

AN EVAPORATOR PLATE HEAT EXCHANGER

The invention is directed to an evaporator plate heat exchanger comprising a stack of injected moulded frames and heat exchange sheets, wherein the stack has two ends and at least four sides. The stack has alternating first and second spaces between the heat exchange sheets and a water supply and discharge fluidly connected to the first spaces.

EP3444550 describes a plate heat exchanger which is designed for and built by a layer-by-layer additive manufacturing process. A channel is present in the interior of the plate itself for supplying water to a space between the plates.

US2003/0230092 describes a stack of thermoformed plastic or metal frames as part of a gas conditioning system. The stack of frames has alternating first and second spaces. To the first spaces water is sprayed in a space above the first spaces as shown in Figure 2. According to the description water is preferably supplied via an injection system. To the second spaces a desiccant fluid is supplied via a supply through holes and lateral channels branching from the supply through holes as shown in Figure 3. The supply through holes run along the length of the stack. At every second space a lateral channel is present in the frame. From this lateral channel the desiccant fluid is supplied by gravity to the second space.

A problem with the design of US2003/0230092 for adding water to the first spaces is its complexity. Spraying water seems like a simple solution but it includes a spraying installation and a space for accommodating such a spraying installation. Further it is found that a uniform supply of water to each first space is difficult to achieve. US2003/0230092 describes also a system to supply a desiccant fluid by a conduit system of supply through holes and lateral channels. It may be envisioned that such a system could also be used for supplying water when the stack is used as an evaporator plate heat exchanger. The problem of such a system is however the lack of an uniform supply of water to each second space because of for example the pressure gradient of the water supply in the supply through holes. Such uniform distribution may be achieved by adapting the design of each lateral channel. But this would make the design very complicated.

The object of the present invention is to provide an evaporator plate heat exchanger having a much simpler water supply and discharge design.

5 This is achieved by the following evaporator plate heat exchanger. An evaporator plate heat exchanger comprising a water supply and a stack of injected moulded frames and heat exchange sheets, wherein the stack has two ends and at least four sides,

 wherein the stack has alternating first and second spaces between the heat
10 exchange sheets,

 the stack further comprises a first enclosed space at one side of the stack which is fluidly connected to the first spaces and not fluidly connected to the second spaces and wherein the first enclosed space is fluidly connected to the water supply.

15 Applicant found that when a volume of water is present in the first enclosed space a uniform supply of water to all first spaces fluidly connected to said first enclosed space may be achieved. The water can easily distribute itself, preferably by gravity and optionally pressure assisted, over the various first spaces. This is different from spraying or from injecting water to the first spaces. The design is
20 further simple in that the first enclosed space may be obtained when stacking the frames as will be described below or may be simply added to a stack as also described below.

 The plate heat exchanger is preferably a so-called fixed plate heat exchanger.
25 Such fixed plate heat exchangers are commonly used to exchange heat between two gasses. Such plate heat exchangers may find use in mechanical ventilation heat recovery (MVHR). The gas or gasses is in most cases air. The fixed plate heat exchanger may also be used to exchange heat between air and other gasses or between two other gasses. In one embodiment warm water may be supplied to the
30 first enclosed space while no gas flow is not present in this first enclosed space. The warm water can in that embodiment increase the temperature of a second air flow flowing in the adjoining second spaces. The plate heat exchanger will then be provided with a water discharge for the warm water. The water discharge may be as described further below in this application. The plate heat exchanger may also be

used as a humidifier to increase the humidity of a gas flowing in the first enclosed spaces. One may even envisage that for such an application no second spaces are present.

5 The heat exchanger may have a vertical flat panel design, a horizontal flat panel design or a cellular design. The stack of such a plate heat exchanger has at least four headers running along the sides of the stack. The first spaces in the stack may be fluidly connected to the inlet for the a gaseous medium via an opening between neighbouring frames in the stack and via a first header. The first spaces in
10 the stack are further fluidly connected to the outlet for the first gas flow via openings between neighbouring frames in the stack and via a second header. The second spaces in the stack may be fluidly connected to the inlet for the second gaseous medium via openings between neighbouring frames in the stack and via a third header and the second spaces in the stack are further fluidly connected to the outlet
15 for the second medium via openings between neighbouring frames in the stack and via a fourth header.

