Uncovering Value Within the UK's Drains & Sewers

Fats, Oils and Grease (FOG) - An Untapped Resource for the Future?

Sophie Mason, August 2023

Across the UK, anger surrounding the state of our rivers and beaches continues to grow amid recurring reports of hazardous sewage spilling into our waterways at near unprecedented rates. It comes as over 384,000 discharges of both treated sewage and untreated sewage overflows were recorded in England and Wales throughout 2022.[1] A problem caused primarily by a lack of system maintenance and chronic underinvestment in the nation's sewage network. In real terms, spending on wastewater infrastructure has fallen from an average of £3 billion in the 1990s to roughly £2.7 billion today, despite a population increase of 16% over the past two decades.[2] The result is a sewerage system that is frequently overwhelmed causing raw effluent to be routinely discharged through sewer overflow pipes (pipes that were originally designed to be used during periods of heavy rain only).

The root cause of sewage spills can be attributed to a number of critical factors, including, a lack of sufficient capacity across the network, infrastructure damage and system failure, heavy or continued rainfall, and blockages within sewers and drains. It is believed that blockages account for around 80% of all sewer flooding incidents in the UK each year, resulting in the flooding of over 5,000 properties annually.[3] Furthermore, approximately 370,000 sewer blockages are reported every year in the UK, and up to 75% of these are understood to be directly caused by substances collectively referred to as **"fat, oil, and grease"**, otherwise known as **FOG**.[4]

What is FOG?

FOG is a common by-product of food processing sites, restaurants, and domestic properties. It is commonly disposed of *via* sinks and drains, and once discarded it is considered a waste. However, in the UK, it is illegal to pour large quantities of this material down drains without proper measures in place (e.g., grease traps) to capture and remove it from wastewaters. Despite this, considerable amounts of FOG-based residues are still known to make their way into the UK's sewers *via* the washing of crockery, cooking utensils, and food preparation equipment for example. If left to accumulate, this waste can cause blockages in drains and sewers to the extent that sanitary sewer overflows, property flooding, and the contamination of water bodies with sewage becomes a growing risk.

Perhaps the most widely reported of all FOG-related blockages in the media are those caused by "fatbergs" – large masses of solid waste, consisting of congealed fat, oil, and grease, combined with incorrectly flushed personal hygiene items (e.g., non-flushable wet wipes, cotton buds, sanitary towels, and even nappies) (Figure 1). In 2017, a giant 250-meter-long fatberg (thought to be the largest discovered in the UK to date) was cleared from the sewers of London – it was found to weigh a

1) The rivers trust, https://theriverstrust.org/sewage-map [accessed August 2023].

2) Financial Times, https://www.ft.com/content/e298ca8d-ab02-4e1a-bae1-452004905cc6 [accessed August 2023].

3) Thames Water, https://www.thameswater.co.uk/help/emergencies/sewer-flooding/sewer-flooding-prevention [accessed August 2023].

4) Lanes for Drains, https://www.lanesfordrains.co.uk/commercial/help-advice/using-drains-and-sewers/disposing-of-fat/ [accessed August 2023].

staggering 130 tonnes. The cost of reactively dealing with fatbergs like this in the UK is believed to be in the region of £100 million per annum.[5]

Fatbergs are a nuisance, but ultimately their generation is avoidable. They form as a result of careless human activity, through the flushing of non-biodegradable items down toilets and the disposal of FOG down sinks. However, by preventing these items from entering sewers and properly dealing with waste materials in general, the issues and costs associated with fatberg formation can largely be avoided.

Figure 1: A 10 tonne fatberg discovered in a London sewer in 2020 *(BBC, 2020)*

In commercial food premises and industrial sites that commonly generate FOG, it is a necessary and legal requirement for businesses to install grease traps or grease recovery units (GRU) in order to capture and remove this residue from wastewaters. Isolated FOG must then be stored in designated, sealable containers, and collected by an Environment Agency registered waste handling company with the required documents to deal with FOG. Once stabilized, this waste is generally sent to landfill, but higher value outlets are now becoming more common (such as for use as an AD feedstock for the production of bioenergy, and used as a starting material for the generation of biofuels).

