Economic Evaluation Report
for S2.2

April 13, 2024

1. EXECUTIVE SUMMARY (2024 prices)

Total Capital Investment	29,399,000 $
Capital Investment Charged to This Project	29,399,000 $
Operating Cost	9,283,000 $/yr
Revenues	14,595,000 $/yr
Batch Size	104,247.57 kg Myco
Cost Basis Annual Rate	729,733 kg Myco/yr
Unit Production Cost	12.72 $/kg Myco
Net Unit Production Cost	12.72 $/kg Myco
Unit Production Revenue	20.00 $/kg Myco
Gross Margin	36.39 %
Return On Investment	22.33 %
Payback Time	4.48 years
IRR (After Taxes)	15.26 %
NPV (at 7.0% Interest)	16,840,000 $

Myco = Total Flow of Stream 'S-303'

2. EQUIPMENT SPECIFICATION AND FOB COST (2024 prices)

Main Equipment

Quantity/ Standby/ Staggered	Name	Description	Unit Cost ($)	Cost ($)
1 / 0 / 0	SP-201	Screw Press	670,000	670,000
		Throughput = 28113.87 kg/h		
1 / 0 / 0	R-201	Stirred Reactor	467,000	467,000
		Vessel Volume = 6.25 m3		
1 / 0 / 0	PZ-201	Pasteurizer	454,000	454,000
		Rated Throughput = 23901.65 L/h		
1 / 0 / 0	V-201	Blending Tank	267,000	267,000
		Vessel Volume = 39943.91 L		
3 / 0 / 0	V-101	Receiver Tank	250,000	750,000
		Vessel Volume = 40805.67 L		
1 / 0 / 0	RVF-301	Rotary Vaccum Filter	245,000	245,000
		Filter Area = 80.00 m2		
1 / 0 / 0	R-101	Stirred Reactor	199,000	199,000
		Vessel Volume = 11019.15 L		
1 / 0 / 0	V-102	Neutralizer	163,000	163,000
		Vessel Volume = 30991.37 L		
1 / 0 / 0	AFR-201	Air-Lift Fermentor	105,000	105,000
		Vessel Volume = 12482.47 L		
1 / 0 / 0	GR-101	Grinder	85,000	85,000
		Rated Throughput = 2000.01 lb/h		
1 / 0 / 0	G-201	Centrifugal Compressor	80,000	80,000
		Compressor Power = 44.52 kW		
1 / 0 / 0	SL-101	Silo	78,000	78,000
		Vessel Volume = 59417.01 L		
1 / 0 / 0	PZ-301	Pasteurizer	25,000	25,000
		Rated Throughput = 1485.14 L/h		
1 / 0 / 0	AF-201	Air Filter	8,000	8,000
		Rated Throughput = 479997.19 L/h		
		Unlisted Equipment		899,000
			TOTAL	4,494,000

3. FIXED CAPITAL ESTIMATE SUMMARY (2024 prices in $)

3A. Total Plant Direct Cost (TPDC) (physical cost)	
1. Equipment Purchase Cost	4,494,000
2. Installation	1,815,000
3. Process Piping	1,573,000
4. Instrumentation	1,798,000
5. Insulation	135,000
6. Electrical	449,000
7. Buildings	2,022,000
8. Yard Improvement	674,000
9. Auxiliary Facilities	1,798,000
TPDC	14,758,000

3B. Total Plant Indirect Cost (TPIC)	
10. Engineering	3,690,000
11. Construction	5,165,000
TPIC	8,855,000

3C. Total Plant Cost (TPC = TPDC+TPIC)	
TPC	23,613,000

3D. Contractor's Fee & Contingency (CFC)	
12. Contractor's Fee	1,181,000
13. Contingency	2,361,000
CFC = 12+13	3,542,000

3E. Direct Fixed Capital Cost (DFC = TPC+CFC)	
DFC	27,155,000

4. LABOR COST - PROCESS SUMMARY

Labor Type	Unit Cost ($/h)	Annual Amount (h)	Annual Cost ($)	%
Operator	69.00	33,552	2,315,078	100.00
TOTAL		33,552	2,315,078	100.00

5. MATERIALS COST - PROCESS SUMMARY

Bulk Material	Unit Cost ($)	Annual Amount		Annual Cost ($)	%
Air	0.00	3,993,859	kg	0	0.00
Citric Acid*H20	700.00	22	ton	15,056	1.22
CSS	0.05	1,960,000	lb	98,000	7.93
H2SO4 (50% w/w)	0.04	499,577	kg	18,249	1.48
Hydrolases	10.00	4,794	kg	47,936	3.88
KH2PO4	5.00	42,277	kg	211,383	17.09
MgSO4*7H20	5.00	21,138	kg	105,692	8.55
Na2HPO4	1.50	10,569	kg	15,854	1.28
NaOH (5% w/v)	0.17	4,074,840	kg	685,604	55.45
NH3	0.20	20,070	kg	4,014	0.32
Water	0.01	2,989,265	gal(STP)	34,750	2.81
TOTAL				1,236,539	100.00

NOTE: Bulk material consumption amount includes material used as:
- Raw Material
- Cleaning Agent
- Heat Transfer Agent (if utilities are included in the operating cost)

6. VARIOUS CONSUMABLES COST (2024 prices) - PROCESS SUMMARY

THE CONSUMABLES COST IS ZERO.

7. WASTE TREATMENT/DISPOSAL COST (2024 prices) - PROCESS SUMMARY

Waste Category	Unit Cost ($)	Annual Amount		Annual Cost ($)	%
Solid Waste				0	0.00
Aqueous Liquid				20,291	100.00
P-1:Cleaning(Cleaning Step #1)	5.00	1,429	MT	7,143	35.20
P-6:CIP-1(Cleaning Step #1)	5.00	146	MT	731	3.60
P-6:SIP-1	0.00	58,800	kg	59	0.29
P-10:CIP-1(Cleaning Step #1)	5.00	531	MT	2,655	13.09
P-10:SIP-1	0.00	587,176	kg	587	2.89
P-16:CIP-1(Cleaning Step #1)	5.00	32	MT	161	0.80
P-16:SIP-1	0.00	4,369	kg	4	0.02
P-20:CIP-1(Cleaning Step #1)	5.00	1,755	MT	8,773	43.24
P-20:SIP-1	0.00	176,400	kg	176	0.87
Organic Liquid				0	0.00
Emissions				0	0.00
TOTAL				20,291	100.00

8. UTILITIES COST (2024 prices) - PROCESS SUMMARY

Utility	Unit Cost ($)	Annual Amount	Ref. Units	Annual Cost ($)	%
Std Power	0.10	1,030,449	kW-h	103,045	40.68
Steam	32.00	740	MT	23,692	9.35
Cooling Water	0.10	34,958	MT	3,496	1.38
Chilled Water	0.50	204,406	MT	102,203	40.34
Steam (Low P)	30.00	696	MT	20,889	8.25
TOTAL				253,324	100.00

9. ANNUAL OPERATING COST (2024 prices) - PROCESS SUMMARY

Cost Item	$	%
Raw Materials	1,237,000	13.32
Labor-Dependent	2,315,000	24.94
Facility-Dependent	5,111,000	55.05
Laboratory/QC/QA	347,000	3.74
Consumables	0	0.00
Waste Treatment/Disposal	20,000	0.22
Utilities	253,000	2.73
Transportation	0	0.00
Miscellaneous	0	0.00
Advertising/Selling	0	0.00
Running Royalties	0	0.00
Failed Product Disposal	0	0.00
TOTAL	9,283,000	100.00

10. PROFITABILITY ANALYSIS (2024 prices)

A.	Direct Fixed Capital	27,155,000 $
B.	Working Capital	386,000 $
C.	Startup Cost	1,358,000 $
D.	Up-Front R&D	0 $
E.	Up-Front Royalties	500,000 $
F.	Total Investment (A+B+C+D+E)	29,399,000 $
G.	Investment Charged to This Project	29,399,000 $

H.	**Revenue/Savings Rates**	
	S-303 (Main Revenue)	729,733 kg/yr

I.	**Revenue/Savings Price**	
	S-303 (Main Revenue)	20.00 $/kg

J.	**Revenues/Savings**	
	S-303 (Main Revenue)	14,594,660 $/yr
1	Total Revenues	14,594,660 $/yr
2	Total Savings	0 $/yr

K.	**Annual Operating Cost (AOC)**	
1	Actual AOC	9,283,000 $/yr
2	Net AOC (K1-J2)	9,283,000 $/yr

L.	**Unit Production Cost /Revenue**	
	Unit Production Cost	12.72 $/kg Myco
	Net Unit Production Cost	12.72 $/kg Myco
	Unit Production Revenue	20.00 $/kg Myco

M.	Gross Profit (J-K)	5,312,000 $/yr
N.	Taxes (25%)	1,328,000 $/yr
O.	Net Profit (M-N + Depreciation)	6,563,000 $/yr

	Gross Margin	36.39 %
	Return On Investment	22.33 %
	Payback Time	4.48 years

Myco = Total Flow of Stream 'S-303'

Materials & Streams Report
for S2.2

April 13, 2024

1. OVERALL PROCESS DATA

Annual Operating Time	7,140.50 h
Unit Production Ref. Rate	729,732.99 kg Myco/yr
Batch Size	104,247.57 kg Myco
Recipe Batch Time	6.43 wk
Recipe Cycle Time	6.01 wk
Number of Batches per Year	7.00

Myco = Total Flow of Stream 'S-303'

2.1 STARTING MATERIAL REQUIREMENTS (per Section)

Section	Starting Material	Active Product	Amount Needed (kg Sin/kg Myco)	Molar Yield (%)	Mass Yield (%)	Gross Mass Yield (%)
Post Processing	(none)	(none)	0.00	Unknown	Unknown	Unknown
Preprocessing	(none)	(none)	0.00	Unknown	Unknown	Unknown
Core Operations	(none)	(none)	0.00	Unknown	Unknown	Unknown

Sin = Section Starting Material, Aout = Section Active Product

2.2 BULK MATERIALS (Entire Process)

Material	kg/yr	kg/batch	kg/kg Myco
Air	3,993,859	570,551.24	5.47
Citric Acid*H20	19,512	2,787.47	0.03
CSS	889,041	127,005.84	1.22
H2SO4 (50% w/w)	499,577	71,368.17	0.68
Hydrolases	4,794	684.80	0.01
KH2PO4	42,277	6,039.53	0.06
MgSO4*7H20	21,138	3,019.76	0.03
Na2HPO4	10,569	1,509.88	0.01
NaOH (5% w/v)	4,074,840	582,120.00	5.58
NH3	20,070	2,867.09	0.03
Water	11,358,790	1,622,684.28	15.57
TOTAL	20,934,467	2,990,638.08	28.69

2.3 BULK MATERIALS (per Section)

SECTIONS IN: Main Branch

Post Processing

Material	kg/yr	kg/batch	kg/kg Myco
Water	2,651,014	378,716.31	3.63
TOTAL	2,651,014	378,716.31	3.63