 The frame and the heat exchange sheet are suitably comprised in a heat exchange plate. The frames are preferably obtained by injection moulding. The heat
20 exchange plate is suitably an insert moulded work product wherein the heat exchange sheet is the insert of the insert moulded work product. Such an insert moulded work product may be obtained as described in US2018/0266774 wherein the heat exchange sheet is first laid in a pre-set mould for injection moulding. After placing the sheet the frame is directly injection moulded on the heat exchange sheet
25 to form the heat exchange plate. Preferably at least two sides of the sheet are fully encapsulated by the injected material and more preferably all sides of the sheet are fully encapsulated by the injected material. This ensures an effective sealed connection between the sheet and the frame. The frame further controls the shape of the sheet as it stretches the sheet into a flat surface.

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 Preferably the heat exchange sheet is an aluminium sheet. In the stack two consecutive heat exchange sheets in the stack will have facing sides to first space. It is preferred that these facing sides are provided with a layer of a hydrophilic material.

The frame may be made of acrylonitrile butadiene styrene (ABS), Nylons (polyamides; PA), polypropylene (PP), polyethylene (PE) or polyvinyl chloride (PVC). Polypropylene has been found to be especially suited.

5 Suitably the stack comprises of alternately stacked first heat exchange plate and differently shaped second heat exchange plate each comprising of a heat exchange sheet. The sheets may also be of the same design which may be oriented differently such to obtain the desired gas inlets and outlets for the different gas flows which exchange heat.

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The stack of frames may comprise a differently shaped end frame at each end of the stack. These end frames preferably do not having the afore mentioned insert. Instead the end frames have a closed wall in the positioned of the insert. This wall is preferably an integral part of the stack.

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The frame of such a fixed plate heat exchanger may have a square, rectangular, rhombic heat exchange or a hexagonal shape. Preferably it has a hexagonal shape resulting in that the stack has six sides and even more preferably it has a square shape or a rectangular shape in that the stack has four sides.

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The frames may connect to each other by any means such as an adhesive. Preferably a mechanical connection is used which avoids the use of an adhesive. A suitable mechanical connection is wherein the frames connect by means of a snap fit connection. More preferably the frames are connected by fusion between the plastic material of the frames. Fusion may be achieved by locally increasing the
25 temperature such that the plastic material of the frames melt and fuse at their mutual interface. This temperature increase may be obtained by locally adding a melt of a plastic material. The melt of a plastic material is preferably a melt of a thermoplastic elastomer. An example of a suited combination for a polypropylene frame is a melt of
30 a Styrene Ethylene Butylene Styrene Block Copolymer.

The evaporator plate heat exchanger is suitably further provided with a water discharge for discharging any not evaporated water. This discharge may be composed of simple openings at the lower side of the first spaces. More preferably

the stack further comprises a second enclosed space at the opposite side of the stack from the first enclosed space which second enclosed space is fluidly connected to the first spaces and not fluidly connected to the second spaces (14) and wherein the second enclosed space is fluidly connected to a water discharge.

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The first and/or second enclosed space is suitably formed as a result of stacking the frames, wherein the frames have openings. The frames have at least one opening which when stacked form the first enclosed space and the frames have at least one opening which when stacked form the second enclosed opening. These first and second enclosed spaces run along the length of the stack. The resulting open ends of these spaces are closed by a wall at each end. This closure may be achieved by the afore mentioned end frames.

The first and second enclosed space may also be a box shaped part having an open side. This box shaped part is suitably fixed to a first side of the stack such that the open side of the box shaped part faces the first side of the stack to obtain the first enclosed space. Another box shaped part is suitably fixed to a third side of the stack such that the open side of the box shaped part faces the third side of the stack to obtain the second enclosed space. The box shaped parts are connected to the stack such that a water tight enclosure is obtained. The box shaped part may have rounded corners and the like. Combinations of the internal enclosed spaces as formed by stacking the frames and the added box shaped parts is also possible. For example a box shaped part as the first enclosed space combined with a second enclosed space is formed as a result of stacking the frames.

