Thermal treatment of wastes of grape skins by drying in a conical spouted bed dryer

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M.J. San José, S. Alvarez, R. López, J. Vegas , J. González

Dpto. de Ingeniería Química. Universidad del País Vasco UPV/EHU

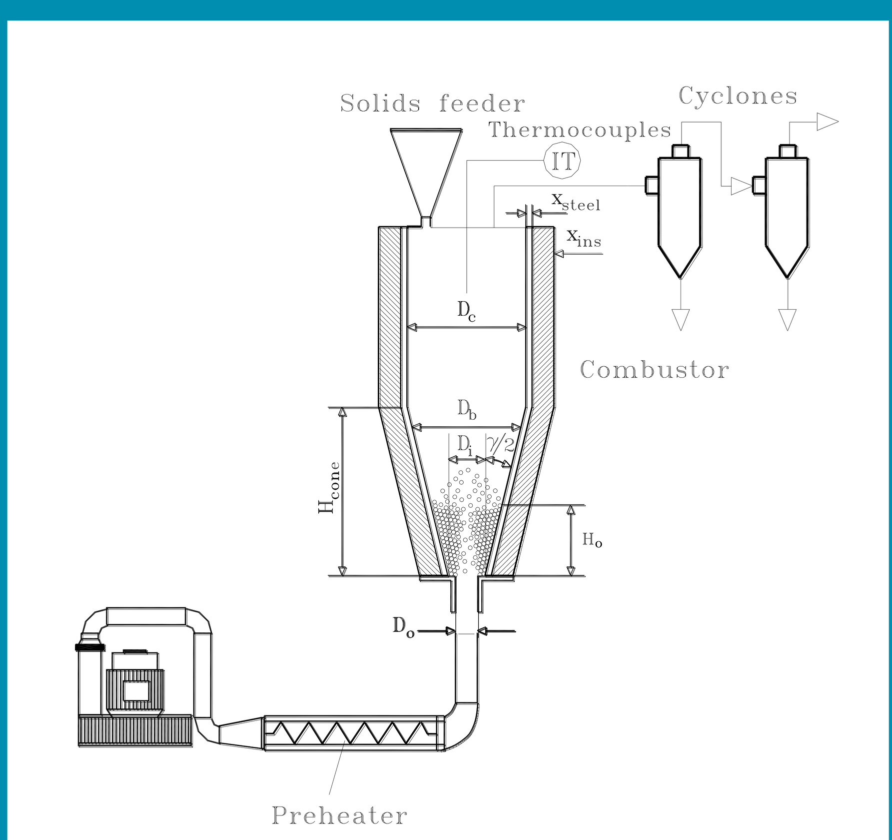
Apdo. 644. 48080 Bilbao. Spain.

