CLAIMS

What is claimed is:

1. A mainstream deammonification process for removing ammonium from a wastewater stream, comprising:

clarifying the wastewater stream in a primary clarifier and producing a primary effluent;

directing a first portion of the primary effluent to a biological treatment reactor and removing carbon from the primary effluent to produce treated wastewater;

after treating the first portion of the primary effluent in the biological treatment reactor, directing the treated wastewater into an integrated fixed film activated sludge (IFAS) deammonification reactor that is provided with intermittent aeration including periods of air on and periods of air off;

directing a second portion of the primary effluent to the IFAS deammonification reactor and in the process bypassing the biological treatment reactor;

injecting the second portion of the primary effluent into the IFAS deammonification reactor during periods of air off and refraining from injecting the second portion of the primary effluent into the IFAS deammonification reactor during periods of air on, wherein the second portion of the primary effluent is mixed with the treated wastewater in the IFAS deammonification reactor to form a wastewater mixture;

in the IFAS deammonification reactor, removing ammonium from the wastewater mixture by a nitritation and anammox process; and

after removing ammonium from the wastewater mixture, directing the wastewater mixture to a secondary clarifier and producing a secondary effluent and a clarifier underflow, and recycling at least a portion of the underflow to the IFAS deammonification reactor.

2. The mainstream deammonification process of claim 1 wherein the process produces sludge and the process includes enhancing the settleability of the sludge produced by the process by providing an anaerobic or anoxic selector in the mainstream deammonification process upstream of the IFAS deammonification reactor and employing the anaerobic or anoxic selector to select non-filamentous biomass.

3. The mainstream deammonification process of claim 1 wherein the IFAS deammonification reactor is a plug flow reactor and includes a series of basins; and wherein the process includes step feeding the treated wastewater and the second portion of the primary effluent to the basins.

4. The mainstream deammonification process of claim 1 including maintaining the residual ammonia concentration in the IFAS deammonification reactor at greater than 1 mg/L.

5. The process of claim 1 wherein, in addition to removing ammonium in the IFAS deammonification reactor through nitritation and anammox, the process further includes partially denitrifying ammonium in the IFAS deammonification reactor by converting at least some nitrate to nitrite.

6. The process of claim 1 further including maintaining aerobic conditions in the IFAS deammonification reactor during periods of air on and maintaining anoxic conditions in the IFAS deammonification reactor during periods of air off.

7. The method of claim 6 wherein, during periods of air on in the IFAS deammonification reactor, the dissolved oxygen concentration is maintained at 0.5-2 mg/L and during periods of air off, maintaining the dissolved oxygen concentration in the IFAS demmonification reactor in the range of 0-0.5 mg/L.

~~8. The process of claim 1 wherein the IFAS deammonification reactor partially denitrifies the wastewater mixture therein by converting at least some nitrate to nitrite.~~

~~9~~8. The process of claim 1 wherein the process is controlled to provide partial denitrification in the IFAS deammonification reactor by maintaining the biodegradable soluble chemical oxygen demand (bsCOD) to TKN at approximately 0.5-2 as gCOD/g-TKN.

~~10~~9. A mainstream deammonification process for removing ammonium and phosphorus from a stream of wastewater while reducing the tendency of sludge produced in the process to bulk, the process comprising:

clarifying the wastewater stream in a primary clarifier and producing a primary effluent;

directing a first portion of the primary effluent to a biological treatment reactor and removing carbon from the primary effluent to produce treated wastewater;

after treating the first portion of the primary effluent in the biological treatment reactor, directing the treated wastewater into an integrated fixed film activated sludge (IFAS) deammonification reactor that is provided with intermittent aeration, including periods of air on and periods of air off;

directing a second portion of the primary effluent to an anaerobic or anoxic selector located upstream of the IFAS deammonification reactor and in the anaerobic or anoxic selector, selecting biological phosphorus removing microorganisms and non-filamentous microorganisms;

directing an effluent from the anaerobic or anoxic selector into the IFAS deammonification reactor and in the process bypassing the biological treatment reactor;

injecting the effluent from the anaerobic or anoxic selector into the IFAS deammonification reactor wherein the effluent from the anaerobic or anoxic selector is mixed with the treated wastewater in the IFAS deammonification reactor to form a wastewater mixture;

in the IFAS deammonification reactor, removing ammonium from the wastewater mixture by a nitritation and an anammox process and removing phosphorus from the wastewater mixture; and

directing the wastewater mixture from the IFAS deammonification reactor to a secondary clarifier and producing a secondary effluent and a clarifier underflow and recycling a portion of the clarifier underflow to the anaerobic or anoxic selector.

~~11~~10. The process of claim ~~10~~ 9 wherein a carbon is supplied to the anaerobic or anoxic selector via the second portion of the primary effluent and return activated sludge from the secondary clarifier.

~~12~~11. The process of claim ~~10~~ 9 wherein the treated wastewater that is treated in the biological treatment reactor is not directed into the anaerobic or anoxic selector but instead bypasses the anaerobic or anoxic selector and is directed into the IFAS deammonification reactor.

~~13~~12. A mainstream deammonification process for removing ammonium from a wastewater stream, comprising:

clarifying the wastewater stream in a primary clarifier and producing a primary effluent;

directing a first portion of the primary effluent to a biological treatment reactor and removing carbon from the primary effluent to produce treated wastewater;

after treating the first portion of the primary effluent in the biological treatment reactor, directing the treated wastewater to an integrated fixed film activated sludge (IFAS) deammonification reactor provided with intermittent aeration including periods of air on and periods of air off and wherein the IFAS deammonification reactor includes a series of basins;

step feeding the treated wastewater into the basins of the IFAS deammonification reactor;

directing a second portion of the primary effluent to the IFAS deammonification reactor and in the process bypassing the biological treatment reactor;

step feeding the second portion of the primary effluent into the basins of the IFAS deammonification reactor during periods of air ~~on~~ off and refraining from step

feeding the second portion of the primary effluent into the IFAS deammonification reactor during periods of air on, wherein the second portion of a primary effluent is mixed with the treated wastewater in the IFAS deammonification reactor to form a wastewater mixture;

in the IFAS deammonification reactor, removing ammonium from the wastewater mixture by a nitritation and anammox process; and

after removing ammonium from the wastewater mixture, directing the wastewater mixture to a secondary clarifier and producing a secondary effluent and a clarifier underflow, and recycling at least a portion of the underflow to the IFAS deammonification reactor.

~~14. The process of claim 13 wherein each of the basins of the IFAS deammonification reactor includes intermittent aeration.~~

~~15~~13. The process of claim ~~13~~ 12 including maintaining a residual ammonium concentration in the IFAS deammonification reactor on the order of 1-5 mg/L.