Study Technical and Cost Analysis for the Implementation of a Recycling Plant of (NFU) in the State of Tlaxcala

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Abstract: The use of urban waste and its reuse it is related to the obtaining of social, economic and environmental benefits in terms of recycling, in the State of Tlaxcala given lack of production methods for the exploitation of waste tyres specifically out of use (NFU), they represent a problem of contamination of the environment. Starting from a market study was carried out an investigation that encompasses the technical study for the implementation of a discarded tires recycling plant, where it is obtained as a main component synthetic rubber that serves as raw material for multiple industries that manufacture components based on the same. The study consists of the analysis of localization options for the place of installation of the project, also define the costs of investment, operation, working capital needed to have a preliminary vision and carry out the financial analysis.

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1. Introduction:

The production of microcars in the world growing, It has given rise to a strong demand for tires at all levels, consequently their manufacture and difficulties to make them disappear once used, they constitute one of the most serious environmental problems in recent years around the world (Fundación Vida Sostenible, 2014). In Mexico, scrap tire is abandoned in landfills and which collect will go to the cement industry for its burning, where the Government of the city of Mexico pays to this industry for its collection and transport per ton that is processed in their ovens (Instituto Politecnico Nacional, 2013).

In Tlaxcala, they have alternatives limited in the field of scrap tire, the scrap tire market is mainly generated by formal establishments, such as tire, auto agencies, vulcanizers or Talacheras, many of these operate informally, that is, they do not have permission from any government authority to carry out their work, the total of the tires that are collected in the landfills, is transported to the nearest cement plant located in the city of Puebla, it uses this waste as an energy source in its furnaces, that is, it incinerates them. Given this problem, there are currently options for recycling this waste, some countries adopt measures and harvesting techniques for this type of waste, being the mechanical crushing method which is commonly used, where the components of a rim can be separated, obtaining byproducts mainly rubber, that according to their characteristics can be used in the manufacture of tiles for recreational spaces, non-slip mats, plugs, through mixtures in road construction, athletic tracks, soccer fields, waterproofing, among others (López, et al., 2009). So starting previously from a market study, where surveys were applied in which the effective demand of the material obtained from the crushed tires was estimated, determining the existence of supply in relation to demand, this article focuses on the technical and economic study, taking into account options and relevant factors for the installation of the plant, distribution of areas, manufacturing process, equipment capacity, as well as the costs generated for the start-up of the project.

2. Methodology:

The procedure and methodology used is framed in the following points;

2.1.Location at the macro level:

For the evaluation of the technical study and the implementation of the recycling plant, a location study was carried out at the macro level and at the micro level of the zone, in this case, the state of Tlaxcala, taking into consideration the municipalities that register the largest number of establishments dedicated to the replacement of new tires by used and that generate more of them (INEGI, 2016).

2.2 Location at the micro level:

Table 1.1 shows the location coordinates that correspond to the municipality of Tetla and that serve as a reference to analyze the elements that influence the choice of the right site for the installation of the tire recycling plant, therefore, a study was made by factors considered considering the relevance and indicating their relative importance of each of them (Meyers, 2006).

After analyzing and to obtain the site adapted for the installation of plant, the size of the company is defined in relation to required spaces, the dimension of production machinery, the capacity of the same and the demand of product determined before in the market research that 13 585kg weekly.

Table 1.1: *Location by coordinates of suppliers of M.P*

Establishments	Coordinates		Offer (ton.)	Calculated coordinates	
Apizaco (57)	19.4141763	-98.1442789	38640	750163.773	-3792294.94
Chiautempan (33)	19.3463219	-98.178962	24150	467213.673	-2371021.93
Huamantla (36)	19.3189151	-97.9168315	24150	466551.801	-2364691.48
Tetla de la Solidaridad (19)	19.4445238	-98.1205748	12880	250445.467	-1263793
Tlaxcala (40)	19.3080265	-98.2265963	27370	528460.685	-2688461.94
Tlaxco (11)	19.6145881	-98.1229882	8050	157897.435	-789890.055
				19.3783853	-98.1229913

Table 2.1: *Factors considered for plant location*

Factors to consider for plant location		Weighing
1	Proximity (supply capacity) of Suppliers	20%
2	Cost of Rent of warehouse or industrial warehouse	13%
3	Availability of warehouses or industrial warehouse	12%
4	Public services	10%
5	Proximity to the client	10%
6	Access roads (communication routes)	10%
7	Location of the competition	10%
8	Availability of Labor	5%
9	Personal transportation	5%
10	Financial Facilities	5%

