Food Particle Transport through a Sewer Network

Stream

The Industrial Doctorate Centre for the Water Sector

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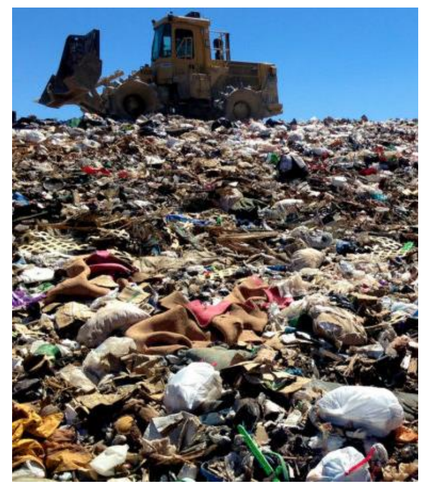
What's the Problem?

Food waste and how to deal with it is an issue across the globe. In the UK, and over Europe, there is little research and no consensus[1] with regard to the use of Food Waste Disposers (FWDs) as an alternative method of dealing with food waste. FWDs are domestic under-sink units that grind food into small particles that then enter the sewers. Food Waste has significant environmental impact so cannot be ignored and the use of FWDs as a solution must be examined.

Environment

- Diverting food waste to landfill has a high carbon footprint
- Methane has a much greater effect upon Global Warming than CO_2
- Alternatives to landfill include curbside collection: however, this still incurs transport emissions and additional costs



Sewers & Waste Water Treatment Plants (WWTPs)

- It is essential to determine whether food wastes will cause issues, such as blockages which can be costly to Utilities
- Unknown what the effect of food waste is upon the assets at the WWTP
- No UK research to predict how much energy could be generated via Anaerobic Digestion(AD) where FWDs are installed

Data Already Collected

Particle size distribution[2]
Settling velocities of each particle size[2]
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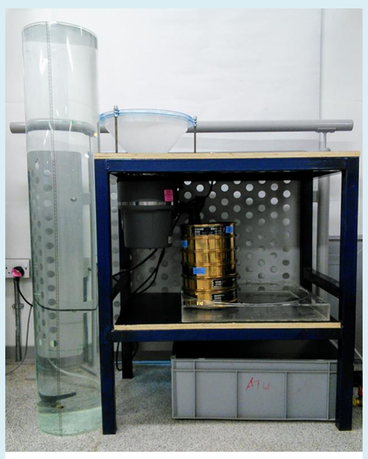
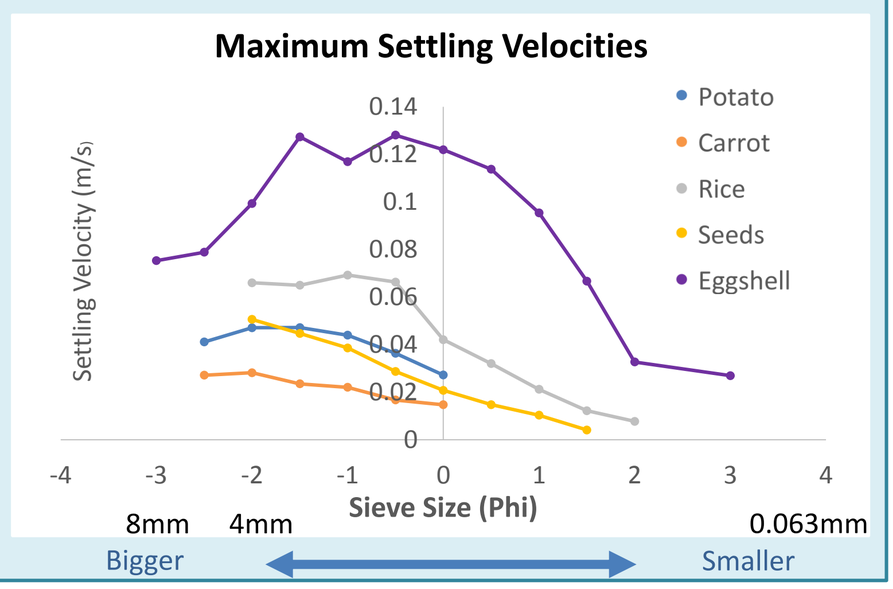
*Field flow data which has been used to **calibrate** an InfoWorks model of the Field Site*



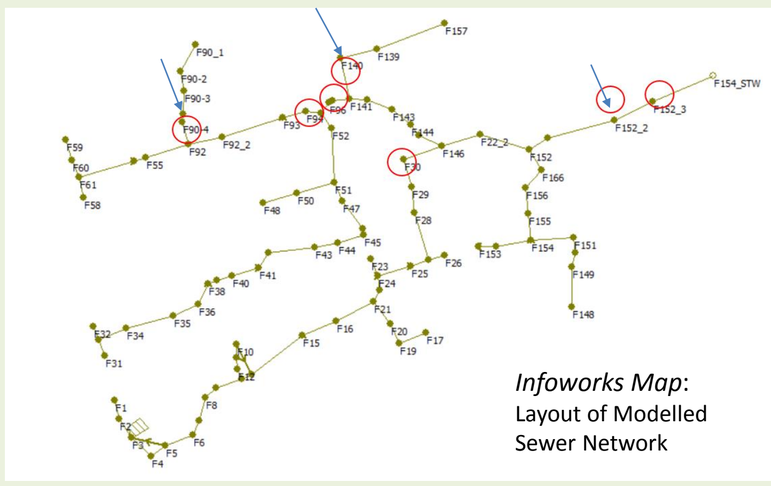
Settling Column and Sieves used in the Grind Trials

