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(54) Title: A FLOATING COVER SYSTEM FOR A BODY OF LIQUID

(57) Abstract: A cover system (10) for a body of liquid (11) comprising a plurality of floatable units (12), each unit (12) dimensioned to cover at least a portion of the body of liquid and able to move freely relative to one or more like units (12). The plurality of floatable units (12) are able to self-arrange to form a substantially uniform cover over at least a portion of the body of liquid (11).
A FLOATING COVER SYSTEM FOR A BODY OF LIQUID

Field of the Invention
The present invention relates to a floating cover system for a body of a liquid. The floating cover system may be adapted for use either to reduce evaporation or encourage evaporation.

The present application claims priority from Australian Provisional Patent application number 2004902384 filed on 6 May 2004 and Australian Provisional Patent application number 2004905033 filed on 3 September 2004.

Background Art
It is not uncommon for 25 to 60% of the water collected in dams in rural areas of Australia to be lost to evaporation caused by the sun or wind or the combination of the two each year. With long summer periods during which no rainfall occurs, after the water has been evaporated from the dams, fresh water for livestock and farm personnel must be transported to these remote rural areas at great expense.

For other industries, evaporation is encouraged. For example, salt producers typically use a series of evaporation ponds as a first step in a process for recovering salt from seawater. The seawater flows through the series of evaporation ponds and is allowed to evaporate naturally due to the action of the sun and wind. The salt concentration of the water progressively increases, forming a brine. When this brine is saturated with salt, it is pumped into crystallisation ponds where further evaporation causes crystals of the salt to form.

Several ways of reducing evaporation from a body of liquid have been proposed. Backyard swimming pools are routinely provided with covers or "pool blankets" which are formed from a single continuous layer of an insulating material
sized to cover the full surface area of the pool. Such pool blankets are often cumbersome to maneuver and are made of thin plastic material that is prone to tearing during installation or removal of the blanket. Such prior art pool blankets are ill-adapted for use for large bodies of liquid.

US Patent 5,861,095 and US5,400,549 each describe a system for covering sewage lagoons using a series of large rectangular insulated panels connected to each other by a complex arrangement of grommets and weighted cables. The insulated panels are used to retain the heat generated during degradation of organic material within the sewerage lagoon.

US 6,673,241 describes the use of a flexible, foldable cover system also particularly suited for sewage lagoons to reduce emission of offensive odours and gases. The cover system is made up of a series of separate foldable cover strips that are connected together using welding or sewing to match the size of the lagoon. Each strip has a complex arrangement of layers of materials designed to impart buoyancy and strength to the strips such that the strips are able to support the growth of an aerobic biomass on the upper surface of the strips in use. The flexible strips described in US 6,673,241 must be fixedly attached to each other to prevent the strips from folding over themselves in use in high winds.

For each of these prior art cover systems, considerable time is required to connect the units together when installing the cover or to disconnect the units to remove the cover to, for example, conduct a dredging operation on the sewerage lagoon.

The present invention was developed to provide an alternative to existing floating cover systems for bodies of
liquid for use in either encouraging or discouraging evaporation.

It will be clearly understood that, although prior art use and publications are referred to herein, this reference does not constitute an admission that any of these form a part of the common general knowledge in the art, in Australia or in any other country.

In the statement of invention, the claims and the description of the invention which follow, except where the context requires otherwise due to express language or necessary implication, the word "comprise" or variations such as "comprises" or "comprising" is used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the invention.

Summary of the Invention

According to one aspect of the present invention there is provided a cover system for a body of liquid comprising:

- a plurality of floatable units, each unit dimensioned to cover at least a portion of the body and able to move relative to one or more like units so as to self-arrange to form a substantially uniform cover over at least a portion of the body of liquid.

Each floatable unit may have a variable buoyancy. Each unit has an upper surface and lower surface and the upper and/or lower surfaces may be planar to reduce the likelihood of the units being displaced from the surface of the body of liquid due to the effects of cross-winds.

When it is desired to only cover a portion of the body of liquid, the cover system may further comprise a barrier which delineates a first area of the body of liquid to be covered from a second area of the body of liquid to remain
uncovered. In one embodiment, the barrier is continuous and forms a containment means within which the plurality of floating units is confined.

Each unit has a footprint in plan view and the footprint of each of the plurality of floatable units may be the same or the cover system may comprise units having different shapes. It is considered advantageous for the footprint to be polygonal to assist the units in self-arranging to form a substantially continuous cover. Various shapes may be used in that the polygonal footprint may be in the shape of a triangle, a square, a rectangle, a pentagon, a hexagon, a heptagon, an octagon, a parallelogram, or a rhombus. One preferred shape of the footprint is that of an equilateral triangle as this shape tessellates particularly well and is also easy to construct.

