

# Quick Lime Production

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**Abstract**—This paper presents the impact of Engineering as a promoter of culture of peace and prosperity by applying the "Cal Viva Production" project developed by the Engineering Faculty of the Universidad La Salle México, in order to improve the quality of life in the community of the municipality of El Botho in Hidalgo, Mexico, through sustainable infrastructure and organizational processes of production.

**Keywords**—Prosperity, Quality of life, Equity, Transformation, Academy-Industry-Government-Society

## I. INTRODUCTION

For many years 'El Botho' community has dedicated to the extraction of limestone from the natural reservoirs of the region. This stone turns into quick lime when is heated in rudimentary kilns with wood from the same region. This process lacks any industrialized method and has been far from any dignified human condition. The workers and their families in 'El Botho' dedicate their lives on the handling of this process as a way of subsistence.

Moreover, the commercial aspect of this production has also been questioned. The quick lime is acquired at very low prices for buyers but represents a low gain for the inhabitants of the municipality. The main market and destiny of the product is on the production of 'nixtamal' which later turns into corn tortillas. This is a problematic about an exploited community with very low economic profits for its production.

The objective of this work is to improve the quality of life in 'El Botho' community in the state of Hidalgo, Mexico, with the production of quick lime through better infrastructure and sustainable organizational processes of production. As particular objectives we can mention the following [1]:

- Generate higher incomes for this indigenous community, to improve their current conditions and life quality.
- Improvement of infrastructure to reduce health problems generated by current conditions.
- Formalization and institutionalization of producers in a company that could offer products and services of high-quality.
- Achieve economic viability of the project for the sustainability of the proposed company.

The project presented some challenges that included the identification of needs and problems of the community, the generation of business options, the creation of efficient facilities for the production of quick lime, talk into the community about the direct and immediate benefits, involve the community into the development of the facilities and generation of business plan.

The Engineering as a promoter of culture of peace and prosperity is the frame that defines this project that looks for prosperity from sustainability, social equity, entrepreneurial spirit, transparency, open voice and community commitments follow the culture of quality.

The project involves engineering in creative solutions to transform and improve human and natural wellbeing through interdisciplinary developments.

## II. QUICK LIME BACKGROUND

Calcium oxide, commonly called quick lime, is an inorganic compound widely used in the steel, food and mining industries. The input is usually obtained from the calcination of calcium carbonate particles in vertical or rotary kilns, previously crushed and classified to an ideal size between  $\frac{3}{4}$  to 3 inches [2].

Traditional Mesoamerican lime-kilns are structures built with densely stacked wet fuel, usually made of fresh wood. They function as real ovens able to reach and maintain the 900 C necessary to convert carbon ( $\text{CaCO}_3$ ) into quick lime ( $\text{CaO}$ ). Wood is used as fuel, which usually contains more than 50% of water, and as a mineral, limestone, shell, or coral [3]

### A. Quick Lime in Mexico

The lime had a widespread use in prehispanic times, mainly as construction material and for nixtamalization (elaboration of corn tortillas). The most important sources of sedimentary rocks used for the production of lime are found southeast of Cuernavaca, and in the Tula, Atotonilco, Apaxco and Ajoloapan regions, in the basin of Mexico [4].

In this region, the exploitation of limestone rocks to produce lime has been transcendental, and its importance, uses and form of exploitation have changed over time. Likewise, the form of access to this resource has varied according to the political entities where it is found [5].

## B. Quick Lime Uses

The lime (Figure 1) is one of the best-known products of all times and with more diverse applications. It was used to dry the air in closed spaces, as antiseptic paint for rooms and facades, tree disinfectant, disinfectant for cholera, typhus and other infectious diseases, and for inhibiting the putrefaction of waters. The water of medicinal lime was used in gargles to dissolve the pseudo diphtheria membranes and in laryngitis, pharyngitis and tonsillitis; internally against vomiting and diarrhea and as an antacid; next to sulfur, soda and arsenic formed a widely used depilant. The lime was also used in the caustic of Vienna associated with potash and medicinal soap. The lime or some of their preparations were use as treatment on rheumatism, white tumor, hydrarthrosis, paralysis, cholera. In the last centuries the sanitary regulations forced to cover with lime the corpses of animals or people killed by infectious diseases and to disinfect fecal materials in epidemic situations by the same procedure [6].



FIGURE 1. Quick Lime

## III. PROJECT DESCRIPTION

In this section there is a brief description and generalities of the project [1].

This project consists in the creation of an organic lime production plant, operated by local producers who have the experience of three generations in the production of this product.

The proposed goals that were established in the short term are to increase the production of lime, and place it in the existing food market, which previously was unable to satisfy the demand given their limited production and secure the incomes to cover expenses and to obtain profits, previously studied in a financial run.

This product has a high added value since it comes from a 100% natural process, so its chemical and physical properties are of high quality.

