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(54) **STEAM OVEN WITH WATER MANAGEMENT SYSTEM**

DAMPFGARGERÄT MIT WASSERVERWALTUNGSSYSTEM

FOUR À VAPEUR AVEC SYSTÈME DE GESTION DE L'EAU

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Description

[0001] The present invention relates to a steam oven with a water management system for the steam oven, and to a method for operating such a steam oven.

[0002] Steam ovens are a well-known category of appliances, dedicated to cooking purposes. Steam ovens are existing, in a first variant, as solo steam appliances. In solo steam appliances, exclusively pure steam cooking functions are available, as no heating systems beside a steam generator are available. In a second variant, steam ovens are existing as combi steam appliances. In combi steam appliances, steam can be used alone for cooking, or combined with other heating systems, to merge the heating effect of steam with the one of hot air.

[0003] To create steam there needs to be available a water supply of a water feeding system which leads the water into the steam generation system.

[0004] When using steam ovens as available on the market, the users are asked to regularly descale the steam generation system in order to remove the lime stone which is collected in the steam generation system.

[0005] A descaling operation removes scale from the steam generation system. It removes, for example, limescale, limestone, calcium and/or layers of oxides formed on the surfaces of the steam generation system.

[0006] Some steam ovens are asking the user in the set-up process of the appliance to give an indication on the water hardness level in order to define the right interval of performing such a descaling procedure.

[0007] The majority of steam ovens as available on the market are equipped with a dedicated descaling function of the steam generation system. The indication when such a descaling process needs to be done is either defined in the user manual and it depends on the user to perform it in time, or steam ovens are available which have an internal counter in the software depending on the water hardness level which is defined by the user, which tells the user when to perform such a descaling process.

[0008] In ovens as available on the market and such as known from e.g. JP 2010190475 A there is no feedback about the real water hardness level and no feedback from the steam generator about the real quantity of lime stone and thus the right time to perform such a descaling process can be just estimated. This can result in a decreased steam generation performance and thus decreased food quality or even in an accumulation of lime stone particles which could harm the steam generation system including tubes and valves.

[0009] EP 2116516 A1 discloses a steam oven with a water management system which comprises an electrolytic cell as a water softening system which is not restorable and does not need to be restored. In this oven, the (Zn) - to - (Ca) ratio in the water stream downstream the cell is measured and the excitation current of the electrolytic cell is controlled so that this ratio is maintained above a given threshold in order to prevent scale formation.

[0010] This invention is especially meant to provide an enhanced approach to the water management in steam ovens with restorable softening systems. It is an object of the present invention to overcome the above drawbacks and problems.

[0011] These problems are solved by the subject matter of the attached independent claims. Preferred embodiments may be taken from the dependent claims.

[0012] The above described problems are advantageously solved by a steam oven according to claim 1, and a method for operating a steam oven according to claim 18.

[0013] According to claim 1, the invention relates to a water management system for a steam oven, comprising

- a water softening system comprising a water inlet and a water outlet,
- wherein the water inlet is connected (or: connectable) to a water supply,
- wherein the water outlet is connected (or: connectable) to a steam generation system of the steam oven,
- wherein the water softening system comprises water-hardness reduction means to reduce a water hardness of a water stream,
- further comprising a or at least one sensor means for providing sensor values of the water stream to an estimation unit and
- further comprising an estimation unit to estimate based on the sensor values whether the water hardness of the water stream is within a predefined range.

[0014] In an embodiment, a first water stream, especially hard water or inlet water, from the water supply flows or can flow through the water inlet and a second water stream, especially soft water or softened water, for the steam generation system flows or can flow through the water outlet. Preferably, the second water stream comprises softened water compared to the first water stream.

[0015] Preferably, the water softening system comprises water-hardness reduction means to reduce a first water hardness of a or the first water stream at the water inlet to a second water hardness of a or the second water stream at the water outlet.

[0016] The sensor means can preferably be arranged at or near the water outlet and/or at or near the water inlet for providing sensor values of the first water stream and/or of the second water stream to the estimation unit.

[0017] The estimation unit is configured to estimate based on the sensor values whether the water hardness of the water stream, especially of the second water stream, is within a predefined range and whether the water softening system shall be restored.

[0018] A water management system of a steam oven according to the invention therefore is especially a water hardness management system, whereas also a sanitizing unit and a flood prevention unit can preferably be included in the water management system.

[0019] Preferably, the water-hardness reduction means comprises or uses at least one or more of ion exchange resins, phosphates dispensers and reverse osmosis systems, preferably contained in at least one cartridge.

[0020] In an embodiment, the water-hardness reduction means and/or the at least one cartridge can interact and/or deal with a total fixed amount of ions, especially of Ca and/or Mg, corresponding to a total amount of water. Dealing with a total fixed amount of Ca and/or Mg can especially mean exchanging the ions, for example the Ca-ions (Ca^{++} ; Calcium-ions) and/or the Mg-ions (Mg^{++} ; Magnesium-ions) against Na-ions (Na^{+} ; Natrium-ions) and/or dispensing phosphates and/or pressing the water through a membrane.

[0021] Dealing with a total fixed amount of water preferably means that for this fixed amount of water, the water hardness of the water stream is within the predefined range. The total amount of water can preferably be variable depending on the hardness of the water stream from the water supply.

[0022] Ion exchange resins can preferably be regenerated, for example by the use of Natrium Chloride (NaCl) to recover their water-hardness reduction functionality. This proceeding can be also used in water softening systems (water softeners) for dishwashers.

[0023] The estimation unit estimates based on the sensor values whether the water hardness of the, especially second, water stream is within a predefined range, wherein the estimation unit preferably estimates based on the sensor values whether the water hardness of the, especially second, water stream is below a predefined level, for example below 3°F or below 7°F . Alternatively or in addition, a water hardness of the, especially second, water stream within a predefined range can preferably mean that the water hardness is above a predefined lower threshold and below a predefined upper threshold.

[0024] When the sensor means and/or the estimation unit estimates based on the sensor values that the water hardness of the water stream, especially of the second water stream, is not within the predefined range and/or that the water softening system shall be restored, an expiration of the softening cartridge is identified and/or a service operation is triggered, wherein the service operation is preferably either a regeneration or a replacement of the at least one cartridge. In some embodiments, a replacement of the at least one cartridge is or can be privileged.

[0025] Preferably, the at least one cartridge is dimensioned to expire at around 2 years, after 2 years or after more than 2 years. Preferably, for oven applications, a relatively low amount of water is needed for the water stream.

[0026] The first water stream preferably corresponds to hard water or inlet water of the water softening system. The second water stream preferably corresponds to soft water or outlet water of the water softening system. Therefore, preferably, water of the first water stream enters the water softening system at the water inlet, is softened within the water softening system and then leaves the water softening system at the water outlet as second water stream. Water softening is preferably achieved using softening active matter, especially lime softening and/or ionexchange resins.

[0027] The water hardness (or: water hardness level) is preferably determined by the concentration of mineral content in the water, especially by the concentration of ions and/or of multivalent cations. More preferably, the water hardness is determined by the sum of the molar concentrations of Ca^{2+} and Mg^{2+} . The sum can be expressed in mol/L or mmol/L units. Various alternative units preferably represent an equivalent mass of calcium oxide (CaO) or calcium carbonate (CaCO_3) that, when dissolved in a unit volume of pure water, would result in the same total molar concentration of Mg^{2+} and Ca^{2+} .

[0028] Water hardness is often not expressed as a molar concentration, but rather in various units, such as degrees of general hardness (dGH or $^{\circ}\text{dH}$), parts per million (ppm, mg/L or American degrees) or French degrees ($^{\circ}\text{fH}$, $^{\circ}\text{f}$ or $^{\circ}\text{F}$). Parts per million (ppm) is usually defined as 1 mg/L CaCO_3 . It is equivalent to mg/L without chemical compound specified. A degree of General Hardness (dGH, $^{\circ}\text{dH}$ or deutsche Härte) is defined as 10 mg/L CaO or 17.848 ppm. A French degree ($^{\circ}\text{fH}$ or $^{\circ}\text{f}$ or $^{\circ}\text{F}$) is defined as 10 mg/L CaCO_3 , equivalent to 10 ppm. The abbreviation "L" (or: "l") preferably corresponds to "liter". The unit mg /L (or: mg/l) preferably corresponds to mg/L CaCO_3 or to mg/L CaO .

[0029] Hard water is preferably water with a high concentration of mineral content and/or water which comes from the water tap or a water feeding system. More preferably, hard water can be water which contains more than 120 ppm or 6.75 dGH or 6.75°dH or 67.5 mg/L CaO .

[0030] Preferably, hard water can be at least one of more of moderately hard water, hard water, very hard water and/or extremely hard water. Possible, especially predetermined, ranges for the water hardness of especially hard water can be between 7°F and more than 32°F , between 4°dH and more than 18°dH and/or between 70 and more than 320 mg/L especially of CaCO_3 , respectively. Possible ranges for moderately hard water are between 4°dH and 8°dH or between 70 and 140 mg/L CaCO_3 , respectively. Possible ranges for hard water can also be between 8°dH and 13°dH or between 140 and 220 mg/L CaCO_3 , respectively. Possible ranges for very hard water are between 13°dH and 18°dH or between

220 and 320 mg/L CaCO_3 , respectively. Possible ranges for extremely hard water are above 18°dH or above 320 mg/L CaCO_3 , respectively.

[0031] Soft water is preferably water with a low concentration of mineral content and/or water after a treatment by the water softening system. More preferably, soft water can be water which contains less than 60 ppm or 3.37 dGH or 3.37 °dH or 33.7 mg/L CaO. Possible ranges for soft water are between 0°F and 7°F, between 0°dH and 4°dH and/or between 0 and 70 mg/L especially of CaCO_3 , respectively.

[0032] The following table shows the classifications, thresholds, ranges and/or hardness levels for soft water, moderately hard water, hard water, very hard water and extremely hard water. A predefined range of the water hardness of the water stream can preferably be at least one of the following ranges and/or a combination thereof.

Classification	Water Hardness in mg/L	Water Hardness in °dH	Water Hardness in °F
Soft	0-70	0-4	0-7
Moderately hard	70-140	4-8	7-14
Hard	140-220	8-13	14-22
Very hard	220-320	13-18	22-32
Extremely hard	>320	>18	>32

[0033] Preferably, a predefined range of the water hardness of the water stream is one of or a combination of the above defined ranges. A predefined range of the water hardness of the water stream therefore may be for example, a range between 0°F and 7°F and/or 0°dH and 4°dH and/or between 0 and 70 mg/L especially of CaCO_3 .

[0034] Preferably, the water management system avoids a descaling operation of the steam generation system of the steam oven. Preferably, the water management system integrates a self-diagnosing, regeneration free, water softening system into the steam oven.

[0035] The water management system can also prevent the need to deal with chemicals to perform the descaling operation of the steam generation system. Preferably, the water management system eliminates downtime of the steam oven due to a descaling operation.

[0036] Furthermore, the water management system can improve the efficiency of the steam generation system by eliminating the steady process of limestone accumulation and subsequent removal.

[0037] The water softening system can be integrated into the steam oven or can be externally to the steam oven. In an embodiment, the water softening system is adapted and/or connected to the water supply. The water supply can be a water tap and/or a water tank and/or a fixed water connection and/or a water pipe and/or a fixed or removable drawer and/or a water feeding system.

[0038] The water supply for the steam oven and/or the water softening system can preferably be set up as a fixed water tank of the oven which needs to be filled using an additional water jar. Furthermore or as an alternative, the water supply for the steam oven can preferably be set up as an extractable water tank which can be extracted from the oven and filled directly on a water tap. Furthermore, the water supply for the steam oven can preferably be set up as a fixed water connection to the water supply system of the house, for example to a water tap.

[0039] The water management system is preferably dimensioned to keep the, especially second, water stream below a water hardness target for a defined amount of supplied water, in order to cover a predefined steam oven usage time, more preferably the whole lifetime of the oven.