To facilitate sliding of adjacent units relative to each other, each unit may be delimited by a planar perimetal edge which reduces frictional resistance to movement of one unit relative to an adjacent unit and/or the boundaries of the body of liquid.

When the cover system is used to encourage evaporation, each unit may further comprise a plate supported by a flotation aid. Advantageously, the flotation aid may be hollow and is arranged to receive the quantity of buoyancy imparting material such that the buoyancy of the unit is adjustable. For this embodiment, the hollow flotation aid may have a transverse cross-section in the shape of a circle, rectangle square, oval or other polygonal shape.

In one embodiment, the floatation aid forms a frame for each unit such that the plate is arranged within and is delimited by the frame. The plate may equally extend beyond the floatation aid or frame.
Each unit may be constructed from a material selected from the group comprising at least; foam, acetal, nylon 11, nylon 12, acrylic-styrene-acrylonitrile alloys, polyphenylene sulfide, polypropylene, ethylene vinyl acetate, polybutylene terephthalate, polyethylene terephthalate, polyphthalamide, polystyrene, polyvinyl chloride, vacuum plated cardboard, plastic coated wood, cork, silicone coated cardboard, kapok, or polyethylene. It is advantageous for the units to be constructed from a semi-crystalline polymer as static electricity builds up in use causing the units to become temporarily and reversibly attached to each other which assists both in holding the cover system together and in removing the units if desired.

The flotation aid has a base and the plate may be positioned at the base of the flotation aid, at a height intermediate to the thickness of the flotation aid or midway relative to the thickness of the flotation aid.

The plate may include one or more holes to allow the passage of fluid from an upper surface of the plate to a lower surface of the plate which regulates a pool of water that accumulates on the plate and flushes debris from the upper surface of the plate. The holes may be randomly or uniformly distributed across the plate.

When used to encourage evaporation, the cover system may further comprise a heat absorbing layer which in one embodiment is arranged on an upper surface of the plate for heating a pool of liquid on the upper surface of the plate.

According to another aspect of the present invention there is provided a floatable unit for use in a cover system as described above.

According to yet another aspect of the present invention there is provided a method for reducing evaporation of a body.
of liquid comprising the steps of:

forming a substantially uniform cover over at least a portion of the body of liquid by floating a plurality of self-arranging floatable units on the body of liquid, each unit dimensioned to cover at least a portion of the body and able to move relative to one or more like units.

When it is desired to only cover one area of a body of liquid the method may further comprise the step installing a barrier which delineates a first area of the body of liquid to be covered from a second area of the body of liquid to remain uncovered. The barrier may extend across the body of liquid or be continuous so as to form a containment means within which the plurality of floating units is confined. The containment means can be positioned at any location on the surface of the body of liquid and can be moved to a new location if desired. If the containment means is moved in this way, the units are free to move with it.

According to yet another aspect of the present invention there is provided a method for encouraging evaporation of a body of liquid comprising the steps of:

forming a substantially uniform cover over at least a portion of the body of liquid by floating a plurality of self-arranging floatable units on the body of liquid, each unit dimensioned to cover at least a portion of the body and able to move relative to one or more like units, each unit further comprising a plate supported by a flotation aid.

When the flotation aid is hollow and arranged to receive the quantity of buoyancy imparting material, the method may further comprise the step of adjusting the buoyancy of the unit by adjusting the quantity of the buoyancy imparting material in the hollow flotation aid.
Brief Description of the Drawings

The embodiments of the present invention will now the described, by way of example only, with reference to the accompanying drawings, in which:

5 Figure 1 is an isometric view of an embodiment of a floatable unit with a polygonal footprint in the shape of an equilateral triangle for use in reducing evaporation of a body of liquid in accordance with a first aspect of the present invention;

10 Figure 2 is a plan view of the unit of Figure 1 showing the location of cross-section A-A;

Figure 3 is a cross-sectional representation through section A-A of the unit illustrated in Figure 2 showing a side view of the unit when in a body of liquid;

15 Figure 4 illustrates a plurality of the units of Figure 1 tessellating with respect to each other and placed within a containment means;

Figure 5 illustrates in plan view various alternative polygonal footprints for the units;

20 Figure 6 illustrates a plurality of diamond-shaped units tessellating with respect to each other and placed within a barrier in a dam;

Figure 7 is an isometric view of an alternative embodiment of a floatable unit used to reduce evaporation in accordance with the first aspect of the present invention, the unit having a polygonal footprint in the shape of an equilateral triangle with truncated corners adapted to allow additional light to pass through;

25 Figure 8 Figure 2 is a plan view of the unit of Figure 7;

30 Figure 9 illustrates a plurality of the units of Figure 7 tessellating with respect to each other and placed within a containment means;

