hypochlorite, which is followed by neutralization of the excessive chemical and then discharging out of the system. Unfortunately, such inactivation treatment with a chemical liquid has the problem of high running cost since it requires a large amount of the chemical liquid and a large amount of energy for incineration.

[0003] Alternative treatment of liquid waste containing microorganisms and/or viruses includes inactivation treatment by heating. Proposed examples of such inactivation treatment by heating include inactivation treatment using a batch heat treatment apparatus using steam or electrical resistance (see, for example, Patent Documents 1 and 2). Such inactivation treatment by heating can solve the problem with the inactivation treatment with a chemical liquid.

[0004] Patent Document 1: Japanese Unexamined Patent Application, Publication No. 2000-263037

Patent Document 2: U.S. Published Patent Application Publication, No. 2016/0145121, Specification

Summary

[0004a] In an aspect, there is a decontamination system for continuously inactivating liquid waste containing a microorganism and/or a virus, the decontamination system comprising: a liquid waste receiving vessel that receives the liquid waste from a liquid waste discharging facility; a steam generator that produces steam; a heat exchanger that heats the liquid waste supplied from the liquid waste receiving vessel by exchanging heat with the steam produced by the steam generator; a liquid waste supply means that has an inverter for making a flow rate of the liquid waste variable and supplies the liquid waste from the liquid waste receiving vessel to the heat exchanger; and a controller that controls the liquid waste receiving vessel, the steam generator, the heat exchanger, and the liquid waste supply means to continuously inactivate the liquid waste, the heat exchanger including: a heater that has a tube heat exchanger including an airtight

pressure vessel having coiled piping and a clamp structure and heats the liquid waste to a predetermined first temperature or more by exchanging heat with the steam produced by the steam generator; and a retention unit that has a tube heat exchanger including an airtight pressure vessel having coiled piping and a clamp structure and maintains the liquid waste at the first temperature or more for a predetermined period of time while exchanging heat with the steam produced by the steam generator after the liquid waste is heated to the first temperature or more by the heater, the decontamination system further comprising: a steam supply path for directly supplying the steam from the steam generator to the retention unit; and a steam system on-off valve provided in the steam supply path, wherein the controller controls the inverter of the liquid waste supply means to allow the flow rate of the liquid waste to fall within a range from 240 mL/minute to 540 mL/minute and controls the steam system on-off valve in response to the flow rate of the liquid waste to control the temperature in the retention unit so as to satisfy sterilization strength F0>30.

DISCLOSURE OF THE INVENTION

Problems to be Solved by the Invention

[0005]

In recent years, however, mainstream bio-pharmaceutical production has shifted from conventional mass production to small-volume continuous production using disposable single-use

CLAIMS

1. A decontamination system for continuously inactivating liquid waste containing a microorganism and/or a virus, the decontamination system comprising:

a liquid waste receiving vessel that receives the liquid waste from a liquid waste discharging facility;

a steam generator that produces steam;

a heat exchanger that heats the liquid waste supplied from the liquid waste receiving vessel by exchanging heat with the steam produced by the steam generator;

a liquid waste supply means that has an inverter for making a flow rate of the liquid waste variable and supplies the liquid waste from the liquid waste receiving vessel to the heat exchanger; and

a controller that controls the liquid waste receiving vessel, the steam generator, the heat exchanger, and the liquid waste supply means to continuously inactivate the liquid waste,

the heat exchanger including:

a heater that has a tube heat exchanger including an airtight pressure vessel having coiled piping and a clamp structure and heats the liquid waste to a predetermined first temperature or more by exchanging heat with the steam produced by the steam generator; and

a retention unit that has a tube heat exchanger including an airtight pressure vessel having coiled piping and a clamp structure and maintains the liquid waste at the first temperature or more for a predetermined period of time while exchanging heat with the steam produced by the steam generator after the

liquid waste is heated to the first temperature or more by the heater,

the decontamination system further comprising:

a steam supply path for directly supplying the steam from the steam generator to the retention unit; and

a steam system on-off valve provided in the steam supply path, wherein

the controller

controls the inverter of the liquid waste supply means to allow the flow rate of the liquid waste to fall within a range from 240 mL/minute to 540 mL/minute and controls the steam system on-off valve in response to the flow rate of the liquid waste to control the temperature in the retention unit so as to satisfy sterilization strength F0>30.

2. The decontamination system according to claim 1, further comprising:

a flow rate detection means that is provided in a flow path between the liquid waste receiving vessel and the heater to detect a flow rate of the liquid waste passing through the flow path;a first temperature detection means that is provided in a flow path between the heater and the retention unit to detect a temperature of the liquid waste passing through the flow path; and a second temperature detection means that is provided in a flow path downstream of the retention unit to detect a temperature of the liquid waste passing through the flow path, wherein the controller controls the liquid waste receiving vessel, the liquid waste supply means, the steam generator, and the heat exchanger based on the flow rate detected by the flow rate detection means, the temperature detected by the first temperature detection means, and the temperature detected by the second temperature detection means.

3. The decontamination system according to claim 2, further comprising a liquid waste circulation means that circulates, to the liquid waste receiving vessel, the liquid waste

discharged from the heat exchanger, wherein

the controller controls the liquid waste circulation means to circulate, to the liquid waste receiving vessel, the liquid waste discharged from the heat exchanger when the temperature detected by the second temperature detection means is less than the first temperature.

4. The decontamination system according to any one of claims 1 to 3, wherein the heat exchanger further includes a preheater that is provided in a flow path between the liquid waste receiving vessel and the heater to preheat the liquid waste supplied from the liquid waste receiving vessel to the heater, and

drain water discharged from the heater is supplied to the preheater.

5. The decontamination system according to claim 4, further comprising a drain circulation means that circulates, to the steam generator, drain water discharged from the preheater.

6. The decontamination system according to any one of claims 1 to 5, wherein the heat exchanger further includes a cooler that has a coiled tube heat exchanger and cools the liquid waste to a predetermined second temperature or less by exchanging heat with cooling water after the liquid waste is maintained at the first temperature or more for the predetermined period of time

by the retention unit.

7. The decontamination system according to claim 6, wherein the heat exchanger further includes a precooler that is provided in a flow path between the retention unit and the cooler and precools the liquid waste to be supplied to the cooler after the liquid waste is maintained at the first temperature or more for the predetermined period of time by the retention unit, and

drain water discharged from the cooler is supplied to the precooler.

8. The decontamination system according to claim 6 or 7, further comprising:

a pressure detection means that is provided in a flow path downstream of the cooler to detect a pressure in the flow path; and

a regulating valve that is provided in a flow path downstream of the pressure detection means to adjust a pressure in the flow path, wherein

the controller controls opening and closing of the regulating valve based on the pressure detected by the pressure detection means.

9. The decontamination system according to any one of claims 1 to 8, further comprising:

a chemical liquid reservoir that stores a chemical

liquid; and

a chemical liquid circulation means that supplies, to the heat exchanger, the chemical liquid stored in the chemical liquid reservoir and circulates, to the chemical liquid reservoir, the chemical liquid supplied to the heat exchanger.

10. The decontamination system according to any one of claims 1 to 9, further comprising:

a strainer that is provided in a liquid waste introduction path for introducing the liquid waste from the liquid waste discharging facility into the liquid waste receiving vessel and filters the liquid waste; and

a strainer cleaning means that thermally cleans the strainer by supplying, to the strainer, the steam produced by the steam generator.