Triggering the creation of biomass logistic centres by the agro-industry

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D5.2a
Summary of the start-up and commercial operation of Cooperativa Agraria San Miguel

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About SUCELLOG project

The SUCELLOG project - Triggering the creation of biomass logistic centres by the agro-industry - aims to widespread the participation of the agrarian sector in the sustainable supply of solid biofuels in Europe. SUCELLOG action focuses in an almost unexploited logistic concept: the implementation of agro-industry logistic centres in the agro-industry as a complement to their usual activity evidencing the large synergy existing between the agro-economy and the bio-economy. Further information about the project and the partners involved are available under www.sucellog.eu.

Project coordinator

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About this document

This report corresponds to a part of the deliverable D5.2 of the SUCELLOG project - Summary of the start-up and commercial operation of agro-industry logistic centres in Spain, France, Italy and Austria. It has been prepared by:

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Table of contents

1. Introduction

This report includes a description of the activities performed within the SUCELLOG project for the Cooperativa Agraria San Miguel to develop an agro industrial logistic centre of mainly agricultural biomass. After the development of a feasibility study and a previous business model by the project, this report exposes the carried out steps during the start-up process: production and combustion test as well as the performed fuel analysis, and as in the follow-up actions in which the cooperative is working.

The aim of the project in this word package is to give support to the agro-industries in those stages.

2. Company description

The cooperative has 1,700 members, among them 450 stockbreeders. The interest of becoming a logistic centre is to create a benefit for their members through the use of their residues (cereal straw) in an efficient manner. The cooperative is located in Tauste, Zaragoza, Spain.

Currently, the main activities of the company are the following:

a. Forage and bales production in 2 production lines from April to November.

b. Cereal drying (mainly corn) in 2 production lines from October to December.

c. Feedstuff production (mainly pelletized) during the whole year.

As a result of the feasibility study and the business model carried out within the framework of the SUCELLOG project about the potential of the cooperative as biomass logistic centre, the company took the decision of trying to start-up this new business activity producing: 1,626 t/yr of Class B mixed agro-pellets (70% of straw, 30% of wood). To consult the feasibility study click HERE.

This report includes the given steps by Cooperativa Agraria San Miguel to start-up an agro-industrial logistic centre.

3. Initial tests

The first step for start-up a new logistic centre within an existent agro-industry –after a positive feasibility study–, is to perform initial production and combustion tests and to analyse the final produced fuel.

3.1. Initial production tests

During the feasibility study, a technical assessing of the facilities of Cooperativa Agraria San Miguel was carried out in order to check if the existent equipment could be used for the pretreatment of provided agricultural residues. Thus, it was determined that, among the main activities of the cooperative, the most suitable equipment for the envisaged fuel production (Class B mixed pellets -70% of straw and 30% of wood) was the utilized in the 2 alfalfa dehydration lines (pellets and alfalfa bales production). Those include: the reduction of the particle size, drying, milling, pelletizing and storage.

Despite that, theoretically, this machine could be used for the production of agro-fuels, it is absolutely needed to perform a production test for the Class B mixed agro-pellets (70% of straw and 30% of wood), and carry out an adjustment of the production equipment for energy pellets of good quality.

3.1.1. Production tests goal

The objective of the first production test was to produce agro-pellets based in cereal straw (70%) - wood (30%) to check their suitability (moisture, durability and bulk density).

The collected samples in the production process were analysed in quality terms (moisture, ash content and LCV) and, thus, their suitability for its sell in the biomass market.

Additionally, it was considered suitable to also perform pelletizing tests of mixed agro-pellets with a 50% of cereal straw and 50% of wood (in principle, more wood means a pellet of better quality) in order to check their suitability as fuel for the boilers of the area, and as well for measuring the electricity and gas consume which would allow to assess the pretreatment costs.

3.1.2. Results

3.1.2.1. Pelletizing test: agro-pellets based in cereal straw (70 %) - wood (30 %)

At the beginning it was thought to perform the analysis of two lots, both without additives, but with different production time and, if it would be necessary, with the addition of water.

In both cases, the moisture content and the productivity were measured in several stages of the pelletizing process, offering positive results. The pellets samples were assessed through the physical characteristics: bulk density (BD) and durability (DU), also with positive results. Therefore, it was concluded that the production of the provided agro-pellets could be carried out in the facilities without the requirement of any modification or additive.

The collected samples of the produced agro-pellet were analysed in an external lab regarding the moisture content, ashes, LCV and chlorine. Except for the chlorine, which showed results quite higher to the expected (more than double), the rest of the parameters fitted with the established by the international standard for mixed pellets (ISO 17225-6 Class B). The ash content, as it was expected (for being a pellet with a high herbaceous content) was very tight, but could be acceptable given that circumstance.

Figure 1: Lot 1 after the cooler.

Figure 2: Lot 2 after the cooler.