35 Figure 10 is an isometric view of one embodiment of a floatable unit in the shape of an equilateral triangle for use in encouraging evaporation in accordance with a second aspect of the present invention;
Figure 11 is a plan view of the floatable unit of Figure 10 illustrating the location of cross-section B-B; Figure 12 is a cross-sectional representation through section B-B of Figure 11 showing the height of the plate relative to the thickness of the floatable unit with the unit placed in a body of liquid; Figure 13 illustrates a plurality of the floatable units of Figure 12 tessellating with respect to each other when placed into a body of liquid; Figure 14 is an isometric view of an alternative embodiment of one of the floatable units used to encourage evaporation with a plan view in the shape of a hexagon; Figure 15 is a plan view of the floatable unit of Figure 14 illustrating the location of cross-section C-C; Figure 16 is a cross-sectional representation through section C-C of Figure 15 showing a plate positioned at the base of the floatable unit; and, Figure 17 illustrates a plurality of the floatable units tessellating with respect to each other when placed into a body of water.

Description of the Embodiments
Before illustrative embodiments of the various aspects of the present invention are described, it is to be understood that the invention is not limited to the particular types of materials or shape of floating units described and illustrated. The terminology used herein is for the purpose of describing particular embodiments only, and is not intended to limit the scope of the present invention. Unless defined otherwise, all technical and scientific terms used herein have the same meanings as commonly understood by one of ordinary skill in the art to which this invention belongs. Although other types of materials and other shapes of floatable units to those described herein can be used to practice or test the various aspects of the present invention, various embodiments are now described with reference to the drawings.
The cover system of the present invention may equally be used for various bodies of liquid, including, but not limited to, ponds, lakes, dams, tailing dams, evaporation ponds, thickeners, swimming pools, fisheries, aquaculture tanks, caustic dams, and the like.

Embodiments related to a first aspect of the present invention are now described in detail in the context of reducing evaporation from a dam in a rural environment. Embodiments related to a second aspect of the invention in the context of a cover system used to encourage evaporation of a salt pond used as one stage in the production of salt are then described.

A first embodiment of the cover system is illustrated in Figures 1 to 4 for use in reducing evaporation from a body of liquid such as a dam. The cover system 10 comprises a plurality of substantially planar floatable units 12, each unit dimensioned to cover a portion of the body of liquid 11, in this case dam water. Each unit 12 is able to move independently relative to one or more like units. By allowing each unit to move independently of the other units, the units naturally self-arrange through contact with one of more like units, through contact with a boundary surface such as the bank of the dam, through the influence of wave, or the influence of Brownian motion, to form a substantially uniform cover over the body of liquid 11.

Each unit 12 is substantially rigid. The word "rigid" does not imply that the floatable units are completely inflexible or unable to be bent at all, but rather that each of the floatable units is capable of maintaining its own shape during contact with one or more like units as the units self-arrange to form the cover system. One of the advantages of making the floatable units substantially rigid is that the units 12 are able to be stacked on top of each other for easy transport, handling and storage when not in use. Because
each unit 12 is able to move independently of other units, the cover system 10 as a whole remains flexible and thus able to move and flex in response to wave motion. The gaps between units 12 effectively act as flexible joints allowing the cover system 10 as a whole to remain flexible.

Each of the units 12 has a polygonal footprint in plan view. In this example, the polygonal footprint of the units 12 is in the shape of an equilateral triangle and this shape is one that tessellates particularly well.

Examples of units 12 of various polygonal footprints (i.e. other shapes in plan view) are illustrated in Figure 5 showing pentagonal, rhombohedral, parallelogram and square shaped units 12. The units could equally have a rectangular, octagonal or isosceles triangle shaped footprint, provided only each unit is able to self-arrange relative to one or more like units. For best results, the shape of the units should be one that tessellates. If the shape includes arcuate portions such that the units cannot tessellate, the cover formed will, as a result, include gaps. Such gaps can however be advantageous if it is desirable to allow light through the cover system 10.

It is not essential that all of the units 12 in a given cover system 10 to have the same polygonal footprint. The cover system 10 works equally well with, for example a mixture of triangular shaped units and rectangular shaped units. However, it has been found that when each of the plurality of floatable units has the same polygonal footprint, the units tessellate better forming a more continuous cover system.