[0040] In addition, the water management system can provide long term duration of the steam oven, preferably life long duration without service and/or descaling.

[0041] In an advantageous embodiment, the water management system is intended to treat a predefined amount of water in the, especially first, water stream, wherein the steam generation system is able to handle a predefined amount of minerals as residual hardness of the second water stream, so that the oven is able to run a predefined number of steam cycles.

[0042] In a specific embodiment, the water management system can be intended to treat a predefined amount of 500 to 800 l, especially 750 l, of water in the, especially first, water stream, wherein the steam generation system is able to handle a predefined amount of approximately 15 g to 21 g minerals as residual hardness of the, especially second, water stream, so that the steam oven is able to run a predefined number of 400 to 600 steam cycles, preferably with a maximum water consumption of each cycle of 1l and/or applying a safety factor of 1 to 1.5.

[0043] Preferably, the residual hardness shall be dimensioned to leave behind an concentration of mineral content in the water that the system and/or the oven can handle without impairment and/or damage. In the above mentioned or in another embodiment, the water management system can be intended to provide the, especially second, water stream, preferably softened water, with a water hardness below 3° F or below 7° F and/or 3 mg/l or 7 mg/l of CaCO_3 to the steam

generation system.

[0044] Preferably, the water management system is capable to handle different levels of water hardness of the first water stream, preferably automatically or by a calibration process performed during the installation of the steam oven.

[0045] In an advantageous embodiment, the sensor means comprises a water hardness sensor means and/or a volume counter and/or a flow measurement unit. The sensor means can further include, in an embodiment, a flow rate sensor and/or a water detection means and/or a water volume counter. The sensor means or a part of it is preferably placed in an area where water could flow in case of failures or uncontrolled water supply. Therefore, preferably uncontrolled water supply can be avoided.

[0046] According to the invention the sensor means comprises a first class of sensor means and/or a second class of sensor means as defined in claim 1.

[0047] For the first class of sensor means, the sensor means are configured to perform a direct measurement of the water hardness. Such a sensor means can directly measure the water hardness, preferably at the water outlet, immediately identify when the water softening system ceases or reduces its performance, and indicate the need for restoration or regeneration of the water softening system. Examples for such sensor means are conductivity sensor means, optical sensor means or capacitive sensor means. An advantage of such sensor means may be the direct feedback on the final outflow water hardness at the water outlet, regardless of possible contingencies like, for example, water hardness fluctuations, mechanical failures and/or defective components of the system.

[0048] For the second class of sensor means, the sensor means are configured to perform a total cumulative water amount calculation of the water stream, for example by volumetric counters or flow meters. Based on the second class of sensor means, the estimation unit determines and/or indicates softening system expiration by assuming the hardness of the water at the water inlet constant, while the maximum amount of water the water softening system can treat is predetermined. Even though the second class of sensors can be blind to contingencies like, for example, water hardness fluctuations, mechanical failures and/or defective components of the system, the second class of sensors is normally easier to integrate and can be more economical.

[0049] The first and second classes of sensors, for the purpose of the invention, can work alone, or can be combined as a sensor means to ensure or enable double check of the water hardness, for example.

[0050] In an embodiment, preferably for an additional third class of sensor means, the sensor means measures and/or can measure water spillage and/or perform leakage detection via threshold conductivity sensors or float based sensors. This third class of sensors can also be combined in a sensor means with one or more of the first and second class to ensure or enable double check.

[0051] The first category of sensors is put downstream the water softening system, for example at or near the water outlet. The first category of sensors monitors the supposedly softened water. The second category can preferably be placed before or after the water softening system, for example at or near the water inlet and/or at or near the water outlet, as the water flow is at least essentially the same.

[0052] The water management system can comprise a flood prevention system, especially an integrated anti-flooding system. Flood prevention means can be common practice, for example, for built-in ovens, and can be even mandatory for high-end ovens.

[0053] Preferably, the flood prevention system is intended to stop the first water stream after a continuous flow of a determined amount of litres of water.

[0054] In an embodiment, the flood prevention system comprises a valve for blocking the water supply.

[0055] The flood prevention system can be connected to the sensor means, wherein the sensor means especially comprises a water detection means and/or a volume counter, so that the valve can be closed upon water detection and/or uncontrolled water supply.

[0056] Preferably, the flood prevention system comprises at least two means: a first means, preferably a or the sensor means, to detect anomalies related to the water supply, and a second means, preferably a valve, more preferably an electric valve, to stop water flow from the water inlet in case of such anomalies.

[0057] The second class of sensor means can preferably be used to replace the third class of sensor means. Preferably, the, especially second class of, sensor means is integrating at least two functions, for example a flood prevention system as well as a water hardness determination or estimation.

[0058] According to the invention, the water softening system upon reach of a predefined overall amount of water and/or upon exceeding a predefined threshold for the water hardness can or shall be restored. Preferably, the water softening system contains a disposable cartridge containing the softening material, especially the softening active matter. The disposable cartridge is a preferred means to reduce a first water hardness of the first water stream at the water inlet to a second water hardness of the second water stream at the water outlet.

[0059] The water softening system can be restored preferably by changing or renewing the disposable cartridge containing the softening material, especially the softening active matter. The softening material, especially the softening active matter, preferably converts hard water into soft water.

[0060] The water softening system is configured to provide an indication to the user that the softening system must

be restored and/or to prevent the steam oven to generate steam until the softening function has been restored, to avoid processing water with excess of hardness and resulting limestone layer creation.

[0061] Preferably, the water softening system is providing an automatic system to detect and to preferably communicate to the user when the softening effectiveness is over or falls below a predefined level.

[0062] In an advantageous embodiment, the water softening system comprises a means to understand when the target or predefined overall amount of water has been reached, to avoid a supply of water exceeding a water hardness threshold to the steam generation system.

[0063] Preferably, the water softening system and/or the water management system provides a direct measurement of the water hardness. More preferably, the sensor means comprises a water hardness sensor in order to perform a direct measurement of the water hardness, which can be installed downstream the softening system.

[0064] As an alternative or in addition, the water softening system and/or the water management system can provide an indirect measurement or estimation of the remaining autonomy of the water softening system, especially whether the second water stream is within a predefined range of water hardness and/or whether the water softening system shall be restored.

[0065] For the indirect measurement or estimation of the remaining autonomy of the softening system and/or the water hardness of the, especially second, water stream, the sensor means preferably comprises a volumetric counter buffering the total amount of water treated by the water softening system and provided to the steam generation system.

[0066] The water softening system can also comprise a sanitizing unit, which can be integrated into the water softening system and/or into the oven. Preferably, the sanitizing unit comprises means to prevent microbial proliferation over the life span of the oven.

[0067] The sanitizing unit can comprise antimicrobial additives in the materials constituting the components in contact with the water and/or sanitizing agent dispensers.

[0068] In an embodiment, the steam oven can be a solo steam appliance, wherein exclusively pure steam cooking functions are available, as no heating systems beside the steam generation system are available. As an alternative, the steam oven can also be a combi steam appliance, wherein steam can be used alone for cooking, or combined with other heating systems, to merge the heating effect of steam with other heating systems. Heating systems can be convection heating and/or hot air and/or upper heat and/or lower heat.

[0069] The steam oven can preferably be an electric and/or domestic oven and/or a household oven.

[0070] The steam oven can preferably be a built-in oven, a stand-alone-oven, a high-end oven, a low class oven or a mid-range oven.

[0071] The steam oven can preferably comprise one or more of the following: a housing, an oven cavity, an oven door with a handle or grip, a convection heating unit in combination with a convection fan and/or an air baffle, an upper heating unit, a lower heating unit and a fan for sucking air out of the cavity through a suction hole.

[0072] Preferably, the steam oven comprises one or more of the following: a steam generation system with a pipe to submit steam into the oven cavity, an oven control unit with an estimation unit and a flood prevention unit, an operating panel for operating the oven as well as items to be cooked arranged on a baking tray.

[0073] According to the independent method claim, the invention also relates to a method for a steam oven with a water management system, especially according to one of the preceding claims, the water management system comprising

- a water softening system comprising a water inlet and a water outlet,
- wherein the water inlet is connected or connectable to a water supply,
- wherein the water outlet is connected or connectable to a steam generation system of the steam oven,

wherein the method comprises the following steps:

- reducing, by means of the water softening system, a water hardness of the water stream,
- providing, by sensor means sensor values of the water stream to an estimation unit and
- estimating by means of the estimation unit, based on the sensor values, whether the water hardness is within a predefined range.

[0074] According to the invention, the sensor values used by the estimation unit are water hardness values and/or cumulative water amount values as described above in connection with the independent device claim.

[0075] In an embodiment, a first water stream, especially hard water or inlet water, flows or can flow from the water supply through the water inlet and a second water stream, especially softened water, for the steam generation system flows or can flow through the water outlet.

[0076] Preferably, the method further comprises the following step: reducing, by means of the water softening system, a first water hardness of the first water stream at the water inlet to a second water hardness of the second water stream

at the water outlet.

[0077] The present invention will be described in further detail with reference to the drawing from which further features, embodiments and advantages may be taken, and in which:

FIG 1 shows a steam oven according to an embodiment of the invention.

[0078] FIG 1 shows an embodiment of the invention which is further described in the following. FIG. 1 shows a steam oven 2 as an electric domestic oven. The oven 2 comprises an oven cavity 90 which is arranged within a housing 91. At the front side, the oven cavity 90 is delimited by an oven door 46 with a handle or grip 45.

[0079] The oven 2 further comprises, at the back side of the cavity 90, a convection heating unit 42 in combination with a convection fan 44 and an air baffle 48.

[0080] The oven 2 further comprises a not shown upper heating unit, a lower heating unit 47 and a fan 50 for sucking air out of the cavity 90 through a suction hole 53 as input and an output channel 52 as an output.

[0081] The oven 2 further comprises a steam generation system 70 with a pipe 71 to submit steam into the oven cavity 90. An oven control unit 30 provides control functions for the oven. The oven control unit 30 comprises an estimation unit 31 and a flood prevention unit 33. The oven 2 further comprises an operating panel 51 at its front side above the door for operating the oven 2. Within the cavity 90, items to be cooked 94 are arranged on a baking tray 93.

[0082] FIG 1 further shows a water management system 1 for the steam oven 2. The water management system 1 comprises a water softening system 20. The water softening system 20 comprises a water inlet 22 and a water outlet 23. The water inlet 22 is connected or connectable to a water supply 61.

[0083] The water outlet 23 is connected or connectable to the steam generation system 70 of the steam oven 2. A first water stream 11, especially hard water or inlet water, from the water supply 61 flows or can flow through the water inlet 22. A second water stream 12, especially soft water or softened water, for the steam generation system 70 flows or can flow through the water outlet 23.

[0084] The following table shows the classifications, thresholds, ranges and hardness levels for soft water, moderately hard water, hard water, very hard water and extremely hard water. A predefined range of the water hardness of the water stream 11, 12 can be at least one of the following ranges and/or a combination thereof.

Classification	Hardness in mg/L	Hardness in °dH	Hardness in °F
Soft	0-70	0-4	0-7
Moderately hard	70-140	4-8	7-14
Hard	140-220	8-13	14-22
Very hard	220-320	13-18	22-32
Extremely hard	>320	>18	>32

[0085] A predefined range of the water hardness of the water stream 11, 12 can be one of or a combination of the above defined ranges. A predefined range of the water hardness of the water stream 11, 12 therefore may be for example, a range between 0°F and 7°F and/or 0°dH and 4°dH and/or between 0 and 70 mg/L CaCO₃ (calcium carbonate).

[0086] Hard water can be at least one of more of moderately hard water, hard water, very hard water and/or extremely hard water. Possible ranges for hard water can be between 7°F and more than 32°F, between 4°dH and more than 18°dH and/or between 70 and more than 320 mg/L CaCO₃, respectively. Possible ranges for moderately hard water are between 4°dH and 8°dH or between 70 and 140 mg/L CaCO₃, respectively. Possible ranges for hard water can also be between 8°dH and 13°dH or between 140 and 220 mg/L CaCO₃, respectively. Possible ranges for very hard water are between 13°dH and 18°dH or between 220 and 320 mg/L CaCO₃, respectively. Possible ranges for extremely hard water are above 18°dH or above 320 mg/L CaCO₃, respectively.

