LIFE13 ENV/ES/001165

Final Technical Report

LIFE WALEVA

Data Project

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(%) of eligible costs	50%

Coordinating Beneficiary

Name Beneficiary	TECNICAS REUNIDAS, S.A.
Contact person	Mr. Vicente López Fernández
Postal address	C/Arapiles 14, 28015, Madrid
Telephone	34911588960
E-mail	vlfernandez@trsa.es

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1 Acronyms

TR: Técnicas Reunidas

LEVA: Levulinic acid

PLS: Pregnant liquor solution

GHGs: greenhouse gas emission

2 Executive Summary

The main objective of WALEVA Project is to remove the rice straw from the fields by means of the implementation of a new technology that minimizes as much as possible the environmental impact. This project has been focused on reduce de CO_2 emission by burning activities and to decrease the impact of the rice in the total greenhouse gas emission (GHGs) determining the amount of carbon dioxide produced by Waleva technology and other possible alternatives to reduce its emission.

As a main result of this project, besides the economic viability taking account the final yield of LEVA, the final grade of LEVA, the OPEX and CAPEX for this technology it has been noticed that the carbon dioxide emitted by the utilization of Waleva technology is lower than the greenhouse gas emissions (GHGs) generated by the common incineration of the rice straw by every rice producer in the world.

In accordance with the calculations and results showed in this report, the reader will understand Waleva technology is able to reduce CO_2 emissions in almost 80%.

The objective of this final technical report is to describe the work developed during the demonstration of WALEVA technology and to summarize the benefits of this technology in the future for the rice industry and in general for every agricultural residue.

The work developed in each one of areas of the process have been explained separately in order to focus on the specific and technical aspects that each process unit.

Finally, the global yield of the process has been calculated as conclusion of the WALEVA technology demonstration.

3 Work Description

3.1 Physical pretreatment

The objective of this step is to prepare the rice straw with the appropriate particle size to be continuously fed into the next unit. The reasons that make necessary to reduce the particle size are to generate a slurry that could be fed continuously by mixing rice straw with water and optimize levulinic acid yield. Therefore, 0,5 tonnes of rice straw were milled.(see Figure 1).

The total amount of rice straw that was milled were 670 kg:

- 180 kg of Gladio from 2014 harvest
- 215 kg Gladio from 2015 harvest
- 275 kg Thaiperla from 2015 harvest

Figure 1. Milling stage

3.2 Chemical hydrolysis

The objective of the chemical hydrolysis is to prepare the chemical transformation of the initial glucose content into levulinic acid, avoiding the production as much as possible of other lateral reactions.

