MONITORING REPORT

Methane capture and combustion from swine manure treatment for
Pocillas and La Estrella

Reference no. UNFCCC 0033

Crediting Period to be Verified: 1st June 2006 – 31th October 2006

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INTRODUCTION

In December 2000, Agricola Super Limitada (Agrosuper), the largest pork production company in Chile, initiated a voluntary process to implement advanced waste management systems (anaerobic and aerobic digestion of hog manure) at its facilities, in order to reduce greenhouse gas (GHG) emissions into the atmosphere.

The project consists of an advanced improvement to the common practice of swine waste treatment in the country, reducing an important volume of greenhouse gases. The technology implementation is based on the use of an anaerobic digester and an activated sludge treatment.

The anaerobic and aerobic digestion technology is being phased in gradually in some of Agrosuper's facilities. The goal is to eventually implement this technology to capture or avoid GHG emissions from all of the company's swine barns. However, this will depend upon the generation of revenues from the sale of Certified Emission Reductions (CERs), which will be used to partially finance the waste treatment systems.

The decision to consider the implementation of more expensive technology was influenced by the adoption of the Kyoto Protocol and the Clean Development Mechanism. The investment decision was further influenced by the confirmation as part of the Marrakech Agreement *"…that a project activity starting as of the year 2000, and prior to the adoption of this decision, shall be eligible for validation and registration as a CDM project activity if submitted for registration before 31 December 2005. If registered, the crediting period for such project activities may start prior to the date of its registration but not earlier than 1 January 2000*".

The expected result from this project activity will be a significant reduction in the volume of methane (CH_4) and nitrous oxide (N_2O) emissions compared to those emissions that would otherwise occur in a scenario with traditional swine manure treatment systems.

According to the approved methodology (AM0006), and based on a cost analysis, the baseline treatment system is represented by the use of open stabilisation lagoons (from now anaerobic lagoon) as the treatment process of liquid waste from swine production. Anaerobic lagoons lead to the direct release of CH_4, N_2O and CO_2 into the atmosphere as result of the anaerobic digestion process that takes place inside the lagoons. Anaerobic lagoon treatment process should be considered as the current national baseline for the agricultural sector, as detailed on the corresponding PDD.

STATUS OF THE PROJECT

The following Table shows the main project activity characteristics, focusing on the starting dates of the systems.

Table 1. Project activity characteristics

Project	Treatment system type	Size of treatment system, volume (m^3)	Irrigation project	Starting date of the treatment system
La Estrella	Heated Digester	31.000	Yes	01/01/2003
Pocillas (1st phase)	Heated Digester	67.000	Yes	01/01/2003
Pocillas (2nd phase)	Inclusion of Activated Sludge	Anoxic tank of 14.000 m^3 and aeration tank of 28.000 m^3	Yes	01/01/2004
La Estrella (2nd phase)	Inclusion of Activated Sludge	Anoxic tank of 8.284 m^3 and aeration tank of 40.214 m^3	Yes	01/11/2005

STATEMENT TO WHAT EXTEND THE PROJECT HAS BEEN IMPLEMENTED AS PLANNED

The project has been completed as planned and described in the Project Design Document (PDD).

The project has been continuously operating since the entering into operation.

Apart from brief stops of the Plant for maintenance purposes, the project has been operating according to schedule and with the parameters mentioned in the PDD.

According page 2 of PDD La Estrella farm has included a aerobic treatment.

PARAMETERS MONITORED ACCORDING TO MONITORING PLAN

In order to implement a precise and representative monitoring plan, Agrosuper has established a continual registration of each monitoring parameter as part of its Environmental Management System and its Quality Management System.

