Influence on the Combustion process of the type of fertilizer used on an energy crop (Populus nigra, L.)

Luis F Calvo, Daniel Blanco, Luis Escudero, Sergio Paniagua

University of Leon, Spain

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Introduction.

Hence, black poplar was used as a lignocellulosic biomass crop. We used *four different clones of poplar*, two of them associated with native Spanish varieties (UNAL and I214) and two varieties of specific clones for biomass (AF-2 and AF-8). *Three different treatments* were applied to fertilize our energy crop: digestate from the anaerobic digestion of manure, sewage sludge from the food industry and a control treatment

*The overall objective of this work was to investigate the differences in thermal behavior in relation to the plant variety and the material used to fertilize an energy crop***.**

A *thermogravimetric technique* was utilized to attain the objective of the study. Thermogravimetric analysis (TGA) is a method widely used for investigating the thermal properties of materials. Non - isothermal, or dynamic, TGA is more commonly used than isothermal TGA, as fewer data are needed to determine the reaction kinetics. One would expect that the thermal behavior would be different for each particular case; however, in view of the results obtained, *no clear trends are evident*

Experimental procedure.

An energy crop with different black poplar clones being grown for biomass (three years of cultivation) was subjected to three different fertilizing treatments. The batch termed CB (*control batch*) was a control sample that was given no form of fertilizer. Batch DB (*digestate batch*) was fertilized during cultivation with digestate derived from an anaerobic digestion process. Finally, batch SB (*sludge batch*) was fertilized during growth with sludge from a sewage treatment works. The material was subjected to a grinding process by using a ball mill (Fig.1A). We selected a sample size of between 6-9 mg. Previously samples were placed in a *thermobalance* (Fig. 1B) and subjected to a heating rate 10°C/min from ambient to 1000ºC. This heating is done under a 100 mL/min air flow to obtain, in this way, the oxidative process of combustion. At all times we work with a 1atm. pressure.

Figure 1.A

Figure 1.B

Figure 1 - Material used in samples' pre-treatment. - Retsch MM200 ball mill (Fig. 1A) and TA Instruments SDT2960 thermobalance (Fig. 1B) -

Results.

Figures 2, 3 and 4 show the relationships between variations over time in the percentage (%/min) of weight (deriv. weight) of the samples for which we want to analyze the thermal behavior.

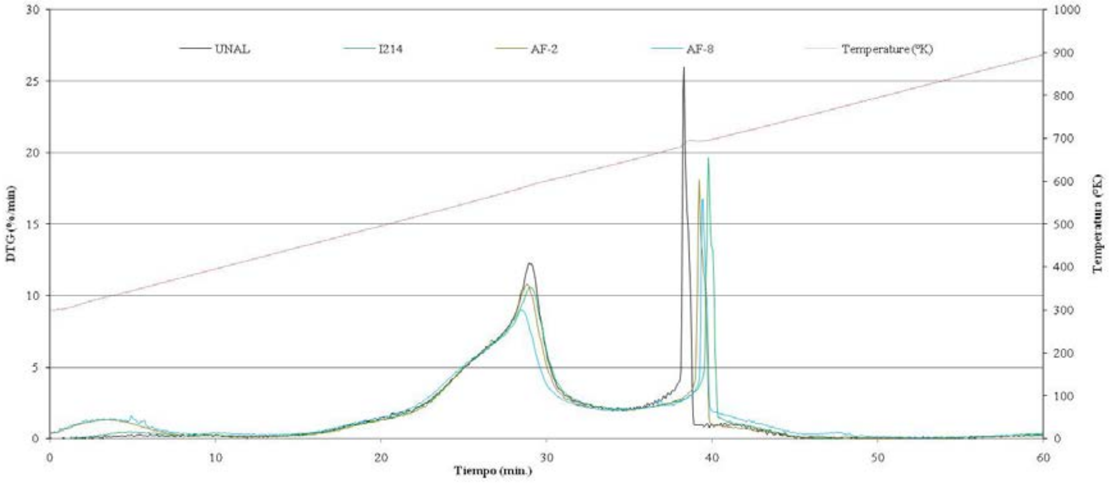

Figure 2 - Changes in the Percentage Variation of Weight of different poplar clones on control batch (CB) -