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The first and second enclosed space as described above may have the same design and shape or may be differently shaped. For example the first enclosed space may be larger or smaller in volume than the second enclosed space. It is also possible that a combination of a space as formed as a result of stacking is combined with a space as formed as a result of adding a box shaped part is part of the heat exchanger.

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In use water will flow from the first enclosed space, preferably by means of gravity, to the first spaces of the stack. In the first spaces all or part of the water

evaporates. Any non evaporated water is discharged from the first spaces of the stack to the second enclosed space, preferably by means of gravity. For achieving this water flow the stack will be positioned horizontally such that the first enclosed space is positioned on or at the top of the stack and the second enclosed space is positioned below or at the bottom of the stack. In use a volume of water will be present in the first enclosed space. This volume of water will be maintained by supplying fresh water via the water supply to compensate for the water supplied to the first spaces. By designing the openings from the first enclosed space to the first spaces with a sufficient pressure drop an uniform distribution of water can be achieved over all first spaces. These openings may be multiple channels or an elongated and parallel opening per first space. Preferably the opening from the first enclosed space to the first spaces is a slit or a row of smaller openings running above substantially the entire width of the sheet as present in the frame. In this way a large area of the sheet will wetted and used in the evaporative cooling process. One elongated opening or slit connects the first enclosed space with one first space. Such a slit may be formed when stacking the frames. By using differently designed frames one may achieve a stack of frames where the first enclosed space is fluidly connected to the first spaces and not to the second spaces in the stack. The driving force for the water to flow through these openings to the first spaces will be the water column in the first enclosed space. This driving force may sufficiently be increased by purposely increasing the water pressure in the first enclosed space, for example by means of a pump. The invention is thus also directed to the use of an evaporator plate heat exchanger according to this invention wherein the first enclosed space contains pressurised water. The openings are preferably designed such that at a given water pressure a known amount of water flows into each first space.

In the second enclosed space non-evaporated water will be collected. The opening or openings between the first space and this second enclosed space are preferably designed such that the water easily flow to said second enclosed space. Thus contrary to the opening or openings at the upper side these no or very low pressure drop exists for water flowing to said second enclosed space via these openings. The opening may for example be a single opening at the lower end of a tilted bottom of the first space This water is discharged from this space via the water

discharge. The discharge may be enhanced by for example a pump. The collected water may be recycled to the first space.

Water may be continuously or intermittently provided to the first enclosed
5 space. Intermittent supply is for example possible when the sheet is provided with a hydrophilic material.

The evaporator plate heat exchanger preferably comprises multiple stacks of interconnected injected moulded frames. Each stack is provided with its own first and
10 second enclosed space. These first and second enclosed spaces are not fluidly connected in that they have their own water supply and water discharge. It is found that the stacks having preferably between 15 and 50 interconnected frames, including the end frames, can be simply manufactured on a large scale. By combining stacks having the same number of interconnected injected moulded
15 frames it is possible to modularly assemble different sized heat exchangers. This allows one to make differently sized plate heat exchangers with a single design of the stack. The supply and discharge of water to the first enclosed spaces and from the second enclosed spaces of the separate stacks may be supplied from a single source and may be combined.

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The frame for such a modular design preferably has a square shape or a rectangular shape resulting in a box shaped stack. The more than one stacks are suitably positioned in line such that the respective first sides and second sides of the stacks are in line and wherein a third side of the stack is connected to an inlet for a
25 first gas flow and an outlet for a second gas flow and wherein a fourth side of the stack is connected to an inlet for the second gas flow and an outlet for the first gas flow. Preferably the inlet for a first gas flow comprises of a header which is in fluid communication with the first spaces of more than one stacks which are positioned in line. Preferably the inlet for a second gas flow comprises of a header which is in fluid
30 communication with the second spaces of the more than one stacks which are positioned in line. Preferably the inlet for a second gas flow comprises of a header which is in fluid communication with the second spaces of the more than one stacks which are positioned in line. Preferably the outlet for a second gas flow comprises of

a header which is in fluid communication with the second spaces of the more than one stacks which are positioned in line.

