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PRODUCTION OF BIODEGRADABLE FOAMS USING SUPERCRITICAL CO_2

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Foams are generally made from synthetic polymers which make them hard to recycle and thus the majority are land filled where they take up a large volume and do not degrade. An alternative is to use biodegradable polymers obtained from natural sources. Only poly(lactic acid) (PLA) can be produced on a large enough scale to achieve this. However, PLA thermally degrades during processing preventing its production into low density foams. To date, only modified PLA has been successfully foamed to a low density[1] but this modification also affects the final properties and degradation behaviour.

A solution to this problem is to use supercritical CO_2 ($scCO_2$) which can act as a plasticiser to lower the melting temperature[2] and viscosity[3] of polymers. This enables PLA to be processed at much lower temperatures, thereby preventing degradation. The added advantage of $scCO_2$ is that on exiting the extruder it returns to the gas phase and therefore the final product consists only of pure PLA.

A single screw extrusion process using $scCO_2$ has been developed for the production of low density biodegradable foams. High pressure differential scanning calorimetry (DSC) and Fourier Transform Infra-Red (FTIR) spectroscopy have shown the depression in melting point of a range of PLAs in the presence of $scCO_2$. In addition, the effect of temperature and CO_2 pressure on the viscosity of molten PLA has been investigated using a high pressure rheometer and a static pressure vessel has been used to investigate the parameters required to foam PLA. A range of PLAs have also been extruded into foams and their properties evaluated.