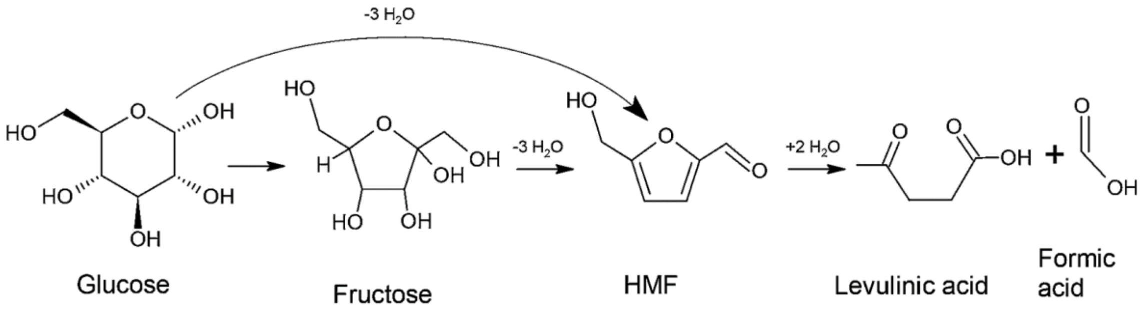
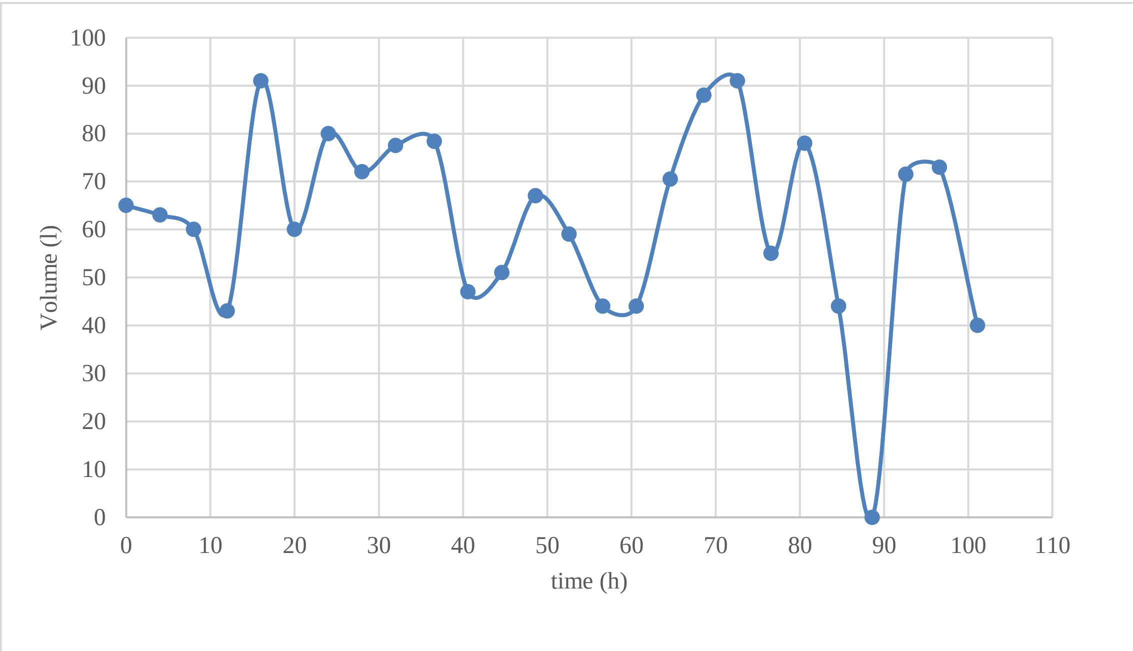


Figure 2. Scheme chemical reaction for LEVA

Graphic 1. shows the evolution of the slurry tank volume fed to the reactor in a demonstration period of time as well as the PLS accumulated in tank.



