[0004a] In one aspect, there is provided a method for treating wastewater comprising:

dewatering a wastewater comprising solubilized phosphates and organic solids to produce a liquid fraction comprising solubilized phosphates and a high solids content sludge comprising organic solids;

feeding the liquid fraction, without the high solids content sludge, into a phosphate recovery reactor, wherein a portion of the solubilized phosphates are precipitated and removed from the liquid fraction to produce a liquid phosphate recovery reactor effluent having a reduced solubilized phosphate content;

combining the high solids content sludge with at least a portion of the liquid phosphate recovery reactor effluent to produce a reduced solids content sludge; and

feeding the reduced solids content sludge into a sludge reactor located downstream of the phosphate recovery reactor, wherein organic solids in the reduced solids content sludge are broken down.

[0005] Another embodiment of a method for treating wastewater includes: (a) dewatering a wastewater comprising solubilized phosphates and organic solids to produce a liquid fraction comprising solubilized phosphates and a high solids content sludge comprising organic matter; (b) feeding the liquid fraction, without the high solids content sludge, into a phosphate recovery reactor, wherein a portion of the solubilized phosphates are precipitated and removed from the liquid fraction to produce a liquid phosphate recovery reactor effluent having a reduced solubilized phosphate content; and (c) feeding the high solids content sludge into a hydrolysis reactor that hydrolyses organic solids in the high solids content sludge to produce a hydrolyzed sludge.

[0005a] In another aspect, there is provided a method for treating wastewater comprising:

dewatering a wastewater comprising solubilized phosphates and organic solids to produce a liquid fraction comprising solubilized phosphates and a high solids content sludge comprising organic matter;

feeding the liquid fraction, without the high solids content sludge, into a phosphate recovery reactor, wherein a portion of the solubilized phosphates are precipitated and removed from the liquid fraction to produce a liquid phosphate recovery reactor effluent having a reduced solubilized phosphate content; and

feeding the high solids content sludge into a hydrolysis reactor that hydrolyses organic solids in the high solids content sludge to produce a hydrolyzed sludge.

[0006] One embodiment of a method for treating wastewater includes: (a) dewatering a wastewater comprising solubilized phosphates and organic solids to produce a liquid fraction comprising solubilized phosphates and a high solids content sludge comprising organic solids;(b) feeding the liquid fraction, without the high solids content sludge, into a phosphate recovery reactor, wherein a portion of the solubilized phosphates are precipitated and removed from the liquid fraction to produce a liquid phosphate recovery reactor effluent having a reduced solubilized phosphate content; (c) adding a phosphate precipitation inducer to the high solids content sludge, wherein solubilized phosphates precipitate in the high solids content sludge to produce a sludge having a reduced solubilized phosphate content; and (d) feeding the sludge having a reduced solubilized phosphate content into a sludge processing chamber located downstream of the phosphate recovery reactor, wherein the sludge undergoes a physical separation, a chemical reaction, or a combination thereof.

[0006a] In another aspect, there is provided method for treating wastewater comprising:

dewatering a wastewater comprising solubilized phosphates and organic solids to produce a liquid fraction comprising solubilized phosphates and a high solids content sludge comprising organic solids;

feeding the liquid fraction, without the high solids content sludge, into a phosphate recovery reactor, wherein a portion of the solubilized phosphates are precipitated and removed from the liquid fraction to produce a liquid phosphate recovery reactor effluent having a reduced solubilized phosphate content;

adding a phosphate precipitation inducer to the high solids content sludge, wherein solubilized phosphates precipitate in the high solids content sludge to produce a sludge having a reduced solubilized phosphate content; and

feeding the sludge having a reduced solubilized phosphate content into a sludge processing chamber located downstream of the phosphate recovery reactor, wherein the sludge undergoes a physical separation, a chemical reaction, or a combination thereof.