Preprocessing			
Material	**kg/yr**	**kg/batch**	**kg/kg Myco**
CSS	889,041	127,005.84	1.22
H2SO4 (50% w/w)	499,577	71,368.17	0.68
NaOH (5% w/v)	4,074,840	582,120.00	5.58
Water	1,428,583	204,083.24	1.96
TOTAL	6,892,041	984,577.25	9.44

Core Operations			
Material	**kg/yr**	**kg/batch**	**kg/kg Myco**
Air	3,993,859	570,551.24	5.47
Citric Acid*H20	19,512	2,787.47	0.03
Hydrolases	4,794	684.80	0.01
KH2PO4	42,277	6,039.53	0.06
MgSO4*7H20	21,138	3,019.76	0.03
Na2HPO4	10,569	1,509.88	0.01
NH3	20,070	2,867.09	0.03
Water	7,279,193	1,039,884.73	9.98
TOTAL	11,391,412	1,627,344.52	15.61

2.4 BULK MATERIALS: SECTION TOTALS (kg/kg Myco)

Raw Material	Post Processing	Preprocessing	Core Operations
Air	0.00	0.00	5.47
Citric Acid*H20	0.00	0.00	0.03
CSS	0.00	1.22	0.00
H2SO4 (50% w/w)	0.00	0.68	0.00
Hydrolases	0.00	0.00	0.01
KH2PO4	0.00	0.00	0.06
MgSO4*7H20	0.00	0.00	0.03
Na2HPO4	0.00	0.00	0.01
NaOH (5% w/v)	0.00	5.58	0.00
NH3	0.00	0.00	0.03
Water	3.63	1.96	9.98
TOTAL	3.63	9.44	15.61

2.5 BULK MATERIALS: SECTION TOTALS (kg/batch)

Raw Material	Post Processing	Preprocessing	Core Operations
Air	0.00	0.00	570,551.24
Citric Acid*H20	0.00	0.00	2,787.47
CSS	0.00	127,005.84	0.00
H2SO4 (50% w/w)	0.00	71,368.17	0.00
Hydrolases	0.00	0.00	684.80
KH2PO4	0.00	0.00	6,039.53
MgSO4*7H20	0.00	0.00	3,019.76
Na2HPO4	0.00	0.00	1,509.88
NaOH (5% w/v)	0.00	582,120.00	0.00
NH3	0.00	0.00	2,867.09
Water	378,716.31	204,083.24	1,039,884.73
TOTAL	378,716.31	984,577.25	1,627,344.52

2.6 BULK MATERIALS: SECTION TOTALS (kg/yr)

Raw Material	Post Processing	Preprocessing	Core Operations
Air	0	0	3,993,859
Citric Acid*H20	0	0	19,512
CSS	0	889,041	0
H2SO4 (50% w/w)	0	499,577	0
Hydrolases	0	0	4,794
KH2PO4	0	0	42,277
MgSO4*7H20	0	0	21,138
Na2HPO4	0	0	10,569
NaOH (5% w/v)	0	4,074,840	0
NH3	0	0	20,070
Water	2,651,014	1,428,583	7,279,193
TOTAL	2,651,014	6,892,041	11,391,412

2.7 BULK MATERIALS (per Material)

Air

Procedure	% Total	kg/yr	kg/batch	kg/kg Myco
Core Operations (Main Branch)				
P-13	100.00	3,993,859	570,551.24	5.47
TOTAL	100.00	3,993,859	570,551.24	5.47

Citric Acid*H20

Procedure	% Total	kg/yr	kg/batch	kg/kg Myco
Core Operations (Main Branch)				
P-8	100.00	19,512	2,787.47	0.03
TOTAL	100.00	19,512	2,787.47	0.03

CSS

Procedure	% Total	kg/yr	kg/batch	kg/kg Myco
Preprocessing (Main Branch)				
P-2	100.00	889,041	127,005.84	1.22
TOTAL	100.00	889,041	127,005.84	1.22

H2SO4 (50% w/w)

Procedure	% Total	kg/yr	kg/batch	kg/kg Myco
Preprocessing (Main Branch)				
P-5	100.00	499,577	71,368.17	0.68
TOTAL	100.00	499,577	71,368.17	0.68

Hydrolases

Procedure	% Total	kg/yr	kg/batch	kg/kg Myco
Core Operations (Main Branch)				
P-17	100.00	4,794	684.80	0.01
TOTAL	100.00	4,794	684.80	0.01

KH2PO4

Procedure	% Total	kg/yr	kg/batch	kg/kg Myco
Core Operations (Main Branch)				
P-29	100.00	42,277	6,039.53	0.06
TOTAL	100.00	42,277	6,039.53	0.06

MgSO4*7H20

Procedure	% Total	kg/yr	kg/batch	kg/kg Myco
Core Operations (Main Branch)				
P-8	100.00	21,138	3,019.76	0.03
TOTAL	100.00	21,138	3,019.76	0.03

Na2HPO4

Procedure	% Total	kg/yr	kg/batch	kg/kg Myco
Core Operations (Main Branch)				
P-29	100.00	10,569	1,509.88	0.01
TOTAL	100.00	10,569	1,509.88	0.01

NaOH (5% w/v)

Procedure	% Total	kg/yr	kg/batch	kg/kg Myco
Preprocessing (Main Branch)				
P-1	100.00	4,074,840	582,120.00	5.58
TOTAL	100.00	4,074,840	582,120.00	5.58

NH3

Procedure	% Total	kg/yr	kg/batch	kg/kg Myco
Core Operations (Main Branch)				
P-14	100.00	20,070	2,867.09	0.03
TOTAL	100.00	20,070	2,867.09	0.03

Water

Procedure	% Total	L/yr	L/batch	L/kg Myco
Post Processing (Main Branch)				
P-20	23.34	2,640,934	377,276.32	3.62
Preprocessing (Main Branch)				
P-1	12.58	1,423,151	203,307.25	1.95
Core Operations (Main Branch)				
P-17	0.38	42,978	6,139.77	0.06
P-6	1.80	204,242	29,177.43	0.28
P-29	2.03	229,986	32,855.14	0.32
P-11	47.94	5,424,967	774,995.32	7.43
P-8	1.76	198,861	28,408.68	0.27
P-10	9.84	1,113,955	159,136.46	1.53
P-16	0.32	36,526	5,217.98	0.05
TOTAL	100.00	11,315,600	1,616,514.33	15.51

3. STREAM DETAILS

Stream Name	S-218	S-221	S-222	S-210
Source	**INPUT**	**P-15**	**P-14**	**INPUT**
Destination	**P-14**	**P-14**	**P-16**	**P-8**
Stream Properties				
Activity (U/ml)	0.00	0.00	0.00	0.00
Temperature (°C)	25.00	40.00	39.85	25.00
Pressure (bar)	1.01	6.01	1.01	1.01
Density (g/L)	0.70	6.66	1.12	994.70
DS Flow (kg-ds/batch)	0.00	0.00	0.00	0.00
Aqueous Flow (kg-aq/batch)	2,867.09	570,551.24	573,418.34	28,517.11
DS (%)	0.00	0.00	0.00	0.00
Total Enthalpy (kW-h)	41.19	6,420.01	6,461.20	832.19
Specific Enthalpy (kcal/kg)	12.36	9.68	9.70	25.11
Heat Capacity (kcal/kg-°C)	0.50	0.24	0.24	1.00
Component Flowrates (kg/batch)				
N2	0.00	437,680.06	437,680.06	0.00
NH3	2,867.09	0.00	2,867.09	0.00
O2	0.00	132,871.19	132,871.19	0.00
Water	0.00	0.00	0.00	28,517.11
TOTAL (kg/batch)	2,867.09	570,551.24	573,418.34	28,517.11
TOTAL (L/batch)	4,118,850.68	85,629,652.61	512,251,623.65	28,668.94

Stream Name	S-211	S-212	S-207	S-208
Source	**INPUT**	**P-8**	**INPUT**	**INPUT**
Destination	**P-8**	**P-11**	**P-29**	**P-29**
Stream Properties				
Activity (U/ml)	0.00	0.00	0.00	0.00
Temperature (°C)	25.00	25.00	25.00	25.00
Pressure (bar)	1.01	1.01	1.01	1.01
Density (g/L)	2,521.60	1,108.24	994.70	1,644.42
DS Flow (kg-ds/batch)	0.00	0.00	0.00	1,509.88
Aqueous Flow (kg-aq/batch)	5,807.24	34,324.35	32,980.55	6,039.53
DS (%)	0.00	0.00	0.00	20.00
Total Enthalpy (kW-h)	37.33	869.52	962.44	36.38
Specific Enthalpy (kcal/kg)	5.53	21.80	25.11	4.15
Heat Capacity (kcal/kg-°C)	0.22	0.87	1.00	0.17
Component Flowrates (kg/batch)				
Citric Acid*H20	2,787.47	2,787.47	0.00	0.00
KH2PO4	0.00	0.00	0.00	6,039.53
MgSO4*7H20	3,019.76	3,019.76	0.00	0.00
Na2HPO4	0.00	0.00	0.00	1,509.88
Water	0.00	28,517.11	32,980.55	0.00
TOTAL (kg/batch)	5,807.24	34,324.35	32,980.55	7,549.41
TOTAL (L/batch)	2,303.00	30,971.94	33,156.13	4,590.92

Stream Name	S-209	S-101	S-102	S-104
Source	P-29	INPUT	P-2	P-3
Destination	P-11	P-2	P-3	P-1
Stream Properties				
Activity (U/ml)	0.00	0.00	0.00	0.00
Temperature (°C)	25.00	25.00	25.00	25.00
Pressure (bar)	1.01	1.01	1.01	1.01
Density (g/L)	1,073.73	650.00	1,152.76	1,152.76
DS Flow (kg-ds/batch)	1,509.88	118,217.04	118,217.04	118,217.04
Aqueous Flow (kg-aq/batch)	39,020.07	8,788.80	8,788.80	8,788.80
DS (%)	3.73	93.08	93.08	93.08
Total Enthalpy (kW-h)	998.82	1,124.84	1,124.84	1,124.84
Specific Enthalpy (kcal/kg)	21.20	7.62	7.62	7.62
Heat Capacity (kcal/kg-°C)	0.84	0.30	0.30	0.30
Component Flowrates (kg/batch)				
Ash	0.00	6,807.51	6,807.51	6,807.51
Cellulose	0.00	30,189.29	30,189.29	30,189.29
Fats	0.00	4,800.82	4,800.82	4,800.82
Hemicellulose	0.00	21,184.57	21,184.57	21,184.57
KH2PO4	6,039.53	0.00	0.00	0.00
Lignin	0.00	36,298.27	36,298.27	36,298.27
Na2HPO4	1,509.88	0.00	0.00	0.00
Proteins	0.00	23,737.39	23,737.39	23,737.39
Water	32,980.55	3,987.98	3,987.98	3,987.98
TOTAL (kg/batch)	40,529.96	127,005.84	127,005.84	127,005.84
TOTAL (L/batch)	37,747.05	195,393.61	110,175.32	110,175.32

