# Melt processing, foaming and rheological characterisation of potato starch using a Multipass Rheometer

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# Abstract

This paper is concerned with the melt processing, foaming and rheological characterisation of starch using a Cambridge multipass rheometer (MPR) (Mackley *et al.*, 1995). The work advances the understanding of the foaming behaviour of starch melts, which is dependent on the flow properties of the test samples. These aspects are of particular relevance to the commercial extrusion expansion of starch, especially in the food and packaging industries. It was found that simple heating of starch powder at low moisture content (< 50%) degraded the starch into an intractable, opaque material. However, pre-treating starch powder by simultaneous heating and pressing between parallel plates generated a clear melt. The melt, when subsequently quenched into a solid sheet, was used to generate molten pressed starch discs, which then produced a homogeneous melt when heated under pressure inside the confined volume of the MPR (Nowjee and Mackley, 2005). In-situ water vapour bubble nucleation and growth within starch melts were studied by viewing through a pair of optical quartz windows fitted in the middle test section of the MPR, while the pistons were moved apart to depressurise the melt. The effect of pressure release rates on the type of foam obtained has also been studied. A preliminary bubble growth model has been developed to compare with experimental bubble growth profiles, with governing equations based on the overall force balance on the starch melt, mass balance of water vapour in the melt and the mass balance of the water vapour within the bubble. The rheological behaviour of molten starch was also investigated using capillary rheometry. The pistons of the MPR were synchronously driven over a range of constant velocities, yielding shear data. Potato starch samples at different moisture contents and operating temperatures showed shear-thinning behaviour, with both apparent and complex viscosities decreasing steadily with increasing shear rate and frequency respectively. The viscosities decreased with increasing moisture content and operating temperatures.

# Reference

Mackley, M.R., Marshall, R.T.J., Smeulders, J.B.A.F, 1995, The multipass rheometer, *Journal of Rheology*, **39** (6), 1293-1309

Nowjee, N.C., Mackley, M.R., The melt rheology and foaming behaviour of starch using a Multipass Rheometer, *Conference Proceedings for the 7th World Congress of Chemical Engineering, Glasgow, Scotland*, 10-14 July, 2005