Portable exhaust toxicity system: A concept of a portable air-liquid interface cell exposure system for laboratory and on-road assessment of exhaust toxicity

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Due to discrepancies between legislative metrics for and health effects of particulate matter, and between laboratory tests and real driving, health-relevant metric applicable to real driving conditions are being sought to evaluate the effects of emerging legislation, technologies and fuels. Models of human lung air-liquid interface have been recently explored to simulate effects of exposure to the whole exhaust. In this study, a compact exposure system, utilizing commercially available inserts with 3D in-vitro model of human lung cells, has been designed and fabricated in-house with the vision of mobile use, minimizing size and power consumption. Preliminary tests were done on a Euro 6 direct injection spark ignition engine operating at speeds and throttle positions corresponding to the WLTC cycle. A sample of diluted exhaust was taken from two systems offering dynamic variation of dilution ratio to account for variable exhaust flow: a proportional sampling gravimetric system and from a rotating disc diluter. The highest particle losses – around 40 % - were in a membrane humidifier, a part of the effort to maintain incubator conditions of 37 C, 80-95 % relative humidity and around 5 % CO_2 at the cells. Two types of cell cultures have been exposed over a period of 5 days, with daily exposure consisting of two runs of WLTC, first with a cold start, active cooling of the engine for two hours, and two additional runs of WLTC, with acceptable rate of cell survival. The compact design and choice of components offers a promise for implementation during common laboratory tests and also on the road.