Stream Name	S-206	S-213	S-214	S-105
Source	P-6	INPUT	P-11	INPUT
Destination	P-11	P-11	P-10	P-1
Stream Properties				
Activity (U/ml)	0.00	0.00	0.00	0.00
Temperature (°C)	30.00	25.00	27.14	25.00
Pressure (bar)	1.01	1.01	1.01	1.01
Density (g/L)	1,057.70	994.70	1,026.49	1,100.00
DS Flow (kg-ds/batch)	67,839.15	0.00	69,349.03	29,106.00
Aqueous Flow (kg-aq/batch)	629,230.43	777,953.34	1,480,528.19	553,014.00
DS (%)	9.73	0.00	4.47	5.00
Total Enthalpy (kW-h)	21,952.04	22,702.33	46,522.71	16,578.67
Specific Enthalpy (kcal/kg)	27.10	25.11	25.83	24.50
Heat Capacity (kcal/kg-°C)	0.90	1.00	0.95	0.98
Component Flowrates (kg/batch)				
Acetic-Acid	37.26	0.00	37.26	0.00
Biomass	20,763.55	0.00	20,763.55	0.00
Citric Acid*H20	0.00	0.00	2,787.47	0.00
Fats	2,400.41	0.00	2,400.41	0.00
H2SO4	0.00	0.00	0.00	0.00
Hexoses	30,197.64	0.00	30,197.64	0.00
KH2PO4	0.00	0.00	6,039.53	0.00
MgSO4*7H20	0.00	0.00	3,019.76	0.00
Na2HPO4	0.00	0.00	1,509.88	0.00
Na2SO4	49,096.46	0.00	49,096.46	0.00
NaOH	0.00	0.00	0.00	29,106.00
Pentoses	4,952.14	0.00	4,952.14	0.00
Solubles	11,925.82	0.00	11,925.82	0.00
Water	577,696.29	777,953.34	1,417,147.29	553,014.00
TOTAL (kg/batch)	697,069.58	777,953.34	1,549,877.22	582,120.00
TOTAL (L/batch)	659,042.19	782,095.06	1,509,880.36	529,200.00

Stream Name	S-106	S-107	S-108	S-110
Source	P-1	P-1	INPUT	P-5
Destination	OUTPUT	P-5	P-5	P-4
Stream Properties				
Activity (U/ml)	0.00	0.00	0.00	0.00
Temperature (°C)	80.00	80.00	25.00	75.92
Pressure (bar)	2.00	2.00	1.01	1.01
Density (g/L)	1.79	1,021.27	1,395.10	1,042.32
DS Flow (kg-ds/batch)	0.00	148,307.76	0.00	119,201.76
Aqueous Flow (kg-aq/batch)	947.44	560,664.47	71,368.17	661,138.64
DS (%)	0.00	20.92	0.00	15.28
Total Enthalpy (kW-h)	131.07	57,060.32	1,392.56	58,626.42
Specific Enthalpy (kcal/kg)	119.03	69.25	16.79	64.64
Heat Capacity (kcal/kg-°C)	0.28	0.87	0.67	0.85
Component Flowrates (kg/batch)				
Acetic-Acid	0.01	39.22	0.00	39.22
Ash	0.00	6,807.51	0.00	6,807.51
Biomass	0.00	41,527.10	0.00	41,527.10
Cellulose	0.00	24,151.43	0.00	24,151.43
Fats	0.00	4,800.82	0.00	4,800.82
H2SO4	0.00	0.00	35,684.09	0.00
Hemicellulose	0.00	3,177.69	0.00	3,177.69
Hexoses	0.00	7,238.35	0.00	7,238.35
Lignin	0.00	21,469.07	0.00	21,469.07
N2	608.96	0.00	0.00	0.00
Na2SO4	0.00	0.00	0.00	51,680.49
NaOH	0.00	29,106.00	0.00	0.00
O2	184.87	0.00	0.00	0.00
Pentoses	0.00	2,961.92	0.00	2,961.92
Solubles	0.00	11,868.70	0.00	11,868.70
Water	153.61	555,824.43	35,684.09	604,618.11
TOTAL (kg/batch)	947.44	708,972.23	71,368.17	780,340.40
TOTAL (L/batch)	529,146.96	694,206.66	51,156.31	748,659.16

Stream Name	S-112	S-201	S-203	S-204
Source	P-4	INPUT	P-17	P-7
Destination	P-17	P-17	P-7	OUTPUT
Stream Properties				
Activity (U/ml)	0.00	0.00	0.00	0.00
Temperature (°C)	75.90	25.00	74.84	74.84
Pressure (bar)	1.01	1.01	1.01	1.01
Density (g/L)	1,042.32	994.70	1,048.34	1,103.80
DS Flow (kg-ds/batch)	119,201.76	0.00	122,566.51	54,727.36
Aqueous Flow (kg-aq/batch)	661,138.64	6,848.00	664,621.89	35,391.46
DS (%)	15.28	0.00	15.57	60.73
Total Enthalpy (kW-h)	58,612.36	199.84	59,001.08	4,199.02
Specific Enthalpy (kcal/kg)	64.63	25.11	64.49	40.09
Heat Capacity (kcal/kg-°C)	0.85	1.00	0.87	0.54
Component Flowrates (kg/batch)				
Acetic-Acid	39.22	0.00	39.22	1.96
Ash	6,807.51	0.00	6,807.51	6,807.51
Biomass	41,527.10	0.00	41,527.10	20,763.55
Cellulose	24,151.43	0.00	2,415.14	2,415.14
Fats	4,800.82	0.00	4,800.82	2,400.41
H2SO4	0.00	0.00	0.00	0.00
Hemicellulose	3,177.69	0.00	794.42	794.42
Hexoses	7,238.35	0.00	31,786.99	1,589.35
Hydrolases	0.00	684.80	0.00	0.00
Lignin	21,469.07	0.00	21,469.07	21,469.07
Na2SO4	51,680.49	0.00	51,680.49	2,584.02
Pentoses	2,961.92	0.00	5,212.78	260.64
Solubles	11,868.70	0.00	12,553.50	627.67
Water	604,618.11	6,163.20	608,101.36	30,405.07
TOTAL (kg/batch)	780,340.40	6,848.00	787,188.40	90,118.82
TOTAL (L/batch)	748,654.28	6,884.46	750,889.98	81,643.85

Stream Name	S-205	S-216	S-219	S-220
Source	**P-7**	**P-10**	**INPUT**	**P-13**
Destination	**P-6**	**P-16**	**P-13**	**P-15**
Stream Properties				
Activity (U/ml)	0.00	0.00	0.00	0.00
Temperature (°C)	74.84	27.14	25.00	25.00
Pressure (bar)	1.01	10.21	1.01	1.01
Density (g/L)	1,041.57	1,026.49	1.18	1.18
DS Flow (kg-ds/batch)	67,839.15	69,349.03	0.00	0.00
Aqueous Flow (kg-aq/batch)	629,230.43	1,480,528.19	570,551.24	570,551.24
DS (%)	9.73	4.47	0.00	0.00
Total Enthalpy (kW-h)	54,802.06	46,521.52	4,011.54	4,011.54
Specific Enthalpy (kcal/kg)	67.64	25.83	6.05	6.05
Heat Capacity (kcal/kg-°C)	0.91	0.95	0.24	0.24
Component Flowrates (kg/batch)				
Acetic-Acid	37.26	37.26	0.00	0.00
Biomass	20,763.55	20,763.55	0.00	0.00
Citric Acid*H20	0.00	2,787.47	0.00	0.00
Fats	2,400.41	2,400.41	0.00	0.00
H2SO4	0.00	0.00	0.00	0.00
Hexoses	30,197.64	30,197.64	0.00	0.00
KH2PO4	0.00	6,039.53	0.00	0.00
MgSO4*7H20	0.00	3,019.76	0.00	0.00
N2	0.00	0.00	437,680.06	437,680.06
Na2HPO4	0.00	1,509.88	0.00	0.00
Na2SO4	49,096.46	49,096.46	0.00	0.00
O2	0.00	0.00	132,871.19	132,871.19
Pentoses	4,952.14	4,952.14	0.00	0.00
Solubles	11,925.82	11,925.82	0.00	0.00
Water	577,696.29	1,417,147.29	0.00	0.00
TOTAL (kg/batch)	697,069.58	1,549,877.22	570,551.24	570,551.24
TOTAL (L/batch)	669,246.12	1,509,879.98	483,837,167.85	483,837,167.85

Stream Name	S-223	S-217	S-301	S-302
Source	P-16	P-16	P-18	INPUT
Destination	OUTPUT	P-18	P-20	P-20
Stream Properties				
Activity (U/ml)	0.00	0.00	0.00	0.00
Temperature (°C)	30.00	30.00	30.00	25.00
Pressure (bar)	1.01	1.01	1.01	1.01
Density (g/L)	1.16	454.35	454.35	994.70
DS Flow (kg-ds/batch)	31,726.11	47,408.20	47,408.20	0.00
Aqueous Flow (kg-aq/batch)	563,472.59	1,480,688.71	1,480,688.71	102,850.82
DS (%)	5.33	3.10	3.10	0.00
Total Enthalpy (kW-h)	15,967.83	50,946.93	50,946.93	3,001.41
Specific Enthalpy (kcal/kg)	23.08	28.69	28.69	25.11
Heat Capacity (kcal/kg-°C)	0.25	0.95	0.95	1.00
Component Flowrates (kg/batch)				
Acetic-Acid	0.26	37.01	37.01	0.00
Biomass	0.00	31,203.03	31,203.03	0.00
Carb. Dioxide	31,726.11	2,417.97	2,417.97	0.00
Citric Acid	0.00	2,548.51	2,548.51	0.00
Fats	0.00	2,400.41	2,400.41	0.00
H2SO4	0.00	0.00	0.00	0.00
Hexoses	0.00	301.98	301.98	0.00
KH2PO4	0.00	5,251.89	5,251.89	0.00
KOH	0.00	324.75	324.75	0.00
MgSO4(aq)	0.00	1,474.44	1,474.44	0.00
N2	437,680.06	0.00	0.00	0.00
Na2HPO4	0.00	1,509.88	1,509.88	0.00
Na2SO4	0.00	49,096.46	49,096.46	0.00
NH3 (aq)	1,397.61	342.02	342.02	0.00
O2	108,787.30	0.00	0.00	0.00
Pentoses	0.00	49.52	49.52	0.00
Solubles	0.00	11,925.82	11,925.82	0.00
Water	15,607.38	1,419,213.22	1,419,213.22	102,850.82
TOTAL (kg/batch)	595,198.70	1,528,096.91	1,528,096.91	102,850.82
TOTAL (L/batch)	514,753,659.93	3,363,296.34	3,363,296.34	103,398.39