3.1.2.2. Pelletizing test: agro-pellet based in cereal straw (50 %) - wood (50 %)

In the same way as in the previous case, the production tests were performed without additives or water addition.

The procedure was the same regarding the assessing of the line behaviour and of the proposed matrix, being collected samples in different stages of the process and measuring the productivity, as well as checking the physical characteristics of the resultant agro-pellet. And also in this case, it was perfectly adapted to the envisaged equipment without the requirement of any modification in the agro industry.

Regarding the chemical characteristics, despite that the results were considerably better (for having reduced the quantity of herbaceous base of the pellet), the content of chlorine was barely modified, still being more than double of the established in the ISO 17225 standard.

The production tests of this agro-pellet were also performed with the objective of measuring the electricity and gas consume and being able of assess the pretreatment costs. The results indicated that is precise that those are conveniently adjusted, taking into account the production period, in order to reduce not only the electric cost but also the personnel one.

Figure 3: Lot 1 after the cooler.

Finally, Cooperativa Agraria San Miguel was satisfied with the tests results and the obtained pellets were used in the combustion tests.

3.2. Results of the fuel chemical characterization analyses

The produced mixes during the test were carried to an external lab for their characterization as fuel. The results of the essays were satisfactory from the point of view of the heating value and assumable regarding the ash content (being a pellet of herbaceous base). However, the chlorine results were higher than the expected (more than double than the advised by the ISO – 17225-6 standard). Results are summarized in the following table:

	Mix 70% straw-30% wood	Mix 50% straw-50% wood
Moisture (w-% ar)	**10**	**5.4**
Ashes (w-% db)	**10**	**7.21**
LCV (MJ/kg ar)	**14.9**	**16.3**
Cl (w-% db)	**0.67**	**0.62**

The higher chlorine content of both mixes drove to perform combustion tests of short duration to avoid damage in the equipments.

3.3. Combustion tests

3.3.1. Combustion tests goal

The objective of the tests was to verify the suitability of the produced pellet during the project according with the results of a theoretical study of percentages for a mix of straw-wood, as fuel in the boilers of the area.

For this purpose, combustion tests were performed in the boilers of the area and in two boilers of the HARGASSNER manufacturer thanks to the cooperation with the Energetic Service Company (ESCO) ENSACO (ENergy SAving COnsulting, S.L.).

3.3.2. Results

3.3.2.1. Combustion test: agro-pellet based in cereal straw (70 %) - wood (30 %) in boilers of the area

The SUCELLOG Project carried out combustion tests in boilers installed in the area, belonging to those detected during the feasibility study as potential consumers of the product to generate by the cooperative.

The first test was carried out in a pig exploitation with two different boilers. To determine the performance of the boilers when fed with agro-pellets, their behaviour was first analysed with the biomass fuel that was being used (olive stone). After measuring the stability conditions with olive stone, the fuel was changed. The agro-pellets were burnt in both boilers during two hours, recording the gas emissions.

The second test was performed in the boiler of another porcine exploitation, carrying out checks of its performance regarding the behaviour of the pellet with respect to ashes and gas emissions.

At the end of the combustion test and, since it could be a potential consumer of the produced agro-pellets by Cooperativa Agraria San Miguel, it was considered precise to analyse the boilers that are currently installed in the municipal pool of Tauste.

In general, the conclusion of the tests was that the local boilers characteristics (lack of important regulation and ash scrapper) were not completely suitable for the operation with fuels with a high content in ash. In the case that the cooperative would like to launch this product into the market, it should make an exhaustive analysis of the typology of the existent equipments.

3.3.2.2. Initial combustion tests in HARGASSNER boilers

In view of the previous results, it was finally decided to contact with an ESCO of the area (ENSACO, Energy Saving Consulting, S.L.) to plan the lab tests with combustion equipment of the HARGASSNER brand, specifically designed for problematic fuels.

Long-term combustion tests were performed on two types of boilers, one for domestic use and the other for industrial use with recirculation of smoke and rotary grille (*ECO PK 60 kW).* After the initial tests, it was discarded the use of these agro-pellets in the first boiler due to, among other aspects, the rapid accumulation of slag in the combustion grate.

Regarding the observed performance in the industrial boiler, after successive tests with agro-pellets 70% straw-30% wood and 50% straw-50% wood, the results were improving in terms of the entry into the boiler regime and, thus, to the smoke analysis. However, the appearance of bluish tones in the combustion chamber was disturbing, since they indicated a high content of chlorine which, with the time, might weaken the equipments due to the originated corrosion. Therefore, it was not considered adequate to test these agro-pellets in boilers working of existing facilities.

3.4. Follow-up actions

In view of the offered results concerning the chemical characterization essays of the agro-pellets envisaged as final product for the Cooperativa Agraria San Miguel, which indicate that the chlorine content did not meet the established limits by the current standard of “Graded non-woody pellets” (ISO 17225-6), the agro-industry, given its high interest in this new business line, took the decision of explore other paths which allow the continuity of the project.

