DEMONSTRATION OF THE AQUA TUTA TECHNOLOGY IN WASTE WATER TREATMENT FROM WET COFFEE PROCESSING OF THE CENTRAL MILL IN JARDIN ANTIOQUIA

REPORTE (updated November 20, 2018)

From November 4th to November 8th, Miguel Verhein and Pal Dye Iverson, representatives from the AQUA TUTA™ (http://www.aquatuta.com) company, were received. Their visit was attended by Santiago Arango (Nespresso), Eduardo Ocampo (Cafexport), Carlos Mario Gonzalez (Cafexport), and Andrés Mauricio Villegas (Nespresso).

AQUA TUTA™ is a spin-off of Algasol Renewables (https://algasolrenewables.com/), which has developed water treatment technology based on convective reaction, with a wide range of applications for waste water treatment in various industries, including aquaculture, textile, petroleum, and crop industries. This technology may be applied to the African palm and coffee industries.

Their demonstration was performed from November 5th to November 7th at Central Mill in Jardín. Said presentation encompassed the following stages:

- Electrical supply Installation and adaptation (November 5th)
- Preliminary testing (November 5th – November 6th)
- Excess mucilage test initiated on November 6th (diluted).
- Excess mucilage test initiated on November 7th (concentrated).

System characteristics:

The system consists of a signal processing brain, a system called a molecule masher, and a filter system, each of which have varying daily processing capacities (i.e AT-10).

The AT-PDU system (as in photo) was used, and was fitted with:

- Processing brain, located at the rear
- Entrance deposit for waste water in the upper area
- Convective reaction deposit
- Filter system
- Supernatant deposit
- Treated water output
- No molecule masher
- The demonstration unit performs at lower levels than the commercial model

[Waste water deposit (input), Processing brain (at the back), Convective reaction compartment, Filter system, Supernatant deposit, Treated water output.]

Graphic 1. View of the PDU system and its parts during the testing operation on November 7th.

Table 1 shows the following: the physicochemical parameters and maximum permissible values of waste water to be discharged into surface water, from productive activities specific to coffee, as specified in Resolution 631 of 2015 (March 17th), Official Newspaper No. 49,486 from April 18, 2015, of the Ministry of Environment and Sustainable Development.

"The Colombian Coffee Milling" document was used for reference (https://www.cenicafe.org/es/publications/Final_libro_Beneficio_isbn.pdf). It uses fewer than 10 liters of water per kilogram of dry parchment coffee, which is considered to be ECOLOGICAL MILL. With this in mind, the reference parameters used are be those reported in the ecological mill resolution.

The table below presents the reference values for compliance with the Colombian norm (Resolution 631 of 2015).

PARAMETER	UNITS	COFFEE MILL ACCORDING TO THE FNC	
		ECOLOGICAL	TRADITIONAL
pH	pH units	5.00 – 9.00	5.00 – 9.00
Chemical Oxygen Demand (COD)	mg / L O2	3000	650
Biochemical Oxygen Demand (BOD)	mg / L O_2	400	
Total Suspended Solids (TSS)	mg / L	800	400
Sedimentable Solids (SS)	mg / L	10	10
Fats and oils	mg / L	30	10
Total phosphorous (P)	mg / L	Analysis and report	Analysis and report
Total nitrogen (N)	mg / L	Analysis and report	Analysis and report
Real color (absorbency measurements at 436, 525, and 620 nm)	m-1	Analysis and report	Analysis and report

The water processed on days six and seven were stored in 500 ml plastic jars, and pH and refraction (indirect measurement of suspended solids) measurements were taken on-site. Additionally, WQI water from the city of Manizales was taken to the laboratory for analysis of Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Suspended Solids (TSS), and pH.

RESULTS

Field analyses performed

Five readings, untreated samples, and the water product of AQUA TUTA treatment and supernatant were taken, in which the average values were as follows:

The AQUA TUTA treatment pH values comply with the reference values specified in Resolution 631 of 2015, both for ecological and traditional coffee benefit, where untreated water did not comply with the applicable norm.

		Values					
		pH					
DATE	**TREATMENT**	**(reference 5.0 – 9.0)**			**TSS**		
6/11/2018	AQUA TUTA	6.20	±	0.02	0.30	±	0.00
	Supernatant	4.77	±	0.03	1.60	±	0.00
	Untreated	3.87	±	0.04	0.60	±	
7/11/2018	AQUA TUTA	6.83	±	0.04	0.25	±	0.30
	Supernatant	4.50	±	0.12		±	
	Untreated	3.79	±	0.02	1.45	±	0.47
Overall total		**5.04**	±	**1.18**	**0.82**	±	**0.67**

Laboratory analysis

Below are the results of analyses performed on the six test samples (the lab report is attached). The methods of analysis were as follows:

PARAMETER	METHOD	TECHNIQUE
pH	S.M. 4500-H+B	Electrometry
Chemical Oxygen Demand COD	S.M.5220 D	Closed reflux and colorimetry
Biochemical Oxygen Demand BOD5	S.M. 5210 B S.M. 4500 O, G	Five-day incubation and membrane electrode
Total solids	S.M. 2540 B	Gravimetry

The compendium of the laboratory results and reference values are contained in the table below:

Summary of the AQUA TUTA technology tests at Central Mill.