When the units 12 are used for reducing evaporation, each unit is substantially planar in that the upper and lower surfaces 28 and 29, respectively of each unit 12 are substantially flat in that each of the upper and lower surfaces occur substantially a single plane. Having a flat upper surface 28 reduces the likelihood of the units 12
lifting off from the surface of the water in the event of high winds blowing across the dam. Optionally or additionally, each unit has a lower surface 29 that is substantially flat to reduce the tendency for the units to lift off by increasing the suction effect between each unit 12 and the body of liquid 11. Without wishing to be bound by theory, if the upper surface 28 was, for example, raised and curved, an aerofoil-type effect would be experienced, creating a low pressure region on the downwind side of the raised area, encouraging the unit to lift off from the water. Having a flat lower surface 29 has been found to encourage a suction effect between each unit 12 and the water further increasing the force needed to be applied to lift each unit 12 from the water. In trials of a prototype of the cover system conducted on a remote rural property in Western Australia, winds in the range of 60 to 100 km per hour did not result in any of the substantially planar units lifting off from the surface of a dam.

A further advantage has been found in ensuring that the perimetal edges 17 of each unit 12 are substantially planar and thus at right angles with the upper and lower surfaces 28 and 29, respectively. Forming the perimetal edges 17 in this way facilitates sliding contact of adjacent units 12 relative to each other which assists them to self-arrange to form the substantially continuous cover. When adjacent units 12 are in abutting contact, the planar perimetal edges 17 become flush with each other, maximising the contact area between these edges 17. Advantageously, maximising the contact area between these edges 17 increases the level of static electricity generated through sliding contact causing adjacent units 12 to become temporarily bonded to each other.

In trials, the units 12 were manufactured using polystyrene, a semi-crystalline polymer that generates and stores a high level of static electricity during sliding contact. It was observed during trials that the polystyrene units became
attracted to each other over time due to a build up in static electricity. When a pulling force was exerted on one of the units 12 adjacent to the bank of the dam 11, it was possible to pull a large number of other units 12 forming the cover system at the same time. This temporary bond between units was observed to break apart spontaneously during a rain storm, further indicating that static electricity was responsible for the apparent temporary bonding between adjacent polystyrene units in use.

Other materials may equally be used in the manufacture of the units, including but not limited to: foam, acetal, nylon 11, nylon 12, acrylic-styrene-acrylonitrile alloys, polyphenylene sulfide, polypropylene, ethylene vinyl acetate, polybutylene terephthalate, polyethylene terephthalate, polyphthalamide, polystyrene, polyvinyl chloride, vacuum plated cardboard, plastic coated wood, cork, silicone coated cardboard, kapok, or polyethylene and/or combinations of these material. For longevity, the material should also be UV stable so as to minimise degradation of the material by the sun. Additives may be included to a material to improve its UV stability.

It is advantageous for some applications that the material selected act as an insulator to keep the water temperature below the cover system to a minimum. The thickness of the units 12 may be varied to control the level of insulation provided - the thicker the units, the greater the level of insulation and the lower the temperature of the liquid being covered. When used to reduce evaporation, it is advantageous for the material to be substantially white in colour to reduce absorbance of UV radiation as this absorbed heat will then radiate back out of the units 12 and may increase the temperature of the body of liquid contributing to an increase in evaporation.

The choice of material may also be influenced by the type of liquid being covered. For example, if caustic is present in
the body of liquid 11, the material of construction of the units 12 should be selected to resist corrosive attack from caustic. In this regard in some applications, consideration should be given to the effect of a breakdown of the material of construction to ensure that this does not lead to contamination of the body of liquid.

It is not necessary for the cover system 10 to form a cover over the full surface of the body of liquid 11. Advantageously, the cover system 10 may include a barrier 40 used to delineate between a first area to be covered 13 and a second area to remain uncovered 15. The cover system 10 may equally be used to cover the full surface area of the dam 11 if desired. By covering only the first area 13 of the body of liquid 11, a temperature differential develops between the first and second areas 13 and 15, respectively resulting in the generation of an artificial current between the two areas of differing temperature. This circulation of water improves the quality of the water in the dam by reducing stagnation.

Evaporation is reduced in proportion to the relative sizes of the first and second areas, 13 and 15, respectively relative to the total surface area of the dam 11. The cover system 10 reduces the exposure of the surface of the dam to the effects of the sun and wind as well as due to the reduction in the temperature of the water. Covering the surface of the dam 11 in this way also reduces harmful production of blue-green algae. The amount of light that is allowed to enter the dam to sustain marine life is controllable by adjusting the relative sizes of the first and second areas 13 and 15, respectively.

In one embodiment, the barrier 40 extends across the dam 11, effectively dividing the dam 11 into the first and second areas 13 and 15, respectively as illustrated in Figure 4. In use, the units 12 are added to the first area 13. As more and more units 12 are added to the first area 13, the units
12 start to bunch up against the barrier 40 and self-arrange to form a substantially continuous cover in the first area 13. The quantity the units 12 required to form the cover system 10 depends on the size and shape of the first area 13.

