The known hydrothermal carbonization systems are often complex and include multi-stage processes. Thus, systems for treatment of organic waste have often very complicated configuration. Attempts to improve efficiency have been made by e.g. cyclic processes and re-using energy from one process stage to another. However, the known systems still often remain inefficient and result in a loss of considerable amounts of thermal energy.

In heat exchangers known from prior art to be used for systems for treatment of organic waste problems have occurred due to high solids content of the substance to be treated causing low flow-properties and thus, poor pumping capability. This has led to blockages in the heat exchangers and thus, to need of cleaning. The heat-exchangers known from prior art are almost impossible to clean. Therefore a great need for a heat-exchanger, which is easy to clean, exists.

In patent application publication EP3514218A1 is disclosed a system for treatment of organic waste by means of hydrothermal carbonization under given process conditions, which system comprises at least one source organic waste, at least one wet waste tank, a wet waste mixing tank, at least a first thermal reactor and a second thermal reactor, a biochar cooler, and at least one steam conduit provided with a valve for providing a connection between the first thermal reactor and the second thermal reactor for supplying steam from the first thermal reactor to the second thermal reactor or from the second thermal reactor to the first thermal reactor in an alternating manner for providing heat and pressure for a thermal hydrolysis process. The system additionally includes at least one water conduit provided with a pump for providing a connection between the first thermal reactor and the second thermal reactor for supplying hot and pressurized water from the first thermal reactor to the second thermal reactor or from the second thermal reactor to the first thermal reactor in an alternating manner for achieving the given process conditions.

Embodiments of the invention eliminate or at least minimize the above problems and disadvantages of prior art heat exchangers.

Further embodiments of the invention simplify the configuration of heat exchangers.

Embodiments of the invention eliminate or at least minimize the above problems and disadvantages of prior art systems for treatment of organic waste.

Further embodiments of the invention simplify the configuration of systems for treatment of organic waste.

Embodiments of the invention create a heat exchanger with decreased size and footprint.

Summary

According to a first aspect of the present invention, there is provided a heat exchanger comprising heat delivery surface tubes arranged in at least one bank of tubes and end elements, which heat exchanger comprises a casing around the bank of the tubes, which tubes are straight, in which heat exchanger the substance to be heated or cooled is configured to be flow in the tubes and a stationary heat transfer medium is located in volumes inside the casing between the tubes and each end of the tubes is attached releasably to the end element, which heat exchanger has a primary side and a secondary side, which are formed by means of channels located in the end elements, and the heat exchanger is by means of the primary side and the secondary side configured to heat up and cool down two different substances by running the two different substances opposite to each other in the primary side and the secondary side, wherein the end elements are formed of tube plates and turn chamber plates, which plates are sealed by seals located between the plates and wherein the channels located in the end elements are located in the tube plates and turn chamber plates of the end elements.

According to a second aspect of the present invention, there is provided a system for treatment of organic waste, which system is a system for treatment of organic waste by means of hydrothermal carbonization, which system comprises at least one source organic waste, at least one wet organic waste tank, at least a one thermal reactor for the hydrothermal carbonization, the above heat exchanger, wherein the at least one wet organic waste tank and the at least one thermal reactor are in flow-connection with the heat exchanger and that the heat exchanger is configured to heat the organic waste to be treated in the thermal reactors by means of hydrothermal carbonization and configured to cool biochar sludge received from the thermal reactors as a result of the hydrothermal carbonization.

An embodiment of the present invention also pertains to a hydrothermal carbonization process, which is a thermo-chemical process with a given process time (duration), in which organic material is disintegrated into carbon-ions by raising the temperature in a closed reactor to about 200-250°C, whereby also the pressure is raised to about 20-25 bar. The organic material disintegrates and the resulting carbon re-condensates into aromatic carbon compounds. The final product of this process is biochar, or hydrochar, the chemical composition of which is similar to fossil coal. The main given process conditions are temperature, pressure and process time (duration). The process conditions can also be called the process parameters.

According to an embodiment the invention, the heat exchanger comprises heat delivery surface tubes arranged in at least one bank of tubes, and end elements, wherein the