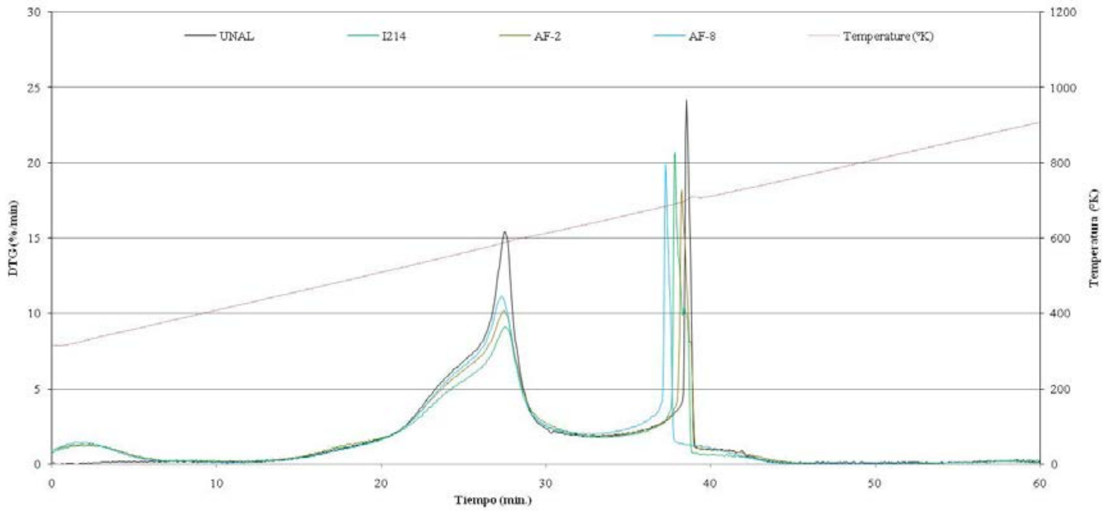

Figure 3 - Changes in the Percentage Variation of Weight of different poplar clones on digestate batch (DB) -

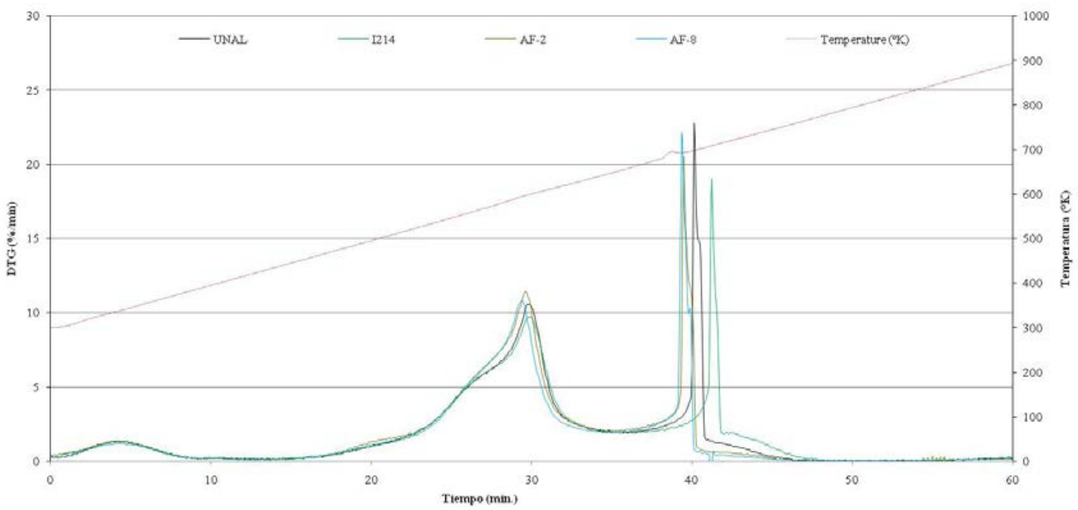

Figure 4 - Changes in the Percentage Variation of Weight of different poplar clones on sludge batch (SB) -

Conclusions.