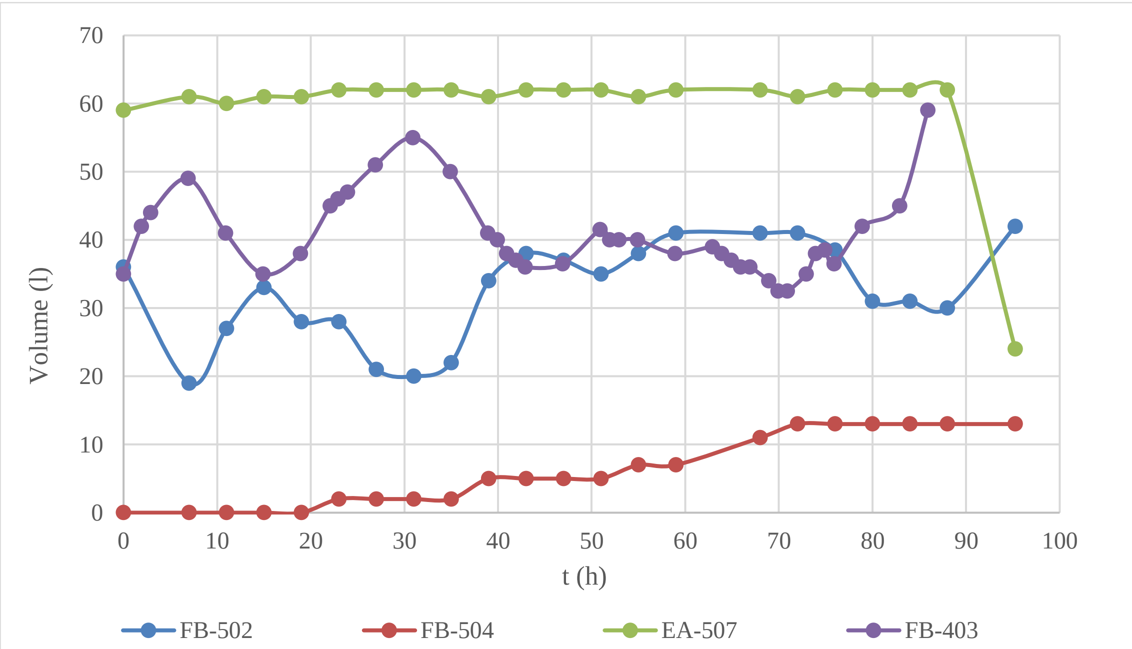
Graphic 1. Evolution of volume

Figure 3. Rice straw pulp

The variables that were controlled in the process were reactor temperature, pressure, flowrate and residence time.

3.3 Purification unit

The objective of this process unit is the purification of levulinic, removing the rest of compounds as much as possible.



Graphic 2. Evolution of volume

3.3.1 LEVA purification

Levulinic acid was recovered from the PLS along with other organic components, as a top product. The LEVA stream should be cooled in the LEVA Cooler to be stored in the LEVA Tank. It was managed to obtain LEVA with High % purity, these samples are shown in Figure 4.

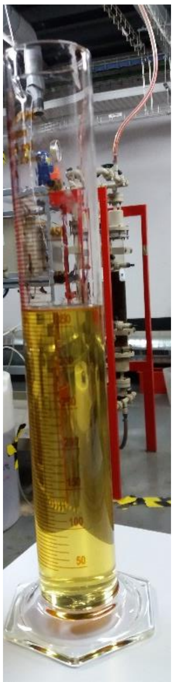


Figure 4. LEVA High % purity

4 Main Results

The objective of the process was to demonstrate that WALEVA technology work in continuous obtaining levulinic acid in high yield (18-22%) and high purity (95-98%). Next table shows the efficiency of each one of the process units of the process as well as the global yield of the process.

Hydrolysis	Purification	Global
LEVA Production (%)	LEVA recovery efficiency (%)	LEVA (%)
36,5	89	25,6*

Table 1. WALEVA process yield

*This yield is referred to the initial content in glucose, which means 10,4% respect to rice straw.

In terms of global LEVA production from rice straw, the main objective was accomplished: to reach a total yield of the process close to 11% respect to the rice straw in order to compare with industrial existing technologies focus on the production of LEVA.

The following table presents the CO_2 emissions released from Waleva plant operation and rice straw burning for the same quantity of rice straw (624150 ton):

Waleva Plant		**Rice straw burning**	
Item	**tons CO_2 / year**	**Item**	**t CO_2 / year**
Transport	11 732	624 150 ton of rice straw	1 067 297
Biochar	172 413		
Rice Straw mills	4 610		
Electricity plant	23 779		
Harvesting	4 029		
Total	**216 563**	**Total**	**1 067 297**

Table 2. Annual CO2 emission of Waleva plant and burning rice straw.

As shown in Table 2, a reduction of around 80% of CO_2 emissions has been estimated if we compare Waleva technology with burning rice straw. In addition, it is very important to highlight that not only CO_2 emissions are reduced, but also other co-pollutants. The most important co-pollutants are sulfur dioxide (SO_2) and nitrogen oxides (NOx) because they contribute to the formation of airborne fine particles and ozone, which are both very dangerous to people and climate change.

Reducing CO_2 emissions not only significantly and quickly reduces harmful co-pollutants, it also saves lives and avoids other adverse environmental impacts on ecosystems, economies and communities.

In order to mitigate the global warming, the results of this study allows considering Waleva technology, as a real option to cooperate with the greenhouse emissions reduction in Europe following the Paris climate agreement.