In another embodiment illustrated in Figure 9, the barrier 40 is continuous so as to form a containment means 42 which can be located at any position within the boundaries of a body of liquid 11. In this embodiment, the first area 13 is delineated by the containment means 42.

When each unit 12 is placed into and floats on the body of liquid 11, a first portion 16 of each unit 12 will be positioned above the water line 20 and a second portion 18 of each unit 12 will be below the water line 20. The relative sizes of the first and second portions 16 and 18 respectively is a function of the buoyancy of each unit 12 compared with the relative density of the body of liquid 11. The units 12 may be manufactured using a material having a particular buoyancy given the specific gravity of the body of liquid to be covered or the natural buoyancy of the material can be altered by using additives during production such as sand to increase the weight of the material. When the liquid is water, the specific gravity of the body of liquid 11 is in the order of 1.0. Thus for water, the buoyancy of the unit would need to be at least less than 1.0 for the unit 12 to float.

It is anticipated that the water level of a dam 11 will vary during the year in response to rainfall evaporation, active drainage of the dam or any other cause of a change in water level. If the water level of the dam decreases, any floatable units 12 adjacent to the banks of the dam end up resting on the banks of the dam 11. Advantageously, these units 12 automatically refloat and reposition themselves in the event that the water level of the dam 11 subsequently increases. Similarly, if the water level increases, the
units 12 that have already been placed in the dam 11 reposition themselves to maintain coverage over substantially the full surface of the dam due to the ability of each unit 12 to move independently of like units. Additional units 12 may be added to the dam 11 in response to an increase in water level. If the water level increases, such additional units 12 will reposition themselves with the units 12 that make up the existing cover system 10.

An alternative embodiment of the units 12 used to form the cover system 10 is illustrated in Figures 7 to 9 for which like reference numerals refer to like parts. In this embodiment, the shape of each unit 12 has been adjusted by cropping each of the three points 50 of the equilateral triangular shape of the units of Figure 1. This is done so that when the units 12 self-arrange to form a substantially continuous cover, small uncovered areas 52 are formed as best seen in Figure 7 to allow additional light to enter the body of water. The size of these uncovered areas 52 can be adjusted by increasing or decreasing the degree to which the points of the polygonal footprint are truncated.

A first embodiment of a second aspect of the present invention in the context of encouraging evaporation is illustrated in Figures 10 to 13 with like reference numerals referring to like parts. With reference to Figure 10, the cover system 10 comprises a plurality of floatable units 12, each unit 12 dimensioned to cover at least a portion of the body of liquid 11 and able to move freely relative to one or more like units 12. By allowing each unit 12 to move independently of the other units 12, it has been found that the units 12 naturally self-arrange through contact with one or more like units 12 in the manner described above in relation to the first aspect of the present invention.

In the embodiment illustrated in Figures 10 to 13, each unit 12 is shaped so as to tessellate with one or more like units
12 and has a footprint in the shape of an equilateral triangle. In an alternative embodiment illustrated in Figures 13 to 17, each unit 12 have a hexagonal footprint with six sides of equal length. Other footprints are equally applicable as described above in relation to the first aspect of the present invention.

In the embodiments used for the second aspect of the present invention, each unit 12 further comprises a plate 26 supported by a flotation aid in the form of a frame 22 which is preferably hollow. The hollow frame 22 is arranged to receive a quantity of buoyancy imparting material within it such that the buoyancy of the unit 12 is adjustable. This allows for the relative sizes of the first portion 16 and second portion 18 to be adjustable by adjusting the effective buoyancy of each unit 12. It is to be understood that the frame 22 need not be hollow provided only that the buoyancy of each floatable unit 12 is sufficient to allow the unit 12 to float on the body of liquid 11.

In the embodiment illustrated in Figures 10 to 13, the hollow frame 22 has a circular cross-section similar to a tube or pipe. In an alternative embodiment illustrated in Figures 14 to 17, the hollow frame 22 has a square cross-section, as best seen in Figure 16. Other shapes for the cross-section of the hollow frame 22 are equally applicable in that the frame may have a transverse cross-section in the shape of an oval, a rectangle, a hexagon, or any other polygonal shape.

The plate 26 has an upper surface 28 and a lower surface 29. In each of the illustrated embodiments, the plate is supported and delimited by the frame 22. In this way, the frame 22 serves the function of a flotation aid for the plate 26. The plate 26 may equally extend outwardly beyond the hollow frame 22 and need not be planar. The overall buoyancy of each unit 12 may be adjusted in the manner
described above to adjust the position of the plate 26 relative to the water line 20 so as to control the size of a pool of liquid 30 that accumulates on the upper surface 28 of the plate 26.