Stream Name	S-303	S-304
Source	P-20	P-20
Destination	OUTPUT	OUTPUT
Stream Properties		
Activity (U/ml)	0.00	0.00
Temperature (°C)	25.54	29.91
Pressure (bar)	1.01	1.01
Density (g/L)	1,008.06	454.00
DS Flow (kg-ds/batch)	26,522.58	20,885.62
Aqueous Flow (kg-aq/batch)	77,724.99	1,505,814.54
DS (%)	25.44	1.37
Total Enthalpy (kW-h)	2,599.71	51,348.63
Specific Enthalpy (kcal/kg)	21.46	28.94
Heat Capacity (kcal/kg-°C)	0.84	0.96
Component Flowrates (kg/batch)		
Acetic-Acid	0.00	37.01
Biomass	26,522.58	4,680.46
Carb. Dioxide	0.00	2,417.97
Citric Acid	0.00	2,548.51
Fats	0.00	2,400.41
H2SO4	0.00	0.00
Hexoses	0.00	301.98
KH2PO4	0.00	5,251.89
KOH	0.00	324.75
MgSO4(aq)	0.00	1,474.44
Na2HPO4	0.00	1,509.88
Na2SO4	0.00	49,096.46
NH3 (aq)	0.00	342.02
Pentoses	0.00	49.52
Solubles	0.00	11,925.82
Water	77,724.99	1,444,339.05
TOTAL (kg/batch)	104,247.57	1,526,700.16
TOTAL (L/batch)	103,413.99	3,362,770.67

4. OVERALL COMPONENT BALANCE (kg/batch)

COMPONENT	INITIAL	INPUT	OUTPUT	FINAL	IN-OUT
Acetic-Acid	0.00	0.00	39.23	0.00	- 39.23
Ash	0.00	6,807.51	6,807.51	0.00	0.00
Biomass	0.00	0.00	51,966.58	0.00	- 51,966.58
Carb. Dioxide	0.00	0.00	34,144.07	0.00	- 34,144.07
Cellulose	0.00	30,189.29	2,415.14	0.00	27,774.15
Citric Acid	0.00	0.00	2,548.51	0.00	- 2,548.51
Citric Acid*H20	0.00	2,787.47	0.00	0.00	2,787.47
Fats	0.00	4,800.82	4,800.82	0.00	0.00
H2SO4	0.00	35,684.09	0.00	0.00	35,684.09
Hemicellulose	0.00	21,184.57	794.42	0.00	20,390.15
Hexoses	0.00	0.00	1,891.33	0.00	- 1,891.33
Hydrolases	0.00	684.80	0.00	0.00	684.80
KH2PO4	0.00	6,039.53	5,251.89	0.00	787.64
KOH	0.00	0.00	324.75	0.00	- 324.75
Lignin	0.00	36,298.27	21,469.07	0.00	14,829.20
MgSO4(aq)	0.00	0.00	1,474.44	0.00	- 1,474.44
MgSO4*7H20	0.00	3,019.76	0.00	0.00	3,019.76
N2	3,078.58	438,069.61	438,289.02	2,969.91	- 110.74
Na2HPO4	0.00	1,509.88	1,509.88	0.00	0.00
Na2SO4	0.00	0.00	51,680.49	0.00	- 51,680.49
NaOH	0.00	29,106.00	0.00	0.00	29,106.00
NH3	0.00	2,867.09	0.00	0.00	2,867.09
NH3 (aq)	0.00	0.00	1,739.63	0.00	- 1,739.63
O2	934.60	132,989.45	108,972.17	901.61	24,050.27
Pentoses	0.00	0.00	310.16	0.00	- 310.16
Proteins	0.00	23,737.39	0.00	0.00	23,737.39
Solubles	0.00	0.00	12,553.50	0.00	- 12,553.50
Water	0.00	2,215,370.35	2,242,449.36	0.00	- 27,079.00
TOTAL	4,013.17	2,991,145.90	2,991,431.96	3,871.52	144.41
				Overall Error:	0.005%

NOTE: Overall component balance does not consider preferences on material input origin options. All origins of components engaged in this process are taken into account in the overall balance.

5. EQUIPMENT CONTENTS

R-101

Procedure	Operation	Time (in h)	Volume (in L)	Vapor (in kg)
P-1	START	1.00	0.00	12.99
P-1	Base Loading (Pull In)	225.75	8,159.58	12.99
P-1	CSS Loading (Transfer In)	225.75	9,733.51	12.99
P-1	Delignification (Batch Stoich. Reaction)	227.75	9,917.24	1.65
P-1	Unload Product (Transfer Out)	228.25	0.00	1.65
P-1	Cleaning (Clean-In-Place)	228.50	0.00	10.97

SL-101

Procedure	Operation	Time (in h)	Volume (in L)	Vapor (in kg)
P-4	START	18.00	0.00	70.07
	AFTER AUTO-INIT	18.00	53,475.31	70.07
P-4	TRANSFER-OUT-1 (Transfer Out (Solids))	642.50	0.00	70.07
P-4	HOLD-1 (Hold)	690.00	0.00	70.07

V-201

Procedure	Operation	Time (in h)	Volume (in L)	Vapor (in kg)
P-10	START	66.50	0.00	47.10
P-10	TRANSFER-IN-1 (Transfer In)	970.50	35,949.52	47.10
P-10	AGITATE-1 (Agitation)	969.50	35,949.52	47.10
P-10	TRANSFER-OUT-1 (Transfer Out)	970.00	0.00	47.10
P-10	CIP-1 (Clean-In-Place)	970.25	0.00	47.10
P-10	HOLD-1 (Hold)	989.50	0.00	47.10
P-10	SIP-1 (Steam-In-Place)	990.50	0.00	47.10

V-101

Procedure	Operation	Time (in h)	Volume (in L)	Vapor (in kg)
P-3	START	0.00	0.00	144.36
	AFTER AUTO-INIT	0.00	110,175.32	144.36
P-3	END	0.00	0.00	144.36

Economic Evaluation Report
for S2.2

April 13, 2024

1. EXECUTIVE SUMMARY (2024 prices)

Total Capital Investment	29,399,000 $
Capital Investment Charged to This Project	29,399,000 $
Operating Cost	9,283,000 $/yr
Revenues	14,595,000 $/yr
Batch Size	104,247.57 kg Myco
Cost Basis Annual Rate	729,733 kg Myco/yr
Unit Production Cost	12.72 $/kg Myco
Net Unit Production Cost	12.72 $/kg Myco
Unit Production Revenue	20.00 $/kg Myco
Gross Margin	36.39 %
Return On Investment	22.33 %
Payback Time	4.48 years
IRR (After Taxes)	15.26 %
NPV (at 7.0% Interest)	16,840,000 $

Myco = Total Flow of Stream 'S-303'

2. EQUIPMENT SPECIFICATION AND FOB COST (2024 prices)

Main Equipment

Quantity/ Standby/ Staggered	Name	Description	Unit Cost ($)	Cost ($)
1 / 0 / 0	SP-201	Screw Press	670,000	670,000
		Throughput = 28113.87 kg/h		
1 / 0 / 0	R-201	Stirred Reactor	467,000	467,000
		Vessel Volume = 6.25 m3		
1 / 0 / 0	PZ-201	Pasteurizer	454,000	454,000
		Rated Throughput = 23901.65 L/h		
1 / 0 / 0	V-201	Blending Tank	267,000	267,000
		Vessel Volume = 39943.91 L		
3 / 0 / 0	V-101	Receiver Tank	250,000	750,000
		Vessel Volume = 40805.67 L		
1 / 0 / 0	RVF-301	Rotary Vaccum Filter	245,000	245,000
		Filter Area = 80.00 m2		
1 / 0 / 0	R-101	Stirred Reactor	199,000	199,000
		Vessel Volume = 11019.15 L		
1 / 0 / 0	V-102	Neutralizer	163,000	163,000
		Vessel Volume = 30991.37 L		
1 / 0 / 0	AFR-201	Air-Lift Fermentor	105,000	105,000
		Vessel Volume = 12482.47 L		
1 / 0 / 0	GR-101	Grinder	85,000	85,000
		Rated Throughput = 2000.01 lb/h		
1 / 0 / 0	G-201	Centrifugal Compressor	80,000	80,000
		Compressor Power = 44.52 kW		
1 / 0 / 0	SL-101	Silo	78,000	78,000
		Vessel Volume = 59417.01 L		
1 / 0 / 0	PZ-301	Pasteurizer	25,000	25,000
		Rated Throughput = 1485.14 L/h		
1 / 0 / 0	AF-201	Air Filter	8,000	8,000
		Rated Throughput = 479997.19 L/h		
		Unlisted Equipment		899,000
			TOTAL	4,494,000

3. FIXED CAPITAL ESTIMATE SUMMARY (2024 prices in $)

3A. Total Plant Direct Cost (TPDC) (physical cost)	
1. Equipment Purchase Cost	4,494,000
2. Installation	1,815,000
3. Process Piping	1,573,000
4. Instrumentation	1,798,000
5. Insulation	135,000
6. Electrical	449,000
7. Buildings	2,022,000
8. Yard Improvement	674,000
9. Auxiliary Facilities	1,798,000
TPDC	14,758,000

3B. Total Plant Indirect Cost (TPIC)	
10. Engineering	3,690,000
11. Construction	5,165,000
TPIC	8,855,000

3C. Total Plant Cost (TPC = TPDC+TPIC)	
TPC	23,613,000

3D. Contractor's Fee & Contingency (CFC)	
12. Contractor's Fee	1,181,000
13. Contingency	2,361,000
CFC = 12+13	3,542,000

3E. Direct Fixed Capital Cost (DFC = TPC+CFC)	
DFC	27,155,000

4. LABOR COST - PROCESS SUMMARY

Labor Type	Unit Cost ($/h)	Annual Amount (h)	Annual Cost ($)	%
Operator	69.00	33,552	2,315,078	100.00
TOTAL		33,552	2,315,078	100.00

5. MATERIALS COST - PROCESS SUMMARY

Bulk Material	Unit Cost ($)	Annual Amount		Annual Cost ($)	%
Air	0.00	3,993,859	kg	0	0.00
Citric Acid*H20	700.00	22	ton	15,056	1.22
CSS	0.05	1,960,000	lb	98,000	7.93
H2SO4 (50% w/w)	0.04	499,577	kg	18,249	1.48
Hydrolases	10.00	4,794	kg	47,936	3.88
KH2PO4	5.00	42,277	kg	211,383	17.09
MgSO4*7H20	5.00	21,138	kg	105,692	8.55
Na2HPO4	1.50	10,569	kg	15,854	1.28
NaOH (5% w/v)	0.17	4,074,840	kg	685,604	55.45
NH3	0.20	20,070	kg	4,014	0.32
Water	0.01	2,989,265	gal(STP)	34,750	2.81
TOTAL				1,236,539	100.00

NOTE: Bulk material consumption amount includes material used as:
- Raw Material
- Cleaning Agent
- Heat Transfer Agent (if utilities are included in the operating cost)

6. VARIOUS CONSUMABLES COST (2024 prices) - PROCESS SUMMARY

THE CONSUMABLES COST IS ZERO.

