CLAIMS

1. A system for deselecting biological solids in an influent containing water, the system comprising:

an inlet configured to receive an influent containing water;

a bioreactor configured to disperse the influent in a solid-liquid mixture, treat the solid-liquid mixture, and form biological solids;

an internal deselector configured to deselect the solid-liquid mixture and retain, retard or provide a differential of the biological solids;

a particle deselector configured to receive the deselected solid-liquid mixture and deselect remainder biological solids from the deselected solid-liquid mixture; and

one or more return lines configured to supply the returnable biological solids to the bioreactor,

wherein:

by using the internal deselector or the particle deselector, particles included in the biological solids have an average solids residence time (avSRT) for selecting fast and slow growing organisms with different treatment functions in the bioreactor;

the particles in the remainder biological solids have a solids residence time (loSRT) that is lower than the average solids residence time (avSRT) in the bioreactor;

the particles in the returnable biological solids in the one or more return lines have a solids residence time (hiSRT) that is higher than the average solids residence time (avSRT) in the bioreactor;

the particle deselector comprises at least one of a density-based (DB) deselector, a particle size-compressibility (PSC) deselector, and a particle shear based deselector; and

the internal deselector is configured to deselect the solid-liquid mixture using one or more of:

a mixing source,

a visible, ultraviolet or infrared photo source,

a heat source,

a gas source,

a pressure source,

an electromagnetic source,

a flow source,
a stratification source,
a differential influent cascade, or
a differential feast and famine.

2. The system in claim 1, wherein the internal deselector comprises at least one of a decanter, a clarifier, a separator, a lamella, a membrane, and a filter configured to separate solid particles having predetermined characteristics from the solid-liquid mixture.

3. The system in claim 1, wherein the biological solids in the bioreactor include particles comprising a sludge volume index less than 80 mL/g.

4. The system in claim 1, wherein the internal deselector is configured to apply a negative or a positive pressure or stratification at or near

a. a reactor interface of the bioreactor,
b. a clarifier interface,
c. a surface of the bioreactor,
d. a surface of a settling blanket,
e. a periphery of a clarifier,
f. a feed zone in the bioreactor where influent or recycles are supplied,
g. a discharge zone in the bioreactor or a clarifier, from which an effluent or recycles are output, or
h. a settle zone in a reactor or clarifier.

5. The system in claim 1, wherein the internal deselector comprises

a. one or more slotted manifolds,
b. one or more perforated manifolds,
c. one or more plates,
d. one or more pipes,
e. one or more baffles,
f. a mixer, or
g. a pump.

6. The system in claim 1, wherein the return line comprises recycle streams from the

internal deselector and the particle deselector to at least two different locations in the bioreactor.

7. The system in claim 1, wherein the particle deselector is further configured to return non-deselected biological solids to the bioreactor.

8. The system in claim 1, wherein the internal deselector is configured to deselect based on density, size, shear, compression, diffusion, or exposure to light or heat energy.

9. A system for deselecting biological solids in an influent containing water, the system comprising:

a bioreactor;

at least one of an internal deselector and an external deselector, with a minimum of two internal and/or external deselectors; and

one or more return lines;

wherein the system is configured to disperse the influent in the bioreactor to form a solid-liquid mixture containing biological solids; and

wherein the minimum of two internal and/or external deselectors comprises:

(i) at least two internal deselectors configured to retain or retard or provide a differential of the biological solids from the solid-liquid mixture in the bioreactor to form a deselected solid-liquid mixture, including

at least one internal deselector configured to perform internal deselection to deselect the biological solids from the solid-liquid mixture using a mixing source, a gas source or a stratification source, and

at least one other internal deselector configured to perform a differential feast and famine; or

(ii) at least one internal deselector and at least one external deselector configured such that

the at least one internal deselector retains or retards or provides the differential of the biological solids from the solid-liquid mixture in the bioreactor, and

the at least one external deselector comprises at least one of a density-based (DB) deselector, a particle size-compressibility (PSC) deselector, and a particle shear based deselector to deselect the biological solids based on

at least one of solids particle density, size, shear-resistance, or compressibility; or

(iii) at least two external deselectors, comprising a first particle deselector and a second particle deselector, wherein the second particle deselector is configured to deselect a deselected part of a portion of the biological solids, based on at least one of solids particle density, size, shear-resistance, or compressibility, from the first particle deselector;

wherein the one or more return lines are configured to supply returnable biological solids to the bioreactor; and

wherein a plurality of solids residence times in the bioreactor for the different particles are supported by the system.

10. The system in claim 9, wherein the at least one internal deselector comprises a deseselector configured to deselect the solid-liquid mixture using one or more of:

a mixing source,
a visible, ultraviolet or infrared photo source,
a heat source,
a gas source,
a pressure source,
an electromagnetic source,
a flow source,
a stratification source,
a differential influent cascade, or
a differential feast and famine.

11. The system in claim 9, wherein the at least one internal deselector comprises at least one of a decanter, a clarifier, a separator, a lamella, a membrane, and a filter configured to separate solid particles having predetermined characteristics from the solid-liquid mixture.

12. The system in claim 9, wherein the biological solids include particles comprising a sludge volume index less than 80 mL/g.

13. The system in claim 9, wherein the at least one internal deselector comprises a deselector configured to apply a negative or a positive pressure or stratification at or near

a. a reactor interface of the bioreactor,
b. a clarifier interface,
c. a surface of the bioreactor,
d. a surface of a settling blanket,
e. a periphery of a clarifier,
f. a feed zone in the bioreactor where influent or recycles are supplied,
g. a discharge zone in the bioreactor or a clarifier, from which an effluent or recycles are output, or
h. a settle zone in a reactor or clarifier.

14. The system in claim 9, wherein the internal deselector comprises
a. one or more slotted manifolds,
b. one or more perforated manifolds,
c. one or more plates,
d. one or more pipes,
e. one or more baffles,
f. a mixer, or
g. a pump.

15. The system in claim 9, wherein the return line comprises recycle streams from the at least one internal deselector and the at least one deselector to at least two different locations in the bioreactor.

16. The system in claim 9, wherein the at least one external deselector is configured to return non-deselected biological solids to the bioreactor.

17. The system in claim 9, wherein the at least one internal deselector is configured to deselect based on density, size, shear, compression, diffusion, or exposure to light or heat energy.