The plate 26 is further provided with one or more holes 32 that serve the function of regulating the size of the pool of liquid 30 that forms on the upper surface 28 of the plate 26. The holes 32 allow for flushing of any solids that would otherwise accumulate on the upper surface 28 of the plate 26 such as salt, algae or other debris. The holes 32 also allow each of the floatable units 12 to remain buoyant even after, for example, rainfall. The rainwater drains through the holes 32 in the plate 26 of each unit 12 as well as through gaps between units 12. The holes 32 are evenly distributed across the plate 26 of each unit 12, but may equally be arranged in a random distribution.

With reference to Figure 12, the plate 26 may be positioned midway relative to the thickness D of the floatable unit 12. The plate 26 may equally position at any height intermediate to the thickness D of the units 12 depending on the particular application of the cover system 10. In an alternative embodiment of the second aspect of the present invention illustrated in Figures 14 to 17, the plate 26 is positioned at the base 34 of each hexagonally-shaped floatable unit 12. The advantage of positioning the plate midway relative to the thickness D of the floatable unit 12 is that each unit 12 may be thrown or otherwise tossed into the body of liquid 11 without regard to the position of the plate 26.

The buoyancy of the units 12 may be set to account for the maximum anticipated weight of salt or other debris that is expected to accumulate on the upper surface 28 of the plate 26 to ensure that the plate 26 remains below the water line 20. The pool of liquid 30 is exposed directly to sunlight
and wind and evaporates preferentially. The holes 32 ensure that the pool 30 is continuously replenished with liquid and allow for debris to be flushed from the plate 32. The pool 30 also serves the function of anchoring the units 12 to the body of liquid 11 to assist in preventing the units 12 from being blown off the body of liquid 11 by wind.

The use of the cover system in encouraging evaporation of a salt water pond as one step in the production of salt will now be described with reference to the embodiment illustrated in Figures 14 to 17. As described above in relation to the first aspect of the present invention, the total surface of the salt water pond 11 may be covered or a barrier 40 may be used to delineate between the first area to be covered 13 and the second area 15 which remains uncovered.

In use, a plurality of units 12 is placed into the salt water pond and the units 12 are able to move freely relative to one or more like units 12 to form the cover system 10. Sufficient units 12 are placed into the pond to form a substantially continuous cover with the units 12 self-arranging to suit the size and shape of the pond 11.

In the embodiment illustrated in Figures 14 to 17, the plate 26 is positioned at the base 34 of the unit 12 and each unit 12 is placed into the pond with the plate facing the surface of the water. The buoyancy of each unit 12 is set such that the plate 26 rests below the water line 20. A pool of water 30 forms on the upper surface 28 of the plate 26 and the size of the pool of water 30 remains substantially constant due to the presence of the plurality of holes 32 in each plate 26. To further encourage evaporation, the upper surface 28 of the plate 26 may be provided with a heat absorbing layer 40 in the form of, for example, a layer of black paint, black plastic or other suitable heat absorbing material. The heat absorbing layer 40 encourages heat to be
absorbed so as to heat the pool of liquid 30 with a view to accelerating evaporation or, in the best case scenario, boiling of the water.

As the water evaporates, salt is left behind on the upper surface 28 of each plate 26. As more water enters the pool 30 to replace the water that has been lost to evaporation, the salt is flushed out of the pool 30 through the holes 32. In this way, evaporation of the salt pond 11 is encouraged. As the level of salty water in the salt pond 11 goes down, the units 12 arranged around the perimeter of the salt pond 11 will end up resting on the sides of the pond and the remaining units will continue to self-arrange to maintain coverage of the pond. When the water level has dropped sufficiently and/or time comes to drain the contents of the salt pond 11, the units 12 can be removed and stacked ready for subsequent use. Alternatively, the units 12 can be left in place in the pond while the contents are drained, with ‘fresh’ salt water added to the pond for a subsequent evaporation cycle. When this fresh salt water is added, the cover system 10 will re-establish itself as the units 12 re-float. The units 12 may equally be floated from one salt pond to an adjacent salt pond.

Experimental Data
In trials three test ponds were set up:
   a) Pond A which was left uncovered as a control pond;
   b) Pond B which was completely covered with planar while units of the type illustrated in Figures 1 to 4 for reducing evaporation; and,
   c) Pond C which was completely covered with black units of the type illustrated in Figures 10 to 13 for encouraging evaporation.

Each pond was 2.5m by 2.5m square and 21 cm deep. The water level and temperatures of water (below the units) were
monitored over a period of six weeks.

At the end of four weeks, Pond C was empty, Pond B was 95% full and the open pond had four centimetres of water still left in it.

It was observed during the testing that the temperature of the water under the units in Ponds B and C was consistently 3.5 to 9 degrees cooler than the water temperature of Pond A. It was further observed that the evaporation rate of Pond C was higher when ambient temperature was higher.