7. WASTE TREATMENT/DISPOSAL COST (2024 prices) - PROCESS SUMMARY

Waste Category	Unit Cost ($)	Annual Amount		Annual Cost ($)	%
Solid Waste				0	0.00
Aqueous Liquid				20,291	100.00
P-1:Cleaning(Cleaning Step #1)	5.00	1,429	MT	7,143	35.20
P-6:CIP-1(Cleaning Step #1)	5.00	146	MT	731	3.60
P-6:SIP-1	0.00	58,800	kg	59	0.29
P-10:CIP-1(Cleaning Step #1)	5.00	531	MT	2,655	13.09
P-10:SIP-1	0.00	587,176	kg	587	2.89
P-16:CIP-1(Cleaning Step #1)	5.00	32	MT	161	0.80
P-16:SIP-1	0.00	4,369	kg	4	0.02
P-20:CIP-1(Cleaning Step #1)	5.00	1,755	MT	8,773	43.24
P-20:SIP-1	0.00	176,400	kg	176	0.87
Organic Liquid				0	0.00
Emissions				0	0.00
TOTAL				20,291	100.00

8. UTILITIES COST (2024 prices) - PROCESS SUMMARY

Utility	Unit Cost ($)	Annual Amount	Ref. Units	Annual Cost ($)	%
Std Power	0.10	1,030,449	kW-h	103,045	40.68
Steam	32.00	740	MT	23,692	9.35
Cooling Water	0.10	34,958	MT	3,496	1.38
Chilled Water	0.50	204,406	MT	102,203	40.34
Steam (Low P)	30.00	696	MT	20,889	8.25
TOTAL				253,324	100.00

9. ANNUAL OPERATING COST (2024 prices) - PROCESS SUMMARY

Cost Item	$	%
Raw Materials	1,237,000	13.32
Labor-Dependent	2,315,000	24.94
Facility-Dependent	5,111,000	55.05
Laboratory/QC/QA	347,000	3.74
Consumables	0	0.00
Waste Treatment/Disposal	20,000	0.22
Utilities	253,000	2.73
Transportation	0	0.00
Miscellaneous	0	0.00
Advertising/Selling	0	0.00
Running Royalties	0	0.00
Failed Product Disposal	0	0.00
TOTAL	9,283,000	100.00

10. PROFITABILITY ANALYSIS (2024 prices)

A.	Direct Fixed Capital	27,155,000 $
B.	Working Capital	386,000 $
C.	Startup Cost	1,358,000 $
D.	Up-Front R&D	0 $
E.	Up-Front Royalties	500,000 $
F.	Total Investment (A+B+C+D+E)	29,399,000 $
G.	Investment Charged to This Project	29,399,000 $

H.	**Revenue/Savings Rates**	
	S-303 (Main Revenue)	729,733 kg/yr

I.	**Revenue/Savings Price**	
	S-303 (Main Revenue)	20.00 $/kg

J.	**Revenues/Savings**	
	S-303 (Main Revenue)	14,594,660 $/yr
1	Total Revenues	14,594,660 $/yr
2	Total Savings	0 $/yr

K.	**Annual Operating Cost (AOC)**	
1	Actual AOC	9,283,000 $/yr
2	Net AOC (K1-J2)	9,283,000 $/yr

L.	**Unit Production Cost /Revenue**	
	Unit Production Cost	12.72 $/kg Myco
	Net Unit Production Cost	12.72 $/kg Myco
	Unit Production Revenue	20.00 $/kg Myco

M.	Gross Profit (J-K)	5,312,000 $/yr
N.	Taxes (25%)	1,328,000 $/yr
O.	Net Profit (M-N + Depreciation)	6,563,000 $/yr

	Gross Margin	36.39 %
	Return On Investment	22.33 %
	Payback Time	4.48 years

Myco = Total Flow of Stream 'S-303'

Equipment Report
for S2.2

April 13, 2024

1. EQUIPMENT SUMMARY (2024 prices)

Name	Type	Units	Standby/ Staggered	Size (Capacity)		Unit Price ($/Unit)	Total Price ($)
AF-201	Air Filter	1	0/0	479,997.19	L/h	8,000	8,000
AFR-201	Air-Lift Fermentor	1	0/0	12,482.47	L	105,000	105,000
V-201	Blending Tank	1	0/0	39,943.92	L	267,000	267,000
G-201	Centrifugal Compressor	1	0/0	44.52	kW	80,000	80,000
GR-101	Grinder	1	0/0	2,000.01	lb/h	85,000	85,000
MX-204	Mixer	1	0/0	567.74	kg/h	0	0
MX-203	Mixer	1	0/0	1,534.53	kg/h	0	0
MX-201	Mixer	1	0/0	40.13	kg/h	0	0
MX-202	Mixer	1	0/0	33.99	kg/h	0	0
V-102	Neutralizer	1	0/0	30,991.37	L	163,000	163,000
PZ-301	Pasteurizer	1	0/0	1,485.14	L/h	25,000	25,000
PZ-201	Pasteurizer	1	0/0	23,901.65	L/h	454,000	454,000
V-101	Receiver Tank	3	0/0	40,805.68	L	250,000	750,000
RVF-301	Rotary Vaccum Filter	1	0/0	80.00	m2	245,000	245,000
SP-201	Screw Press	1	0/0	28,113.87	kg/h	670,000	670,000
SL-101	Silo	1	0/0	59,417.01	L	78,000	78,000
R-101	Stirred Reactor	1	0/0	11,019.15	L	199,000	199,000
R-201	Stirred Reactor	1	0/0	6.25	m3	467,000	467,000

2. ITEMIZED EQUIPMENT LIST

AF-201 (Air Filter)		
Equipment size was calculated		
Number of Units	1.00	
Number of Standby Units	0.00	
Number of Staggered Units	0.00	
Installation Factor	0.50	
Maintenance Factor	0.10	
Cost Allocation Factor	1.00	
Usage Rate	100.00	$/equipment-h
Availability Rate	100.00	$/h
Material of Construction		CS
Purchase Cost (system model for Air Filter)	7,500.00	$/unit
Rated Throughput	479,997.19	L/h
Usage: Air Inlet		

AFR-201 (Air-Lift Fermentor)		
Equipment size was calculated		
Number of Units	1.00	
Number of Standby Units	0.00	
Number of Staggered Units	0.00	
Installation Factor	0.50	
Maintenance Factor	0.10	
Cost Allocation Factor	1.00	
Usage Rate	100.00	$/equipment-h
Availability Rate	100.00	$/h
Material of Construction		SS316
Purchase Cost (system model for Air-Lift Fermentor)	105,000.00	$/unit
Max Volume	1,500,000.00	L
Min Working/Vessel Volume	0.00	%
Max Working/Vessel Volume	90.00	%
Volume	12,482.47	L
Height	4.92	m
Design Pressure	1.52	bar
Vessel is constructed according to ASME standards		
Diameter	1.64	m
Heat Transfer Coefficient	638.61	Watt/m2-K
Riser / Downcomer Area Ratio	5.00	
Riser Volume	10,402.06	L
Downcomer Volume	2,080.41	L
Downcomer Heat Transfer Area	8.52	m2

V-201 (Blending Tank)

Equipment size was calculated		
Number of Units	1.00	
Number of Standby Units	0.00	
Number of Staggered Units	0.00	
Installation Factor	0.30	
Maintenance Factor	0.10	
Cost Allocation Factor	1.00	
Usage Rate	100.00	$/equipment-h
Availability Rate	100.00	$/h
Material of Construction		SS316
Purchase Cost (system model for Blending Tank)	267,000.00	$/unit
Max Volume	80,000.00	L
Min Working/Vessel Volume	0.00	%
Max Working/Vessel Volume	90.00	%
Volume	39,943.91	L
Height	7.71	m
Design Pressure	1.52	bar
Vessel is constructed according to ASME standards		
Diameter	2.57	m

G-201 (Centrifugal Compressor)

Equipment size was calculated		
Number of Units	1.00	
Number of Standby Units	0.00	
Number of Staggered Units	0.00	
Installation Factor	0.50	
Maintenance Factor	0.10	
Cost Allocation Factor	1.00	
Usage Rate	100.00	$/equipment-h
Availability Rate	100.00	$/h
Material of Construction		CS
Purchase Cost (system model for Centrifugal Compressor)	80,000.00	$/unit
Power	44.52	kW

GR-101 (Grinder)

Equipment size was set by user		
Number of Units	1.00	
Number of Standby Units	0.00	
Number of Staggered Units	0.00	
Installation Factor	0.50	
Maintenance Factor	0.10	
Cost Allocation Factor	1.00	
Usage Rate	100.00	$/equipment-h

Availability Rate	100.00	$/h
Material of Construction		CS
Purchase Cost (system model for Grinder)	85,000.00	$/unit
Rated Throughput	2,000.01	lb/h

MX-204 (Mixer)		
Equipment size was calculated		
Number of Units	1.00	
Number of Standby Units	0.00	
Number of Staggered Units	0.00	
Installation Factor	0.50	
Maintenance Factor	0.10	
Cost Allocation Factor	1.00	
Usage Rate	100.00	$/equipment-h
Availability Rate	100.00	$/h
Material of Construction		CS
Purchase Cost (system model for Mixer)	0.00	$/unit
Rated Throughput	567.74	kg/h

MX-203 (Mixer)		
Equipment size was calculated		
Number of Units	1.00	
Number of Standby Units	0.00	
Number of Staggered Units	0.00	
Installation Factor	0.50	
Maintenance Factor	0.10	
Cost Allocation Factor	1.00	
Usage Rate	100.00	$/equipment-h
Availability Rate	100.00	$/h
Material of Construction		CS
Purchase Cost (system model for Mixer)	0.00	$/unit
Rated Throughput	1,534.53	kg/h

MX-201 (Mixer)		
Equipment size was calculated		
Number of Units	1.00	
Number of Standby Units	0.00	
Number of Staggered Units	0.00	
Installation Factor	0.50	
Maintenance Factor	0.10	
Cost Allocation Factor	1.00	
Usage Rate	100.00	$/equipment-h
Availability Rate	100.00	$/h

Material of Construction		CS
Purchase Cost (system model for Mixer)	0.00	$/unit
Rated Throughput	40.13	kg/h

MX-202 (Mixer)

Equipment size was calculated		
Number of Units	1.00	
Number of Standby Units	0.00	
Number of Staggered Units	0.00	
Installation Factor	0.50	
Maintenance Factor	0.10	
Cost Allocation Factor	1.00	
Usage Rate	100.00	$/equipment-h
Availability Rate	100.00	$/h
Material of Construction		CS
Purchase Cost (system model for Mixer)	0.00	$/unit
Rated Throughput	33.98	kg/h

V-102 (Neutralizer)

