APPENDIX-A

Table A1. Sewage properties and characteristics used in the current model

Sewage flow characteristics		
S.No	Parameters	Values
1	City Population Equivalent	1.3E+06
2	Sewage produced/ Person	150 L
3	Suspended solids/ Person	0.06 kg
4	BOD in influent / Person	0.05 kg
5	BOD removed in primary clarifier	30%
6	Target Effluent	20 mg/ L
7	F/M (Food / Microbial)	0.7
8	MLSS (Mixed Liquor Suspended Solids)	4000 mg/ L
9	MLVSS/MLSS (MLVS-Mixed Liquor Volatile Suspended Solids)	0.8
10	Sewage inlet temperature	10 ℃

Table A2. Clarifier-settling tanks, aeration and thickening system parameters

Upstream Process Parameters					
	CAPEX[a], $	Power Demand[b] kWh/m^3	Solid Removal Efficiency %, η	Polymer Demand	Source
Primary and Secondary Clarifier Systems (Tank, Pumps, Rakes)	6.02 E+06	35.67	60	NA	[1, 2]
Aeration tank and Blowers	5.42 E+06	0.0459	NA	NA	[2, 3, 4] and estimation.
Belt Thickener	2.92 E+06	0.3	85	0.003 kg /kg dry solids	[5, 6]

[a] Adapted based on scale up factors from available literature.

[b] Adapted and calculated based on empirical correlations and available literature.

Table A3. Aeration Energy requirement validation

Aeration Basin Power Requirements				
		[4]	Model (Empirical based, safety factor-1.25)	
Q	M^3/d	100	100	
SS	g/m^3	1800	1800	
BOD	g/m^3d	660-770	700	INPUTS
F/M		0.3-0.46	0.4	
K, (BOD removal rate)	g/m^3hr	NA	0.001	
SOTE	η	4%	4%	
O2/BOD	Kg/kgd	1	1	
Volume of Reactor	m^3/unit	7900	7762	
Air supplied	m^3/hr	244800	298029	
HRT	Hours	6.2-4.8	6.01	
Centrifugal Blower Power	kW	5294	5472	
Power	Kwhr/Kg O2 dissolved	1.5	1.84	OUTPUTS

Anaerobic Digestor Process Parameters					
	CAPEX[a], $	Power Demand[b], kWh/m^3.day	VS destruction Efficiency %, η	Methane production, ml/ kg VS	Source
Anaerobic Digestor	90	0.12	0.5	450	[7,8,9]

Table A4. Anaerobic Digestor process parameters

[a] Concrete cost/ m^3 .

[b] mixing energy requirement.

Table A5. Anaerobic digestion system products and compositions

	Sludge Type	VS Destruction /day	Product	Composition	Parameters
1	Mixed Sludge	2.5%	CH_4-450 ml/ kg VS	CH_4-60%, CO_2-40%	20-Days, 6.5 pH and 35 ℃
2	Primary Sludge	4%	VFAs-600 mg/L.day	Acetic acid -40%, propionic acid -25%, butyric acid -20% and Valeric acid -15%	5-days, 10 pH and 25 ℃
	Waste activated sludge	3.5%	VFAs-300 mg/L.day		10-days, 10 pH and 25 ℃

Table A6. Product recovery system parameters

Product Recovery and Intensification				
Separation Technology	CAPEX[a], $	Power Demand[b]	Separation Efficiency %, η	Source
CED/BPED	3.2 E+06[c]	3 kWh/kg	90	[10]
Membrane Filtration (MF/UF)	377.52 $/ m^3.d	0.1 kW/3.78 m^3	90[d]	[11,12,13]
Super Critical-(SCO_2) Extraction	2E+06 / 400 L Batch	0.8 kWh/kg	60	[14,15]

[a] Adapted based on scale up factors from available literature.

[b] Adapted, calculated based on empirical correlations and available literatures.

[c] Membrane cost -1774 $/$m^2$, 2 yearly replaced, Peripheral and Stack cost – 3 x Membrane cost.

[d] Turbidity removal.

CHP and Boiler System					
	CAPEX[a], $	Power Demand[b]	Energy Efficiency %, η	Methane Leak	Source
CHP	1340 / kW	3[c] %	85	2%	[16-18]
Water Scrubbing	1.65E+06/ 1000 m^3/hr	0.25 kWhr/ Nm^3	90[d]	2%	[19, 20]
Boiler & accessories	542 / kW	NA	85	NA	[21]

Table A7. CHP and Boiler system parameters

[a] Adapted based on scale up factors from available literature.

[b] Adapted and calculated based on empirical correlations and available literatures.

[c] Parasitic power demand.

[d] Water scrubbing energy efficiency at 98% methane purity.

Table A8. Pyrolysis product composition and energy content

Pyrolysis Product composition at 550 ℃				
	Oil	Gas	Char	Source
Composition %	25	42	30	Estimate
Energy (MJ/kg)	32-43	7-23	9.56-14.2	Estimate

Table A9. Pyrolysis system parameters

Pyrolysis System				
	CAPEX[a], $	Power Demand	Energy Efficiency %, η	Source
Pyrolysis	53 $/kg	6.5 MJ/ Kg [b]	85	Estimate

[a] Adapted based on scale up factors from available literature.

[b] Heat Energy demand.

De-Watering System					
	CAPEX[a],	Power Demand	Solid Removal Efficiency %, η	Polymer/Chemical Demand	Source
Centrifuge	132 $/kg	3.2 kW/m^3. s	90	0.01 kg / kg of dry solids	Estimate
Dryer	287 $/kg	2.15*10^6 J/ Kg [b]	90	NA	[22, 23]

Table A10. Dewatering system parameters

[a] Adapted based on scale up factors from available literature.

[b] Heat Energy demand.

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