In domestic properties however, less stringent rules generally apply as FOG is produced in much smaller quantities than in commercial food premises. Grease traps and GRUs are therefore, not a legal requirement, and so it is advised that dishes should be wiped prior to washing, to ensure that any residual FOG is not discarded down the drain. Furthermore, it is also recommended that excess cooking oils, fatty food deposits, and plate scrapings etc. be disposed of in general waste bins, or where possible, in food waste recycling. Where large amounts of FOG are generated domestically (e.g., the contents of deep-fat fryers), many councils advise that waste is poured into sealable containers and disposed of via general waste bins or taken to local recycling centres.

Disposal is the most common means of managing FOG waste at present (both domestically and commercially) – it is rarely diverted to higher value applications. However, there is huge potential associated with managing FOG in a more sustainable way i.e., through energy recovery (e.g., anaerobic digestion and biodiesel production) and recycling (e.g., product/chemical generation). It is an energy dense and carbon rich resource, which makes it an ideal feedstock for the production of energy, fuel and a range of possible biobased products. The valorisation of this waste material promotes the recycling of carbon, reduces the need for fossil-derived feedstocks, and contributes overall to the wider circular economy.

Characteristics of FOG

In general, FOG is made up of lipid rich compounds e.g., free fatty acids (FFAs), triacylglycerols (TAGs), esters, waxes, phospholipids, sterols and sterol esters. However, the exact composition of FOG can vary considerably depending on the source of the material i.e., whether it is a cooking oil, grease trap waste, mill effluent, rendering fat, soapstock, or sewage sludge for example.

The two most prominent types of FOG are known more generally as **yellow grease** and **brown grease**. Yellow grease typically refers to used cooking oils (UCO) recovered from businesses/industries that use

5) ITV, https://www.itv.com/news/2021-06-30/what-can-be-done-to-stop-sink-blockages-and-fatbergs-from-forming [accessed August 2023].

oil in large quantities for cooking. Brown grease on the other hand refers to the wastes recovered from grease traps and other grease recovery systems in commercial/industrial kitchens. Yellow grease is largely homogenous and can be cleaned up relatively easily for reuse/recycling in applications downstream (e.g., biodiesel production). However, brown grease is much less consistent, made up of a complex mixture of residual FOG, suspended rotten solids, and wastewater. It has a much higher content of contaminants and water than yellow grease, and as such, the majority of grease trap waste (GTW) is sent to landfill as it is generally more difficult to clean up and deal with. Despite the challenges surrounding the valorisation of brown grease/GTW, if it is pretreated and processed effectively then there remains a huge opportunity to make better use of the valuable compounds contained within this material.

Potential Applications of FOG

In Europe, it is estimated that the economic value associated with the biochemical products recoverable from FOG is in the region of approximately €100 million. However, at present FOG is rarely diverted to higher value applications, meaning that most of this value is largely lost to landfill or discarded to the sewer network due to a lack of cost-effective utilisation routes.

Key areas where FOG has the potential to be used in the future include in **biofuels**, **bioenergy** and **biobased chemical** applications. At present, yellow grease (i.e., UCO) is already used in vast quantities in the production of biodiesel due to the homogenous nature of this material and the relative ease in which it can be used. UCO can also be used in the production of sustainable aviation fuels (SAF), however, at present, its use is primarily reserved for on-road biofuel production in the EU. Brown grease (i.e., GTW) on the other hand, is not widely used in biofuel applications due to issues of contamination and non-homogeneity, but research is currently underway to develop more efficient methods of pretreating GTW so that it can be used in applications such as this in the future.

Other possible applications of FOG are as a feedstock for anaerobic digestion (AD), and as a starting material for the synthesis of biobased chemicals downstream (e.g., polyhydroxyalkanoates (PHAs) and bioderived surfactants). The use of FOG presents an opportunity to replace less sustainable fossil-derived feedstocks in applications such as these. However, a considerable amount of dedicated research is still required in order to drive the commercial development of these product opportunities going forward.

Contact Us

For more information on the possible applications of FOG and the market opportunities available to this readily available waste, contact NNFCC for further insight into the potential of this relatively untapped biobased resource.

NNFCC

Biocentre, York Science Park, Innovation Way, Heslington, York, YO10 5NY

Phone: +44 (0)1940 217182 **Email**: enquiries@nnfcc.co.uk

www.nnfcc.co.uk