The invention shall be illustrated making use of Figures 1-11.

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Figure 1 shows an expanded stack (4) of injected moulded frames (5) provided with insert moulded heat exchange sheets (6). In Figure 2 the frames (5) are connected to form a stack (4) oriented in its preferred horizontal direction. The frames (5) are provided with openings (17) which will form the first and second enclosed spaces (15,16) when the frames (5) are stacked and connected. At both ends of the stack end frames (2a,2b) are provided which do not have these openings (17) and therefore enclose the first and second enclosed spaces at these ends of the stack (4).

15 Between the frames (5) first (13) and second (14) spaces are formed as shown in Figure 2. As can be seen in Figure 2 the first spaces (13) are open at a upper part of side (10) and the second spaces (14) are open in a lower part of side (10). This allows to position a gas header (not shown) for separate gas flows in first and second spaces above each other as shown in Figures 6 and 7 and 11. The dimensions in Figure 2 of the thickness of a frame (5) is drawn not to scale such to more clearly illustrate the positioning of the openings in side wall (10). To achieve these alternating openings for first and second spaces the frames (5) are suitably of alternating different designs. These alternatingly stacked first heat exchange plate (16a) and differently shaped second heat exchange plate (16b) are shown in Figure 25 3 each comprising of a heat exchange sheet (6). A further difference is that in frames (16a) of the stack (4) the first and second enclosed spaces (15,16) are connected to the first space (13) by channels (20a,20b). In Figure 3 the frames (16a,16b) are shown with reference numbers (9,10,11,12) to show which side of the frames correspond with the side of the stack (4). Ridges (12a) and (10a) are present to connect to a header as shown in Figure 11.

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In Figure 2 a water supply (1) and a water discharge (2) is drawn as conduits connected to enclosed first and second enclosed spaces (15,16) respectively. The first enclosed space (15) is fluidly connected to water supply (1) and the second

enclosed space (16) is fluidly connected to water discharge (2). These fluid connections may be made by drilling a hole in a connected stack of frames from sides (9) and (11) until the enclosed spaces are reached.

5 Figure 4 shows the exterior of a stack (4) of interconnected frames (5) to which stack a box shaped part (18) is added to form the first enclosed space (15) at the upper side (9) of the stack. The open side of the box shaped part (18) faces side (9) of the stack (4). Further a box shaped part (19) is added to form the second enclosed space (16) at the lower side (11) of the stack (4). The open side of the box
10 shaped part (19) faces side (11) of the stack (4). The shape of the box shaped part may in fact be any shape which has an open side suited to be connected to the sides of the stack.

 Figure 5 shows a cross-sectional view AA' of Figure 4 in a first space (13). A
15 frame (5) with an insert moulded heat exchange sheet (6) is shown. In the box shaped part (18) is shown above a slit like opening (20) to the first space (13). Further a slit like opening (20c) is shown to connect first space (13) with second enclosed space (16).

20 Figure 6 shows in a simplified manner how the stacks of Figures 1-5 may be combined with headers. A stack (4) is shown from one end (7). At the upper end of side (10) a third gas flow header (24) is shown for supplying a first gas flow (solid line) to the first spaces (13). At the upper end of side (12) a first gas flow header (26) is shown for supplying a second gas flow (dotted line) to the second spaces (14). At
25 the lower end of side (12) a fourth gas flow header (27) is shown for collecting gas from the first spaces (13). At the lower end of side (10) a second gas flow header (25) is shown collecting gas from the second spaces (14). These headers are obviously further connected to an gas supply and an gas discharge system not shown in this figure.