In contacts with experts, both CIRCE and SPANISH COOPS raise as possible cause the existence of a saline soil in the area. This is why the “GRUPO DE COOPERACIÓN para la Optimización del uso de la paja como materia prima para la producción de biomasa sólida de acuerdo a normativa ISO 17225-6:2014 en la Sociedad Cooperativa Agraria San Miguel de Tauste” Project (Cooperation group for the optimization for the use of the Straw as raw material for the production of solid biomass according the ISO 17225-6:2014 standard in Sociedad Cooperativa Agraria San Miguel de Tauste) was presented to the public funding call of the Rural Development Program for Aragon 2014-2020, which was resolved favourably.

The objective is to perform a characterization of the soils surrounding the cooperative, which are differenced as large homogeneous units, with respect to their potential as straw producers, having a chlorine content which allows that a mix with wood (or just straw) generates a competitive pellet that meets the quality parameters established by the ISO 17225-6 standard. In these moments it is in development stage, having carried out the first sampling of the soils for its analysis. The activities also include the determination, production and combustion of the mixes based in straw, as it was done in the SUCELLOG project.

4. Summary and conclusions

This report includes a summary of the activities carried out by Cooperativa Agraria San Miguel, supported by the SUCELLOG project to develop an agro industrial logistic centre, mainly based in the production and combustion tests, as well as the performed analysis about the final produced fuel.

As a result of the feasibility study and the business model carried out within the framework of the SUCELLOG project concerning the potential of the cooperative as biomass logistic centre, it was recommended the production of 1,626 t/yr of Class B mixed agro-pellets (70% of straw and 30% of wood).

During the Work Package 5, the SUCELLOG project supported the agro-industry in several aspects linked with the start-up of the logistic centre.

In first place, production tests of the fuel (mixes of 70% straw and 30% of wood and 50% of straw and 50% of wood) were performed in their facilities (pelletizing line) to watch the behaviour of the line and the matrix with the proposed resources mix. It could be observed that the production of proposed agro-pellet does not require of any modifications in the facility, nor additives, to reach a proper mechanical durability and bulk density. Regarding the production costs, as it happens in the case of its usual alfalfa production, the production period has to be carefully selected in order to reduce, not only the electric cost but also the personnel one.

During those tests, samples of the produced pellet were collected to be analysed from the point of view of its chemical and energy characteristics in an external lab (cost assumed by the cooperative). The results of the essays were satisfactory from the point of view of the heating value and assumable in relation with the ash content, being an herbaceous based pellet. However, the chlorine content results were considerably higher to the expected ones (more than double of the advised by the ISO-17225-6 standard).

The SUCELLOG project also carried out combustion tests in installed boilers of the area, belonging to those detected during the feasibility study as potential consumers of the product to generate by the cooperative. However, the characteristics of the local boilers (lack of important regulation and ash scrapper) were not completely suitable for the operation with high ash content fuels. For all of it, it was finally decided to contact with an ESCO of the area (ENSACO, Energy Saving Consulting, S.L) to plan the tests in a lab with one of the HARGASSNER brand, specifically designed for problematic fuels.

In spite of that results on the HARGASSNER boiler were not bad, the chlorine content was the main aspect which made that it was preferred not to try in real facilities, since it could weaken the equipments due to corrosion.

Given the great interest of the cooperative in this new business line, and in view of the high chlorine contents, it was made the decision of exploring other paths to continue the project. In contacts with experts, both CIRCE and SPANISH COOPS raise as possible cause the existence of a saline soil in the area. This is why the “GRUPO DE COOPERACIÓN para la Optimización del uso de la paja como materia prima para la producción de biomasa sólida de acuerdo a normativa ISO 17225-6:2014 en la Sociedad Cooperativa Agraria San Miguel de Tauste” Project (Cooperation group for the optimization for the use of the Straw as raw material for the production of solid biomass according the ISO 17225-6:2014 standard in Sociedad Cooperativa Agraria San Miguel de Tauste) was presented to the public funding call of the Rural Development Program for Aragon 2014-2020, which was resolved favourably.

The objective is to perform a characterization of those soils surrounding the cooperative, which are differenced as large homogeneous units, with respect of their potential as straw producers, having a chlorine content which allows that a mix with wood (or just straw) generates a competitive pellet that meets the quality parameters established by the ISO 17225-6 standard. In these moments it is in development stage, having carried out the first sampling of the soils for its analysis. The activities also include the determination, production and combustion of the mixes based in straw, as it was done in the SUCELLOG project.

It is expected that the results of this additional project, which emerged from SUCELLOG, could make possible the start-up of a new business line associated to the biofuels production in Cooperativa Agraria San Miguel.