Tel. 34-94-6015362. Fax. 34-94-6013500. e-mail: mariajose.sanjose@ehu.es

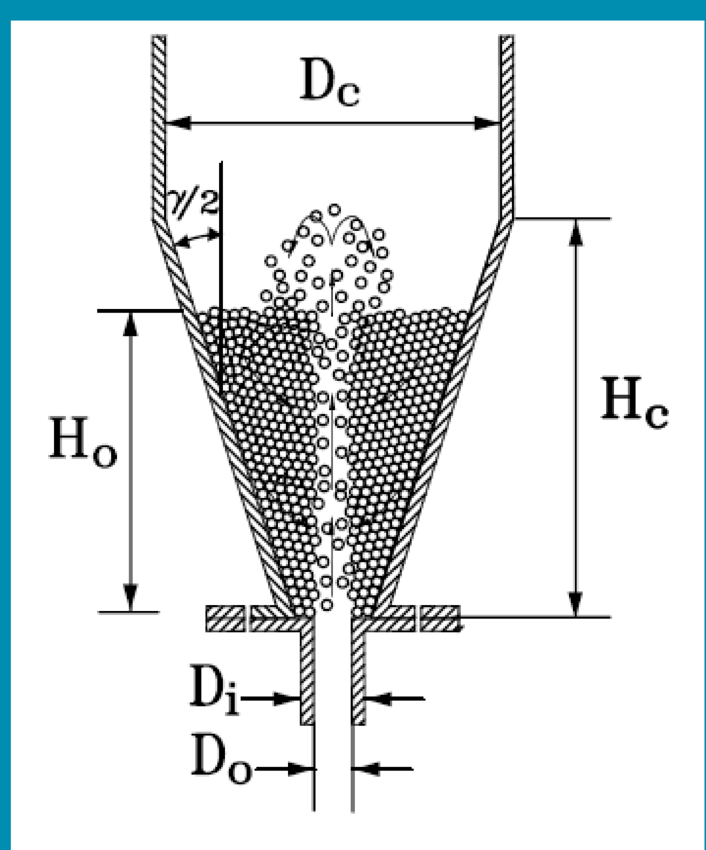
Abstract

- ☑ Biomass is the fourth most used renewable energy source, which already supplies 14% of the world's primary energy consumption, and about 5% of the primary energy used in the United States in 2016 [1]. Vineyard (Vitis vinifera) processing, with a world extension of cultivated lands of 7.5 million Ha in 2016, with a global grape production of almost 76 million tons in 2016 and worldwide wine production of 241 million of hl (Wine Institute, 2017), generates a large amount of wastes suitable for valorization. The main organic wastes of the wine sector are pomace constituted by skins and scrapes, obtained after the extraction of the grape juice (Barcia et al., 2014); lees (Pérez-Serradilla et al., 2008); and vinasse.
- ☑ One alternative to exploit these wastes is thermal treatment for energy valorization by means of an appropriate technology. The exploitation of a renewable energy source as biomass by spouted beds clean technology is a sustainable alternative. This technology has been successfully applied in a conical geometry for exploitation of agroforestal biomass wastes and industrial sludge by drying (San José et al., 2010a, 2010b, 2013a) and by combustion (San José et al., 2013b, 2014a, 2014b, 2018).
- ☑ In this paper, a conical spouted bed combustor has been used for thermal exploitation of wine sector wastes by combustion. The performance of a conical spouted bed for drying of beds consisting of grape skins and scrapes in the spouted bed regime. Likewise, drying of skins and scrapes has been carried out in a conical spouted bed combustor at 105 ºC to improve the thermal treatment.

Materials and Methods



Experimental equipment with the conical spouted bed reactor



Conical spouted bed dryer with grape skin wastes in the spouted bed regime

☑ **Wastes of grape skin**

Density of wet and dry wastes of grape skin, ρ_s = 1050 kg/m^3 and 870 kg/m^3

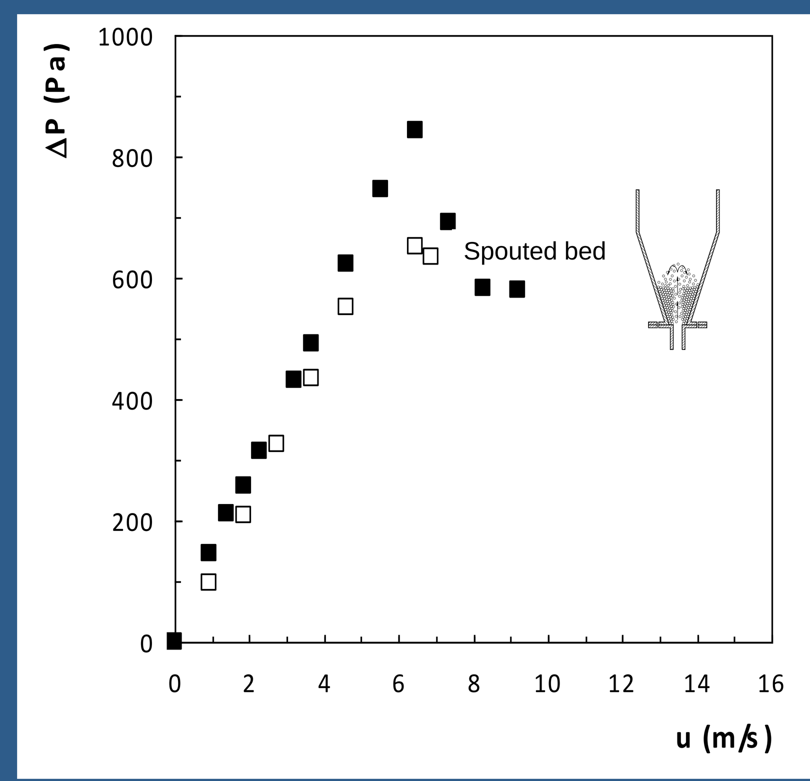
Mean Sauter diameter, d_S =3-7 mm

(a) (b)