The following description details the operational and management structure developed for monitoring the emission reductions during the verification process:

Table 2. Monitored information based on the monitoring plan

DATA VARIABLE	DATA UNIT	DATA ORIGIN
Animal Population	Heads	Daily animal Stock and inlet program of pigs (Net inlet considering mortality). Information managed by Agrosuper
Average Weight of Animals	kg	Pavilion test and growing tendency curves. Information managed by Agrosuper
Manure Flow After Aerobic Treatment Stage	m^3/day	This parameter is calculated with total inlet flow minus sludge volume.
Manure Flow Before Aerobic Treatment	m^3/day	This parameter is monitored from a flow meter installed before the activated sludge.
Flow of Sludge from Aerobic Treatment	m^3/day	Referential volume from sludge transportation requirements. Information managed by third party
5 days BOD in Manure after Aerobic Treatment Stage	mg/L	Activated Sludge monitoring registers, managed by third party
Total Nitrogen Content in Manure after Aerobic Treatment Stage	mg/L	Activated Sludge monitoring registers, managed by third party.
Temperature of Manure after Aerobic Treatment Stage	ºC	Activated Sludge monitoring registers, managed by third party.
Biogas Flow Extracted by Digester	SCFM	Registers from the CLP. Information managed by Agrosuper
CO2 Concentration in Gas Flow	%	Registers from the CLP. Information managed by Agrosuper
Flare Efficiency	%	Design Combustion Efficiency, Provided by third party

The monthly average value of the total nitrogen content and the temperature of the manure are presented in the following table:

Table 3. Montly average monitored nitrogen content and temperature

Month	Total Nitrogen TKN (mg/l)	Temperature (ºC)
June	223	16.1
July	192	15.5
August	245	15.1
September	332	18.1
October	250	19.3

MONITORING PERIOD AND EMISSION REDUCTIONS

The monitoring period goes from 01/06/2006 – 31/10/2006
The following tables show emissions for baseline scenario of Pocillas and La Estrella:

Table 4. Baseline Emissions in Pocillas

Summary of baseline emissions For period comprehended between 2005 - 2006		
Ton CO2eq	2005	2006
JANUARY	Verified	Verified
FEBRUARY	Verified	Verified
MARCH	Verified	Verified
APRIL	Verified	Verified
MAY	Verified	Verified
JUNE	Verified	17.612
JULY	Verified	19.340
AUGUST	Verified	17.690
SEPTEMBER	Verified	17.707
OCTOBER	Verified	16.452
NOVEMBER	Verified	
DECEMBER	Verified	
TOTAL		88.801

Table 5. Baseline Emissions in La Estrella

Summary of baseline emissions in La Estrella For period comprehended between 2005 - 2006		
Ton CO2eq	2005	2006
JANUARY	Verified	Verified
FEBRUARY	Verified	Verified
MARCH	Verified	Verified
APRIL	Verified	Verified
MAY	Verified	Verified
JUNE	Verified	15.216
JULY	Verified	18.057
AUGUST	Verified	21.346
SEPTEMBER	Verified	19.757
OCTOBER	Verified	20.564
NOVEMBER	Verified	
DECEMBER	Verified	
TOTAL		94.940

The following tables show emissions for project scenario of Pocillas and La Estrella:

Table 6. Project Emissions in Pocillas

Summary of project emissions Pocillas For period comprehended between 2005 - 2006		
Ton CO2eq	2005	2006
JANUARY	Verified	Verified
FEBRUARY	Verified	Verified
MARCH	Verified	Verified
APRIL	Verified	Verified
MAY	Verified	Verified
JUNE	Verified	1.087
JULY	Verified	1.117
AUGUST	Verified	1.014
SEPTEMBER	Verified	1.041
OCTOBER	Verified	1.058
NOVEMBER	Verified	
DECEMBER	Verified	
TOTAL		5.317

Table 7. Project Emissions in La Estrella

Summary of Project emissions in La Estrella For period comprehended between 2005 - 2006		
Ton CO2eq	2005	2006
JANUARY	Verified	Verified
FEBRUARY	Verified	Verified
MARCH	Verified	Verified
APRIL	Verified	Verified
MAY	Verified	Verified
JUNE	Verified	3.994
JULY	Verified	4.740
AUGUST	Verified	5.603
SEPTEMBER	Verified	5.186
OCTOBER	Verified	5.398
NOVEMBER	Verified	
DECEMBER	Verified	
TOTAL		24.921