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 Figure 7 shows three stacks (21,22,23) of square frames (5) wherein the stacks (21,22,23) have the same dimensions. The stacks (21,22,23) are positioned in line such that the respective sides (9,10,11,12) are in line. The closed end frames of one stack (21) thus faces the closed end frame of the next stack (21a) in the row of

stacks. Further the first enclosed spaces and second enclosed spaces of the four stacks (21,21a, 22,23) are separate spaces and thus not connected to form a single space. Sides (10) and (12) of all stacks (21, 21a, 22,23) are provided with headers (24,25,26,27) as shown in Figure 6. Each header is, in contrast with the stacks
5 (21,21a,22,23), comprised of a common space which allows for example to supply the first gas flow (shown as the solid line in Figures 6 and 7) to the separate first spaces of the three stacks (21,21a,22,23) from a common header (26) as in Figure 6.

10 It is preferred that such a header is comprised of interconnected modular elements (28) of the same size and shape. In this way one can easily assemble different sized headers when combining different numbers of such standardised stacks (21,21a,22,23). In this figure one header is obtained by combining four modular elements (28). It is also possible that per stack length more modular
15 elements are used such that along side (10) of one stack (21) 2 to 4 modular elements are present. Such modular elements (28) suitably also allow that headers (24) and header (25) are connected and that header (26) and header (27) are connected to the stack. For example by ridges (10a, 12a) of Figure 3a and 3b. Headers (24) and (25) may be fluidly connected and disconnected by means of a
20 valve. This makes the illustrated plate heat exchangers especially suited to be used in the process described in WO2016/206714.

Figure 8 shows a modular element (28) which may be used as part of the headers shown in Figures 6 and 7. The modular element (28) is suitably a hollow
25 cube shaped gas flow element (30) as shown in this figure. The gas flow element (30) has an interior space (34), six open faces (35), eight vertices (36) and twelve edges (37) interconnecting the eight vertices (36).

Figure 9 shows a connecting frame (38) provided with an opening (39) and four
30 edges (40). Along the edges (40) extrusions are seen directed in both directions perpendicular to the plane of the frame. These extrusions are suitably cantilever snap-fit connections (41) which can connect to an edge (37) of the gas flow element (30) as seen in Figure 3.

Figure 10 shows a detail of a modular member of Figure 8 at one of its vertices (36) wherein one open face is provided with a connecting frame (38) and a neighbouring open face is provided with an enclosing wall element (45). Both the connecting frame (38) as the enclosing wall element (45) are provided with numerous protrusions (46) in a perpendicular direction with respect to the plane of the connecting frame (38) or plane of the enclosing wall element (45). The protrusions (46) are provided with a sharp edge (47) at its end which are dimensioned such that they form a cantilever snap fit connection with the edge (37). As shown the location of the protrusions (46) of the connecting frame (38) and the enclosing wall element (45) are not at the same positions along the edges of these elements. This makes it possible that neighbouring open faces of a modular member can be provided with connecting frames (38), enclosing wall elements (45) or other elements by a snap fit connection on its common edge (37).

Thus preferably the modular element is a hollow cuboid shaped gas flow element, each gas flow element having an interior space, six open faces, eight vertices and twelve edges interconnecting the eight vertices,

wherein the four edges of at least one open face of a first gas flow element of one header (24,25,26,27) is connected in a gas tight manner to four edges of an open face of a second hollow cuboid shaped gas flow element of the same header at their respective connecting open faces and ,

wherein at their respective connecting open faces the four edges of the open face of the first gas flow element is connected in a gas tight manner to four edges of the open face of the second hollow cuboid shaped gas flow element by means of a connecting frame,

wherein the connecting frame is provided with means to connect to the four edges of the open face of the first gas flow element and is provided with connecting means to connect to the four edges of the open face of the second hollow cuboid shaped gas flow element.

Preferably at one side of the stack or stacks the hollow cuboid shaped gas flow elements of one header are connected to the hollow cuboid shaped gas flow elements of the other header. When a row of multiple gas flow elements are connected to a row of stacks or to another row of gas flow elements it may happen

that because of manufacturing tolerances no connection is possible. This may be mitigated by using a gas tight bellow between one or more of the stacks and/or between one or more of the gas flow elements which bellows allows a varying distance between the stacks and/or gas flow elements.