[0087] Soft water is preferably water with a low concentration of mineral content and/or water after a treatment by the water softening system 20. More preferably, soft water can be water which contains less than 60 ppm or 3.37 dGH or 3.37 °dH or 33.7 mg/L CaO. Possible ranges for soft water are between 0°F and 7°F, between 0°dH and 4°dH and/or between 0 and 70 mg/L CaCO₃, respectively.

[0088] The water softening system 20 comprises means to reduce a first water hardness of the first water stream 11 at the water inlet 22 to a second water hardness of the second water stream 12 at the water outlet 23.

[0089] An advantageous way to reduce a first water hardness of the first water stream 11 at the water inlet 22 to a second water hardness of the second water stream 12 at the water outlet 23 is the use of ion exchange resins, phosphates dispensers and/or reverse osmosis systems as water-hardness reduction means, preferably contained in one or more cartridges 24.

[0090] Such cartridges 24 can deal or interact with a total fixed amount of ions, especially Ca and Mg, corresponding to a total amount of water.

[0091] Dealing or interacting with the water stream, especially with a total fixed amount of Ca and/or Mg, can especially comprise exchanging the ions by a ion exchanger. For example, the Ca-ions (Ca^{++} ; Calcium-ions) and/or the Mg-ions (Mg^{++} ; Magnesium-ions) can be exchanged against Na-ions (Na^{+} ; Natrium-ions). As an alternative or in addition, dealing or interacting can comprise dispensing phosphates in a phosphates dispenser and/or pressing the water through a membrane in a reverse osmosis system.

[0092] Dealing with a total fixed amount of water preferably means that for this fixed amount of water, the water hardness of the water stream is within the predefined range. The total amount of water can preferably be variable depending on the hardness of the water stream from the water supply at the water inlet 22.

[0093] The ion exchange resins can be regenerated, as also used in dishwasher water softeners, which are regenerated by Natrium Chloride (NaCl) to recover the water softening functionality.

[0094] When the sensor means 80 and/or the estimation unit 31 identifies an expiration of the softening cartridge 24, a service operation is triggered, which can be either a regeneration or a replacement of the cartridge 24 or its content. For oven applications, due to relatively low amount of water needed, the replacement of the cartridge 24 can be privileged, especially when the cartridge 24 is dimensioned in such a way that the water softening capabilities last for around 2 years or longer.

[0095] FIG 1 further shows sensor means 80 at the water outlet 23 for providing sensor values of the second water stream 12 to the estimation unit 31, for example by means of a first transmission line 32 or a radio transmission. As an alternative or in addition, but not shown, the sensor means 80 can also be arranged partly or entirely at the water inlet 22 for providing sensor values of the first water stream 11 to the estimation unit 31.

[0096] The sensor means 80 comprises at least one or more sensors of at least one of the following two classes (i.e. of the first class and/or of the second class), which will be described in the following.

[0097] The water softening system 20 can provide a direct measurement, preferably a water hardness sensor, installed downstream the softening system at the second water stream 12 within the sensor means 80. In addition or as an alternative, the water softening system 20 can also provide an indirect measurement or determination, for example a volumetric counter buffering the total amount of water treated by the softening system 20 and provided to the steam generation system 70.

[0098] The sensor means 80 can comprise a first class of sensors. In this case, the sensor means can perform a direct measurement of the water hardness. Such sensor means can directly measure the water hardness, preferably at the water outlet 23, immediately identify when the water softening system 20 ceases or reduces its performance, and preferably indicate the need for restoration or regeneration. Examples for such sensor means 80 are conductivity sensor means, optical sensor means or capacitive sensor means. An advantage of such sensor means 80 is or may be the direct feedback on the final outflow water hardness at the water outlet 23, regardless of possible contingencies like, for example, water hardness fluctuations, mechanical failures and/or defective components of the water softening system 20.

[0099] Furthermore, the sensor means 80 can comprise a second class of sensors. In this case, the sensor means 80 can perform a total cumulative water amount calculation of the water stream 11, 12, for example by volumetric counters or flow meters. Based on the second class of sensor means 80, the estimation unit 31 can preferably determine and/or indicate an expiration of the softening system 20 by assuming the hardness of the water at the water inlet 22 constant, while the maximum amount of water the water softening system 20 can treat is predetermined. Even though the second class of sensors can be blind to contingencies like, for example, water hardness fluctuations, mechanical failures and/or defective components of the water softening system 20, the second class of sensors is normally easier to integrate and can be more economical.

[0100] The first and second classes of sensors, for the purpose of the invention, can work alone, or can be combined as a sensor means 80 to ensure double check of the water hardness, for example.

[0101] In addition, the sensor means 80 can further comprise a third class of sensors. In this case, the sensor means 80 can measure water spillage and perform leakage detection via threshold conductivity sensors or floater based sensors. Also this third class of sensors can also be combined with one or more of the first and second class to ensure double check of the water hardness, for example.

[0102] The first class of sensors is put downstream the water softening system 20, for example at or near the water outlet 23. The first class of sensors thus monitors the supposedly softened water. The second class can be placed before or after the water softening system 20, for example at or near the water inlet 22 or at or near the water outlet 23, as the water flow is at least essentially the same.

[0103] FIG 1 also shows the estimation unit 31 which estimates based on the sensor values whether the water hardness is within a predefined range or below a predefined level. In addition, the estimation unit 31 can also estimate based on the sensor values whether the water softening system 20 shall be restored.

[0104] The water management system 1 avoids a descaling operation of the steam generation system 70 of the steam oven 2. It is possible to integrate the water softening system 20 as a self-diagnosing and regeneration free means into

the steam oven 2.

[0105] Therefore, the water management system 1 prevents the need to deal with chemicals to perform the descaling operation of the steam generation system 70. In addition, the water management system eliminates downtime of the steam oven 2 due to a descaling operation, as no descaling operation is necessary.

[0106] The water management system 1 also improves the efficiency of the steam generation system 70 by eliminating the steady process of limestone accumulation and subsequent removal.

[0107] The water softening system 20 is in FIG 1 externally to the steam oven 2. Alternatively and not shown, the water softening system 20 can be also integrated into the steam oven 2.

[0108] The water softening system 20 is adapted and connected to the water supply 61. The water supply 61 can be a water tap and/or a fixed or removable drawer and/or a fixed water connection.

[0109] The water supply 61 for the steam oven 2 can be set up as a fixed water tank which needs to be filled using an additional water jar. As a first alternative, the water supply 61 for the steam oven 2 can also be set up as an extractable water tank which can be extracted from the oven and filled directly on the water tap. As a second alternative, the water supply 61 for the steam oven 2 can also be set up as a fixed water connection to the water supply system of the house, for example to a water tap.

[0110] The water management system 1 is dimensioned to keep the second water stream 12 below a water hardness target for a defined amount of supplied water, in order to cover a certain and/or predefined steam oven usage time, preferably the whole lifetime of the oven 2. The water management system 1 can provide long term duration of the steam generation system 70, preferably life long duration without service.

[0111] The water management system 1 is intended to treat a predefined amount of water in the first water stream 11, wherein the steam generation system 70 is able to handle a predefined amount of minerals as residual hardness of the second water stream 12, so that the oven is able to run a predefined number of steam cycles.

[0112] As a non-limiting example, the water management system can be intended to treat a predefined amount of 500 l to 800 l of water in the first water stream 11. The steam generation system 70 can be able to handle a predefined amount of approximately 15 g to 21 g of minerals as residual hardness of the second water stream 12. Therefore, in the example, the steam oven 2 is able to run a predefined number of 400 to 600 steam cycles with a maximum water consumption of each cycle of 1l and applying a safety factor of 1,5.

[0113] The water management system 1, in an embodiment, is intended to provide the second water stream 12, preferably softened water, with a water hardness below 3° F or below 7° F and/or corresponding to 3 mg/l or 7 mg/l of CaCO₃ to the steam generation system.

[0114] The water management system 1 is also capable to handle different levels of water hardness of the first water stream 11. This handling can be performed automatically or by a calibration process performed during the installation of the steam oven 2.

[0115] The sensor means 80 as part of the water management system 1 comprises or can comprise a water hardness sensor means and/or a volume counter and/or a flow measurement unit. The sensor means can be placed in an area where water could flow in case of failures or uncontrolled water supply.

[0116] The water management system 1 comprises a flood prevention unit 33, especially an integrated anti-flooding system. The flood prevention unit is intended to stop the first water stream 11 after a continuous flow of a determined amount of litres of water.

[0117] The flood prevention unit 33 controls a valve 60 for blocking the water supply 61 by means of a second transmission line 34 or a radio transmission.

[0118] The flood prevention unit 33 is connected to the sensor means 80. The sensor means can comprise a water detection means and/or a volume counter, so that the valve 60 can be closed upon water detection and/or uncontrolled water supply.

[0119] Upon reach of a predefined overall amount of water, the water softening system 20 can be restored. The water softening system 20 can be restored by changing or renewing the disposable cartridge 24 containing the softening material, especially the softening active matter. Restoring can be performed by changing the disposable cartridge 24 which contains the softening active matter.

[0120] The water softening system 20 provides an indication to the user that the softening system 20 must be restored and/or prevents the steam oven to generate steam until the softening function has been restored, to avoid processing water with excess of hardness and resulting limestone layer creation. Examples of such an indication to the user are an optical and/or acoustical signalling.

[0121] The water softening system 20 is providing an estimation unit 31 to detect and to preferably communicate to the user when the softening effectiveness is over or falls below a predefined level.

[0122] The estimation unit 31 estimates when the target or predefined overall amount of water of the water softening system 20 has been reached, to avoid a supply of water exceeding a water hardness threshold to the steam generation system 70.

[0123] The water softening system 20 can also comprise a sanitizing unit 21, which can be integrated into the water

softening system 20. The sanitizing unit 21 comprises means to prevent microbial proliferation over the life span of the system and antimicrobial additives in the materials constituting the components in contact with the water and/or sanitizing agent dispensers.

5 List of reference numerals

[0124]

- | | | |
|----|----|--------------------------|
| | 1 | water management system |
| 10 | 2 | steam oven |
| | 11 | first water stream |
| | 12 | second water stream |
| | 20 | water softening system |
| | 21 | sanitizing unit |
| 15 | 22 | water inlet |
| | 23 | water outlet |
| | 24 | cartridge |
| | 30 | oven control unit |
| | 31 | estimation unit |
| 20 | 32 | first transmission line |
| | 33 | flood prevention unit |
| | 34 | second transmission line |
| | 42 | convection heating unit |
| | 44 | convection fan |
| 25 | 45 | handle or grip |
| | 46 | oven door |
| | 47 | lower heating unit |
| | 48 | air baffle |
| | 50 | fan |
| 30 | 51 | operating panel |
| | 52 | output channel |
| | 53 | suction hole |
| | 60 | valve |
| | 61 | water supply |
| 35 | 70 | steam generation system |
| | 71 | pipe |
| | 80 | sensor means |
| | 90 | oven cavity |
| | 91 | housing |
| 40 | 92 | items to be cooked |
| | 93 | baking tray |

Claims

- 45 1. Steam oven (2) with a water management system (1) for the steam oven (2), the water management system (1) comprising:
- a water softening system (20) comprising a water inlet (22) and a water outlet (23),
 - 50 - wherein the water inlet (22) is connected or connectable to a water supply (61),
 - wherein the water outlet (23) is connected or connectable to a steam generation system (70) of the steam oven (2),
 - wherein the water softening system (20) comprises water-hardness reduction means (24) to reduce a water hardness of a water stream (11, 12),
 - 55 - further comprising sensor means (80) for providing sensor values of the water stream (11, 12) to an estimation unit (31),
- the steam oven comprising an oven control unit (30) providing control functions for the steam oven (2), wherein the oven control unit (30) comprises the estimation unit (31), wherein the estimation unit (31) is configured to

estimate based on the sensor values whether the water hardness of the water stream (11, 12) is within a predefined range,
wherein

A) the sensor means (80) comprises a first class of sensor means configured to perform a direct measurement of the water hardness downstream the water softening system (20), preferably conductivity sensor means, optical sensor means and/or capacitive sensor means,
and/or

B) the sensor means (80) comprises a second class of sensor means configured to perform a total cumulative water amount calculation of the water stream (11, 12), for example by volumetric counters or flow meters, wherein, in case B), the estimation unit (31) is configured to estimate whether the water hardness of the water stream (11, 12) is within a predefined range based on the calculated cumulative water amount by assuming the hardness of the water at the water inlet (22) constant, while the maximum amount of water the water softening system (20) can treat is predetermined,

and wherein the water softening system (20)

- can be restored upon reach of a predefined overall amount of water and/or upon exceeding a predefined threshold for the water hardness, preferably by changing a disposable cartridge (24) containing softening material, especially softening active matter, and/or

- is configured, upon reach of a predefined overall amount of water and/or upon exceeding a predefined threshold for the water hardness, to provide an indication to the user that the softening system (20) must be restored and/or to prevent the steam generation system (70) to generate steam until the softening function has been restored, to avoid processing water with an excess of hardness and resulting limestone layer creation.

