# Engineered Solutions – From Concept to Completion

## CONTROLLED EMISSION TOILET SYSTEM INSTALLATIONS FOR ROLLING STOCK

**Background**

Whilst all new trains introduced to service in the UK since the mid 1990s have been fitted with Controlled Emission Toilet (CET) systems, there are still a significant number of older rail vehicles fleets which retain 'ballast flush' installations. A number of these vehicle fleets will continue to be required for service for an extended period, with some withdrawals now projected for the mid 2020s.

'Ballast Flush' systems are a legacy of an outdated approach to the disposal of waste, which is increasingly unacceptable in the 21st Century. The issues surrounding the disposal of untreated human waste onto the railway infrastructure are numerous but include:

- Generation of biological hazard risks for vehicle maintenance staff and infrastructure workers
- Visual impact of waste, especially at stations leading to a public perception of the railways as being antiquated and dirty
- Wider environmental impact of paper and other materials being left to decompose in an uncontrolled manner

Whilst the widespread introduction of CET on trains has greatly reduced the amount of waste being disposed of onto the infrastructure, it has also led to some unexpected consequences. Amongst these is the expectation amongst passengers that they should be able to use on board toilets at any stage during their journeys, not just whilst moving and a reduction in the familiarity of infrastructure workers to the potential hazards of working around 'ballast flush' equipped rolling stock. As a result there is still a problem with the use of 'ballast flush' toilets in stations and a significant number of incidents of infrastructure workers being contaminated with waste whilst at work.

In addition to the issues listed above, there are a number of other undesirable aspects to the toilets fitted to the older generation rolling stock fleets. The principal amongst these is that the toilets require large volumes of water to flush, often 10-13 litres per flush, which is wasteful in a number of ways. For instance a typical toilet water tank contains as much as 450 litres of water and will be replenished every 2-3 days. This represents a volume of water which in general comes from mains water supplies and has thus been filtered and treated to the standards required for drinking water. In addition this large volume of water represents a mass within the vehicles which needs to be accelerated and decelerated by the locomotive during every journey. Whilst the energy waste per installation is small, over the course of a working week for a typical train, this quickly becomes significant.

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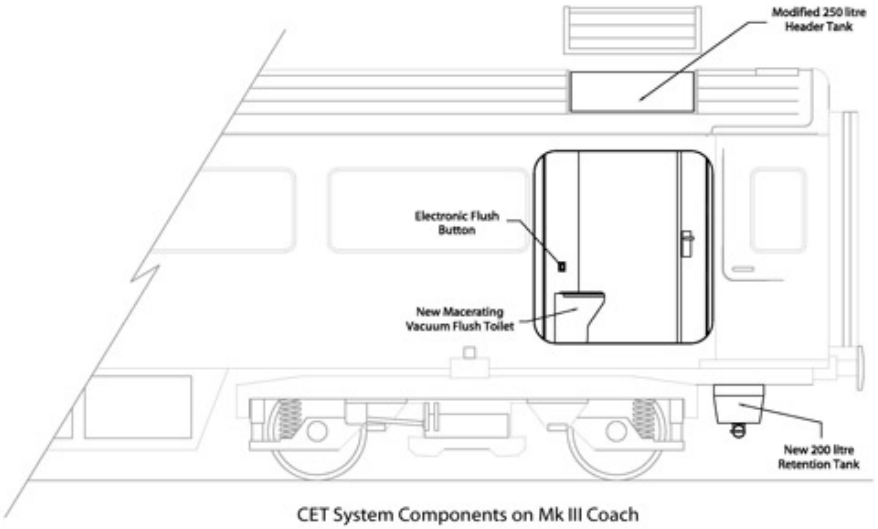
## Solution

Working in partnership with rail vehicle specialists Smart Rail Services Limited and initially focussing on the Mk III coach as used in High Speed Train and locomotive hauled sets, Flowonics has designed a CET system that can be quickly and simply installed on these vehicles. Detailed engineering feasibility, evaluation of system requirements and examination of vehicles has been carried out from which a CET system has been designed for this application. The system design has been incorporated into a detailed vehicle modification procedure, which has been reviewed against the requirements of applicable Mandatory Standards.

The system briefly comprises:

- Removal of existing toilet pan, discharge chute and flush mechanism
- Installation of new macerating, vacuum flush toilet of a type already proven in rail applications and pipework connections to the retention tank
- Installation of electronic flush button and fascia panel
- Connection to existing vehicle air, water and electrical power supplies
- Installation of a new retention tank and discharge pipework on the vehicle underframe




CET System Components on Mk III Coach

Connection of the new installation to existing water, air and electricity can all be made locally on the vehicles and the requirements of the CET system are well within the capabilities of the existing vehicle supplies. The retention tank has been designed to be of sufficient size to allow emptying to be carried out on the same 2-3 day cycle as is used for existing CET equipped vehicles. Discharge pipework to enable the emptying of the system is located near the vehicle ends, in accordance with the industry convention to enable vehicles to be handled by current emptying facilities. All new equipment to be fitted on the underframe has been designed to ensure that access to other equipment for inspection and maintenance is not hampered. New pipework required for the CET system has been designed based upon significant experience of similar systems fitted on existing vehicles, ensuring that known failure mechanisms are taken into account.

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## Benefits

The benefits arising from the installation of CET systems in place of current 'ballast flush' toilets are significant and include both perceptional and practical elements. Benefits accrue to both vehicle owners/operators and the wider rail network, its managers and maintainers.

For owners/operators the installation of a CET system makes the toilets on modified vehicles appear 'modern' and provides passengers with a consistent experience across a wider range of rail vehicle types. The removal of the 'ballast flush' toilet eliminates the source of human waste contamination of the vehicle underframe and underframe mounted components. This dramatically reduces the potential hazards for vehicle maintenance workers arising from exposure to human waste on underframe components.

Additional benefits are generated by the significant reduction in water capacity that is required by CET installations. Using the Mk III vehicle as an example, each standard coach currently carries tanks capable of holding 100 Gallons (450 litres) at each end, each of which could be reduced to 225litres for a CET system without adverse impact on the frequency of refilling. When factoring in the 'dry weight' of the retention tank this equates to a potential reduction of nearly 0.5Tonne (approximately 1-1.5%) in the overall weight of the vehicle. Whilst only a small reduction in regards to the total weight of each vehicle but given an average annual mileage of 250,000 km this represents a reduction of 125,000 Tonne kilometres per year per vehicle.

Benefits for infrastructure owners/managers/maintainers accrue from the elimination of another of the sources of hazardous waste on the network. This will reduce the requirements for cleaning of ballast in publicly visible areas, such as at stations and major termini and a dramatic reduction in the requirement for the traps/waste mats often used to simplify collection/removal of toilet waste at stations.

Finally benefits to the industry as a whole will be generated from the improved perception of the public that a cleaner network will generate.

For further information regarding this and other Engineered Solutions from Flowonics, please contact:


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