Operations in macrophyte bioreactor train

Unit number	Type	Unit description
3.0	Holding / Mixing Tank	Mixing supplementary substrate streams and providing buffer capacity to average flows and compositions
3.1	Macrophyte Bioreactor	Macrophyte Bioreactor
3.2	Solid/Liquid Separator	Separates Macrophyte Biomass from Compliant Effluent (leaving system)
3.3	Solid/Solid Separator	Separates Biomass from Sediment. This may involve separate steps, e.g. manual harvesting (seasonal), and sediment de-sludging (annual)
3.4	Size Fractioning Separator	Macrophyte Biomass harvested and fractionated into high quality Fibre and lower quality Cellulosic Biomass
3.5	Splitter	Lower quality Cellulosic Biomass to Solids Bioreactor and to product stream (further processing)
3.6	Splitter	N & P Rich Sediment to product stream and to Solids Bioreactor

Streams in macrophyte bioreactor train

Stream number	Stream description	Relation to process units	Relation to other streams Equations refer to mass balance (kg/day)
F1	Almost Compliant Effluent	From Unit 2.2: Separator Into Unit 3.0: Holding tank for Macrophyte Bioreactor	F = E1 - E2 Composition same as dissolved composition E1
F2	Supplementary Feed	Into Unit 3.0: Holding tank for Macrophyte Bioreactor	Incoming stream, volume and composition set by user. (Optional stream)
F3	Supplementary Feed	Into Unit 3.0: Holding tank for Macrophyte Bioreactor	Incoming stream, volume and composition set by user. (Optional stream)
F4	Supplementary Feed	Into Unit 3.0: Holding tank for Macrophyte Bioreactor	Incoming stream, volume and composition set by user. (Optional stream)
G1	Wet Macrophyte Biomass	From Unit 3.1: Macrophyte Bioreactor Into Unit 3.2: Separator	G1 = (F + G6 + G7) * Macrophyte yield coefficient * Separation efficiencies Composition changed from F1, a combination of liquid, fibre and sediment.
G2	Solids	From Unit 3.2: Separator (Effluent Removal) Into Unit 3.3: Separator (Product & Biomass Recovery)	G2 = G1 – Z Macrophyte biomass as well as any sediment
G3	Fibre & Biomass	From Unit 3.3: Separator (Product & Biomass Recovery) Into Unit 3.4: Separator	G3 = G2 – G4
G4	Sediment	From Unit 3.3: Separator (Product & Biomass Recovery) Into Unit 3.6: Splitter	Slow accumulating sediment consisting of algal(dead) biomass, rich in N and P.
G5	Cellulosic Biomass Stream	From Unit 3.4: Separator Into Unit 3.5: Splitter	Similar composition to G3 Volume G5 = G3 – X1
G6	CO_2	From Atmosphere Into Unit 3.1: Macrophyte Bioreactor	CO_2 only
G7	H_2O	Between atmosphere and Unit 3.1: Macrophyte Bioreactor	H_2O only
U4	Macrophyte Bottoms (Cellulosic Biomass)	From Unit 3.5: Splitter Into Unit 4.0: Holding tank for Solids Bioreactor	U4 = G5 – X2 Composition same as G5, X2
U5	Macrophyte Bottoms (N,P Rich Sediment)	From Unit 3.6: Splitter Into Unit 4.0: Holding tank for Solids Bioreactor	U5 = G4 – X3 Composition same as G4, X3
X1	Fibre Stream	From Unit 3.4: Separator Exit system	G*(1- moisture content fraction) * Fibre compositional fraction * Separation efficiencies
X2	Cellulosic Biomass Product Stream	From Unit 3.5: Splitter Exit system	X2 = G5 – U4
X3	N,P Rich Sediment	From Unit 3.6: Splitter Exit system	X3 = G4 – U5
Z	Compliant Effluent	From Unit 3.2: Separator Exit system	Composition must comply with discharge standards (either for discharge into natural water body or for irrigation)