2. Steam oven (2) according to claim 1,

- wherein a first water stream (11), especially hard water or inlet water, from the water supply (61) can flow through the water inlet (22) and a second water stream (12), especially soft or softened water, for the steam generation system (70) can flow through the water outlet (23) and/or

- wherein the estimation unit (31) is configured to estimate based on the sensor values whether the water hardness of the water stream (12), especially of the second water stream (12), is within a predefined range and/or whether the water softening system (20) shall be restored and/or

- wherein hard water is preferably at least one of more of moderately hard water, hard water, very hard water and/or extremely hard water, wherein a predefined range of the water hardness, especially for hard water, is or can be between 7°F and more than 32°F, between 4°dH and more than 18°dH and/or between 70 and more than 320 mg/L CaCO₃, respectively and/or

- wherein soft water or softened water is preferably water with a low concentration of mineral content and/or water after a treatment by the water softening system (20), wherein more preferably, soft water is or can be water which contains less than 60 ppm or 3.37 dGH or 3.37 °dH or 33.7 mg/L CaO, wherein a predefined range is or can be, especially for soft water, between 0°F and 7°F, between 0°dH and 4°dH and/or between 0 and 70 mg/L CaCO₃, respectively.

3. Steam oven (2) according to claim 1 or 2,

- wherein the water softening system (20) comprises water-hardness reduction means (24) to reduce a first water hardness of the first water stream (11) at the water inlet (22) to a second water hardness of the second water stream (12) at the water outlet (23) and/or

- wherein the water-hardness reduction means (24) comprise or use at least one of ion exchange resins, phosphates dispensers and reverse osmosis systems, preferably contained in at least one cartridge and/or

- wherein the water-hardness reduction means (24) and/or the at least one cartridge can deal or interact with, especially absorb and/or exchange, a total fixed amount of ions, especially Ca and/or Mg, corresponding to a total or predetermined amount of water.

4. Steam oven (2) according to claim 1, wherein the water management system

a) avoids a descaling operation of the steam generation system (70) and/or integrates the water softening

system (20) as a self-diagnosing and regeneration free means into the steam oven (2) and/or
b) prevents the need to deal with chemicals to perform a descaling operation of the steam generation system (70) and/or
c) eliminates downtime of the steam oven (2) due to a descaling operation and/or
d) improves the efficiency of the steam generation system (70) by eliminating the steady process of limestone accumulation and subsequent removal.

5. Steam oven (2) according to claim 1 or 2, wherein

a) the water softening system (20) is integratable into the steam oven (2) or externally to the steam oven (2) and/or
b) the water softening system (20) is adapted and/or connected to the water supply (61) and/or
c) the water supply (61) is a water tap and/or a water pipe and/or a fixed water connection and/or a water tank and/or a fixed or removable drawer, wherein the water supply (61) is preferably

c1) a fixed water tank within the steam oven (2) which needs to be filled using an additional water jar and/or
c2) an extractable water tank which can be extracted from the steam oven (2) and filled directly on a water tap and/or
c3) a fixed water connection to the water supply system of the house, for example to a water tap.

6. Steam oven (2) according to one of the preceding claims, wherein the water management system is

a) dimensioned to keep the, especially second, water stream (12) below a water hardness target for a defined amount of supplied water, in order to cover a predefined steam oven usage time, preferably the whole lifetime of the steam oven (2), and/or

b) providing long term duration of the steam oven, preferably life long duration without service and/or
c) intended to treat a predefined amount, preferably 500 l to 800 l, of water in the water stream (11), wherein the steam generation system (70) is able to handle a predefined amount of minerals, preferably approximately 15 g to 21 g, as residual hardness of the, especially second, water stream (12), so that the steam oven is able to run a predefined number, preferably 400 to 600, of steam cycles, preferably with a maximum water consumption of each cycle of 1l and/or applying a safety factor of 1 to 1,5, and/or

c) intended to provide the, especially second, water stream (12), preferably softened water, within a predefined range of water hardness or with a predefined water hardness, preferably below 3° F or 7° F or between 0°F and 7°F and/or corresponding to 3 mg/l or 7 mg/l of CaCO₃ to the steam generation system (70) and/or

d) capable to handle different levels of water hardness of the, especially first, water stream (11), preferably automatically or by a calibration process performed during the installation of the steam oven (2).

7. Steam oven (2) according to one of the preceding claims,

- wherein the sensor means (80) are at the water outlet (23) and/or at the water inlet (22) for providing sensor values of the, especially first, water stream (11) and/or of the, especially second, water stream (12) to an estimation unit (31) and/or

- wherein the sensor means (80) comprises a water hardness sensor means and/or a volume counter and/or a flow measurement unit, wherein the sensor means is preferably placed in an area where water could flow in case of failures or uncontrolled water supply and/or

- wherein the sensor means (80) preferably also comprises a third class of sensor means, wherein the sensor means is preferably configured to measure water spillage and/or perform leakage detection, especially via threshold conductivity sensors or float based sensors.

8. Steam oven (2) according to claim 1, wherein a first water stream (11), especially hard water or inlet water, from the water supply (61) can flow through the water inlet (22) and a second water stream (12), especially soft or softened water, for the steam generation system (70) can flow through the water outlet (23) and

- wherein the estimation unit (31) is configured to estimate based on the sensor values whether the water hardness of the water stream (12), especially of the second water stream (12), is within a predefined range or whether the water softening system (20) shall be restored.

9. Steam oven (2) according to claim 8,

- wherein hard water is preferably is or can be between 7°F and more than 32°F, between 4°dH and more than 18°dH and/or between 70 and more than 320 mg/L CaCO₃, respectively and
 - wherein soft water is or can be water which contains less than 60 ppm or 3.37 dGH or 3.37 °dH or 33.7 mg/L CaO, wherein a predefined range is or can be, especially for soft water, between 0°F and 7°F, between 0°dH and 4°dH and/or between 0 and 70 mg/L CaCO₃, respectively.

10. Steam oven (2) according to claim 1 or 8 or 9,

- wherein the water softening system (20) comprises water-hardness reduction means (24) to reduce a first water hardness of the first water stream (11) at the water inlet (22) to a second water hardness of the second water stream (12) at the water outlet (23) and
 - wherein the water-hardness reduction means (24) comprise or use at least one of ion exchange resins, phosphates dispensers and reverse osmosis systems, preferably contained in at least one cartridge.

11. Steam oven (2) according to any of claims 1, 9 or 10,

- wherein the sensor means (80) are at the water outlet (23) and/or at the water inlet (22) for providing sensor values of the, especially first, water stream (11) and/or of the, especially second, water stream (12) to an estimation unit (31) and
 - wherein the sensor means (80) comprises a water hardness sensor means and/or a volume counter and/or a flow measurement unit, wherein the sensor means is preferably placed in an area where water could flow in case of failures or uncontrolled water supply and
 - wherein the sensor means (80) preferably comprises a third class of sensor means configured to measure water spillage and/or perform leakage detection, especially via threshold conductivity sensors or float based sensors.

12. Steam oven (2) according to one of the preceding claims, wherein the water management system comprises a flood prevention unit (33), especially an integrated anti-flooding system, wherein preferably the flood prevention unit

a) is intended to stop the, especially first, water stream (11) after a continuous flow of a determined amount of litres of water and/or
 b) controls a valve (60) for blocking the water supply (61) and/or
 c) is connected to the sensor means (80), wherein the sensor means especially comprises a water detection means and/or a volume counter, so that the valve can be closed upon water detection and/or uncontrolled water supply.

13. Steam oven (2) according to one of the preceding claims, wherein the estimation unit (31)

a) detects and preferably communicates to the user when the softening effectiveness of the water softening system is over or falls below a predefined level and/or
 b) estimates when the target or predefined overall amount of water for the water softening system has been reached, to avoid a supply of water exceeding a water hardness threshold to the steam generation system (70).

14. Steam oven (2) according to one of the preceding claims, wherein the water softening system comprises an especially integrated sanitizing unit (21), wherein preferably the sanitizing unit comprises

a) means to prevent microbial proliferation over the life span of the steam oven and/or
 b) antimicrobial additives in the materials constituting the components in contact with the water and/or
 c) sanitizing agent dispensers.

15. Steam oven (2) according to one of the preceding claims, wherein

a) the steam oven is a solo steam appliance, wherein only pure steam cooking functions are available, as no heating systems beside the steam generation system are available or
 b) wherein the steam oven is a combi steam appliance, wherein steam can be used alone for cooking, or combined with other heating systems, to merge the heating effect of steam with other heating systems, especially with hot air and/or upper heat and/or lower heat.

16. Steam oven (2) according to claim 15, comprising

- an oven cavity (90)
- a steam generation system (70) with a pipe (71) to submit steam into the oven cavity (90)
- an oven control unit (30) providing control functions for the oven and the estimation unit (31);
- the water management system (1),

wherein the water outlet of the water management system is connected to the steam generation system (70) of the steam oven (2).

17. Steam oven (2) according to claim 15 or 16, wherein the steam oven is an electric domestic oven comprising one or more of the following: a housing (91), an oven cavity (90), an oven door (46) with a handle or grip (45), a convection heating unit (42) in combination with a convection fan (44) and/or an air baffle (48), an upper heating unit, a lower heating unit (47), a fan (50) for sucking air out of the cavity (90) through a suction hole (53), a steam generation system (70) with a pipe (71) to submit steam into the oven cavity (90), an oven control unit (30) with the estimation unit (31) and a flood prevention unit (33), an operating panel (51) for operating the oven as well as items to be cooked (92) arranged on a baking tray (93).

18. Method for operating a steam oven (2) with a water management system according to one of the preceding claims, the water management system comprising

- a water softening system (20) comprising a water inlet (22) and a water outlet (23),
- wherein the water inlet (22) is connected or connectable to a water supply (61),
- wherein the water outlet (23) is connected or connectable to a steam generation system (70) of the steam oven (2), wherein the method comprises the following steps:
- reducing, by means of the water softening system (20), a water hardness of the water stream (11, 12),
- providing, by sensor means (80), sensor values of the water stream (11, 12) to an estimation unit (31), wherein the estimation unit (31) is part of a control unit (30) providing control functions for the steam oven (2), the sensor values being water hardness values and/or cumulative water amount values and
- estimating, by means of the estimation unit (31), based on the sensor values whether the water hardness is within a predefined range, wherein, if the sensor values are cumulative water amount values, the estimation is performed assuming the hardness of the water at the water inlet (22) constant, while the maximum amount of water the water softening system (20) can treat is predetermined, and
- upon reaching a predefined overall amount of water and/or upon exceeding a predefined threshold for the water hardness, providing an indication to the user that the softening system (20) must be restored and/or preventing the steam generation system from generate steam until the softening system has been restored, in order to avoid processing water with an excess of hardness and resulting limestone layer creation.