The opportunity is good because lime is used for many processes, and in this case, it was used for the process of nixtamalized corn.

The production plant consists of 4 ovens coated with kaolin with a capacity of 20 tons each furnace, and an office to manage the business. Also, it has specific areas for packaging, storage and distribution of the product.

## A. Bussines Plan

The process for the design of the business plan that was implemented is summarized below [1]:

- Elaboration of Mission, Vision, Quality Policy
- Operative plan
- Marketing plan
- Purposes and highlights
- Image within the market
- Competitors
- SWOT Analysis

Highlighting the mission established as: "*Produce organic lime of the best quality, satisfying the needs of all our consumers through a joint work with our customers and collaborators achieving a synergy for the development of the community*".

## B. Interpretation of the Financial Run

A financial run refers to a study that is performed before the creation of a bussines to define its economic viability. This study values the expenses, costs and incomes that will be generated by the company on a certain period of time [7]. Its importance is to evaluate if the initial proposal will generate the expected gains, as well as the return of the amount inverted on an evaluated time, and to provide confidence to investors

### 1) Analysis and economic impact

If you had sales for a quantity of 14 tons per week (volume) at a price of \$2,000.00 mexican pesos and sales of 100 weekly bags at a price of \$5.00, you would obtain an annual profit of \$37,016.40 for the company in the first year of operation. After this year the profits will increase by 58% for the second year taking into account that sales would have to increase by 5%.

With an investment of \$226,782.00 it is understood that it has an IRR (internal rate of return) of 44.5% at the end of five years of operation, which means that the money invested today would represent the value of \$379,347.78 pesos.

Evaluating the cost-benefit, which means that for each peso invested it will generate a peso with seven cents.

### 2) Advanges for the staff

The advantages for the staff were determined such as the following:

- Each worker will be registered in the social security plan.

- Each worker will have a fixed salary of \$3,500.00 per month.
- Working in a more secure environment.
- The workplace will be specialized and planned for the production of the product.
- 8-hour workdays only.

### 3) Project viability

The analysis that allowed to decide the viability of the project was constituted of the following aspects:

- The product "Organic Cal" to be registered and used for the process of nixtamalized food must comply with the Official Mexican Standard NOM-187-SSA1 / SCFI-2002, Products and services. Dough, tortillas, toasts and flours prepared for processing and establishments where they are processed. Sanitary specifications. Commercial information.

- The test methods for this product are: determination of calcium oxides, determination of purity, and determination of heavy metals by the method of atomic absorption spectrophotometry.

- Fortunately, the results in the chemical analyzes performed for this product were more than satisfactory, so it is possible to use them for human consumption, its high quality and manufacturing process allows it to be offered as a 100% organic and indigenous artisanal product that generates an added value to this organic lime.

- The market in which is intended to enter with this project is highly demanded, but there is not enough supply to satisfy it, so it is possible to intervene in the market in an immediate way. Currently, there are requests for this product due to its high quality, but in the absence of production, and formalization of the product, it has not been possible to close the sales. It can be shown in the following graph, taken from the General Direction of Mining Development September 2013 [8], (Figure 2) the imports made to Mexico because the demand in the country is not satisfied. (The product falls into the category of the CAL VIVA chart).

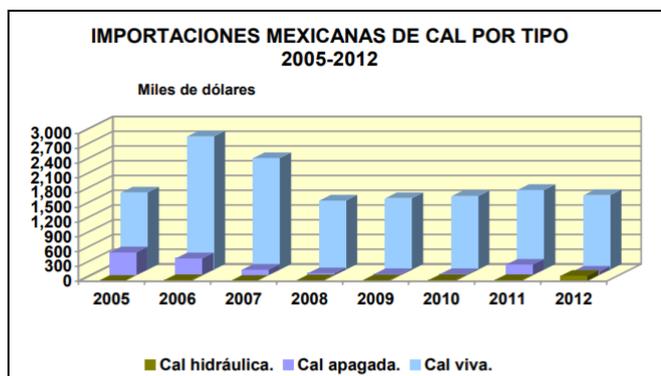


FIGURE 2. Mexican imports of lime

- The price of this product is low in relation to its high quality as shown in this graph taken from the General Directorate of Mining Development September 2013, so it is expected to have sales of approximately 88 tons per month (Figure 3).



FIGURE 3. Commercial Balance of Lime in Mexico

- Investment opportunities were raised and reviewed through recommendations made by the General Directorate of Mining Development September 2012, and all aspects were considered for the success of this project.

- The project was benefited by an announcement of the company MONSANTO called "Semilleros del Futuro Edición 2014", for the sum requested for the development of the project. Posterior meetings were held with the municipal presidency of the town for the construction of the plant. The municipal presidency of the region is in the best available support for the realization of this project, and details of the executive project are refined for its next start.