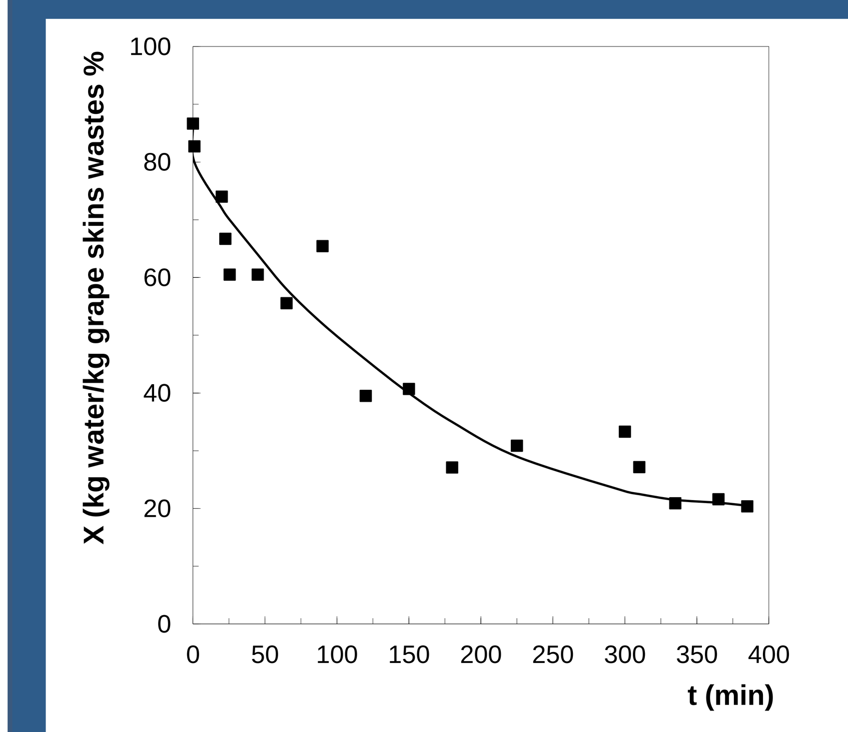
Particles of grape skin. (a) wet; (b) dry

Results

- ☑ Spouted bed regime in beds of grape skins in conical spouted bed reactor is determined when pressure drop fluctuations have standard deviation lower than 10 Pa [13].
- ☑ Pressure drop evolution is measured by increasing gas velocity from zero over the spouted bed regime. Then gas flow is slowly reduced until the spout collapses at minimum spouting velocity.
- ☑ Bed pressure drop of beds of grape skins shows a pronounced hysteresis.



Evolution of pressure drop with air velocity for beds of grape skins. γ= 36º, D_o= 0.04 m



Time evolution of the moisture content of a bed of grape skin wastes. Experimental system: γ= 36º; D_o= 0.03 m, M= 100 g, d_S = 4.78 mm, initial moisture content 86.5 wt % (d.b.), u= 1.02 u_{ms}; T= 105 ºC.

☑ **Drying**

- ☑ During the drying process, the moisture content of a bed consisting of grape skin wastes decreases with the time from the initial moisture to the equilibrium moisture content.
- ☑ The decrease in the moisture content is more pronounced at the beginning of the drying.
- ☑ At the end of the drying, the variation of grape skins moisture content with the time is almost asymptotic until the equilibrium moisture content is attained.
- ☑ Drying time necessary to obtain equilibrium moisture content at 105 ºC is 400 minutes.

References

- ☑ Konduri, R.K., Altwicker, E.R., Morgan, M.H.III.. Chem. Eng. Sci., 54(2), (1998), 185-204.
- ☑ Rasul, M.G. Fuel, 80(15), (2001), 2189-2191.
- ☑ San José, M.J., Alvarez, S., Ortiz de Salazar, A., Morales, A., Bilbao, J. Chem. Eng. Transac. 21 (2010a) 145-150.
- ☑ San José, M.J., Alvarez, S., López, L.B., Olazar, M., Bilbao, J. I In Drying 2010 (Vol B); Barleben-Magdeburg: Docupoint GmbH, (2010b) (Vol B), 1242-1248.
- ☑ San José, M.J., Alvarez, S., Peñas, F.J., García, I. Chem. Eng. Sci. 100 (2013a) 413-420.
- ☑ San José, M.J., Alvarez, S., García, I., Peñas, F.J. Fuel 110(1) (2013b) 178-184.
- ☑ San José, M.J., Alvarez, S., Peñas, F.J., García, I.. Chem. Eng. J. 238(15) (2014a) 227-233.
- ☑ San José, M.J., Alvarez, S., García, I., Peñas, F.J. Chem. Eng. Res. Des. 92 (2014b) 672-678.
- ☑ San José, M.J., Alvarez, S. Chem. Eng. Technol. 38(4) (2015), 709-714.
- ☑ San José, M.J., Alvarez, S., López, R. Computer Aided Chemical Engineering 40, (2017), 517-522.
- ☑ San José, M.J., Alvarez, S., López, R. Catal. Today, 305, (2018), 13-18.
- ☑ Tambone, F., Scaglia, S., D'Imporzano, G., Schievano, A., Orzi, V., Salati., S. Chemosphere 81 (2010) 577-583.
- ☑ Van Caneghem, J., Brems, A., Lievens, P., Block, C., Billen, P., Vermeulen, I., Dewil. R., et al. Prog. Energy Combust. Sci. 38(4), (2012), 551-582.
- ☑ Wine Institute, OIV report on the world vitivinicultural situation (2017).

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