XilaCat SA

Industrial Process Design

3. The analysis

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Introduction

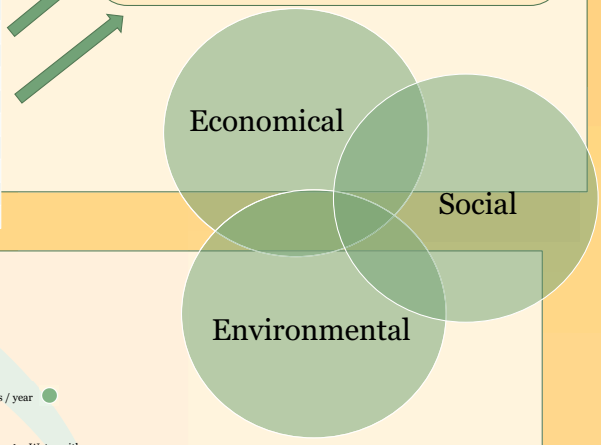
To evaluate the performance of our project, three analysis were done. The economical analysis allowed us to see which were the major costs and investments. The environmental analysis pointed out the potential concerns our project might have to consider to become a sustainable process. Finally, the social analysis describes the labour and management organization.

Item	Value
Total capital investment	**18 051 000 €**
Total plant direct cost	9 330 000 €
Equipment purchase cost	2 854 000 €
Installation	1 111 000 €
Piping	999 000 €
Instrumentation	1 142 000 €
Insulation	86 000 €
Electrical	285 000 €
Buildings	1 284 000 €
Yard improvement	428 000 €
Auxiliary facilities	1 142 000 €
Total plant indirect cost	5 598 000 €
Engineering	2 332 000 €
Construction	3 265 000 €
Others	2 239 000 €
Contractor's fee	746 000 €
Contingency	1 493 000 €
Working capital	26 000 €
Start-up cost	858 000 €
Annual operating cost	**919 000 €**
Raw materials	26 000 €
Labour dependent	208 000 €
Laboratory/QC/QA	31 000 €
Consumables	4 000 €
Utilities	649 000 €
Annual production	**32.11 kg/year**
Unit production cost	**28 608.37 €/kg**
Unit price	**38 €/kg**
Revenues	**1 000 €/yr**
Payback time	**25.38 years**

Due to SuperPro Designer limitations, we had to make some assumptions:

- SPD does not count the price of the land, which is 874,617.0 €
- Some equipment prices are not given by the program and they are counted as zero; we know them, but their value in the program can can't be modified
- Also, only the power consumption of some equipment is available and the calculus is an approximation
- The price of xylanase is calculated using only the annual operating cost (919 000 / 32.11 = 28 608)
- Prices are taken from the year 2013

- The most important items in our annual operating cost are the **labour** (22.63%) and the **utilities** (70.62%). We annually spend 644 240 € on **electrical power**, which represents the 99.25% of the utilities cost.
- It is **difficult to improve** the cost of the labour and the power because both the operators minimum salary and the power price are defined by law.
- The use of more **efficient equipment** might be a solution, but that would come with an increase of cost.



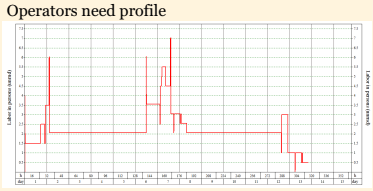
Plant manager

- Engineer profile
- He handles the plant control

Chief manager

- He is part of the main company
- He works on our section once a week
- He deals with administration and finances

Operators need profile



Operators

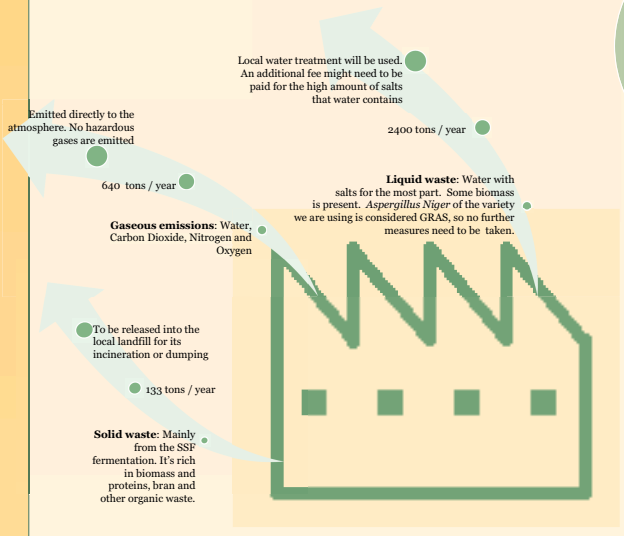
- Three 8 hours shifts
- Two operators each shift

Temporary workers

- Additional workers will be temporarily contracted in times of higher workload

External services

- Cleaning service
- Maintenance
- Transport of raw materials, rice bran, salts, utilities...



Growing concerns in environmental problems such as climate change, energy consumption and water usage make the environmental analysis of a process a very important . The main problem in our process is the big amount of residual water and solid waste that it generates.

To do the environmental analysis, the amount of one substance per kilogram of desired product is calculated. Afterwards, every one of this substances is associated with one Environmental Factor, which when combined with the matter balance give us an approximation of the process's environmental performance.

Item	Input Mw	Output Mw	Input Mult	Output Mult	Kg/KgP	Enviromental Index Mw	Environmental Index Mult	Environmental Index Mw output	Environmental Index Mult output
Water	0	0	1	1	77000	0	0	77000	77000
KH_2PO_4	0.08	0.33	5.2	1.3	168	13.44	55.44	873.6	218.4
Amm.sulfate	0.15	0.33	5.2	1.69	109	16.35	35.97	566.8	184.21
Carb Dioxide	1	0.08	1.3	1	2278	2278	182.24	2961.4	2278
Mag.Sulfate	0.08	0	1	1.3	0.126	0.01008	0	0.126	0.1638
Total					79555.126	2307.80008	273.65	81401.926	79680.7738

Item	Input	Output
Mass Index [kg kg−1 P]	79555,126	79555,126
Number of A components	0	0
Environmental Index [Index points kg−1 P]	2307,80008	273,65
Environmental Index [Index points kg−1 P]	81401,926	79680,774
General Effect Index (0–1)	0,02900882	0,0034398
General Effect Index (1–256)	1,02321409	1,0015794

Conclusions

- We conceived, designed and structured a project from the start. Our work was not one of bibliographic revision (even though bibliographic support was needed) but one of development of an idea using the knowledge acquired throughout the degree.
- Finally, the process is not economically feasible. The main problems are the equipment cost, the electrical power cost and the labour.
- To overcome these obstacles, genetic engineering of *Aspergillus niger* to achieve a higher yield of xylanase per batch could be performed. Also, targeting a bigger market (e.g. other industries, other countries) could result in more benefits with the same cost, as the equipment can produce higher amounts of xylanase without further investments.
- Pilot plant studies and further optimization studies are the logical next steps in making this project a reality.

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