COMBUSTION AND CARBONIZATION OF OLIVE-POMACES DRIED USING SOLAR PROCESS

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Abstract

In the last decades, many efforts were focused on the thermochemical transformation of agricultural and industrial residues to generate energy, chemicals or activated carbons. The present study concerns olive pomaces (O.P) materials coming from the Region of Meknès – Tafilalet. These residues result from the olive oil extraction process (pulp and stones).The studied samples are raw and pressed O-P, dried at various temperatures (40°C-60°C-80°C) in using thermal solar energy.The physico-chemical characteristics of these samples and of hemicellulose (H.), cellulose (C.) and lignin (L.) compounds are compared, before and after their carbonization. The thermal treatments of such materials lead to chars which can be used as precursors for the synthesis of activated carbons.

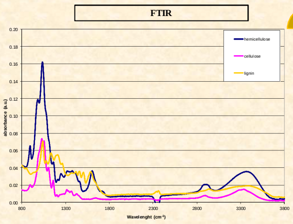
Characterization of Hemicellulose, Cellulose and Lignin compounds

Hemicellulose (ref:36-355-3); Cellulose (ref:9004-34-6) and Lignin (ref:8072-93-3) from Sigma Aldrich Co

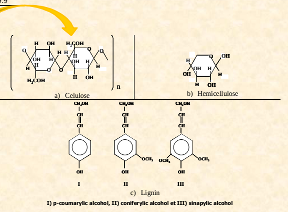
Elementary analyses

	C (%)	H (%)	N (%)	S (%)	O (%)	H2O + residues (%)
Hemicellulose	41.2	5.9	0	0	50.0	2.9
Cellulose	42.3	6.4	0	0	50.6	0.7
Lignin	47.8	4.9	0	4.1	33.3	9.9

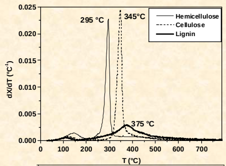
FTIR

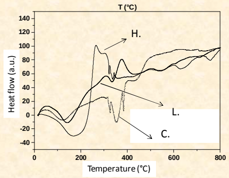


The functional groups for each compound correspond to phenolic groups (1080 cm^{-1}), carboxylic –OH (1250 cm^{-1}) and aromatic C=C (1650 cm^{-1})



Experimental conditions:
T_{final}: 800°C-1h
Heating rate: 20°C.min^{-1}
Vector gas: argon
Flow: 160 mL.min^{-1}





Carbonization : Mass loss (TGA)

H. = 76.5%

C. = 80.9%

L. = 55.1%

Exothermic peak for H. and L.

Endothermic peak for C.

DTA peaks between 300°C and 350°C characteristic of the release of hydrocarbons.

Carbonization of H., C. and L. compounds

Lignin decomposes over a wide range of temperature, whereas hemicellulose and cellulose show characteristic peaks

Characterization of Olive Pomace samples

Elementary analyses

Raw olive pomaces

	C (%)	H (%)	N (%)	S (%)	O (%)	H2O + residues (%)
Raw O.P.	40.4	6.2	1.7	0	29.4	21.9
Raw O.P. (40°C)	45.5	6.6	1.3	0	31.5	15.1
Raw O.P. (60°C)	55.1	7.9	1 .3	0	29.0	6.7
Raw O.P. (60°C)	52.8	7.4	1.3	0	32.0	6.5

Pressed olive pomaces

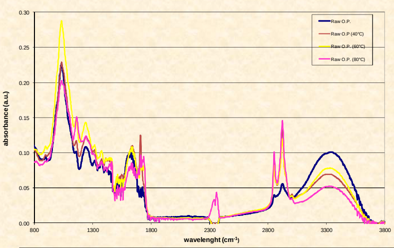
	C (%)	H (%)	N (%)	S (%)	O (%)	H2O + residues (%)
Pressed O.P.	41.6	5.9	2.2	0	28.4	21.9
Pressed O.P. (40°C)	48.9	7.3	2.1	0	27.7	14.0
Pressed O.P. (60°C)	55.0	7.5	2.0	0	26.9	8.5
Pressed O.P. (60°C)	53.1	7.5	2.3	0	29.5	7.5

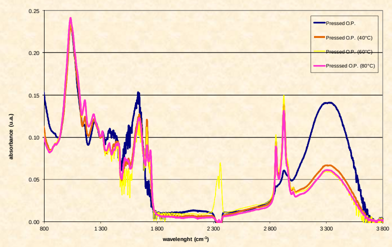
No significant differences between raw and pressed O.P.
As the water content decreases, the temperature of the drying by thermal solar energy increases.

O.P. residues: quantification of H., C. and L. (INRA)

	H. (%)	C. (%)	L. (%)
Raw and pressed O.P.	38.0	26.0	36.0

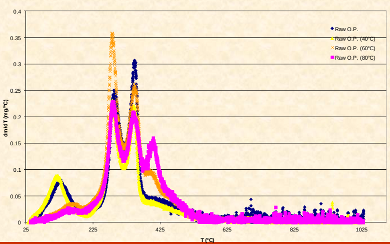
FTIR

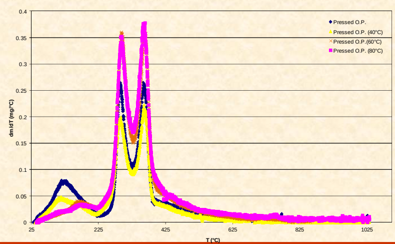




FTIR spectra of raw and pressed O.P. are close to hemicellulose spectrum with the same peaks.
-Peak at 2900 cm^{-1}, corresponding to aliphatic groups, is due the presence of remaining oil in the raw and pressed O.P.

DTG data

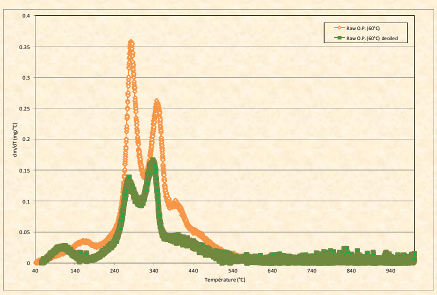




-100°C : 18 % water loss for raw and pressed O.P. and for O. P. dried at 40°C,
5% water loss for O.P. dried at 60 et 80°C

-For raw O.P.: drying allows the release of oil from the vegetal cells where it is trapped = peaks at 405°C.
-For pressed O.P., disappearance of the peak at 405°C: no more presence of oil in the materials.

The DTG data of the raw and pressed O.P samples correspond to DTG data of Hemicellulose and Cellulose: peak at 280°C for Hemicellulose and peak at 350°C for Cellulose



Hexane extraction of raw O.P., dried at 60°C, in order to «deoiled» the sample: Disappearance of the peak at 405°C, which confirms the occurrence of oil in raw O.P. and dried O.P. materials.

Conclusion

The knowledge of the physico-chemical characteristics of the raw, pressed and dried materials and of their thermal behavior will be used to establish a kinetic model of thermal decomposition during the carbonization and the combustion of the olive-pomaces residues.

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