## IV. RESULTS

The direct beneficiaries of the project were the indigenous community to generate higher incomes and may raise their conditions and quality of life (Figure 4). The indirect beneficiaries of the project are the final consumers of the product, by raising the quality of the lime used for nixtamalization, and the consumption of vitamin B3 is increased, which reduces the possibility of contracting diseases such as pellagra.

In real data, the beneficiaries were:

- Ten direct producers of quick lime.
- One hundred and fifty indirect producers and their families at regional level.

### A. Project achievements

The obtained achievements that were generated during the development of this project were:

- Planning, design, and construction of an industrial plant for the production of quick lime (Figure 5).

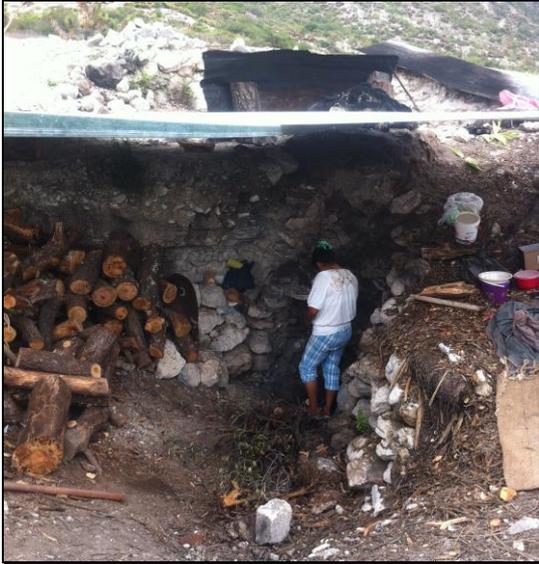


FIGURE 4. Beneficiaries

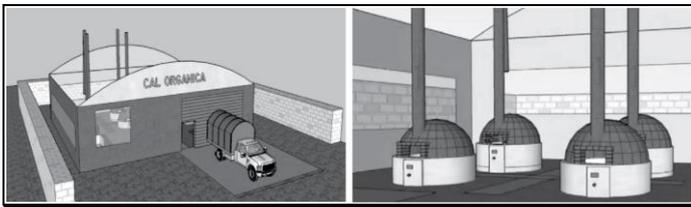


FIGURE 5. Design of an industrial plant

- Elaboration of the base budget for the construction of the production plant.
- Preparation of the calculation-based memory in the production plant.
- Participation of the community in the construction of the production plant.
- Development of a business plan with a financial run to measure amortization, return on the investment and profits as well as the income statement.



FIGURE 6. Community involvement

- Conclusion of the mandatory social service of three students of Civil Engineering that participated in the project: Alejandro Urzúa Camacho, Enrique Guzmán Navarrete and Jair Rodrigo Hinojosa Robles.
- Participation of a faculty member of the Engineering school as advisor and technical coordinator of the project: José Carson Torres Martínez (Figure 7).



FIGURE 7. Participating students and Faculty member

- Participation of the directors of the school of Engineering and from other areas and departments of the University to coordinate actions and commitments.
- Participation of the municipal authorities of 'El Botho', Hidalgo.
- Participation of leaders of other private organizations.
- Fund raising from various sources for the construction of the plant.
- Obtaining the degree in Civil Engineering of the three students (Figure 7) participating in the design, construction, development of the business plan, and the start-up of the lime production plant. First graduates in the modality of "extraordinary merits" [9].

## B. Impact on Lasallian Educational Mission

The aspects in the participation of the students and the advisor who collaborated directly in the development of the project and who promoted the Lasallian Educational Mission were the following:

\* The students and faculty member held several work meetings with municipal authorities, businessmen, tenants and community representatives to plan, define and project the work of the industrial plant.

\* Students and faculty member studied the extraction, exploitation and transfer processes from the raw material from the deposits to the new plant.

\*Students and faculty member dialogued with the community representatives to integrate working teams that would achieve the construction of the facility and develop the necessary sessions to train several members of the community regarding the business plan.

\* Students and faculty member got the necessary agreements for obtaining the financial funds, donations in materials and working tools for the construction of the plant.

\* Municipal authorities as well as university authorities inaugurated the plant in the presence of the community and their families.

## CONCLUSIONS

This project if contracted in the market, would have cost three times the price of the investment applied on it, and it has a return rate of 43.84% with a cost-benefit assessment of 1.07, representing a 90% overall efficiency.

The community members involved in this project have a job with a salary and social security without any health risks.

The production is estimated in 14 tons per week.

The development of this project permitted a coordinated and well-versed relationship between the academy, the industry, the government and some other non-governmental organizations; it also allowed a transdisciplinary collaboration with a direct commitment in the community and with a high level of social responsibility [10].

As future work and improvements to this proposal are:

- The possibility of replicating this industrial plant with other lime producers from the region.
- The possibility of creating a unique regional company to consolidate the product in the market and take clear leadership in productive development.
- To install smoke extractors to accomplish environmental, ecological and sustainability standards, due to ovens still work with regional waste wood.

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