Although the way in which we fertilize a crop does influence on the growth of plants (work published thereafter) thermal characteristics aren't influenced by this kind of fertilized. Something that can be reaffirmed in the table 1 information.

Table I - Thermogravimetric study results -

	CONTROL				DIGESTATE				SLUDGE			
	UNAL	I214	AF-2	AF-8	UNAL	I214	AF-2	AF-8	UNAL	I214	AF-2	AF-8
Peak I - Desvolatilization												
T_0 (K)	470,43	451,03	471,58	470,80	483,90	484,82	465,72	462,67	479,68	481,52	485,44	476,98
T_f (K)	525,43	528,03	531,08	541,80	560,40	523,32	540,22	510,17	558,68	544,02	543,94	507,98
$DTG_{máx}$ (%/min)	1,257	1,228	1,148	1,279	1,652	1,301	1,338	0,728	1,496	1,185	1,558	1,014
$T_{DTGmáx}$ (K)	490,93	497,53	492,58	495,80	513,40	500,82	494,72	480,17	508,68	501,02	502,44	485,98
Peak II - Desvolatilization												
T_0 (K)	543,93	541,03	554,58	550,30	562,40	545,32	546,72	545,67	550,68	547,02	551,94	546,48
T_f (K)	644,43	646,53	609,08	615,80	599,90	641,82	612,72	641,67	608,68	609,52	631,44	599,48
$DTG_{máx}$ (%/min)	12,250	10,570	10,760	8,589	15,450	9,079	10,170	11,140	10,550	9,708	11,410	10,830
$T_{DTGmáx}$ (K)	589,93	590,53	588,58	590,80	584,90	589,82	588,72	587,67	589,18	589,52	587,94	584,48
Peak I - Combustion												
T_0 (K)	653,93	665,53	664,08	657,30	652,40	658,32	657,72	657,67	653,68	668,52	647,94	648,48
T_f (K)	681,93	688,03	703,58	700,30	726,90	696,32	715,75	691,67	698,68	713,52	687,44	690,98
$DTG_{máx}$ (%/min)	2,629	2,604	2,739	2,482	2,754	2,159	2,627	2,638	2,372	2,513	2,415	2,397
$T_{DTGmáx}$ (K)	665,93	680,03	681,08	686,30	684,90	673,82	683,22	617,17	674,18	687,02	664,44	666,48
Peak II - Combustion												
T_0 (K)	682,43	697,53	691,58	696,30	698,90	691,82	696,22	686,67	692,18	702,02	685,44	683,43
T_f (K)	684,43	683,53	693,08	717,80	700,40	693,82	698,22	687,67	693,18	704,02	687,44	684,48
$DTG_{máx}$ (%/min)	25,960	18,720	18,090	3,636	24,150	20,690	18,200	19,900	22,780	19,040	20,510	22,140
$T_{DTGmáx}$ (K)	683,43	698,53	692,58	710,30	699,90	692,82	697,22	687,17	692,68	703,02	686,44	683,98
Peak III - Combustion												
T_0 (K)	690,43	698,53	699,08	689,30	731,40	710,82	697,72	719,67	699,18	736,02	708,94	711,98
T_f (K)	753,93	759,53	731,58	758,30	757,40	761,82	765,72	755,17	755,68	741,52	728,94	750,98
$DTG_{máx}$ (%/min)	0,980	0,894	0,739	3,683	0,917	0,541	0,986	0,848	1,228	1,111	0,526	0,646
$T_{DTGmáx}$ K)	715,43	721,03	719,58	707,30	733,40	728,32	717,72	723,67	706,68	738,02	721,94	719,98

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List of figures and tables.

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