Equipment size was calculated		
Number of Units	1.00	
Number of Standby Units	0.00	
Number of Staggered Units	0.00	
Installation Factor	0.20	
Maintenance Factor	0.10	
Cost Allocation Factor	1.00	
Usage Rate	100.00	$/equipment-h
Availability Rate	100.00	$/h
Material of Construction		CS
Purchase Cost (system model for Neutralizer)	163,000.00	$/unit
Max Volume	500,000.00	L
Min Working/Vessel Volume	0.00	%
Max Working/Vessel Volume	90.00	%
Volume	30,991.37	L
Height	6.27	m
Design Pressure	1.52	bar
Vessel is constructed according to ASME standards		
Diameter	2.51	m

PZ-301 (Pasteurizer)		
Equipment size was calculated		
Number of Units	1.00	
Number of Standby Units	0.00	
Number of Staggered Units	0.00	
Installation Factor	0.50	
Maintenance Factor	0.10	
Cost Allocation Factor	1.00	
Usage Rate	100.00	$/equipment-h
Availability Rate	100.00	$/h
Material of Construction		SS316
Purchase Cost (system model for Pasteurizer)	25,000.00	$/unit
Rated Throughput	1,485.14	L/h
Holding Tube Length	212.49	m
Holding Tube Diameter	0.66	cm
Heater Heat Transfer Area	0.07	m2
Cooler Heat Transfer Area	0.14	m2
Regenerator Heat Transfer Area	3.46	m2

PZ-201 (Pasteurizer)		
Equipment size was calculated		
Number of Units	1.00	
Number of Standby Units	0.00	
Number of Staggered Units	0.00	
Installation Factor	0.50	
Maintenance Factor	0.10	
Cost Allocation Factor	1.00	
Usage Rate	100.00	$/equipment-h
Availability Rate	100.00	$/h
Material of Construction		SS316
Purchase Cost (system model for Pasteurizer)	454,000.00	$/unit
Rated Throughput	23,901.65	L/h
Holding Tube Length	2.51	m
Holding Tube Diameter	24.46	cm
Heater Heat Transfer Area	0.95	m2
Cooler Heat Transfer Area	11.32	m2
Regenerator Heat Transfer Area	728.69	m2

V-101 (Receiver Tank)		
Equipment size was calculated		
Number of Units	3.00	
Number of Standby Units	0.00	
Number of Staggered Units	0.00	
Installation Factor	0.30	
Maintenance Factor	0.10	

Cost Allocation Factor	1.00	
Usage Rate	100.00	$/equipment-h
Availability Rate	100.00	$/h
Material of Construction		SS316
Purchase Cost (system model for Receiver Tank)	250,000.00	$/unit
Max Volume	50,000.00	L
Min Working/Vessel Volume	0.00	%
Max Working/Vessel Volume	90.00	%
Volume	40,805.67	L
Height	7.76	m
Design Pressure	1.52	bar
Vessel is constructed according to ASME standards		
Diameter	2.59	m

RVF-301 (Rotary Vaccum Filter)

Equipment size was set by user		
Number of Units	1.00	
Number of Standby Units	0.00	
Number of Staggered Units	0.00	
Installation Factor	0.50	
Maintenance Factor	0.15	
Cost Allocation Factor	1.00	
Usage Rate	100.00	$/equipment-h
Availability Rate	100.00	$/h
Material of Construction		CS
Purchase Cost (system model for Rotary Vaccum Filter)	245,000.00	$/unit
Filter Area	80.00	m2

SP-201 (Screw Press)

Equipment size was calculated		
Number of Units	1.00	
Number of Standby Units	0.00	
Number of Staggered Units	0.00	
Installation Factor	0.00	
Maintenance Factor	0.08	
Cost Allocation Factor	1.00	
Usage Rate	100.00	$/equipment-h
Availability Rate	100.00	$/h
Material of Construction		SS316
Purchase Cost (system model for Screw Press)	670,000.00	$/unit
Throughput	28,113.87	kg/h

SL-101 (Silo)		
Equipment size was calculated		
Number of Units	1.00	
Number of Standby Units	0.00	
Number of Staggered Units	0.00	
Installation Factor	0.00	
Maintenance Factor	0.10	
Cost Allocation Factor	1.00	
Usage Rate	100.00	$/equipment-h
Availability Rate	100.00	$/h
Material of Construction		Concrete
Purchase Cost (system model for Silo)	78,000.00	$/unit
Max Volume	30,000,000.00	L
Max Working/Vessel Volume	90.00	%
Volume	59,417.01	L
Height	8.80	m
Design Pressure	1.11	bar
Vessel is not constructed according to ASME standards		
Diameter	2.93	m

R-101 (Stirred Reactor)		
Equipment size was calculated		
Number of Units	1.00	
Number of Standby Units	0.00	
Number of Staggered Units	0.00	
Installation Factor	0.30	
Maintenance Factor	0.10	
Cost Allocation Factor	1.00	
Usage Rate	100.00	$/equipment-h
Availability Rate	100.00	$/h
Material of Construction		SS316
Purchase Cost (system model for Stirred Reactor)	199,000.00	$/unit
Max Volume	40,000.00	L
Min Working/Vessel Volume	0.00	%
Max Working/Vessel Volume	90.00	%
Volume	11,019.15	L
Height	4.44	m
Design Pressure	1.52	bar
Vessel is constructed according to ASME standards		
Diameter	1.78	m

R-201 (Stirred Reactor)		
Equipment size was calculated		
Number of Units	1.00	
Number of Standby Units	0.00	
Number of Staggered Units	0.00	
Installation Factor	1.00	
Maintenance Factor	0.10	
Cost Allocation Factor	1.00	
Usage Rate	100.00	$/equipment-h
Availability Rate	100.00	$/h
Material of Construction		SS304
Purchase Cost (user-defined model)	0.00	$/unit
Reference Year: 2009		
Capacity Variable: Volume in m3		
Power Law: Cost= Co x (Q/Qo)**a		$
Low End 1	300.00	
High End 1	1,000.00	
Base Volume (Qo) 1	500.00	
Base Cost (Co) 1	500,000.00	
Exponent (a) 1	0.70	
Max Volume	1,000.00	m3
Min Working/Vessel Volume	0.00	%
Max Working/Vessel Volume	90.00	%
Volume	6.25	m3
Height	3.68	m
Design Pressure	1.52	bar
Vessel is constructed according to ASME standards		
Diameter	1.47	m

3. EQUIPMENT CONSUMABLES

No consumable uses are present in the process.

There are no Auxiliary Equipment Utilized in the process!

Itemized Cost Report
for S2.2

April 13, 2024

1. OVERALL PROCESS PARAMETERS

Annual Operating Time	7,140.50 h/yr
Unit Production Ref. Rate	729,733 kg Myco/yr
Batch Size	104,247.57 kg Myco
Recipe Batch Time	6.43 wk
Recipe Cycle Time	6.01 wk
Number of Batches Per Year	7.00

Myco = Total Flow of Stream 'S-303'

2. CAPITAL INVESTMENT PER PROCESS SECTION (in $) (2024 prices)

Section	Equipment Purchase Cost (PC)	Direct Fixed Capital (DFC)	Working Capital	Start-up and Validation	Up Front R&D	Up Front Royalties	Total Capital Investment
Post Processing	337,500	2,098,980	50,782	104,949	0	500,000	2,754,711
Preprocessing	1,593,750	9,400,882	117,345	470,044	0	0	9,988,271
Core Operations	2,563,125	15,655,571	217,584	782,779	0	0	16,655,933
Total	4,494,375	27,155,433	385,711	1,357,772	0	500,000	29,398,915

3. COST PER PROCESS SECTION (2024 prices)

Post Processing

Starting material: (none)
Active product: (none)

Cost Item	$/kg Myco	$/batch	$/year	%
Materials	0.01	1,159	8,110	0.83
Facility	0.56	58,082	406,572	41.65
Labor	0.60	62,790	439,530	45.03
Consumables	0.00	0	0	0.00
Lab/QC/QA	0.09	9,419	65,930	6.75
Utilities	0.06	6,719	47,036	4.82
Waste Trtmt/Disp	0.01	1,279	8,950	0.92
Transportation	0.00	0	0	0.00
Miscellaneous	0.00	0	0	0.00
TOTAL	1.34	139,447	976,127	100.00

Preprocessing

Starting material: (none)
Active product: (none)

Cost Item	$/kg Myco	$/batch	$/year	%
Materials	1.10	115,175	806,224	27.01
Facility	2.43	253,236	1,772,654	59.39
Labor	0.44	46,288	324,013	10.85
Consumables	0.00	0	0	0.00
Lab/QC/QA	0.07	6,943	48,602	1.63
Utilities	0.04	3,767	26,369	0.88
Waste Trtmt/Disp	0.01	1,020	7,143	0.24
Transportation	0.00	0	0	0.00
Miscellaneous	0.00	0	0	0.00
TOTAL	4.09	426,429	2,985,005	100.00

Core Operations

Starting material: (none)
Active product: (none)

Cost Item	$/kg Myco	$/batch	$/year	%
Materials	0.58	60,315	422,204	7.93
Facility	4.02	418,768	2,931,375	55.08
Labor	2.13	221,648	1,551,536	29.15
Consumables	0.00	0	0	0.00
Lab/QC/QA	0.32	33,247	232,730	4.37
Utilities	0.25	25,703	179,918	3.38
Waste Trtmt/Disp	0.01	600	4,198	0.08
Transportation	0.00	0	0	0.00
Miscellaneous	0.00	0	0	0.00
TOTAL	7.29	760,280	5,321,962	100.00

SUMMARY PER COST ITEM (Entire Process)

Cost Item	$/kg Myco	$/batch	$/year	%
Raw Materials	1.69	176,648	1,236,539	13.32
Facility	7.00	730,086	5,110,601	55.05
Labor	3.17	330,725	2,315,078	24.94
Consumables	0.00	0	0	0.00
Lab/QC/QA	0.48	49,609	347,262	3.74
Utilities	0.35	36,189	253,324	2.73
Waste Trtmt/Disp	0.03	2,899	20,291	0.22
Transportation	0.00	0	0	0.00
Miscellaneous	0.00	0	0	0.00
TOTAL	12.72	1,326,156	9,283,094	100.00

SUMMARY PER SECTION

Section	$/kg Myco	$/batch	$/year	%
Post Processing	1.34	139,447	976,127	10.52
Preprocessing	4.09	426,429	2,985,005	32.16
Core Operations	7.29	760,280	5,321,962	57.33
TOTAL	12.72	1,326,156	9,283,094	100.00

4. BREAKDOWN PER COST ITEM AND SECTION (1000$/year)

Section	Materials	Facility	Labor	Lab/ QC/QA	Utilities	Waste Trt/Dsp	TOTAL	%
Post Processing	8	407	440	66	47	9	976	10.52
Preprocessing	806	1,773	324	49	26	7	2,985	32.16
Core Operations	422	2,931	1,552	233	180	4	5,322	57.33
TOTAL	1,237	5,111	2,315	347	253	20	9,283	100.00