Table 2.2: *Calculate for factors weighted for the location of plan.*

Number of Factor	Weighing	Tlaxcala	Huamantla	Apizaco	Tetla	Chiautempan	Tlaxco
1	20%	1.8	1.2	1.4	1.6	1.8	1
2	13%	1.04	1.17	1.04	1.17	1.04	0.9
3	12%	1.08	0.96	0.84	1.08	0.96	1.1
4	10%	0.8	0.9	0.7	0.9	0.8	0.9
5	10%	0.9	0.7	0.9	0.8	0.8	0.5
6	10%	0.8	0.9	0.8	0.9	0.9	0.9
7	10%	0.7	0.9	0.7	0.8	0.9	0.9
8	5%	0.4	0.35	0.4	0.35	0.45	0.35
9	5%	0.4	0.45	0.4	0.45	0.45	0.4
10	5%	7.92	7.53	0.35	8.05	0.4	0.4
Sum of Factors		15.84	15.06	7.53	16.1	8.5	7.35

2.3. Infrastructure:

The plant plans a land with a minimum area of 670 m², to be able to distribute the required infrastructure;

Table 3.1: *Space required for plant operation. Source. Own Elaboration*

Section	Areas	Area in m²
Administrative areas	25%	112
Areas of storage and unloading of raw material	9.60%	31
Production areas	50.29%	337
Packing and loading area	20%	134
Total	100%	670

The administrative area will be shaped by the following dependencies:

Area of the floor:

- Secretary - Reception
- Dining room
- Office Manager and supervisor
- Bathrooms and Dressing Rooms

The area of production will be composed of the following dependencies:

- Area of loading material and unloading of raw material
- Storage of used tires
- Production of crushed rubber
- Pre-shredding area
- Grinding area
- Steel extraction zone
- Press zone
- Fiber aspiration area
- Granulation area
- Packing area
- Storage of finished product

2.4. Space distribution required:

Considering the space occupied by area, an affinity analysis diagram was made to show the relationship that exists between each department that will make up the tire recycling plant out of use (Muther, et al., 2008).

Table 4.1: *Criteria of the relationship between areas*

Code	Judgments
1	Material flow
2	Inspection and control
3	Common staff
4	Necessary contact
5	Convenience

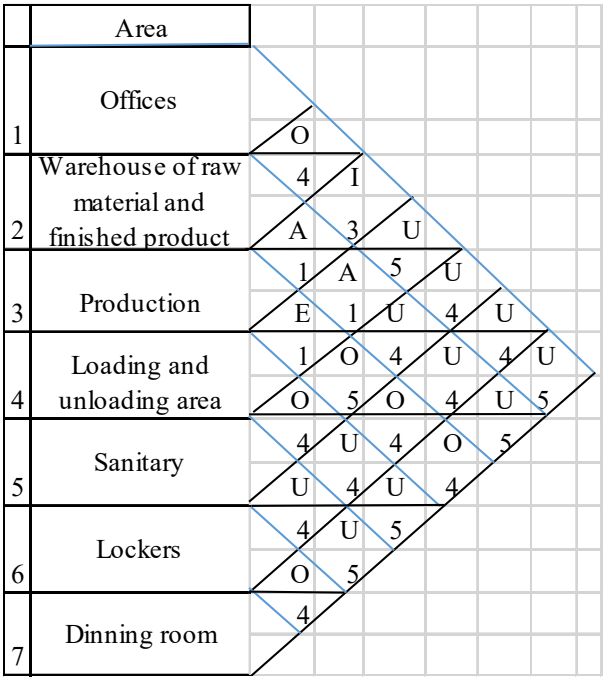

Figure 4.1. Relationship between departments

Table 4.2: *Relationship criteria between departments*

Value	Closeness	Correspondence
A	Absolutely necessary	
E	Especially important	
I	Important	
O	Ordinary closeness	
U	Without importance	
X	Unwanted	

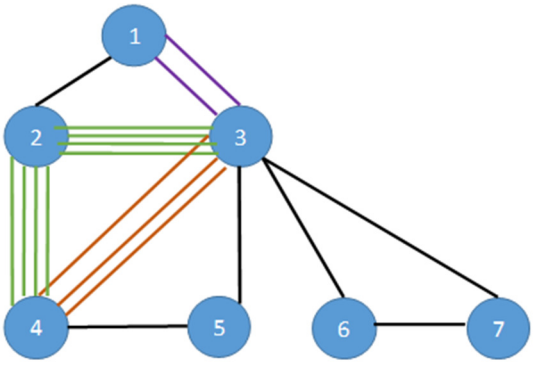

Figure 4.2. Relationship of travel and activity

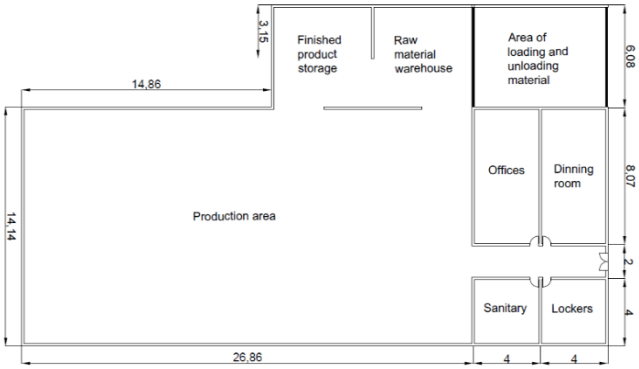

Figure 4.3. Physical Distribution of the Plant.

