# Eradicating harmful impacts of manufacturing

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The human and environmental dangers posed by a widely used manufacturing technique could be almost eradicated thanks to research led by Plymouth University.

Fibre-reinforced polymer matrix composites are employed in a vast array of industries, and are painted or sprayed onto products to provide a high-quality finish in transport applications, chemical plants, renewable energy systems and pipelines.

But that finishing process causes the vapours of a volatile organic compound – styrene, found in polyesters and vinyl-esters – to be emitted, posing potential health and wellbeing risks to the workforces involved and the wider environment.

Now a team from Plymouth University, part of the €1.4million InGeCt project funded by the European Union's Framework Programme 7 (FP7) initiative, has identified that in-mould gel-coating could reduce average styrene levels by more than 98 per cent and provide a route to improved workplace conditions and reduced environmental impact.

Dr John Summerscales, Associate Professor in Composites Engineering at Plymouth University, led the study. He said:

"Styrene has been the subject of extensive debate in respect of health and environmental issues. Exposure to styrene has previously been linked to altered mood states, in particular aggression, while its vapour

has been reported to cause depression, fatigue and a slowing in reaction times. By reducing styrene levels in the workplace, there would be numerous positive results such as improving retention of workforce personnel, minimising release to the environment and reducing odour at the factory boundary."

The European-wide study compared three techniques used in the finishing process – conventional hand-painted gel-coating, in-mould gel-coating with a separator fabric and in-mould surfacing with a silicone shim processes – to establish if styrene levels can be significantly reduced by the adoption of closed mould systems.

The hand-painted technology was found to have significantly higher levels of styrene emission than the two closed mould processes. For the open mould process, the average styrene levels were in the range 28-70 parts per million (ppm).

The two closed mould technologies were shown to significantly reduce the measured styrene levels, to lie in the range 0.23-0.37 ppm, demonstrating a reduction in average styrene emission levels of more than 98 per cent, with obvious benefits for worker health and the reduction of environmental burdens.

Dr Summerscales added:

"The occupational exposure limits for styrene currently vary across the European Union, but a recent directive (REACH) is likely to result in the harmonisation of permitted styrene levels – most probably at the current lowest (Scandinavian) level. The recommendation for a 20ppm time-weighted average, which would be an 80 per cent cut in the UK, is unlikely to be achievable with open mould gel-coating. The research we have undertaken aims to keep composites manufacturing within the EU, rather than exporting difficult manufacturing processes to less regulated

countries, with subsequent benefits for employment within European nations."

InGeCt was a two-year research collaboration, whose main aim is to develop an innovative environmentally friendly gel-coating technology for composites for marine and wind-turbine applications to reduce VOC emissions, processing time and cost.

Provided by University of Plymouth