CLAIMS

[Claim 1]

An ammonia-containing wastewater treatment apparatus, comprising:

an ammonia removal unit comprising a vapor-liquid separation membrane, a first liquid chamber disposed adjacent to a first surface of the vapor-liquid separation membrane, and a second liquid chamber disposed adjacent to a second surface of the vapor-liquid separation membrane, the ammonia removal unit removing ammonia from ammonia-containing wastewater flowing through the first liquid chamber and bringing a sulfuric acid solution into contact with the ammonia which is removed, the sulfuric acid solution flowing through the second liquid chamber in counterflow with respect to the ammonia-containing wastewater, thereby recovering the ammonia as an ammonium sulfate solution;

an inlet-side valve configured to open and close a sulfuric acid solution inlet side of the second liquid chamber, and an outlet-side valve configured to open and close a sulfuric acid solution outlet side of the second liquid chamber;

a controller configured to close the inlet-side valve and the outlet-side valve when a flow of the sulfuric acid solution through the second liquid chamber is stopped; and

a pressure relief unit configured to remove a pressure between the inlet-side valve and the outlet-side valve,

wherein the controller is configured to close the inlet-side valve and the outlet-side valve and to actuate the pressure relief unit when the flow of the sulfuric acid solution through the second liquid chamber is stopped.

[Claim 2]

The ammonia-containing wastewater treatment apparatus according to claim 1, comprising:

a treated water circulation unit configured to circulate treated water obtained from the ammonia removal unit from an outlet side to an inlet side of the first liquid chamber, when the flow of the sulfuric acid solution through the second liquid chamber is stopped.

[Claim 3]

The ammonia-containing wastewater treatment apparatus according to any one of claims 1 to 2, comprising:

a sulfuric acid adding unit configured to regulate a concentration of sulfuric acid in the sulfuric acid solution to be supplied to the second liquid chamber, wherein

the concentration of the sulfuric acid in the sulfuric acid solution to be added from the sulfuric acid adding unit is 50 percent by mass or greater.

[Claim 4]

The ammonia-containing wastewater treatment apparatus according to any one of claims 1 to 3, comprising:

an ammonium-sulfate solution circulation unit configure to circulate the ammonium-sulfate solution which is recovered from an outlet side to an inlet side of the second liquid chamber; and

an ammonium sulfate concentration measuring unit configured to measure a concentration of ammonium sulfate in the ammonium-sulfate solution which is recovered, wherein

the ammonium-sulfate solution which is recovered is extracted when the concentration of the ammonium sulfate which is measured is equal to or greater than a predetermined value.

[Claim 5]

The ammonia-containing wastewater treatment apparatus according to any one of claims 1 to 4, wherein

the ammonia-containing wastewater in the ammonia removal unit has a temperature in a range of 30 to 55°C.

[Claim 6]

The ammonia-containing wastewater treatment apparatus according to any one of claims 1 to 5, wherein

the ammonia-containing wastewater in the ammonia removal unit has a pH of 11 or greater.

[Claim 7]

The ammonia-containing wastewater treatment apparatus according to claim 1 to 6, further comprising:

an oxidizing agent removal unit configured to remove an oxidizing agent contained in the ammonia-containing wastewater before the ammonia-containing wastewater flows through the first liquid chamber.

[Claim 8]

A method of treating ammonia-containing wastewater comprising:

an ammonia removing step of removing ammonia from ammonia-containing wastewater flowing through a first liquid chamber in an ammonia removal unit comprising a vapor-liquid separation membrane, the first liquid chamber disposed adjacent to a first surface of the vapor-liquid separation membrane, and a second liquid chamber disposed adjacent to a second surface of the vapor-liquid separation membrane, and bringing a sulfuric acid solution into contact with the ammonia which is removed, the sulfuric acid solution flowing through the second liquid chamber in counterflow with respect to the ammonia-containing wastewater, thereby recovering the ammonia as an ammonium sulfate solution,

wherein an inlet-side valve configured to open and close a sulfuric acid solution inlet side of the second liquid chamber, and an outlet-side valve configured to open and close a sulfuric acid solution outlet side of the second liquid chamber, are closed, and a pressure relief unit configured to remove a pressure between the inlet-side valve and the outlet-side valve is actuated, when the flow of the sulfuric acid solution through the second liquid chamber is stopped.