19. Method according to claim 18,

- wherein a first water stream (11), especially hard water or inlet water, can flow from the water supply (61) through the water inlet (22) and a second water stream (12), especially softened water, for the steam generation system (70) can flow through the water outlet (23) and/or
- wherein the method further comprises the following step: reducing, by means of the water softening system (20), a first water hardness of the first water stream (11) at the water inlet (22) to a second water hardness of the second water stream (12) at the water outlet (23).

20. Method according to claim 19, wherein the method further comprises the following step or steps:

- providing, by sensor means (80) at the water outlet (23) and/or at the water inlet (22), sensor values of the first water stream (11) and/or of the second water stream (12) to an estimation unit (31) and
- estimating by means of the estimation unit (31), based on the sensor values whether the water hardness is within a predefined range and/or whether the water softening system (20) shall be restored.

Patentansprüche

1. Dampfgargerät (2) mit einem Wasserverwaltungssystem (1) für das Dampfgargerät (2), wobei das Wasserverwal-

tungssystem (1) umfasst:

- ein Wasserenthärtungssystem (20), das einen Wassereinlass (22) und einen Wasserauslass (23) umfasst,
- wobei der Wassereinlass (22) mit einer Wasserversorgung (61) verbunden oder verbindbar ist,
- wobei der Wasserauslass (23) mit einem Dampferzeugungssystem (70) des Dampfgargeräts (2) verbunden oder verbindbar ist,
- wobei das Wasserenthärtungssystem (20) Wasserhärtereduktionsmittel (24) umfasst, um eine Wasserhärte eines Wasserstroms (11, 12) zu reduzieren,
- ferner umfassend ein Sensormittel (80) zum Bereitstellen von Sensorwerten des Wasserstroms (11, 12) an eine Schätzeinheit (31), wobei das Dampfgargerät eine Gargerätsteuereinheit (30) umfasst, die Steuerfunktionen für das Dampfgargerät (2) bereitstellt, wobei die Gargerätsteuereinheit (30) die Schätzeinheit (31) umfasst, wobei die Schätzeinheit (31) dazu ausgelegt ist, basierend auf den Sensorwerten zu schätzen, ob die Wasserhärte des Wasserstroms (11, 12) innerhalb eines vordefinierten Bereichs liegt,

wobei

A) das Sensormittel (80) eine erste Klasse von Sensormitteln umfasst, die dazu ausgelegt sind, eine direkte Messung der Wasserhärte stromabwärts des Wasserenthärtungssystems (20) durchzuführen, vorzugsweise Leitfähigkeitssensormittel, optische Sensormittel und/oder kapazitive Sensormittel,

und/oder

B) das Sensormittel (80) eine zweite Klasse von Sensormitteln umfasst, die dazu ausgelegt sind, eine kumulative Gesamtwassermengenberechnung des Wasserstroms (11, 12) durchzuführen, zum Beispiel durch Volumenzähler oder Durchflussmesser,

wobei im Fall B) die Schätzeinheit (31) dazu ausgelegt ist, basierend auf der berechneten kumulativen Wassermenge zu schätzen, ob die Wasserhärte des Wasserstroms (11, 12) innerhalb eines vordefinierten Bereichs liegt, indem die Härte des Wassers am Wassereinlass (22) als konstant angenommen wird, während die maximale Wassermenge, die das Wasserenthärtungssystem (20) behandeln kann, vorgegeben ist, und wobei das Wasserenthärtungssystem (20)

- bei Erreichen einer vordefinierten Gesamtwassermenge und/oder bei Überschreiten eines vordefinierten Schwellenwerts für die Wasserhärte wiederhergestellt werden kann, vorzugsweise durch Auswechseln einer Einwegkartusche (24), die Enthärtungsmaterial, insbesondere Enthärtungsaktivstoffe, enthält, und/oder

- dazu ausgelegt ist, bei Erreichen einer vordefinierten Gesamtwassermenge und/oder bei Überschreiten eines vordefinierten Schwellenwerts für die Wasserhärte dem Benutzer anzuzeigen, dass das Enthärtungssystem (20) wiederhergestellt werden muss und/oder zu verhindern, dass das Dampferzeugungssystem (70) Dampf erzeugt, bis die Enthärtungsfunktion wiederhergestellt ist, um die Verarbeitung von Wasser mit einem Härteüberschuss und die daraus resultierende Bildung einer Kalksteinschicht zu vermeiden.

2. Dampfgargerät (2) nach Anspruch 1,

- wobei durch den Wassereinlass (22) ein erster Wasserstrom (11), insbesondere hartes Wasser oder Zulaufwasser, aus der Wasserversorgung (61) und durch den Wasserauslass (23) ein zweiter Wasserstrom (12), insbesondere weiches oder enthärtetes Wasser, für das Dampferzeugungssystem (70) fließen kann und/oder
- wobei die Schätzeinheit (31) dazu ausgelegt ist, basierend auf den Sensorwerten zu schätzen, ob die Wasserhärte des Wasserstroms (12), insbesondere des zweiten Wasserstroms (12), innerhalb eines vordefinierten Bereichs liegt und/oder ob das Wasserenthärtungssystem (20) wiederhergestellt werden soll und/oder
- wobei hartes Wasser vorzugsweise mindestens eines oder mehr von mäßig hartem Wasser, hartem Wasser, sehr hartem Wasser und/oder extrem hartem Wasser ist, wobei ein vordefinierter Bereich der Wasserhärte, insbesondere für hartes Wasser, zwischen 7 °F und mehr als 32 °F, zwischen 4 °dH und mehr als 18 °dH und/oder zwischen 70 und mehr als 320 mg/L CaCO₃ liegt bzw. liegen kann und/oder
- wobei weiches Wasser oder enthärtetes Wasser vorzugsweise Wasser mit einer niedrigen Konzentration an Mineralien und/oder Wasser nach einer Behandlung durch das Wasserenthärtungssystem (20) ist, wobei noch bevorzugter weiches Wasser Wasser ist oder sein kann, das weniger als 60 ppm oder 3,37 dGH oder 3,37 °dH oder 33,7 mg/L CaO enthält, wobei ein vordefinierter Bereich, insbesondere für weiches Wasser, zwischen 0 °F und 7 °F, zwischen 0 °dH und 4 °dH und/oder zwischen 0 und 70 mg/L CaCO₃ liegt oder liegen kann.

3. Dampfgargerät (2) nach Anspruch 1 oder 2,

- wobei das Wasserenthärtungssystem (20) ein Wasserhärtereduktionsmittel (24) umfasst, um eine erste Wasserhärte des ersten Wasserstroms (11) am Wassereinlass (22) auf eine zweite Wasserhärte des zweiten Wasserstroms (12) am Wasserauslass (23) zu reduzieren und/oder
- wobei das Wasserhärtereduktionsmittel (24) mindestens eines von Ionenaustauscherharzen, Phosphatspendern und Umkehrosmosesystemen umfasst oder verwendet, die vorzugsweise in mindestens einer Kartusche enthalten sind und/oder
- wobei das Wasserhärtereduktionsmittel (24) und/oder die mindestens eine Kartusche mit einer festgelegten Gesamtmenge an Ionen, insbesondere Ca und/oder Mg, die einer Gesamt- oder vorbestimmten Wassermenge entspricht, umgehen oder interagieren, insbesondere absorbieren und/oder austauschen kann.

4. Dampfgargerät (2) nach Anspruch 1, wobei das Wasserverwaltungssystem

- a) einen Entkalkungsvorgang des Dampferzeugungssystems (70) vermeidet und/oder das Wasserenthärtungssystem (20) als selbstdiagnostizierendes und regenerationsfreies Mittel in das Dampfgargerät (2) integriert und/oder
- b) den Umgang mit Chemikalien zur Durchführung eines Entkalkungsvorgangs des Dampferzeugungssystems (70) verhindert und/oder
- c) die Stillstandszeiten des Dampfgargeräts (2) aufgrund eines Entkalkungsvorgangs eliminiert und/oder
- d) die Effizienz des Dampferzeugungssystems (70) durch Eliminieren des stetigen Prozesses der Kalksteinablagerung und anschließenden Entfernung verbessert.

5. Dampfgargerät (2) nach Anspruch 1 oder 2, wobei

- a) das Wasserenthärtungssystem (20) in das Dampfgargerät (2) oder außerhalb des Dampfgargeräts (2) integrierbar ist und/oder
- b) das Wasserenthärtungssystem (20) an die Wasserversorgung (61) angepasst und/oder angeschlossen ist und/oder
- c) die Wasserversorgung (61) ein Wasserhahn und/oder eine Wasserleitung und/oder ein Festwasseranschluss und/oder ein Wassertank und/oder eine feste oder herausnehmbare Schublade ist, wobei die Wasserversorgung (61) vorzugsweise Folgendes ist:
 - c1) ein fester Wassertank innerhalb des Dampfgargeräts (2), der mit einem zusätzlichen Wassertopf befüllt werden muss und/oder
 - c2) ein herausnehmbarer Wassertank, der aus dem Dampfgargerät (2) herausgenommen und direkt an einem Wasserhahn befüllt werden kann und/oder
 - c3) ein fester Wasseranschluss an das Wasserversorgungssystem des Hauses, z. B. an einen Wasserhahn.

6. Dampfgargerät (2) nach einem der vorhergehenden Ansprüche, wobei das Wasserverwaltungssystem:

- a) so bemessen ist, dass der, insbesondere zweite, Wasserstrom (12) unterhalb eines Wasserhärtesollwertes für eine definierte Menge an zugeführtem Wasser gehalten wird, um eine vordefinierte Nutzungszeit des Dampfgargeräts, vorzugsweise die gesamte Lebensdauer des Dampfgargeräts (2), abzudecken, und/oder
- b) eine lange Nutzungsdauer des Dampfgargeräts, vorzugsweise eine lebenslange Nutzungsdauer ohne Wartung bereitzustellen und/oder
- c) dazu bestimmt ist, eine vordefinierte Menge, vorzugsweise 500 l bis 800 l, Wasser im Wasserstrom (11) zu behandeln, wobei das Dampferzeugungssystem (70) in der Lage ist, eine vordefinierte Menge an Mineralien, vorzugsweise etwa 15 g bis 21 g, als Resthärte des, insbesondere zweiten, Wasserstroms (12) zu verarbeiten, sodass das Dampfgargerät in der Lage ist, eine vordefinierte Anzahl, vorzugsweise 400 bis 600, von Dampfsyklen, vorzugsweise mit einem maximalen Wasserverbrauch jedes Zyklus von 1 l und/oder unter Anwendung eines Sicherheitsfaktors von 1 bis 1,5, zu fahren, und/oder
- c) dazu bestimmt ist, den, insbesondere zweiten, Wasserstrom (12), vorzugsweise enthärtetes Wasser, innerhalb eines vordefinierten Wasserhärtebereichs oder mit einer vordefinierten Wasserhärte, vorzugsweise unterhalb von 3 °F oder 7 °F oder zwischen 0 °F und 7 °F und/oder entsprechend 3 mg/l oder 7 mg/l CaCO_3 , dem Dampferzeugungssystem (70) zuzuführen und/oder
- d) in der Lage ist, unterschiedliche Wasserhärten des, insbesondere ersten, Wasserstroms (11) zu verarbeiten, vorzugsweise automatisch oder durch einen Kalibriervorgang, der während der Installation des Dampfgargeräts (2) durchgeführt wird.