[0007] Another embodiment of a method for treating wastewater includes: (a) dewatering a wastewater comprising solubilized phosphates and organic solids to produce a liquid fraction comprising solubilized phosphates and a high solids content sludge comprising organic solids; (b) feeding the liquid fraction, without the high solids content sludge, into a phosphate recovery reactor, wherein a portion of the solubilized phosphates are precipitated

and removed from the liquid fraction to produce a liquid phosphate recovery reactor effluent having a reduced solubilized phosphate content; (c) adding a phosphate precipitation inducer to the high solids content sludge, wherein solubilized phosphates precipitate in the high solids content sludge to produce a sludge having a reduced solubilized phosphate content; and (e) feeding the sludge having a reduced solubilized phosphate content into a sludge processing chamber located downstream of the phosphate recovery reactor, wherein the sludge undergoes a physical separation, a chemical reaction, or a combination thereof.

[0008] Another embodiment of a method for treating wastewater includes: (a) dewatering a wastewater comprising solubilized phosphates and organic solids to produce a liquid fraction comprising solubilized phosphates and a high solids content sludge comprising organic solids;(b) feeding the liquid fraction, without the high solids content sludge, into a phosphate recovery reactor, wherein a portion of the solubilized phosphates are precipitated and removed from the liquid fraction to produce a liquid phosphate recovery reactor effluent having a reduced solubilized phosphate content; (c) adding a phosphate precipitation inducer to the liquid phosphate recovery reactor effluent, wherein solubilized phosphates precipitate out of liquid phosphate recovery reactor effluent to produce a secondary reduced phosphate effluent; and (d) feeding the secondary reduced phosphate effluent into a processing chamber located downstream of the phosphate recovery reactor, wherein the secondary reduced phosphate effluent undergoes a physical separation, a chemical reaction, or a combination thereof.

[0008a] In another aspect, there is provided a method for treating wastewater comprising:

dewatering a wastewater comprising solubilized phosphates and organic solids to produce a liquid fraction comprising solubilized phosphates and a high solids content sludge comprising organic solids;

feeding the liquid fraction, without the high solids content sludge, into a phosphate recovery reactor, wherein a portion of the solubilized phosphates are precipitated and removed from the liquid fraction to produce a liquid phosphate recovery reactor effluent having a reduced solubilized phosphate content;

adding a phosphate precipitation inducer to the liquid phosphate recovery reactor effluent, wherein solubilized phosphates precipitate out of liquid phosphate recovery reactor effluent to produce a secondary reduced phosphate effluent; and

feeding the secondary reduced phosphate effluent into a processing chamber located downstream of the phosphate recovery reactor, wherein the secondary reduced phosphate effluent undergoes a physical separation, a chemical reaction, or a combination thereof.

[0009] Another embodiment of a method for treating wastewater includes: (a) dewatering a wastewater comprising solubilized phosphates and organic solids to produce a liquid fraction comprising solubilized phosphates and a high solids content sludge comprising organic solids; (b) feeding the liquid fraction, without the high solids content sludge, into a

phosphate recovery reactor, wherein a portion of the solubilized phosphates are precipitated and removed from the liquid fraction to produce a liquid phosphate recovery reactor effluent having a reduced solubilized phosphate content; (c) mixing the high solids content sludge with an effluent, a sludge, or both, from an auxiliary wastewater treatment reactor; and (d) feeding the mixture into a sludge reactor located downstream of the phosphate recovery reactor, wherein organic solids in the mixture are hydrolyzed.

[0009a] In another aspect, there is provided a method for treating wastewater comprising:

dewatering a wastewater comprising solubilized phosphates and organic solids to produce a liquid fraction comprising solubilized phosphates and a high solids content sludge comprising organic solids;

feeding the liquid fraction, without the high solids content sludge, into a phosphate recovery reactor, wherein a portion of the solubilized phosphates are precipitated and removed from the liquid fraction to produce a liquid phosphate recovery reactor effluent having a reduced solubilized phosphate content;

mixing the high solids content sludge with an effluent, a sludge, or both, from an auxiliary wastewater treatment reactor; and

feeding the mixture into a sludge reactor located downstream of the phosphate recovery reactor, wherein organic solids in the mixture are hydrolyzed.