Date	Variable	Original water	AQUA TUTA	Supernatant	Coffee reference values
06 Nov	pH	3,753	5,212	6,271	5.00-9.00
	COD	5863	1498	4144	3,000
	BOD5	2352	652	1888.5	400.00
	Total Solids (TSS)	14060	760	5520	800
07 Nov	pH	4,430	4,908	3,902	5.00-9.00
	COD	4588	1383	2368	3,000
	BOD5	1885.5	604	972.5	400.00
	Total Solids (TSS)	151820	902	14470	800

Summary of compliance with the Colombian norm for non-domestic water discharge. Parameters specified in Resolution 631 of 2015 used for reference.

Date	Variable	Original water	AQUA TUTA	Supernatant	Coffee reference values
06 Nov	pH	DOES NOT COMPLY	COMPLIES	COMPLIES	5.00-9.00
	COD	DOES NOT COMPLY	COMPLIES	DOES NOT COMPLY	3,000
	BOD5	DOES NOT COMPLY	DOES NOT COMPLY	DOES NOT COMPLY	400.00
	Total Solids (TSS)	DOES NOT COMPLY	DOES NOT COMPLY	DOES NOT COMPLY	800
07 Nov	pH	DOES NOT COMPLY	DOES NOT COMPLY	DOES NOT COMPLY	5.00-9.00
	COD	DOES NOT COMPLY	COMPLIES	COMPLIES	3,000
	BOD5	DOES NOT COMPLY	DOES NOT COMPLY	DOES NOT COMPLY	400.00
	Total Solids (TSS)	DOES NOT COMPLY	DOES NOT COMPLY	DOES NOT COMPLY	800

These results show that the AQUA TUTA technology performed better for concentrated waste water treatment (November 7th), than for the diluted water norm (November 6th).

Clear differences are shown between the pH parameters measured in the field (with portable devices) and the laboratory, for all samples analyzed. This may be due to the difference in devices, storage conditions, and transport (despite sample conservation).

Laboratory results show that the AQUA TUTA technology complies with the reference parameters established for pH and COD, and very nearly comply with the BOD and TSS parameters presented in the table which summarizes the results.

[Operation and output view for water treated with the PDU device, Sample Nov. 06, 2018, Sample Nov. 07, 2018.]

CENTRAL MILL DATA

Concept	**Figures**	**Unit**
Historic annual processing potential	2,000,000	kg coffee cherry
Historic annual processing potential	400,000	kg CPS
Water consumption	9.8	liters x kg CPS
Discharge volume (peak day)	55	m^3

There is not data which refers to the processing cost of discharged waste water.

Final considerations

- Laboratory results showed that AQUA TUTA technology complies with the reference parameters established for pH and COD, and very nearly complies with BOD and TSS parameters, despite having used a demonstration unit.
- Notably, the characteristics of the PDU model used in the demonstration differ from the AT-10 model, which possesses all processing modules, and would considerably improve results.
- Development of a collaborative strategy for evaluation of the AT-10 model in real, productive conditions on a central mill level, as well as for farms of different sizes, is proposed.
- The AQUA TUTA technology, employed for the processing of waste water, which emerges as a coffee product, presents the following benefits:
    - High levels of potential for waste water processing in different concentrations, as indicated by the results of the tests performed.
    - Requires a low time for water processing, so as to comply with the parameters stipulated in the applicable norm.
    - Returns water with optimal pH, BOD, COD, and TSS conditions, which permit compliance with applicable Colombian environmental norms.
    - AQUA TUTA technology has a treatment capacity of between 120-240 m^3 per day, depending on the model used, which is sufficient to treat the waste waters at the facility: 55 m^3 on a peak harvest day.
    - Given the evidence provided by the demonstration, AQUA TUTA technology would reduce the labor required for waste water management.
    - The system requires low operating costs, associated only with the 230-volt electrical connection.
    - It is necessary to develop an environmental appraisal strategy (value) which permits the use of this technology on different scales (central mill and large farms), considering installation, functioning, and consumable costs.
- Difficulties present in terms of electrical connection, given that it requires a three-pronged 230- volt connection, which is not normal on rural Colombian coffee farms, except in special cases (large farms and central facilities).