Leakages from energy consumption are calculated multiplying the energy consumption (kWh/month) by the Emission Factor (0,469 tCO2eq/MWh) for SIC ("Sistema Interconectado Central") grid, obtained from the PDD" Nueva Aldea Biomass Power Plant Phase 2 (Nueva Aldea Power Plant Phase 2)" registered on June 2th, 2006 (methodology ACM0006).

Calculations for activated sludge leakage energy consumption are calculated using energy consumption monitored monthly by Aguas y Riles.

For the digester, there is not any data of energy consumption monitored. In this case, instead of taking monitored data, energy consumption is estimated considering the installed power of the mixers (kW), a consumption factor, hours of agitation per day and number of mixers operating daily. Then, the sum of daily energy consumption for each month is multiplied by the Emission Factor (0,469 tCO2eq/MWh) for SIC grid.

Estimation of leakage due to additional electricity consumption Pocillas-La Estrella.

Table 8. Consume electricity for Digester Pocillas

Consume electricity for Digester POCILLAS		
For period comprehended between 2005 - 2006		
Kwh/mes	2005	2006
JANUARY	Verified	Verified
FEBRUARY	Verified	Verified
MARCH	Verified	Verified
APRIL	Verified	Verified
MAY	Verified	Verified
JUNE	Verified	43.875
JULY	Verified	32.192
AUGUST	Verified	15.452
SEPTEMBER	Verified	33.750
OCTOBER	Verified	25.445
NOVEMBER	Verified	
DECEMBER	Verified	
TOTAL		**150.714**

Table 9. Consume electricity for Digester La Estrella

Consume electricity for Digester La Estrella		
For period comprehended between 2005 - 2006		
Kwh/mes	2005	2006
JANUARY	Verified	Verified
FEBRUARY	Verified	Verified
MARCH	Verified	Verified
APRIL	Verified	Verified
MAY	Verified	Verified
JUNE	Verified	21.753
JULY	Verified	20.605
AUGUST	Verified	18.156
SEPTEMBER	Verified	21.451
OCTOBER	Verified	15.662
NOVEMBER	Verified	
DECEMBER	Verified	
TOTAL		**97.627**

Table 10. Leakage estimation electricity Pocillas Digester

	Leakage Electricity tCO2eq/mes POCILLAS	
	For period comprehended between 2005 - 2006	
Ton CO2 eq	2005	2006
JANUARY	Verified	Verified
FEBRUARY	Verified	Verified
MARCH	Verified	Verified
APRIL	Verified	Verified
MAY	Verified	Verified
JUNE	Verified	21
JULY	Verified	16
AUGUST	Verified	8
SEPTEMBER	Verified	16
OCTOBER	Verified	12
NOVEMBER	Verified	
DECEMBER	Verified	
TOTAL		**73**

Table 11. Leakage estimation electricity La Estrella Digester

	Leakage Electricity tCO2eq/mes La Estrella For period comprehended between 2005 - 2006	
Ton CO2 eq	2005	2006
JANUARY	Verified	Verified
FEBRUARY	Verified	Verified
MARCH	Verified	Verified
APRIL	Verified	Verified
MAY	Verified	Verified
JUNE	Verified	11
JULY	Verified	10
AUGUST	Verified	9
SEPTEMBER	Verified	11
OCTOBER	Verified	8
NOVEMBER	Verified	
DECEMBER	Verified	
TOTAL		**49**