The present invention has a number of advantages over the prior art, including:

(a) the self-arranging characteristic of the units avoids the need to connect the units to each other at the time of installation and avoids the need to disconnect the units when the time comes to remove the cover system providing a significant saving in time and energy;

(b) the units block sunlight from the surface of the water, thereby decreasing the amount of algae that grows on the surface of the water;

(b) the units provide insulation from ambient air temperature to maintain a greater temperature in the body of covered water year round;

(c) if one area of the body of water is covered, this area will remain warmer than the remainder, generating artificial currents to increase circulation of the water in the body of liquid; and,

(d) evaporation is reduced as a result of the reduced effects of wind blowing across the surface of the body of the water.

Now that various embodiments of the present invention has been described in detail, it will be apparent to those skilled in the relevant arts that numerous modifications and variations may be made without departing from the basic
inventive concepts. All such modifications and variations are deemed to be within the scope of the present invention the nature of which is to be determined from the above description.
THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A cover system for a body of liquid comprising:
   a plurality of floatable units, each unit dimensioned
to cover at least a portion of the body and able to move
relative to one or more like units so as to self-arrange to
form a substantially uniform cover over at least a portion
of the body of liquid.

10 2. A cover system according to claim 1, wherein each
floatable unit has a variable buoyancy.

3. A cover system according to claim 1 or 2, wherein
each unit has an upper surface and lower surface and the
upper and/or lower surfaces are planar.

4. A cover system according to any one of claims 1 to
3 further comprising a barrier which delineates a first area
of the body of liquid to be covered from a second area of
the body of liquid to remain uncovered.

5. A cover system according to any one of claims 1 to
4 wherein each unit has a footprint in plan view and the
footprint of each of the plurality of floatable units is the
same.

6. A cover system according to any one of claims 1 to
5 wherein each unit comprises a polygonal footprint.

7. A cover system according to claim 6 wherein the
polygonal footprint is in the shape of a triangle, a square,
a rectangle, a pentagon, a hexagon, a heptagon, an octagon, a
parallelogram, or a rhombus.

8. A cover system according to claim 7 wherein each
unit is in the shape of an equilateral triangle.
9. A cover system according to any one of claims 1 to 8 wherein each unit is delimited by a planar perimetal edge to facilitate sliding of adjacent units relative to each other.

10. A cover system according to any one of claims 4 to 9 wherein the barrier is continuous and forms a containment means within which the plurality of floating units is confined.

11. A cover system according to any one of claims 1 to 10 wherein each unit further comprises a plate supported by a flotation aid.

12. A cover system according to claim 11 wherein the flotation aid is hollow and is arranged to receive the quantity of buoyancy imparting material such that the buoyancy of the unit is adjustable.

13. A cover system according to claim 12 wherein the hollow flotation aid includes a transverse cross-section in the shape of a circle, rectangle or square.

14. A cover system according to any one of claims 11 to 13 wherein the flotation aid forms a frame for each unit such that the plate is arranged within and is delimited by the frame.

15. A cover system according to any one of claims 1 to 14 wherein each unit is constructed from a material selected from the group comprising at least; foam, acetal, nylon 11, nylon 12, acrylic-styrene-acrylonitrile alloys, polyphenylene sulfide, polypropylene, ethylene vinyl acetate, polybutylene terephthalate, polyethylene terephthalate, polyphthalamide, polystyrene, polyvinyl chloride, vacuum plated cardboard, plastic coated wood, cork, silicone coated cardboard, kapok, or polyethylene.
16. A cover system according to any one of claims 1 to 14 wherein each unit is constructed from a semi-crystalline polymer.

17. A cover system according to any one of claims 11 to 16 wherein the flotation aid has a base and the plate is positioned at the base of the flotation aid.

18. A cover system according to any one of claims 11 to 16 wherein the plate is positioned at a height intermediate to the thickness of the flotation aid.

19. A cover system according to claim 18 wherein the plate is positioned midway relative to the thickness of the flotation aid.

20. A cover system according to any one of claims 11 to 19 wherein the plate includes one or more holes to allow the passage of fluid from an upper surface of the plate to a lower surface of the plate.

21. A cover system according to claim 20 wherein the one or more holes are uniformly distributed across the plate.

22. A cover system according to any one of claims 11 to 21 wherein each unit further comprises a heat absorbing layer.

23. A cover system according to claim 22 wherein the heat absorbing layer is arranged on an upper surface of the plate for heating a pool of liquid on the upper surface of the plate.

24. A floatable unit for use in a cover system according to any one of claims 1 to 23.
25. A method for reducing evaporation of a body of liquid comprising the steps of:
   forming a substantially uniform cover over at least a portion of the body of liquid by floating a plurality of self-arranging floatable units on the body of liquid, each unit dimensioned to cover at least a portion of the body and able to move relative to one or more like units.