7. Dampfgargerät (2) nach einem der vorhergehenden Ansprüche,

- wobei das Sensormittel (80) am Wasserauslass (23) und/oder am Wassereinlass (22) zum Bereitstellen von Sensorwerten des, insbesondere ersten, Wasserstroms (11) und/oder des, insbesondere zweiten, Wasserstroms (12) an eine Schätzeinheit (31) vorgesehen ist und/oder
- wobei das Sensormittel (80) ein Wasserhärtesensormittel und/oder einen Volumenzähler und/oder eine Durchflussmesseinheit umfasst, wobei das Sensormittel vorzugsweise in einem Bereich angeordnet ist, in dem im Falle von Störungen oder unkontrollierter Wasserzufuhr Wasser fließen könnte und/oder
- wobei das Sensormittel (80) vorzugsweise auch eine dritte Klasse von Sensormitteln umfasst, wobei das Sensormittel vorzugsweise dazu ausgelegt ist, den Wasseraustritt zu messen und/oder eine Leckageerkennung durchzuführen, insbesondere über Schwellenleitfähigkeitssensoren oder auf Schwimmern basierende Sensoren.

8. Dampfgargerät (2) nach Anspruch 1, wobei durch den Wassereinlass (22) ein erster Wasserstrom (11), insbesondere hartes Wasser oder Zulaufwasser, aus der Wasserversorgung (61) und durch den Wasserauslass (23) ein zweiter Wasserstrom (12), insbesondere weiches oder enthärtetes Wasser, für das Dampferzeugungssystem (70) fließen kann und

- wobei die Schätzeinheit (31) dazu ausgelegt ist, basierend auf den Sensorwerten zu schätzen, ob die Wasserhärte des Wasserstroms (12), insbesondere des zweiten Wasserstroms (12), innerhalb eines vordefinierten Bereichs liegt oder ob das Wasserenthärtungssystem (20) wiederhergestellt werden soll.

9. Dampfgargerät (2) nach Anspruch 8,

- wobei hartes Wasser vorzugsweise zwischen 7 °F und mehr als 32 °F, zwischen 4 °dH und mehr als 18 °dH und/oder zwischen 70 und mehr als 320 mg/l CaCO₃ liegt bzw. liegen kann und
- wobei weiches Wasser Wasser ist oder sein kann, das weniger als 60 ppm oder 3,37 dGH oder 3,37 °dH oder 33,7 mg/l CaO enthält,

wobei ein vordefinierter Bereich, insbesondere für weiches Wasser, zwischen 0 °F und 7 °F, zwischen 0 °dH und 4 °dH und/oder zwischen 0 und 70 mg/l CaCO₃ liegt oder liegen kann.

10. Dampfgargerät (2) nach Anspruch 1 oder 8 oder 9,

- wobei das Wasserenthärtungssystem (20) ein Wasserhärtereduktionsmittel (24) umfasst, um eine erste Wasserhärte des ersten Wasserstroms (11) am Wassereinlass (22) auf eine zweite Wasserhärte des zweiten Wasserstroms (12) am Wasserauslass (23) zu reduzieren und
- wobei Wasserhärtereduktionsmittel (24) mindestens eines von Ionenaustauscherharzen, Phosphatspendern und Umkehrosmosesystemen umfasst oder verwendet, die vorzugsweise in mindestens einer Kartusche enthalten sind.

11. Dampfgargerät (2) nach einem der Ansprüche 1, 9 oder 10,

- wobei das Sensormittel (80) am Wasserauslass (23) und/oder am Wassereinlass (22) zum Bereitstellen von Sensorwerten des, insbesondere ersten, Wasserstroms (11) und/oder des, insbesondere zweiten, Wasserstroms (12) an eine Schätzeinheit (31) vorgesehen ist und
- wobei das Sensormittel (80) ein Wasserhärtesensormittel und/oder einen Volumenzähler und/oder eine Durchflussmesseinheit umfasst, wobei das Sensormittel vorzugsweise in einem Bereich angeordnet ist, in dem im Falle von Störungen oder unkontrollierter Wasserzufuhr Wasser fließen könnte und
- wobei das Sensormittel (80) vorzugsweise eine dritte Klasse von Sensormitteln umfasst, die dazu ausgelegt sind, den Wasseraustritt zu messen und/oder eine Leckageerkennung, insbesondere über Schwellenleitfähigkeitssensoren oder auf Schwimmern basierende Sensoren, durchzuführen.

12. Dampfgargerät (2) nach einem der vorhergehenden Ansprüche, wobei das Wasserverwaltungssystem eine Überflutungsschutzeinheit (33), insbesondere ein integriertes Anti-Überflutungssystem, umfasst, wobei vorzugsweise die Überflutungsschutzeinheit

- a) dazu bestimmt ist, den, insbesondere ersten, Wasserdampf (11) nach einem kontinuierlichen Fluss einer

bestimmten Literzahl von Wasser zu stoppen und/oder

b) ein Ventil (60) zum Sperren der Wasserzufuhr (61) ansteuert und/oder

c) mit dem Sensormittel (80) verbunden ist, wobei das Sensormittel insbesondere ein Wassererkennungsmittel und/oder einen Volumenzähler umfasst, sodass das Ventil bei Wassererkennung und/oder unkontrollierter Wasserzufuhr geschlossen werden kann.

13. Dampfgargerät (2) nach einem der vorhergehenden Ansprüche, wobei die Schätzeinheit (31):

a) erkennt und vorzugsweise dem Benutzer mitteilt, wenn die Enthärtungswirksamkeit des Wasserenthärtungssystems einen vordefinierten Wert über- oder unterschreitet und/oder

b) schätzt, wann die Sollmenge oder die vordefinierte Gesamtwassermenge für das Wasserenthärtungssystem erreicht ist, um zu vermeiden, dass dem Dampferzeugungssystem (70) Wasser zugeführt wird, das einen Wasserhärteschwellenwert überschreitet.

14. Dampfgargerät (2) nach einem der vorhergehenden Ansprüche, wobei das Wasserenthärtungssystem eine besonders integrierte Desinfektionseinheit (21) umfasst, wobei die Desinfektionseinheit vorzugsweise umfasst:

a) ein Mittel zur Verhinderung einer mikrobiellen Vermehrung während der Lebensdauer des Dampfgargeräts und/oder

b) antimikrobielle Zusatzstoffe in den Materialien, aus denen die mit dem Wasser in Berührung kommenden Komponenten bestehen, und/oder

c) Spender für ein Desinfektionsmittel.

15. Dampfgargerät (2) nach einem der vorhergehenden Ansprüche, wobei

a) das Dampfgargerät ein Solo-Dampfgargerät ist, wobei nur reine Dampfgarfunkenen verfügbar sind, da keine Heizsysteme neben dem Dampferzeugungssystem vorhanden sind oder

b) wobei das Dampfgargerät ein Kombidampfgargerät ist, wobei der Dampf allein zum Garen verwendet oder mit anderen Heizsystemen kombiniert werden kann, um die Heizwirkung von Dampf mit anderen Heizsystemen, insbesondere mit Heißluft und/oder Oberhitze und/oder Unterhitze, zu kombinieren.

16. Dampfgargerät (2) nach Anspruch 15, umfassend:

- einen Gargerätehohlraum (90)

- ein Dampferzeugungssystem (70) mit einem Rohr (71) zum Einleiten von Dampf in den Gargerätehohlraum (90)

- eine Gargerätsteuereinheit (30), die Steuerfunktionen für das Gargerät und die Schätzeinheit (31) bereitstellt;

- das Wasserverwaltungssystem (1),

- wobei der Wasserauslass des Wasserverwaltungssystems mit dem Dampferzeugungssystem (70) des Dampfgargeräts (2) verbunden ist.

17. Dampfgargerät (2) nach Anspruch 15 oder 16, wobei das Dampfgargerät ein elektrisches Haushaltsgerät ist, das eines oder mehrere umfasst von: einem Gehäuse (91), einem Gargerätehohlraum (90), einer Gargerätetür (46) mit einem Griff (45), einer Konvektionsheizeinheit (42) in Kombination mit einem Konvektionsventilator (44) und/oder einem Luftleitblech (48), einer oberen Heizeinheit, einer unteren Heizeinheit (47), einem Ventilator (50) zum Ansaugen von Luft aus dem Gargerätehohlraum (90) durch ein Saugloch (53), einem Dampferzeugungssystem (70) mit einem Rohr (71) zum Einleiten von Dampf in den Gargerätehohlraum (90), eine Gargerätsteuereinheit (30) mit der Schätzeinheit (31) und einer Überflutungsschutzeinheit (33), ein Bedienfeld (51) zum Bedienen des Gargeräts sowie von auf einem Backblech (93) angeordnetem Gargut (92).

18. Verfahren zum Betreiben eines Dampfgargeräts (2) mit einem Wasserverwaltungssystem nach einem der vorhergehenden Ansprüche, wobei das Wasserverwaltungssystem umfasst:

- ein Wasserenthärtungssystem (20), das einen Wassereinlass (22) und einen Wasserauslass (23) umfasst,

- wobei der Wassereinlass (22) mit einer Wasserversorgung (61) verbunden oder verbindbar ist,

- wobei der Wasserauslass (23) mit einem Dampferzeugungssystem (70) des Dampfgargeräts (2) verbunden oder verbindbar ist,

wobei das Verfahren die folgenden Schritte umfasst:

- Reduzieren der Wasserhärte des Wasserstroms (11, 12) mittels des Wasserenthärtungssystems (20),
- Bereitstellen von Sensorwerten des Wasserstroms (11, 12) durch ein Sensormittel (80) an eine Schätzeinheit (31), wobei die Schätzeinheit (31) Bestandteil einer Steuereinheit (30) ist, die Steuerfunktionen für das Dampfgargerät (2) bereitstellt, wobei die Sensorwerte Wasserhärtewerte und/oder kumulative Wassermengenwerte sind und
- Schätzen mittels der Schätzeinheit (31) basierend auf den Sensorwerten, ob die Wasserhärte innerhalb eines vordefinierten Bereichs liegt, wobei, wenn die Sensorwerte kumulative Wassermengenwerte sind, die Schätzung unter der Annahme durchgeführt wird, dass die Härte des Wassers am Wassereinlass (22) konstant ist, während die maximale Wassermenge, die das Wasserenthärtungssystem (20) behandeln kann, vorgegeben ist, und
- bei Erreichen einer vordefinierten Gesamtwassermenge und/oder bei Überschreiten eines vordefinierten Schwellenwerts für die Wasserhärte dem Benutzer anzuzeigen, dass das Enthärtungssystem (20) wiederhergestellt werden muss, und/oder zu verhindern, dass das Dampferzeugungssystem Dampf erzeugt, bis das Enthärtungssystem wiederhergestellt ist, um die Verarbeitung von Wasser mit einem Übermaß an Härte und die daraus resultierende Bildung einer Kalksteinschicht zu vermeiden.

19. Verfahren nach Anspruch 18,

- wobei durch den Wassereinlass (22) ein erster Wasserstrom (11), insbesondere hartes Wasser oder Zulaufwasser, von der Wasserversorgung (61) und durch den Wasserauslass (23) ein zweiter Wasserstrom (12), insbesondere enthärtetes Wasser, für das Dampferzeugungssystem (70) fließen kann und/oder
- wobei das Verfahren ferner den folgenden Schritt umfasst: Reduzieren einer ersten Wasserhärte des ersten Wasserstroms (11) am Wassereinlass (22) auf eine zweite Wasserhärte des zweiten Wasserstroms (12) am Wasserauslass (23) mittels des Wasserenthärtungssystems (20) .

20. Verfahren nach Anspruch 19, wobei das Verfahren ferner den folgenden Schritt oder die folgenden Schritte umfasst:

- Bereitstellen von Sensorwerten des ersten Wasserstroms (11) und/oder des zweiten Wasserstroms (12) durch ein Sensormittel (80) am Wasserauslass (23) und/oder am Wassereinlass (22) an eine Schätzeinheit (31) und
- Schätzen mittels der Schätzeinheit (31) basierend auf den Sensorwerten, ob die Wasserhärte innerhalb eines vordefinierten Bereichs liegt und/oder ob das Wasserenthärtungssystem (20) wiederhergestellt werden soll.