Table 12. Leakage estimation electricity Pocillas Activated Sludge

	Leakage Electricity tCO2eq/mes Pocillas Activated Sludge	
	2005	2006
JANUARY	Verified	Verified
FEBRUARY	Verified	Verified
MARCH	Verified	Verified
APRIL	Verified	Verified
MAY	Verified	Verified
JUNE	Verified	129
JULY	Verified	115
AUGUST	Verified	97
SEPTEMBER	Verified	97
OCTOBER	Verified	118
NOVEMBER	Verified	
DECEMBER	Verified	
TOTAL		**556**

Between 26/08/06 and 31/10/06, the sludge from Pocillas aerobic treatment was disposed anaerobically. According to AM0006, methane leakage emissions due to anaerobic management are calculated based on the biochemical oxygen demand (BOD_5) of the sludge. However, the measurement of BOD_5 of a dehydrated sludge in the laboratory has a high level of uncertainty and local laboratories cannot present certified analysis. For this reason, the BOD_5 of the sludge is calculated by means of a mass balance taking into account the monitored BOD_5 of the influent and the monitored BOD_5 of the effluent of the system. The following equation represents the mass balance use to calculate the BOD_5 of the sludge.

$$Influent\ flow * DBO_{5\ influent} = Sludge\ flow * DBO_{5\ sludge} + Effluent\ flow * DBO_{5\ effluent}$$

Therefore, the BOD_5 of the sludge can be calculated as follows.

$$DBO_{5\ sludge} = \frac{Influent\ flow * DBO_{5\ influent} - Effluent\ flow * DBO_{5\ effluent}}{Sludge\ flow}$$

According to AM0006, the long term BOD (BOD_u), is estimated from the BOD_5 of the sludge. According to AM0006, the leakage is calculated using the BOD_u, through the following equation.

$$Leakage_{sludge} = GWP_{CH4} * 0.25 * BOD_u * Sludge\ flow * \frac{1}{1{,}000{,}000}$$

Estimation of leakage due to sludge managed anaerobically in Pocillas.

Table 13. Leakage estimation due to Sludge Managed Anaerobically in Pocillas

	Leakage Electricity tCO2eq/mes Pocillas Sludge Managed Anaerobically	
	2005	2006
JANUARY	Verified	Verified
FEBRUARY	Verified	Verified
MARCH	Verified	Verified
APRIL	Verified	Verified
MAY	Verified	Verified
JUNE	Verified	0
JULY	Verified	0
AUGUST	Verified	276
SEPTEMBER	Verified	1.140
OCTOBER	Verified	872
NOVEMBER	Verified	
DECEMBER	Verified	
TOTAL		**2.288**

The following tables show the emission reductions during that period.

Table 14. Emission reductions summary in Pocillas

Summary of emission reductions in Pocillas considered leakage electricity		
Ton CO2eq	2005	2006
JANUARY	Verified	Verified
FEBRUARY	Verified	Verified
MARCH	Verified	Verified
APRIL	Verified	Verified
MAY	Verified	Verified
JUNE	Verified	16.375
JULY	Verified	18.092
AUGUST	Verified	16.295
SEPTEMBER	Verified	15.413
OCTOBER	Verified	14.392
NOVEMBER	Verified	
DECEMBER	Verified	
TOTAL		**80.567**

Table 15. Emission reductions summary in La Estrella

Summary of emission reductions in La Estrella considered leakage electricity		
Ton CO2eq	2005	2006
JANUARY	Verified	Verified
FEBRUARY	Verified	Verified
MARCH	Verified	Verified
APRIL	Verified	Verified
MAY	Verified	Verified
JUNE	Verified	11.211
JULY	Verified	13.307
AUGUST	Verified	15.734
SEPTEMBER	Verified	14.560
OCTOBER	Verified	15.158
NOVEMBER	Verified	
DECEMBER	Verified	
TOTAL		**69.970**

Table 16: Summary of all Emission reductions claimed for the period

Ton CO2eq	1st January 2006 – 31st May 2006	1st June 2006 – 31st October 2006	Total
Pocillas		80.567	80.567
La Estrella		69.970	69.970
Total		**150.537**	**150.537**

On behalf of Agrícola Super LTDA.

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