[0010] Another embodiment of a method for treating wastewater includes: (a) dewatering a wastewater comprising solubilized phosphates and organic solids to produce a liquid fraction comprising solubilized phosphates and a high solids content sludge comprising organic solids; (b) feeding the liquid fraction, without the high solids content sludge, into a phosphate recovery reactor, wherein a portion of the solubilized phosphates are precipitated and removed from the liquid fraction to produce a liquid phosphate recovery reactor effluent having a reduced solubilized phosphate content; (c) mixing the liquid phosphate recovery reactor effluent with an effluent, a sludge, or both, from an auxiliary wastewater treatment reactor; and (d) feeding the mixture into a sludge reactor located downstream of the phosphate recovery reactor, wherein organic solids in the diluted sludge are hydrolyzed.

[0010a] In another aspect, there is provided a method for treating wastewater comprising:

dewatering a wastewater comprising solubilized phosphates and organic solids to produce a liquid fraction comprising solubilized phosphates and a high solids content sludge comprising organic solids;

feeding the liquid fraction, without the high solids content sludge, into a phosphate recovery reactor, wherein a portion of the solubilized phosphates are precipitated and removed from the liquid fraction to produce a liquid phosphate recovery reactor effluent having a reduced solubilized phosphate content;

mixing the liquid phosphate recovery reactor effluent with an effluent, a sludge, or both, from an auxiliary wastewater treatment reactor; and

feeding the mixture into a sludge reactor located downstream of the phosphate recovery reactor, wherein organic solids in the diluted sludge are hydrolyzed.

[0011] Another embodiment of a method for treating wastewater includes: (a) dewatering a wastewater comprising solubilized phosphates and organic solids to produce a liquid fraction comprising solubilized phosphates and a high solids content sludge comprising organic solids; (b) feeding the liquid fraction, without the high solids content sludge, into a phosphate recovery reactor, wherein a portion of the solubilized phosphates are precipitated and removed from the liquid fraction to produce a liquid phosphate recovery reactor effluent having a reduced solubilized phosphate content; and (c) feeding the liquid phosphate recovery reactor effluent into a nitrogen recovery reactor that removes ammonia from the liquid phosphate recovery reactor effluent to produce a nitrogen recovery reactor effluent.

[0011a] In another aspect, there is provided a method for treating wastewater comprising:

dewatering a wastewater comprising solubilized phosphates and organic solids to produce a liquid fraction comprising solubilized phosphates and a high solids content sludge comprising organic solids;

feeding the liquid fraction, without the high solids content sludge, into a phosphate recovery reactor, wherein a portion of the solubilized phosphates are precipitated and removed from the liquid fraction to produce a liquid phosphate recovery reactor effluent having a reduced solubilized phosphate content; and

feeding the liquid phosphate recovery reactor effluent into a nitrogen recovery reactor that removes ammonia from the liquid phosphate recovery reactor effluent to produce a nitrogen recovery reactor effluent.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] Illustrative embodiments of the invention will hereafter be described with reference to the accompanying drawings, wherein like numerals denote like elements.

[0013] FIG. 1 is a flowchart showing a first embodiment of a wastewater treatment process.

[0014] FIG. 2 is a flowchart showing a second embodiment of a wastewater treatment process.

[0015] FIG. 3 is a flowchart showing a third embodiment of a wastewater treatment process.

[0016] FIG. 4 is a schematic diagram of an electrodialysis stack comprising a series of monovalent-selective cation exchange membranes and monovalent-selective anion exchange membranes that can be used as a nitrogen recovery reactor.

[0017] FIG. 5 is a process flow diagram illustrating the processing flow used in the electrodialysis stack of FIG. 4.

DETAILED DESCRIPTION

[0018] Systems and methods for the treatment of wastewater are provided. By incorporating one or more intermediate phosphate recovery reactors and manipulating the effluent and/or solid streams from those reactors, the systems and methods are able to provide effluent and solid streams having customized phosphate content throughout the wastewater treatment process. As a result, the systems and methods provide users with unprecedented