Revendications

1. Four (2) à vapeur avec un système (1) de gestion d'eau pour le four (2) à vapeur, le système (1) de gestion d'eau comportant :

- un système (20) d'adoucissement d'eau comportant une entrée (22) d'eau et une sortie (23) d'eau,
- l'entrée (22) d'eau étant reliée ou pouvant être reliée à une alimentation (61) en eau,
- la sortie (23) d'eau étant reliée ou pouvant être reliée à un système (70) de génération de vapeur du four (2) à vapeur,
- le système (20) d'adoucissement d'eau comportant des moyens (24) de réduction de la dureté de l'eau servant à réduire une dureté de l'eau d'un courant (11, 12) d'eau,
- comportant en outre des moyens (80) de capteurs servant à fournir des valeurs de capteurs du courant (11, 12) d'eau à une unité (31) d'estimation, le four à vapeur comportant une unité (30) de commande de four assurant des fonctions de commande pour le four (2) à vapeur, l'unité (30) de commande de four comportant l'unité (31) d'estimation, l'unité (31) d'estimation étant configurée pour estimer, d'après les valeurs de capteurs, si la dureté de l'eau du courant (11, 12) d'eau se trouve à l'intérieur d'une plage prédéfinie,

A) les moyens (80) de capteurs comportant une première classe de moyens de capteurs configurés pour effectuer une mesure directe de la dureté de l'eau en aval du système (20) d'adoucissement d'eau, de préférence un moyen de capteur de conductivité, un moyen de capteur optique et/ou un moyen de capteur capacitif,

B) les moyens (80) de capteurs comportant une deuxième classe de moyens de capteurs configurés pour effectuer un calcul de quantité totale cumulée d'eau du courant (11, 12) d'eau, par exemple par des compteurs volumétriques ou des débitmètres,

l'unité (31) d'estimation étant configurée, dans le cas B), pour estimer si la dureté de l'eau du courant (11, 12) d'eau se trouve à l'intérieur d'une plage prédéfinie d'après la quantité d'eau cumulée calculée en supposant constante la dureté de l'eau à l'entrée (22) d'eau, tandis que la quantité maximum d'eau que le système (20) d'adoucissement d'eau peut traiter est prédéterminée,

et le système (20) d'adoucissement d'eau

- pouvant être régénéré lorsqu'une quantité globale prédéfinie d'eau est atteinte et/ou lorsqu'un seuil prédéfini de dureté de l'eau est dépassé, de préférence en changeant une cartouche jetable (24) contenant du matériau d'adoucissement, en particulier une matière active d'adoucissement, et/ou
- étant configuré, lorsqu'une quantité globale prédéfinie d'eau est atteinte et/ou lorsqu'un seuil prédéfini de dureté de l'eau est dépassé, pour fournir une indication à l'utilisateur selon laquelle le système (20) d'adoucissement doit être régénéré et/ou pour empêcher le système (70) de génération de vapeur de générer de la vapeur jusqu'à ce que la fonction d'adoucissement ait été régénérée, pour éviter de traiter de l'eau présentant un excès de dureté et la création d'une couche de calcaire qui en résulte.

2. Four (2) à vapeur selon la revendication 1,

- un premier courant (11) d'eau, en particulier de l'eau dure ou de l'eau d'entrée, en provenance de l'alimentation (61) en eau pouvant s'écouler à travers l'entrée (22) d'eau et un deuxième courant (12) d'eau, en particulier de l'eau douce ou adoucie, destiné au système (70) de génération de vapeur pouvant s'écouler à travers la sortie (23) d'eau et/ou

- l'unité (31) d'estimation étant configurée pour estimer, d'après les valeurs de capteurs, si la dureté de l'eau du courant (12) d'eau, en particulier du deuxième courant (12) d'eau, se trouve à l'intérieur d'une plage prédéfinie et/ou si le système (20) d'adoucissement d'eau doit être régénéré et/ou

- l'eau dure étant de préférence au moins de l'eau modérément dure, de l'eau dure, de l'eau très dure et/ou de l'eau extrêmement dure, une plage prédéfinie de la dureté de l'eau, en particulier pour l'eau dure, étant ou pouvant être comprise respectivement entre 7°F et plus de 32°F, entre 4°dH et plus de 18°dH et/ou entre 70 et plus de 320 mg/l de CaCO₃, et/ou

- l'eau douce ou l'eau adoucie étant de préférence de l'eau présentant une faible concentration de contenu minéral et/ou de l'eau après un traitement par le système (20) d'adoucissement d'eau, de façon plus préférentielle, l'eau douce étant ou pouvant être de l'eau qui contient moins de 60 ppm ou 3,37 dGH ou 3,37 °dH ou 33,7 mg/l de CaO, une plage prédéfinie étant ou pouvant être, en particulier pour l'eau douce, comprise entre 0°F et 7°F, entre 0°dH et 4°dH et/ou entre 0 et 70 mg/l de CaCO₃, respectivement.

3. Four (2) à vapeur selon les revendications 1 ou 2,

- le système (20) d'adoucissement d'eau comportant des moyens (24) de réduction de la dureté de l'eau servant à réduire une première dureté de l'eau du premier courant (11) d'eau à l'entrée (22) d'eau jusqu'à une deuxième dureté de l'eau du deuxième courant (12) d'eau à la sortie (23) d'eau et/ou

- les moyens (24) de réduction de la dureté de l'eau comportant ou utilisant au moins un élément parmi des résines d'échange d'ions, des distributeurs de phosphates et des systèmes d'osmose inverse, de préférence contenus dans au moins une cartouche et/ou

- les moyens (24) de réduction de la dureté de l'eau et/ou la ou les cartouches pouvant traiter ou interagir avec, en particulier absorber et/ou échanger, une quantité totale fixe d'ions, en particulier Ca et/ou Mg, correspondant à une quantité totale ou prédéterminée d'eau.

4. Four (2) à vapeur selon la revendication 1, le système de gestion d'eau

- a) évitant une opération de détartrage du système (70) de génération de vapeur et/ou intégrant le système (20) d'adoucissement d'eau en tant que moyen auto-diagnostiqué et exempt de régénération dans le four (2) à vapeur et/ou

- b) empêchant qu'il soit nécessaire d'avoir affaire à des produits chimiques pour effectuer une opération de détartrage du système (70) de génération de vapeur et/ou

- c) éliminant un temps d'arrêt du four (2) à vapeur en raison d'une opération de détartrage et/ou

- d) améliorant le rendement du système (70) de génération de vapeur en éliminant le processus permanent d'accumulation et d'enlèvement subséquent du calcaire.

5. Four (2) à vapeur selon les revendications 1 ou 2, a) le système (20) d'adoucissement d'eau pouvant être intégré

dans le four (2) à vapeur ou extérieurement au four (2) à vapeur et/ou

b) le système (20) d'adoucissement d'eau étant adapté et/ou relié à l'alimentation (61) en eau et/ou
c) l'alimentation (61) en eau étant un robinet d'eau et/ou un tuyau d'eau et/ou un branchement fixe d'eau et/ou
un réservoir d'eau et/ou un tiroir fixe ou amovible, l'alimentation (61) en eau étant de préférence

c1) un réservoir d'eau fixe à l'intérieur du four (2) à vapeur, qu'il est nécessaire de remplir à l'aide d'un vase
d'eau supplémentaire et/ou

c2) un réservoir d'eau extractible qui peut être extrait du four (2) à vapeur et rempli directement sur un
robinet d'eau et/ou

c3) un branchement fixe d'eau au système d'alimentation en eau de la maison, par exemple à un robinet
d'eau.

6. Four (2) à vapeur selon une des revendications précédentes, le système de gestion d'eau étant

a) dimensionné pour maintenir, en particulier, le deuxième courant (12) d'eau en-dessous d'une cible de dureté
de l'eau pour une quantité définie d'eau fournie, afin de couvrir un temps prédéfini d'utilisation du four à vapeur,
de préférence la durée de vie entière du four (2) à vapeur, et/ou

b) assurant une durée à long terme du four à vapeur, de préférence une durée à vie sans entretien et/ou

c) destiné à traiter une quantité prédéfinie, de préférence 500 l à 800 l, d'eau dans le courant (11) d'eau, le
système (70) de génération de vapeur étant capable de gérer une quantité prédéfinie de minéraux, de préférence
environ 15 g à 21 g, en tant que dureté résiduelle, en particulier, du deuxième courant (12) d'eau, de telle sorte
que le four à vapeur puisse exécuter un nombre prédéfini, de préférence 400 à 600, cycles de vapeur, de
préférence avec une consommation maximum d'eau de chaque cycle de 1l et/ou en appliquant un facteur de
sécurité de 1 à 1,5, et/ou

c) destiné à fournir, en particulier, le deuxième courant (12) d'eau, de préférence d'eau adoucie, à l'intérieur
d'une plage prédéfinie de dureté de l'eau ou avec une dureté prédéfinie de l'eau, de préférence en-dessous
de 3°F ou 7°F ou entre 0°F et 7°F et/ou correspondant à 3 mg/l de ou 7 mg/l de CaCO₃ au système (70) de
génération de vapeur et/ou

d) capable de gérer différents niveaux de dureté de l'eau, en particulier, du premier courant (11) d'eau, de
préférence automatiquement ou par un processus d'étalonnage effectué pendant l'installation du four (2) à
vapeur.

7. Four (2) à vapeur selon une des revendications précédentes,

- les moyens (80) de capteurs se trouvant à la sortie (23) d'eau et/ou à l'entrée (22) d'eau pour fournir des
valeurs de capteurs, en particulier, du premier courant (11) d'eau et/ou, en particulier, du deuxième courant
(12) d'eau à une unité (31) d'estimation et/ou

- les moyens (80) de capteurs comportant un moyen de capteur de dureté de l'eau et/ou un compteur de volume
et/ou une unité de mesure de débit, les moyens de capteurs étant de préférence placés dans une zone où de
l'eau pourrait s'écouler en cas de défaillances ou d'alimentation en eau non contrôlée et/ou

- les moyens (80) de capteurs comportant de préférence également une troisième classe de moyens de capteurs,
les moyens de capteurs étant de préférence configurés pour mesurer un déversement d'eau et/ou effectuer
une détection de fuites, en particulier par l'intermédiaire de capteurs de conductivité seuil ou de capteurs à
flotteur.

8. Four (2) à vapeur selon la revendication 1, un premier courant (11) d'eau, en particulier de l'eau dure ou de l'eau d'entrée, en provenance de l'alimentation (61) en eau pouvant s'écouler à travers l'entrée (22) d'eau et un deuxième courant (12) d'eau, en particulier de l'eau douce ou adoucie, destiné au système (70) de génération de vapeur pouvant s'écouler à travers la sortie (23) d'eau et

- l'unité (31) d'estimation étant configurée pour estimer, d'après les valeurs de capteurs, si la dureté de l'eau
du courant (12) d'eau, en particulier du deuxième courant (12) d'eau, se trouve à l'intérieur d'une plage prédéfinie
ou si le système (20) d'adoucissement d'eau doit être régénéré.

9. Four (2) à vapeur selon la revendication 8,

- l'eau dure étant ou pouvant être de préférence comprise entre 7°F et plus de 32°F, entre 4°dH et plus de

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18°dH et/ou entre 70 et plus de 320 mg/l de CaCO₃, respectivement et

- l'eau douce étant ou pouvant être de l'eau qui contient moins de 60 ppm ou 3,37 dGH ou 3,37 °dH ou 33,7 mg/l de CaO,

5 une plage prédéfinie étant ou pouvant être, en particulier pour l'eau douce, comprise entre 0°F et 7°F, entre 0°dH et 4°dH et/ou entre 0 et 70 mg/l de CaCO₃, respectivement.

10. Four (2) à vapeur selon les revendications 1 ou 8 ou 9,

10 - le système (20) d'adoucissement d'eau comportant des moyens (24) de réduction de la dureté de l'eau servant à réduire une première dureté de l'eau du premier courant (11) d'eau à l'entrée (22) d'eau jusqu'à une deuxième dureté de l'eau du deuxième courant (12) d'eau à la sortie (23) d'eau et

15 - les moyens (24) de réduction de la dureté de l'eau comportant ou utilisant au moins un élément parmi des résines d'échange d'ions, des distributeurs de phosphates et des systèmes d'osmose inverse, de préférence contenu dans au moins une cartouche.