26. A method for reducing evaporation according to claim 25 wherein each unit has an upper surface and lower surface and the upper and/or lower surfaces are planar.

27. A method for reducing evaporation according to claim 25 or 26 further comprising the step of installing a barrier which delineates a first area of the body of liquid to be covered from a second area of the body of liquid to remain uncovered.

28. A method for reducing evaporation according to any one of claims 25 to 27 wherein each unit has a footprint in plan view and the footprint of each of the plurality of floatable units is the same.

29. A method for reducing evaporation according to any one of claims 25 to 28 wherein each unit comprises a polygonal footprint.

30. A method for reducing evaporation according to claim 29 wherein the polygonal footprint is in the shape of a triangle, a square, a rectangle, a pentagon, a hexagon, a heptagon, an octagon, a parallelogram, or a rhombus.

31. A method for reducing evaporation according to claim 29 wherein each unit is in the shape of an equilateral triangle.

32. A method for reducing evaporation according to any
one of claims 25 to 31 wherein each unit is delimited by a planar perimetal edge to facilitate sliding of adjacent units relative to each other.

33. A method for reducing evaporation according to any one of claims 27 to 32 wherein the barrier is continuous and forms a containment means within which the plurality of floating units is confined.

34. A method for encouraging evaporation of a body of liquid comprising the steps of:
   forming a substantially uniform cover over at least a portion of the body of liquid by floating a plurality of self-arranging floatable units on the body of liquid, each unit dimensioned to cover at least a portion of the body and able to move relative to one or more like units, each unit further comprising a plate supported by a flotation aid.

35. A method for encouraging evaporation of a body of liquid according to claim 34 wherein the flotation aid is hollow and arranged to receive the quantity of buoyancy imparting material and the method further comprises the step of adjusting the buoyancy of the unit by adjusting the quantity of the buoyancy imparting material in the hollow flotation aid.

36. A method for encouraging evaporation of a body of liquid according to claim 35 wherein the hollow flotation aid includes a transverse cross-section in the shape of a circle, rectangle or square.

37. A method for encouraging evaporation of a body of liquid according to any one of claims 34 to 36 wherein the flotation aid forms a frame for each unit such that the plate is arranged within and is delimited by the frame.
38. A method for encouraging evaporation of a body of liquid according to any one of claims 34 to 37 wherein the flotation aid has a base and the plate is positioned at the base of the flotation aid, at a height intermediate to the thickness of the flotation aid or midway relative to the thickness of the flotation aid.

39. A method for encouraging evaporation of a body of liquid according to any one of claims 34 to 38 wherein the plate includes one or more holes to allow the passage of fluid from an upper surface of the plate to a lower surface of the plate.

40. A method for encouraging evaporation of a body of liquid according to claim 39 wherein the one or more holes are uniformly distributed across the plate.

41. A method for encouraging evaporation of a body of liquid according to any one of claims 34 to 40 wherein each unit further comprises a heat absorbing layer.

42. A method for encouraging evaporation of a body of liquid according to claim 41 wherein the heat absorbing layer is arranged on an upper surface of the plate for heating a pool of liquid on the upper surface of the plate.

43. A cover system substantially as herein described with reference to and as illustrate in the accompanying drawings.

44. A floatable unit substantially as herein described with reference to and as illustrate in the accompanying drawings.

45. A method for reducing evaporation of a body of liquid substantially as herein described with reference to and as illustrate in the accompanying drawings.
46. A method for encouraging evaporation of a body of liquid substantially as herein described with reference to and as illustrate in the accompanying drawings.
INTERNATIONAL SEARCH REPORT

International application No.  
PCT/AU005/000641

A.    CLASSIFICATION OF SUBJECT MATTER

Int. Cl. 7: C02F 1/14, B65D 88/36, C02F 1/10, B01D 1/14, B01D 1/30

According to International Patent Classification (IPC) or to both national classification and IPC

B.    FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C02F 1/14, 1/10, 1/04, B65D 88/34, 88/36, B01D 1/00, 1/14, 1/30

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DWPI + KW(FLOT+ or FLOAT+)

C.    DOCUMENTS CONSIDERED TO BE RELEVANT

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<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<td>1-19, 22-24</td>
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<td>A</td>
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Further documents are listed in the continuation of Box C

See patent family annex

* Special categories of cited documents:
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Date of the actual completion of the international search
11 August 2005

Date of mailing of the international search report
18 AUG 2005

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Form PCT/ISA/210 (second sheet) (January 2004)
INTERNATIONAL SEARCH REPORT

Information on patent family members

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2005/000641

DOCUMENTS CONSIDERED TO BE RELEVANT

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Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX