

Supplementary Information

Studies of particle drying using non-invasive Raman spectrometry and particle size analysis

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Calculation of the approximate mass sampled during Raman analysis of stationary and agitated powders

Stationary powders. The volume (V) of powder sampled can be approximated by the following:

$$V = \pi r^2 h$$

where r is the radius of the laser spot and h is the depth of powder sampled. Although the penetration depth of backscatter Raman measurements is several mm, the majority of the signal originates from the upper surface layers of the sample. For example, Monte Carlo simulations by Matousek and Parker¹ showed that 88% of the backscatter Raman signal from a 4 mm thick tablet was generated in the top 1 mm layer and only 12% of the signal originated from the remaining 3 mm of sample. If the sampling depth is assumed to be 1 mm, then $V = 28.3 \text{ mm}^3$ with a laser spot diameter of 6 mm. If the density of the powder is assumed to be equal to that of COA (1.365 g cm^{-3}), then the mass of COA sampled is 0.039 g.

Agitated powders. The volume of powder sampled in the drier during acquisition of one spewctrum when an agitation rate of 20 rpm was employed can be calculated as follows. The probe is positioned 6 cm from the centre of the drier and the circumference of a circle with a radius of 6 cm is 37.7 cm. Therefore, with an agitation rate of 20 rpm, the powder will have a velocity of 12.57 cm s^{-1} at the probe location (i.e. at a distance of 6 cm from the centre of the drier). Spectra were collected using 1 accumulation and a 10 s exposure time, and so the powder will move a distance of 125.7 cm during the acquisition of one spectrum. If the area of powder sampled can be approximated by the area of two semi-circles (diameter of 6 mm) plus the area of a rectangle with dimensions of 6 mm $\times$ 125.7 cm, then the total area sampled is equal to 75.7 cm^2 . Assuming a sampling depth of 1 mm then the volume of powder sampled is 7568 mm^3 . If the density of the powder is assumed to be equal to that of COA (1.365 g cm^{-3}), then the mass of COA sampled is 10.33 g.

1. P. Matousek and A.W. Parker, *Appl. Spectrosc.*, 2006, **60**, 1353-1357.

Table S1. The volume weighted and surface weighted means, d(4,3) and d(3,2), respectively, obtained by laser diffraction particle size analysis for material removed from the vessel at the end of drying for each experiment.

Expt	Agitation Method	Oil Temp/°C	% solvent loss on drying	d(4,3) after drying ^a /μm	d(3,2) after drying ^b /μm
1	Continuous	40	50	69	24
2	Intermittent	40	50	110	36
3	Continuous	60	100	77	20
4	Intermittent	60	100	67	25
5	Continuous	40	100	50	17
6	Intermittent	60	50	95	31
7	Intermittent	40	100	95	30
8	Continuous	60	50	63	22

^a d(4,3) before drying was 138 μm

^b d(3,2) before drying was 41 μm