2.5. Production Capacity:

The machinery to be used for the production plant, it has a maximum production capacity of 500kg per hour, so in a day of 8 working hours you can get 4 tons of crushed rubber, initially the plant will work at 80% of its daily capacity, so it will process 174 units of discarded tires with an average weight 23kg, in order to obtain a daily production of 3.2 tons of rubber granules.

Table 5. *Estimated annual production*.

Rubber granules	Maximum Production	
	kg	Ton.
Dairy produce	3, 200,0	3.2
Mensural production	76,800,0	76.0
Annual production	921.600,0	921.6

Table 5.1. *Production by equipment operating at 80% capacity.*

Machinery	Process per hour	Conversion kg.	Daily hours	Total Tons
Pre-shredded section	22_hour units	400	8	3.2
Granulated section	400_hour units	400	8	3.2
Grinding Section	400kg/ hour	400	8	3.2
Screening & Cleaning Section	400kg/ hour	400	8	3.2
Packaging Equipment	400kg/ hour	400	8	3.2

Estimated production operating at 80%

2.6. Costs:

Table 6.1 shows the necessary investment for the implementation of the tire recycling project.

Table 6.2 quantitatively includes the investment required on the assets constituted by the services for the start-up of the project (Sergio Manuel Jiménez Cardoso, 2002).

Table 6.2 Fixed costs and monthly variable costs.

Monthly	Variable Cost	Monthly Fixed Costs	
Concept	Amount ($)	Concept	Amount ($)
Raw material	6,409.24	Rent of ship office	21,000.00
Electric power	8,000.00	Cleaning	1,500.00
Water	500	Telephone internet	400.00
Operator salaries	39,150.00	Administrative salaries	24,759.00
Fuels	24,428.00	Stationery	500.00
Maintenance	16,666.67	Advertising	0.00
Other materials	2,953.55	Other expenses	500.00
Total ($)	98,107.46	Total ($)	48,659.00

3. Conclusions and discussion:

Through the technical study it was possible to determine the best alternative at the macro and micro level for the installation of the tire recycling plant, the size of the plant needed for the operation, and the different areas that will make it up, regarding the system of distribution and collection of raw material, it is considered a truck that will Pass through the establishments that discard used tires, once at the beginning of the week as an initial plan. The truck that will collect the tires will have a load capacity of 3ton, so the number of tires that can be transported is 110 to 130 depending on the size of them, the route considered

Table 6.1. *Materials and equipment necessary for operation*

Fixed asset			Deferred assets		
Quantity	Description	Unitary ($)	Quantity	Description	Unitary ($)
For Production			1	Electrical installation	30,000.00
1	Recycling system of NFU	1,974,320.00	1	Electric power contract	50,000.00
1	Lift truck (900kg) 2000lb	40,000.00	1	Telephone and internet contract	400.00
1	Van 4ton	210,000.00	1	Water intake and drainage contract	3,000.00
1	Floor scale 1,000kg	15,000.00	1	Security deposit for ship (600m2)	21,000.00
1	Tool set	10,000.00	1	Ship income (600m2 x 35$/m2)	21,000.00
For Administration and Sales			Administrative		
2	Desk	2,100.00	1	License for land use and opening	5,000.00
4	Chair	800.00	1	Declaration of environmental impact	15,000.00
2	Regulator for P.C.	800.00	1	Freight and insurance	13,750.00
1	Archivist	1,400.00	1	Constitutive Act	
2	Computer desk	4,300.00	1	Corporate image (logo, stationery)	10,000.00
1	Multifunctional	1,150.00			

will be from the point where the plant will be installed, carrying out the route for the distances where the waste tire suppliers are located, in packaging and packing required that is commonly used to store and transport the product will be in bags of capacity of 50kg per bag, so that pallets that can support the weight of the sacks and to be able to mobilize the material to load the truck that will carry out this work are used. The required pallets will be of the standard type, which supports a weight of 1,000kg. After determining the location of the plant, an economic valuation of the technical variables of the project is carried out, that allow an accurate appreciation of the resources needed, in addition to providing useful information to carry out the economic and financial study and determine the feasibility of it.

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