCTURES

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to devices for protecting subaqueous concrete walls and concrete pipes or the like, and more particularly to antifoulant concrete slabs or liners saturated with additives detrimental to marine organisms, said slabs or liners being adapted for attachment to existing subaqueous walls or pipes.

2. Description of the Prior Art

Marine fouling on submerged concrete structures has been a major problem dating back to antiquity. There are no prior art methods which include the use of a toxic agent in the concrete paste mix employed in the construction of the submerged structures. Consequently, fouling growth is not satisfactorily checked although the concept of adding a toxic marine growth deterrent to concrete would seem to have merit.

SUMMARY OF THE INVENTION

The foregoing as well as other attendant disadvantages have been overcome in the present invention by employing antifoulant concrete slabs or liners which are attached to precleaned existing subaqueous concrete walls or to the inside of existing concrete pipes.

The concrete slabs or liners are fabricated by incorporating in the concrete mix, expanded shale aggregates impregnated with a mixture of creosote and other chemicals toxic to marine fouling organisms. Such protective slabs or liners may be readily replaced when the toxic chemicals are completely leached out.

Accordingly, an object of this invention is to provide an underwater concrete pipe or wall-like structure which is protected from fouling marine growth thereon.

Another object is to provide a concrete liner or slab which is attached to a submerged pipe or an underwater walled structure for protection against marine growth, said liner or slab having incorporated therein a porous material impregnated with a chemical solution toxic to marine growth which leaches out very slowly to inhibit marine growth.

Still another object is to provide an inexpensive liner or slab for protection of underwater structures against deleterious marine growth which is efficient and reliable in operation.

Other objects, advantages and novel features of the invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross sectional view of a removable antifouling concrete liner in position on the interior of a concrete seawater conduit or pipe.

FIG. 2 is an end view of the antifouling concrete liner independent from the seawater conduit.

FIG. 3 is a perspective view showing the removable antifouling concrete slabs attached to the surface of an underwater structure.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In preventing the fouling growth which occurs on all submerged concrete structures, the present invention comprises a precast concrete liner 10 or a slab 12

shown in FIGS. 1 and 3 respectively. Both structures incorporate an expanded shale aggregate which has been impregnated with chemicals toxic to marine organisms and are fabricated in the size and form of the submerged conduit 14 or wall 16 to which they are to be attached. They are preferably between about 1 to 2 inches in thickness. Actual attachment may be accomplished by any suitable means including a bolting arrangement or by adhesives. One of the advantages of this invention is that the protective liners 10 or slabs 12 are easily replaced when the toxic chemicals are completely leached out. Another very important part of this invention involves the use of expanded shale aggregate in the concrete. Such aggregates have a very high porosity and when impregnated with one of the preferred toxic chemicals listed below will allow said chemical to leach out at a slow and uniform rate. Prior to this disclosure, the toxic chemicals were not able to be properly incorporated into a concrete because the chemicals would either leach out too fast or too slowly or perhaps not at all.

In fabricating such liners and slabs, expanded shale aggregates $\frac{1}{4}$ to $\frac{3}{8}$ inch in diameter are impregnated with a mixture of 85 to 90 percent by weight of phenols (creosote) and 10 to 15 percent by weight of other chemicals toxic to marine fouling organisms. Such chemicals include bis(tri-n-butyltin) oxide, copper naphthenate, cupreous oxide, copper-8-quinolate, aniline green, pentachlorophenol, and copper sulfate with bis (tri-n-butyltin) oxide, aniline green and pentachlorophenol being preferred. Other toxic materials may also be employed if required.

The following examples illustrate the impregnation treatment of expanded shale aggregates with a specific chemical prior to being incorporated in the precast concrete liners or slabs.

EXAMPLE I

Mix expanded shale aggregates with creosote oil and concentrated bis(tri-n-butyltin) oxide in a container and place under 25 inches vacuum for 1 hour. Release vacuum. Repeat this procedure about two times in order to force as much toxic chemical as possible into the pores of expanded shale aggregates.

Place the chemically treated expanded shale aggregate in a filtering apparatus and remove the excess creosote oil and bis (tri-n-butyltin) oxide by a dripping.

Dip the chemically treated shale aggregates into a container filled with mineral spirits for a few seconds or wash with a spray of mineral spirits. This is to remove the oily and sticky creosote oil and bis(tri-n-butyltin) oxide solution from the surface of the shale and not from the pores.

Dry in air for a few hours.

Place in an oven and dry at a temperature of about 85° C for about 2 hours. The surface of the expanded shale should be dry and not sticky; otherwise, it will not mix with cement paste. The activated charcoal should retain over 25 percent or more of its weight in creosote oil and bis(tri-n-butyltin) oxide.

Mix a suitable quantity of expanded shale treated with toxic chemical with concrete.