5.1.1 MATERIAL COST - SECTION SUMMARY

Bulk Materials

Section Name	Cost ($/year)	%
Post Processing	8,110.31	0.66
Preprocessing	806,224.26	65.20
Core Operations	422,204.35	34.14
TOTAL	1,236,538.92	100.00

5.1.2 MATERIAL COST - BREAKDOWN BY SECTION

Post Processing

Material Name	Unit Cost ($)	Amount per year		Cost ($/year)	%
Water	0.01	697,661	gal(STI	8,110.31	100.00
TOTAL				8,110.31	100.00

Preprocessing

Material Name	Unit Cost ($)	Amount per year		Cost ($/year)	%
CSS	0.05	1,960,000	lb	98,000.00	12.16
H2SO4 (50% w/w)	0.04	499,577	kg	18,249.39	2.26
NaOH (5% w/v)	0.17	4,074,840	kg	685,604.38	85.04
Water	0.01	375,957	gal(STI	4,370.50	0.54
TOTAL				806,224.26	100.00

Core Operations

Material Name	Unit Cost ($)	Amount per year		Cost ($/year)	%
Air	0.00	3,993,859	kg	0.00	0.00
Citric Acid*H20	700.00	22	ton	15,056.06	3.57
Hydrolases	10.00	4,794	kg	47,936.00	11.35
KH2PO4	5.00	42,277	kg	211,383.47	50.07
MgSO4*7H20	5.00	21,138	kg	105,691.73	25.03
Na2HPO4	1.50	10,569	kg	15,853.76	3.75
NH3	0.20	20,070	kg	4,013.93	0.95
Water	0.01	1,915,648	gal(STI	22,269.40	5.27
TOTAL				422,204.35	100.00

5.1.3 MATERIAL COST - BREAKDOWN BY MATERIAL TYPE

Air

Section Name	Unit Cost ($)	Amount per year		Cost ($/year)	%
Core Operations	0.00	3,993,859	kg	0.00	0.00
TOTAL		3,993,859	kg	0.00	0.00

Citric Acid*H20

Section Name	Unit Cost ($)	Amount per year		Cost ($/year)	%
Core Operations	700.00	22	ton	15,056.06	100.00
TOTAL		22	ton	15,056.06	100.00

CSS

Section Name	Unit Cost ($)	Amount per year		Cost ($/year)	%
Preprocessing	0.05	1,960,000	lb	98,000.00	100.00
TOTAL		1,960,000	lb	98,000.00	100.00

H2SO4 (50% w/w)

Section Name	Unit Cost ($)	Amount per year		Cost ($/year)	%
Preprocessing	0.04	499,577	kg	18,249.39	100.00
TOTAL		499,577	kg	18,249.39	100.00

Hydrolases

Section Name	Unit Cost ($)	Amount per year		Cost ($/year)	%
Core Operations	10.00	4,794	kg	47,936.00	100.00
TOTAL		4,794	kg	47,936.00	100.00

KH2PO4

Section Name	Unit Cost ($)	Amount per year		Cost ($/year)	%
Core Operations	5.00	42,277	kg	211,383.47	100.00
TOTAL		42,277	kg	211,383.47	100.00

MgSO4*7H20

Section Name	Unit Cost ($)	Amount per year		Cost ($/year)	%
Core Operations	5.00	21,138	kg	105,691.73	100.00
TOTAL		21,138	kg	105,691.73	100.00

Na2HPO4

Section Name	Unit Cost ($)	Amount per year		Cost ($/year)	%
Core Operations	1.50	10,569	kg	15,853.76	100.00
TOTAL		10,569	kg	15,853.76	100.00

NaOH (5% w/v)

Section Name	Unit Cost ($)	Amount per year		Cost ($/year)	%
Preprocessing	0.17	4,074,840	kg	685,604.38	100.00
TOTAL		4,074,840	kg	685,604.38	100.00

NH3

Section Name	Unit Cost ($)	Amount per year		Cost ($/year)	%
Core Operations	0.20	20,070	kg	4,013.93	100.00
TOTAL		20,070	kg	4,013.93	100.00

Water

Section Name	Unit Cost ($)	Amount per year		Cost ($/year)	%
Post Processing	0.01	697,661gal(STI		8,110.31	23.34
Preprocessing	0.01	375,957gal(STI		4,370.50	12.58
Core Operations	0.01	1,915,648gal(STI		22,269.40	64.08
TOTAL		2,989,265gal(STI		34,750.21	100.00

5.1.4 MATERIAL COST - DETAILED BREAKDOWN BY MATERIAL TYPE

Air

Core Operations

Procedure Name	Unit Cost ($/kg)	Amount (kg/year)	Cost ($/year)	%
P-13	0.00	3,993,859	0.00	0.00
TOTAL		3,993,859	0.00	0.00

Citric Acid*H20

Core Operations

Procedure Name	Unit Cost ($/ton)	Amount (ton/year)	Cost ($/year)	%
P-8	700.00	22	15,056.06	100.00
TOTAL		22	15,056.06	100.00

CSS

Preprocessing

Procedure Name	Unit Cost ($/lb)	Amount (lb/year)	Cost ($/year)	%
P-2	0.05	1,960,000	98,000.00	100.00
TOTAL		1,960,000	98,000.00	100.00

H2SO4 (50% w/w)

Preprocessing

Procedure Name	Unit Cost ($/kg)	Amount (kg/year)	Cost ($/year)	%
P-5	0.04	499,577	18,249.39	100.00
TOTAL		499,577	18,249.39	100.00

Hydrolases

Core Operations

Procedure Name	Unit Cost ($/kg)	Amount (kg/year)	Cost ($/year)	%
P-17	10.00	4,794	47,936.00	100.00
TOTAL		4,794	47,936.00	100.00

KH2PO4

Core Operations

Procedure Name	Unit Cost ($/kg)	Amount (kg/year)	Cost ($/year)	%
P-29	5.00	42,277	211,383.47	100.00
TOTAL		42,277	211,383.47	100.00

MgSO4*7H20

Core Operations

Procedure Name	Unit Cost ($/kg)	Amount (kg/year)	Cost ($/year)	%
P-8	5.00	21,138	105,691.73	100.00
TOTAL		21,138	105,691.73	100.00

Na2HPO4

Core Operations

Procedure Name	Unit Cost ($/kg)	Amount (kg/year)	Cost ($/year)	%
P-29	1.50	10,569	15,853.76	100.00
TOTAL		10,569	15,853.76	100.00

NaOH (5% w/v)

Preprocessing

Procedure Name	Unit Cost ($/kg)	Amount (kg/year)	Cost ($/year)	%
P-1	0.17	4,074,840	685,604.38	100.00
TOTAL		4,074,840	685,604.38	100.00

NH3

Core Operations

Procedure Name	Unit Cost ($/kg)	Amount (kg/year)	Cost ($/year)	%
P-14	0.20	20,070	4,013.93	100.00
TOTAL		20,070	4,013.93	100.00

Water

Post Processing

Procedure Name	Unit Cost ($/gal(STP))	Amount (gal(STP)/ye	Cost ($/year)	%
P-20	0.01	697,661	8,110.31	100.00
TOTAL		697,661	8,110.31	100.00

Preprocessing

Procedure Name	Unit Cost ($/gal(STP))	Amount (gal(STP)/ye	Cost ($/year)	%
P-1	0.01	375,957	4,370.50	100.00
TOTAL		375,957	4,370.50	100.00

Core Operations

Procedure Name	Unit Cost ($/gal(STP))	Amount (gal(STP)/ye	Cost ($/year)	%
P-17	0.01	11,354	131.99	0.59
P-6	0.01	53,955	627.23	2.82
P-29	0.01	60,756	706.29	3.17
P-11	0.01	1,433,125	16,660.07	74.81
P-8	0.01	52,533	610.70	2.74
P-10	0.01	294,276	3,420.96	15.36
P-16	0.01	9,649	112.17	0.50
TOTAL		1,915,648	22,269.40	100.00

6.1 LABOR COST - SECTION SUMMARY

Section Name	Amount (h/year)	Cost ($/year)	%
Post Processing	6,370	439,530	18.99
Preprocessing	4,696	324,013	14.00
Core Operations	22,486	1,551,536	67.02
TOTAL	33,552	2,315,078	100.00

6.2 LABOR COST - BREAKDOWN BY SECTION

Post Processing

Labor Type	Unit Cost ($/h)	Amount (h/year)	Cost ($/year)	%
Operator	69.00	6,370	439,530	100.00
TOTAL		6,370	439,530	100.00

Preprocessing

Labor Type	Unit Cost ($/h)	Amount (h/year)	Cost ($/year)	%
Operator	69.00	4,696	324,013	100.00
TOTAL		4,696	324,013	100.00

Core Operations

Labor Type	Unit Cost ($/h)	Amount (h/year)	Cost ($/year)	%
Operator	69.00	22,486	1,551,536	100.00
TOTAL		22,486	1,551,536	100.00

6.3 LABOR COST - BREAKDOWN BY LABOR TYPE

6.3a Summary of Labor Types Currently Used by the Process

Labor Type	Adj.Basic ($/h)	Lumped ($/h)	Amount (h/year)	Cost ($/year)	%
Operator	69.00	50	33,552	2,315,078	100.00
TOTAL			33,552	2,315,078	100.00

6.3b Breakdown by Section

Operator

Section Name	Unit Cost ($/h)	Amount (h/year)	Cost ($/year)	%
Post Processing	69.00	6,370	439,530	18.99
Preprocessing	69.00	4,696	324,013	14.00
Core Operations	69.00	22,486	1,551,536	67.02
TOTAL		33,552	2,315,078	100.00

6.4 LABOR COST - DETAILED BREAKDOWN BY LABOR TYPE

Operator

Post Processing

Procedure Name	Unit Cost ($/h)	Amount (h/year)	Cost ($/year)	%
P-20	69.00	6,370	439,530	100.00
TOTAL		6,370	439,530	100.00

Preprocessing

Procedure Name	Unit Cost ($/h)	Amount (h/year)	Cost ($/year)	%
P-2	69.00	163	11,270	3.48
P-1	69.00	4,288	295,838	91.30
P-5	69.00	82	5,635	1.74
P-4	69.00	163	11,270	3.48
TOTAL		4,696	324,013	100.00

Core Operations

Procedure Name	Unit Cost ($/h)	Amount (h/year)	Cost ($/year)	%
P-17	69.00	3,920	270,480	17.43
P-7	69.00	327	22,540	1.45
P-6	69.00	204	14,088	0.91
P-10	69.00	1,152	79,454	5.12
P-14	69.00	5,100	351,925	22.68
P-16	69.00	11,783	813,050	52.40
TOTAL		22,486	1,551,536	100.00