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Preferably the hollow cuboid shaped gas flow elements of one header are connected to the hollow cuboid shaped gas flow elements of the other header and wherein in the connection between the two headers valves may be present allowing to fluidly connect and disconnect the connected headers.

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Such a connected header is shown in Figure 11 showing a header (26) composed of five fluidly interconnected gas flow elements (30) and a header (27) composed of five fluidly interconnected gas flow elements (30). The header (26) and (27) are open to the viewer and closed at its not visible back wall. The open side will be connected to side (12) of the stack (4) or stacks (4). At their end the headers (26,27) are connected to a gas inlet flow element (42) and a gas outlet element (43) which may be connected to gas supply conduit and gas discharge conduit. A motor (45) may operate a valve (46) to cut off the gas supply from gas inlet flow element (42). A motor (47) may operate valves (48) fluidly connecting and disconnecting header (26) and header (27)

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The hollow cuboid shaped gas flow element is suitably made of a polymer. Preferably the hollow cuboid shaped gas flow element is a single injected moulded work product. The connecting frame is also preferably made of a polymer and is preferably a single injected moulded work product.

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The dimensions of the hollow cuboid shaped gas flow element may vary. When they are used in combination with a plate heat exchanger it is preferred to use elements having a minimal dimension of an edge of 0.1 m and a maximum dimension for an edge of 0.3 m being the distance along the edge between two vertices.

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The hollow cuboid shaped gas flow element, the connecting frame, the rectangular shaped frame and/or the rectangular shaped closed frame may be made

of a polymer. Preferably a polymer which may be used in injection moulding. Suitable polymers are polypropylene (PP) and/or polyoxymethylene (POM).

5 The connecting frame preferably has about the same dimensions as the sides of the hollow cuboid shaped gas flow element. The connecting frame is either closed to provide for the partition or provided with an opening at its centre to allow a fluid communication between the first and second hollow cuboid shaped gas flow element. This open space is preferably about the same shape as the open face of the hollow cuboid shaped gas flow element. The remaining edges of the frame are
10 provided with the means to connect to the four edges of the open face of the first gas flow element and provided with connecting means to connect to the four edges of the open face of the second hollow cuboid shaped gas flow element.

CLAIMS

1. An evaporator plate heat exchanger comprising a water supply (1) and a stack (4) of injected moulded frames (5) and heat exchange sheets (6), wherein the stack has two ends (7,8) and at least four sides (9,10,11,12), wherein the stack (4) has alternating first (13) and second (14) spaces between the heat exchange sheets (6), the stack (4) further comprises a first enclosed space (15) at one side of the stack (4) which is fluidly connected to the first spaces (13) and not fluidly connected to the second spaces (14) and wherein the first enclosed space (15) is fluidly connected to the water supply (1).
2. An evaporator plate heat exchanger according to claim 1, wherein the stack (4) further comprises a second enclosed space (16) at the opposite side of the stack which is fluidly connected to the first spaces (13) and not fluidly connected to the second spaces (14) and wherein the second enclosed (13) space is fluidly connected to a water discharge (2).
3. An evaporator plate heat exchanger according to any one of claims 1-2, wherein the frame (5) and the heat exchange sheet (6) are comprised in a heat exchange plate (16) and wherein the heat exchange plate (16) is an insert moulded work product wherein the heat exchange sheet (6) is the insert of the insert moulded work product.
4. An evaporator plate heat exchanger according to claim 3, wherein the stack (4) comprises alternatingly stacked first heat exchange plate (16a) and differently shaped second heat exchange plate (16b).
5. An evaporator plate heat exchanger according to any one of claims 1-4, wherein the first and/or the optional second enclosed space is formed by openings (17) in the injected moulded frames (5) and wherein the resulting two open ends are closed by a wall as present in closed end frames (2a,2b).