EXAMPLE II

Mix expanded shale aggregate ($\frac{1}{4}$ to $\frac{3}{8}$ inch) with creosote oil (87 percent by weight), concentrated bis(tri-n-butyltin) oxide (11 percent by weight) aniline

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green (0.2 percent by weight), in a container and place under about 23 inches vacuum for about 30 minutes. Release vacuum. Repeat this procedure three times in order to force as much toxic chemical as possible into the pores of the aggregate. Leave the saturated aggregates in the chemical solution for about 6 hours.

Place the chemically treated expanded shale aggregate in a filtering apparatus and remove the excess chemical by dripping.

Dip the chemically treated expanded shale aggregate into a container filed with mineral spirits for a few seconds or wash with a spray of mineral spirits. This is to remove the mixture of oily and sticky creosote oil, bis-(tri-n-butyltin) oxide, analine green, and pentachlorophenol from the surface of the aggregate.

Dry in air for about 1 hour. The expanded shale aggregate should retain about 30 percent of its weight in chemical solution.

The mix ratio between cement and aggregate is one part cement to one part dry, untreated expanded shale aggregate (determine dry weight before the aggregate is impregnated with a chemical solution), and the water cement ratio is 0.45.

The concrete liner 10 and slabs 12 prepared by the method of Examples I and II were successful in resisting marine growth due to the controlled release or leaching of toxic chemical from the porous product incorporated within the concrete. In addition, the concrete liners and slabs prepared by both Examples were each compared to control concrete liner and slab samples prepared in identical fashion except that the toxic agent was omitted from the control. The controls had severe fouling marine growth accumulate thereon over an extended period of time but both of the concretes in Examples I and II were free of marine growth for the same period of time.

Once such concrete liner or slab is in position, no scraping or other treatment is necessary to remove fouling growth since the chemical leaching in a controlled manner from the impregnated expanded shale aggregates prevents fouling accumulation on the concrete.

Obviously, many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

I claim:

1. A subaqueous structure adapted to resist fouling marine growth thereon comprising:
 - a concrete surface member positioned on said subaqueous structure in protective fashion, said surface member being about 1 to 2 inches in thickness, designed to conform to the shape of said subaqueous structure, and attached thereto by a bolting arrangement;
 - said concrete surface member being fabricated of a

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concrete with high porosity expanded shale aggregate incorporated therein, the ratio being one part cement to one part dry expanded shale aggregate and water to cement ratio being 0.45, said shale being impregnated with a mixture including about 85 to 90 percent by weight of creosote and about 10 to 15 percent by weight of a chemical toxic to marine growth which leaches out of said shale at a slow rate thus deterring marine growth on said subaqueous structure.

2. The subaqueous structure as defined in claim 1 wherein the chemical is selected from the group consisting of bis-(tri-n-butyltin) oxide, copper naphthenate, cupreous oxide, copper-8-quinolate, pentachlorophenol, copper sulfate, and aniline green.

3. The subaqueous structure as defined in claim 1 wherein the creosote comprises 89 percent by weight of the mixture and the chemical comprises 11 percent by weight of bis-(tri-n-butyltin) oxide, 1 percent by weight pentachlorophenol and 0.2 percent by weight aniline green.

4. The subaqueous structure as defined in claim 2 wherein the high porosity expanded shale aggregates are between $\frac{1}{4}$ to $\frac{3}{8}$ inch in diameter.

5. A concrete member for attachment to an underwater pipe in order to prevent fouling marine growth from accumulating thereon comprising:

a concrete liner being about 1 to 2 inches in thickness and shaped to conform to the configuration of the pipe to which said liner is attached;

said concrete liner characterized by having incorporated therein a high porosity expanded shale aggregate with said aggregates being between $\frac{1}{4}$ to $\frac{3}{8}$ inch in diameter and saturated with a mixture of creosote oil and other chemicals toxic to fouling marine growth, said chemicals selected from the group consisting of bis-(tri-n-butyltin) oxide, pentachlorophenol, and analine green.

6. A concrete member for attachment to an underwater wall in order to prevent fouling marine growth from accumulating thereon comprising:

a concrete slab being about 1 to 2 inches in thickness and shaped to conform to the configuration of the wall to which said slab is attached;

said concrete slab characterized by having incorporated therein a high porosity expanded shale aggregate with said aggregates being between $\frac{1}{4}$ to $\frac{3}{8}$ inch in diameter and impregnated with a mixture of creosote oil and other chemicals toxic to fouling marine growth, said chemicals selected from the group consisting of bis-(tri-n-butyltin) oxide, pentachlorophenol and analine green, said creosote being present in the mixture by about 85 to 90 percent by weight and the toxic chemicals being present in the mixture by about 10 to 15 percent by weight.

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