11. Four (2) à vapeur selon l'une quelconque des revendications 1, 9 ou 10,

20 - les moyens (80) de capteurs se trouvant à la sortie (23) d'eau et/ou à l'entrée (22) d'eau pour fournir des valeurs de capteurs, en particulier, du premier courant (11) d'eau et/ou, en particulier, du deuxième courant (12) d'eau à une unité (31) d'estimation et

- les moyens (80) de capteurs comportant un moyen de capteur de dureté de l'eau et/ou un compteur de volume et/ou une unité de mesure de débit, les moyens de capteurs étant de préférence placés dans une zone où de l'eau pourrait s'écouler en cas de défaillances ou d'alimentation en eau non contrôlée et

25 - les moyens (80) de capteurs comportant de préférence une troisième classe de moyens de capteurs configurés pour mesurer un déversement d'eau et/ou effectuer une détection de fuites, en particulier par l'intermédiaire de capteurs de conductivité seuil ou de capteurs à flotteur.

30 12. Four (2) à vapeur selon une des revendications précédentes, le système de gestion d'eau comportant une unité anti-inondation (33), en particulier un système anti-inondation intégré, l'unité anti-inondation, de préférence :

a) étant destinée à arrêter, en particulier, le premier courant (11) d'eau après un écoulement continu d'une quantité déterminée de litres d'eau et/ou

b) commandant une vanne (60) servant à bloquer l'alimentation (61) en eau et/ou

35 c) étant reliée aux moyens (80) de capteurs, les moyens de capteurs comportant en particulier un moyen de détection d'eau et/ou un compteur de volume, de sorte que la vanne peut être fermée suite à une détection d'eau et/ou à une alimentation en eau non contrôlée.

40 13. Four (2) à vapeur selon une des revendications précédentes, l'unité (31) d'estimation

a) détectant et, de préférence, communiquant à l'utilisateur le moment où l'efficacité d'adoucissement du système d'adoucissement d'eau est au-dessus ou tombe au-dessous d'un niveau prédéfini et/ou

45 b) estimant le moment où la quantité globale cible ou prédéfinie d'eau pour le système d'adoucissement d'eau a été atteinte, pour éviter une fourniture d'eau dépassant un seuil de dureté de l'eau au système (70) de génération de vapeur.

14. Four (2) à vapeur selon une des revendications précédentes, le système d'adoucissement d'eau comportant une unité (21) de désinfection, en particulier intégrée, l'unité de désinfection comportant de préférence

50 a) des moyens destinés à empêcher une prolifération microbienne au cours de la durée de vie du four à vapeur et/ou

b) des additifs antimicrobiens dans les matériaux constituant les composants en contact avec l'eau et/ou

c) des distributeurs d'agents désinfectants.

55 15. Four (2) à vapeur selon une des revendications précédentes,

a) le four à vapeur étant un appareil exclusivement à vapeur dans lequel uniquement des fonctions de cuisson à la vapeur pure sont disponibles, aucun système de chauffe en dehors du système de génération de vapeur

n'étant disponible, ou

b) le four à vapeur étant un appareil à vapeur combiné dans lequel la vapeur peut être utilisée seule pour la cuisson, ou combinée avec d'autres systèmes de chauffe, pour fusionner l'effet de chauffe de la vapeur avec d'autres systèmes de chauffe, en particulier avec de l'air chaud et/ou de la chaleur par le haut et/ou de la chaleur par le bas.

16. Four (2) à vapeur selon la revendication 15, comportant

- une cavité (90) de four
- un système (70) de génération de vapeur doté d'un tuyau (71) pour introduire de la vapeur dans la cavité (90) de four
- une unité (30) de commande de four assurant des fonctions de commande pour le four et l'unité (31) d'estimation;
- le système (1) de gestion d'eau,

la sortie d'eau du système de gestion d'eau étant reliée au système (70) de génération de vapeur du four (2) à vapeur.

17. Four (2) à vapeur selon la revendication 15 ou 16, le four à vapeur étant un four ménager électrique comportant un ou plusieurs des éléments suivants: une enveloppe (91), une cavité (90) de four, une porte (46) de four dotée d'une poignée ou d'une manette (45), une unité (42) de chauffe par convection en combinaison avec un ventilateur (44) de convection et/ou un déflecteur (48) d'air, une unité de chauffe supérieure, une unité (47) de chauffe inférieure, un ventilateur (50) servant à aspirer de l'air hors de la cavité (90) à travers un trou (53) d'aspiration, un système (70) de génération de vapeur doté d'un tuyau (71) pour introduire de la vapeur dans la cavité (90) de four, une unité (30) de commande de four avec l'unité (31) d'estimation et une unité anti-inondation (33), un tableau (51) de commande servant à utiliser le four ainsi que des articles à cuire (92) disposés sur un plateau (93) de cuisson.

18. Procédé d'utilisation d'un four (2) à vapeur doté d'un système de gestion d'eau selon une des revendications précédentes, le système de gestion d'eau comportant

- un système (20) d'adoucissement d'eau comportant une entrée (22) d'eau et une sortie (23) d'eau,
- l'entrée (22) d'eau étant reliée ou pouvant être reliée à une alimentation (61) en eau,
- la sortie (23) d'eau étant reliée ou pouvant être reliée à un système (70) de génération de vapeur du four (2) à vapeur,

le procédé comportant les étapes suivantes :

- réduire, au moyen du système (20) d'adoucissement d'eau, une dureté de l'eau du courant (11, 12) d'eau,
- faire fournir, par des moyens (80) de capteurs, des valeurs de capteurs du courant (11, 12) d'eau à une unité (31) d'estimation, l'unité (31) d'estimation faisant partie d'une unité (30) de commande assurant des fonctions de commande pour le four (2) à vapeur, les valeurs de capteurs étant des valeurs de dureté de l'eau et/ou des valeurs de quantité cumulée d'eau et
- estimer, au moyen de l'unité (31) d'estimation, d'après les valeurs de capteurs, si la dureté de l'eau se trouve à l'intérieur d'une plage prédéfinie, l'estimation étant effectuée, si les valeurs de capteurs sont des valeurs de quantité cumulée d'eau, en supposant constante la dureté de l'eau à l'entrée (22) d'eau, tandis que la quantité maximum d'eau que le système (20) d'adoucissement d'eau peut traiter est prédéterminée, et
- lorsqu'une quantité globale prédéfinie d'eau est atteinte et/ou lorsqu'un seuil prédéfini de dureté de l'eau est dépassé, fournir une indication à l'utilisateur selon laquelle le système (20) d'adoucissement doit être régénéré et/ou empêcher le système de génération de vapeur de générer de la vapeur jusqu'à ce que le système d'adoucissement ait été régénéré, afin d'éviter de traiter de l'eau présentant un excès de dureté et la création d'une couche de calcaire qui en résulte.

19. Procédé selon la revendication 18,

- un premier courant (11) d'eau, en particulier de l'eau dure ou de l'eau d'entrée, pouvant s'écouler en provenance de l'alimentation (61) en eau à travers l'entrée (22) d'eau et un deuxième courant (12) d'eau, en particulier de l'eau adoucie, destiné au système (70) de génération de vapeur pouvant s'écouler à travers la sortie (23) d'eau et/ou
- le procédé comportant en outre l'étape suivante : réduire, au moyen du système (20) d'adoucissement d'eau,

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une première dureté de l'eau du premier courant (11) d'eau à l'entrée (22) d'eau jusqu'à une deuxième dureté de l'eau du deuxième courant (12) d'eau à la sortie (23) d'eau.

20. Procédé selon la revendication 19, le procédé comportant en outre l'étape ou les étapes suivantes :

- 5 - faire fournir, par des moyens (80) de capteurs à la sortie (23) d'eau et/ou à l'entrée (22) d'eau, des valeurs de capteurs du premier courant (11) d'eau et/ou du deuxième courant (12) d'eau à une unité (31) d'estimation et
- 10 - estimer, au moyen de l'unité (31) d'estimation, d'après les valeurs de capteurs, si la dureté de l'eau se trouve à l'intérieur d'une plage prédéfinie et/ou si le système (20) d'adoucissement d'eau doit être régénéré.

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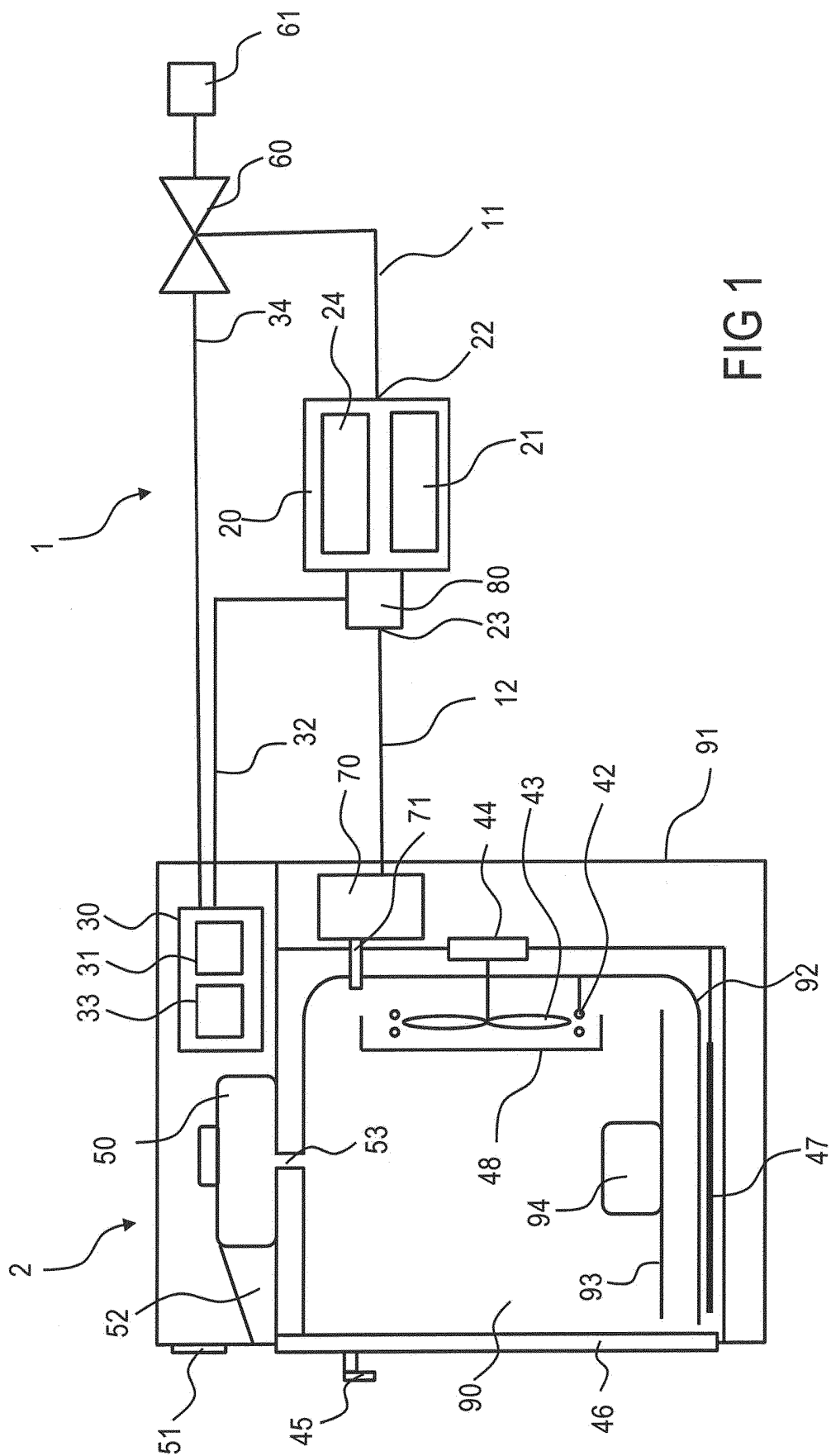


FIG 1

REFERENCES CITED IN THE DESCRIPTION

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