6. An evaporator plate heat exchanger according to any one of claims 1-5,
wherein the first enclosed space (15) is formed by a box shaped part (18)
having an open side and wherein the box shaped part (18) is fixed to the first
side (9) of the stack (4) such that the open side faces the first side (9) of the
stack and/or wherein the optional second enclosed space (13) is formed by a
box shaped part (19) having an open side and wherein the box shaped part
(19) is fixed to the third side (11) of the stack (4) such that the open side faces
the third side (11) of the stack (4).
7. An evaporator plate heat exchanger according to any one of claims 1-6,
wherein the first enclosed space (15) is fluidly connected to the first spaces
(13) by means of elongated and parallel openings (20) or parallel rows of
smaller openings.
8. An evaporator plate heat exchanger according to any one of claims 1-7,
wherein the heat exchange sheet is an aluminium sheet.
9. An evaporator plate heat exchanger according to any one of claims 1-8,
wherein two consecutive heat exchange sheets in the stack have facing sides
to first space and wherein the facing sides are provided with a layer of a
hydrophilic material.
10. An evaporator plate heat exchanger according to any one of claims 1-9,
wherein the frame (5) of the heat exchange plate (16) is made of acrylonitrile
butadiene styrene (ABS), Nylons (polyamides; PA), polypropylene (PP),
polyethylene (PE) or polyvinyl chloride (PVC).
11. An evaporator plate heat exchanger according to any one of claims 1-10,
wherein the frame (5) has a square shape or a rectangular shape.
12. An evaporator plate heat exchanger according to any one of claims 1-11,
comprising multiple stacks (21,21a,22,23) of interconnected injected moulded
frames, each stack provided with closed end frames.

13. An evaporator plate heat exchanger according to claim 12, wherein the stacks (21,22,23) have the same number of interconnected injected moulded frames (5).
- 5 14. An evaporator plate heat exchanger according to any one of claims 1-13, wherein the number of interconnected frames (5) is between 15 and 50.
15. An evaporator plate heat exchanger according to claim 14, wherein the frame (5) has a square shape or a rectangular shape resulting in a box shaped stack (21,21a,22,23) and wherein the stacks (21,21a,22,23) are positioned in line
10 such that their respective sides (9,10,11,12) are in line and wherein a second side (10) of the stack is connected to an header (24) for a first gas flow and connected to a header (25) for a second gas flow and wherein a fourth side (12) of the stack is connected to a header (26) for the second gas flow and to
15 a header (27) for the first gas flow.
16. An evaporator plate heat exchanger according to claim 15, wherein the headers (24,25,26,27) are comprised of interconnected modular elements (28) of the same size and shape.
- 20 17. An evaporator plate heat exchanger according to claim 16, wherein the modular element (28) is a hollow cuboid shaped gas flow element (30), each gas flow element (30) having an interior space (34), six open faces (35), eight vertices (36) and twelve edges (37) interconnecting the eight vertices (36),
25 wherein the four edges (37) of at least one open face (35) of a first gas flow element (30) of one header (24,25,26,27) is connected in a gas tight manner to four edges (37) of an open face (35) of a second hollow cuboid shaped gas flow element (30) of the same header at their respective connecting open faces (35) and ,
30 wherein at their respective connecting open faces (35) the four edges (37) of the open face (35) of the first gas flow element (30) is connected in a gas tight manner to four edges (37) of the open face (35) of the second hollow cuboid shaped gas flow element (30) by means of a connecting frame (38),

wherein the connecting frame (38) is provided with means to connect to the four edges of the open face of the first gas flow element (30) and is provided with connecting means to connect to the four edges (37) of the open face (35) of the second hollow cuboid shaped gas flow element (30).

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18. An evaporator plate heat exchanger according to claim 17, wherein at one side of the stack or stacks (4) the hollow cuboid shaped gas flow elements (30) of one header (24,25,26,27) are connected to the hollow cuboid shaped gas flow elements (30) of the other header (24,25,26,27).

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19. An evaporator plate heat exchanger according to claim 18, wherein the hollow cuboid shaped gas flow elements (30) of one header (24,25,26,27) are connected to the hollow cuboid shaped gas flow elements (30) of the other header (24,25,26,27) and wherein in the connection between the two headers valves (48) are present allowing to fluidly connect and disconnect the connected headers (24,25,26,27).

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20. Use of an evaporator plate heat exchanger according to any one of claims 1-19, wherein the first enclosed space contains pressurised water.

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