7.1 CONSUMABLES COST - SECTION SUMMARY

Section Name	Amount (N/A)	Cost ($/year)	%
TOTAL		0	0.00

7.2 CONSUMABLES COST - BREAKDOWN BY SECTION

7.3 CONSUMABLES COST - BREAKDOWN BY CONSUMABLE CATEGORY

7.4 CONSUMABLES COST - DETAILED BREAKDOWN BY TYPE

8.1 WASTE COST - SECTION SUMMARY

Section Name	Amount (kg/year)	Cost ($/year)	%
Post Processing	1,931,058	8,950	44.11
Preprocessing	1,435,215	7,143	35.20
Core Operations	5,526,285	4,198	20.69
TOTAL	8,892,558	20,291	100.00

8.2 WASTE COST - BREAKDOWN BY SECTION

Post Processing

Waste Type	Average Unit Cost	Amount (/year)	Cost ($/year)	%
Aqueous Waste	0.00 $/kg	1,931,058 kg	8,950	100.00
Subtotal		1,931,058 kg	8,950	100.00

Preprocessing

Waste Type	Average Unit Cost	Amount (/year)	Cost ($/year)	%
Aqueous Waste	0.01 $/kg	1,428,583 kg	7,143	100.00
Emissions	0.00 $/kg	6,632 kg	0	0.00
Subtotal		1,435,215 kg	7,143	100.00

Core Operations

Waste Type	Average Unit Cost	Amount (/year)	Cost ($/year)	%
Aqueous Waste	0.00 $/kg	1,359,894 kg	4,198	100.00
Emissions	0.00 $/kg	4,166,391 kg	0	0.00
Subtotal		5,526,285 kg	4,198	100.00

8.3 WASTE COST - BREAKDOWN BY WASTE TYPE

Aqueous Waste

Section Name	Average Unit Cost	Amount (/year)	Cost ($/year)	%
Post Processing	0.00 $/kg	1,931,058 kg	8,950	44.11
Preprocessing	0.01 $/kg	1,428,583 kg	7,143	35.20
Core Operations	0.00 $/kg	1,359,894 kg	4,198	20.69
TOTAL		4,719,535 kg	20,291	100.00

Emissions

Section Name	Average Unit Cost		Amount (/year)		Cost ($/year)	%
Preprocessing	0.00	$/kg	6,632	kg	0	0.00
Core Operations	0.00	$/kg	4,166,391	kg	0	0.00
TOTAL			4,173,023	kg	0	0.00

8.4 WASTE COST - DETAILED BREAKDOWN BY WASTE TYPE

Aqueous Waste

Post Processing

Procedure / Stream	Unit Cost ($)	Amount (/year)		Cost ($/year)	%
P-20 / CIP-1 (Cleaning Step #1)	5.00	1,755	MT	8,773	98.03
P-20 / SIP-1	0.00	176,400	kg	176	1.97
TOTAL				8,950	100.00

Preprocessing

Procedure / Stream	Unit Cost ($)	Amount (/year)		Cost ($/year)	%
P-1 / Cleaning (Cleaning Step #1)	5.00	1,429	MT	7,143	100.00
TOTAL				7,143	100.00

Core Operations

Procedure / Stream	Unit Cost ($)	Amount (/year)		Cost ($/year)	%
P-6 / CIP-1 (Cleaning Step #1)	5.00	146	MT	731	17.42
P-6 / SIP-1	0.00	58,800	kg	59	1.40
P-10 / CIP-1 (Cleaning Step #1)	5.00	531	MT	2,655	63.25
P-10 / SIP-1	0.00	587,176	kg	587	13.99
P-16 / CIP-1 (Cleaning Step #1)	5.00	32	MT	161	3.85
P-16 / SIP-1	0.00	4,369	kg	4	0.10
TOTAL				4,198	100.00

Emissions

Preprocessing

Procedure / Stream	Unit Cost ($)	Amount (/year)		Cost ($/year)	%
P-1 / S-106	0.00	6,632	kg	0	0.00
TOTAL				0	0.00

Core Operations

Procedure / Stream	Unit Cost ($)	Amount (/year)		Cost ($/year)	%
P-16 / S-223	0.00	4,166,391	kg	0	0.00
TOTAL				0	0.00

9.1 UTILITIES COST - SECTION SUMMARY

Electricity

Section Name	Amount (kW-h/year)	Cost ($/year)	%
Post Processing	323,400	32,340.00	31.38
Preprocessing	113,251	11,325.06	10.99
Core Operations	593,799	59,379.86	57.63
TOTAL	1,030,449	103,044.92	100.00

Heat Transfer Agents

Section Name	Amount (kg/year)	Cost ($/year)	%
Post Processing	11,841,750	14,696.32	9.78
Preprocessing	470,138	15,044.43	10.01
Core Operations	228,488,558	120,538.52	80.21
TOTAL	240,800,446	150,279.28	100.00

9.2 UTILITIES COST - BREAKDOWN BY SECTION

Post Processing

Utility	Unit Cost ($/kW-h)	Amount (/year)		Cost ($/year)	%
Std Power	0.10	323,400	kW-h	32,340.00	100.00
TOTAL		323,400	kW-h	32,340.00	100.00

Utility	Unit Cost ($)	Amount (/year)		Cost ($/year)	%
Steam	32.00	176	MT	5,644.80	38.41
Chilled Water	0.50	11,556	MT	5,778.12	39.32
Steam (Low P)	30.00	109	MT	3,273.40	22.27
TOTAL				14,696.32	100.00

Preprocessing

Utility	Unit Cost ($/kW-h)	Amount (/year)		Cost ($/year)	%
Std Power	0.10	113,251	kW-h	11,325.06	100.00
TOTAL		113,251	kW-h	11,325.06	100.00

Utility	Unit Cost ($)	Amount (/year)		Cost ($/year)	%
Steam	32.00	470	MT	15,044.43	100.00
TOTAL				15,044.43	100.00

Core Operations

Utility	Unit Cost ($/kW-h)	Amount (/year)		Cost ($/year)	%
Std Power	0.10	593,799	kW-h	59,379.86	100.00
TOTAL		593,799	kW-h	59,379.86	100.00

Utility	Unit Cost ($)	Amount (/year)		Cost ($/year)	%
Steam	32.00	94	MT	3,002.64	2.49
Cooling Water	0.10	34,958	MT	3,495.79	2.90
Chilled Water	0.50	192,850	MT	96,424.83	80.00
Steam (Low P)	30.00	587	MT	17,615.27	14.61
TOTAL				120,538.52	100.00

9.3 UTILITIES COST - BREAKDOWN BY UTILITY TYPE

Std Power

Section Name	Unit Cost ($/kW-h)	Amount (kW-h/year)	Cost ($/year)	%
Post Processing	0.10	323,400	32,340.00	31.38
Preprocessing	0.10	113,251	11,325.06	10.99
Core Operations	0.10	593,799	59,379.86	57.63
TOTAL		1,030,449	103,044.92	100.00

Steam

Section Name	Unit Cost ($/MT)	Amount (MT/year)	Cost ($/year)	%
Post Processing	32.00	176	5,644.80	23.83
Preprocessing	32.00	470	15,044.43	63.50
Core Operations	32.00	94	3,002.64	12.67
TOTAL		740	23,691.87	100.00

Cooling Water

Section Name	Unit Cost ($/MT)	Amount (MT/year)	Cost ($/year)	%
Core Operations	0.10	34,958	3,495.79	100.00
TOTAL		34,958	3,495.79	100.00

Chilled Water

Section Name	Unit Cost ($/MT)	Amount (MT/year)	Cost ($/year)	%
Post Processing	0.50	11,556	5,778.12	5.65
Core Operations	0.50	192,850	96,424.83	94.35
TOTAL		204,406	102,202.95	100.00

Steam (Low P)

Section Name	Unit Cost ($/MT)	Amount (MT/year)	Cost ($/year)	%
Post Processing	30.00	109	3,273.40	15.67
Core Operations	30.00	587	17,615.27	84.33
TOTAL		696	20,888.67	100.00

9.4 UTILITIES COST - DETAILED BREAKDOWN BY UTILITY TYPE

Std Power

Post Processing

Procedure Name	Unit Cost ($/kW-h)	Amount (kW-h/year)	Cost ($/year)	%
P-20	0.10	258,720	25,872.00	80.00
Unlisted Equipment	0.10	16,170	1,617.00	5.00
General Load	0.10	48,510	4,851.00	15.00
TOTAL		323,400	32,340.00	100.00

Preprocessing

Procedure Name	Unit Cost ($/kW-h)	Amount (kW-h/year)	Cost ($/year)	%
P-2	0.10	88,904	8,890.41	78.50
P-1	0.10	481	48.15	0.43
P-5	0.10	1,215	121.49	1.07
Unlisted Equipment	0.10	5,663	566.25	5.00
General Load	0.10	16,988	1,698.76	15.00
TOTAL		113,251	11,325.06	100.00

Core Operations

Procedure Name	Unit Cost ($/kW-h)	Amount (kW-h/year)	Cost ($/year)	%
P-17	0.10	1,322	132.22	0.22
P-10	0.10	1,057	105.69	0.18
P-15	0.10	314,122	31,412.24	52.90
P-16	0.10	158,537	15,853.74	26.70
Unlisted Equipment	0.10	29,690	2,968.99	5.00
General Load	0.10	89,070	8,906.98	15.00
TOTAL		593,799	59,379.86	100.00

Steam

Post Processing

Procedure Name	Unit Cost ($/MT)	Amount (MT/year)	Cost ($/year)	%
P-20	32.00	176	5,644.80	100.00
TOTAL		176	5,644.80	100.00

Preprocessing

Procedure Name	Unit Cost ($/MT)	Amount (MT/year)	Cost ($/year)	%
P-1	32.00	470	15,044.43	100.00
TOTAL		470	15,044.43	100.00

Core Operations

Procedure Name	Unit Cost ($/MT)	Amount (MT/year)	Cost ($/year)	%
P-6	32.00	89	2,862.83	95.34
P-16	32.00	4	139.80	4.66
TOTAL		94	3,002.64	100.00

Cooling Water

Core Operations

Procedure Name	Unit Cost ($/MT)	Amount (MT/year)	Cost ($/year)	%
P-15	0.10	34,958	3,495.79	100.00
TOTAL		34,958	3,495.79	100.00

Chilled Water

Post Processing

Procedure Name	Unit Cost ($/MT)	Amount (MT/year)	Cost ($/year)	%
P-18	0.50	11,556	5,778.12	100.00
TOTAL		11,556	5,778.12	100.00

Core Operations

Procedure Name	Unit Cost ($/MT)	Amount (MT/year)	Cost ($/year)	%
P-6	0.50	45,512	22,756.17	23.60
P-16	0.50	147,337	73,668.67	76.40
TOTAL		192,850	96,424.83	100.00

Steam (Low P)

Post Processing

Procedure Name	Unit Cost ($/MT)	Amount (MT/year)	Cost ($/year)	%
P-18	30.00	109	3,273.40	100.00
TOTAL		109	3,273.40	100.00

Core Operations

Procedure Name	Unit Cost ($/MT)	Amount (MT/year)	Cost ($/year)	%
P-10	30.00	587	17,615.27	100.00
TOTAL		587	17,615.27	100.00