Grind Trials[2]

Particle size distributions tend to have a normal distribution with a peak around the -1.5phi sieve, however there is variability between foods. For maximum settling velocities, the general trend is the larger the particle size, the greater the settling velocity, with variability in the higher particle sizes due to their non-spherical nature. Eggshell's average settling velocity is closer to a medium sand, whereas the remaining samples' settling velocities are closer to that of a fine sand.



The **field site** comprises of two roughly equal halves, an older control area with no FWDs and a new development with FWDs installed and a separate sewer system.



Infoworks Map: Layout of Modelled Sewer Network

Locations of the sensors within the network are noted by a circle on the Infoworks map. Only the part of the network with FWD's was modelled and all flows entering from the other part of the network are labelled with an arrow.

Modelling of Food Particle Transport in Sewers

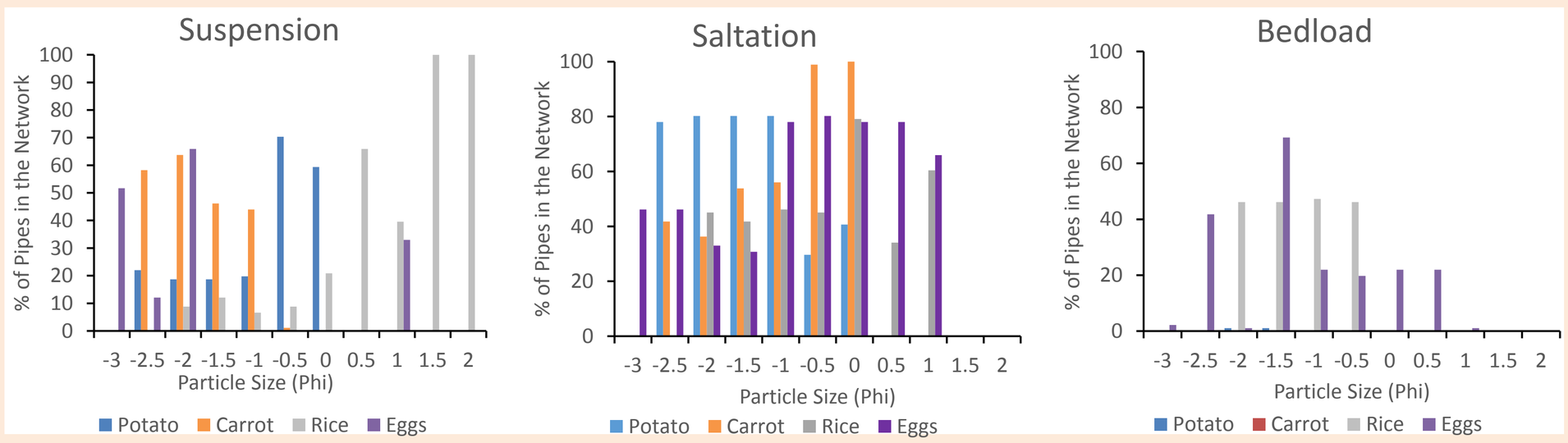
Field data was used to generate a 24h profile of dry weather flow (DWF) conditions in the network. It can be calculated whether a particle will settle or remain in bedload, saltation or suspension using the fall velocity of the particle (w) and the shear velocity in the pipe (u*). No settling particles were identified.

Suspension: in the main body of the water

Saltation: thin layer between suspension and bedload where particles "skip" along the pipe

Bed Load: the slower material that rolls along the surface of the pipe

Settled: not moving with the flow, stationary on the pipe surface



Summary

This model suggests that of the foods tested so far, there will be no settling of particles in the pipes at the field site during DWF.
This means that all of the material would be transported to the WWTP.
Using this methodology it is possible to assess the risk associated with FWDs for any given network and for any diet.

Next Steps

As FWDs create an increased load for a WWTPs it is necessary to quantify this impact. It will be possible to estimate the degradation of food particles through a sewer network and thus estimate of how much FWDs may boost AD at WWTPs and quantify any financial benefit.

References

1 CIWEM have a positive outlook on FWD use, whereas Water UK are very negative
CIWEM, [Accessed September 2016] *Policy Position Statement: Food Waste Disposers*. Available at: http://ciwem.org/wp-content/uploads/2016/04/Food-waste-disposers.pdf
Water UK, 2017. *Sewer Misuse: Macerators*. Available at: http://www.water.org.uk/policy/environment/waste-and-wastewater/sewer-misuse/macerators

2 Legge, A., Jensen, H., Ashley, R., Tait, S. & Nichols, A. 2017. Characterisation of particles from food waste disposers and their expected behaviour in sewers. Proceedings of 14th IWA/IAHR International Conference onUrban Drainage (ICUD), Prague, Czech Republic, 10-15 September 2017.

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