

FATBERGS

LWI DELUGES

Fatbergs are a nuisance and, quite frankly, disgusting. How can we find the root of the problem and solve it?

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GETTY IMAGES, THAMES WATER, DEEP TREKKER, DREAMSTIME

Every day beneath the streets of London, sewer cleaners are fighting a grim war against giant 'fatbergs' clogging the system

WE BARELY GIVE a second thought to the greasy monsters that lurk in sewers beneath our streets, growing larger every day. We might even feed them without realising it.

This might sound like the plot of a cheesy Hollywood film, but it's the strange reality of a growing waste problem in the 21st century – and engineers, not film stars, are the heroes fighting back with new inventions to vanquish the fatberg monsters.

Fatbergs are rock-like heaps of waste that build up in sewer systems thanks to the unsavoury and lazy habits of humans. Cooking fat and oils poured down sinks congeal in the sewers, forming a thick layer around pipes. This fatty build-up stops sewage from flowing freely, which can cause it to back up. But it's the addition of non-biodegradable solids such as wet wipes and nappies that, when mixed with the fat, create hard fatbergs capable of growing to the size of buses and completely blocking sewage systems. In short, it's one disgusting recipe for disaster.

Financially draining

In a recent survey by Thames Water, the UK's largest water and wastewater services company, one in eight people said they have flushed nappies down toilets, one in four flush tampons and three in 10 flush wet wipes without considering the consequences, which include mammoth fatbergs. Wet wipes are a particularly large scourge of the sewers, making up approximately 93 per cent of the material causing the 300,000 sewer blockages experienced every year, according to a 2017 study carried out by Water UK. This harmful habit costs UK water companies around £100m per year in maintaining and unblocking sewage systems – money that quite literally goes down the drain.

A huge amount of money is also being spent on enlarging our sewer systems. The UK and other countries are building bigger, better sewers to accommodate more waste from growing populations.

Work is well under way on the Thames Tideway Tunnel, which has been dubbed the 'super sewer' and is the biggest upgrade to London's Victorian sewer network since it was designed by civil engineer Joseph Bazalgette around 150 years ago. At that time, the population of London stood at around four million. That number has now more than doubled to nearly nine million, and the fact that the old sewers act as a drainage system for rainwater as well as carrying away all the dirty water from the capital's homes and workplaces means it is overwhelmed. A total of 20 million tonnes of raw sewage ends up being dumped into the tidal section of the Thames every year, which lowers oxygen levels, suffocating fish – an environmental scandal.

The major upgrade promises to change this by dramatically reducing the amount of waste dumped into the Thames. The 16-mile (25km) tunnel has now been constructed and will be the equivalent of a motorway for sewage and excess surface water run-off when it is finished in 2025. But boosting capacity alone won't solve the problem of >



Thames Water removed 140 tonnes of fatbergs from the drains of Greenwich, Pall Mall and the Shard in London in 2019



KNOWLEDGE

FASCINATING AND FETID FATBERG FACTS

- 'Fatberg' is a compound of the words 'fat' and 'iceberg'. It was added to oxforddictionaries.com in 2015, alongside 'manspreading', 'hangry' and 'Brexit'.
- The Romans moaned about clogged pipes, apparently sending slaves underground to clean their sewers, but fatbergs are a modern creation, due to the amount of non-biodegradable rubbish people flush down their toilets.
- A chemical reaction called 'saponification', which occurs in sewers, is the same process that our ancestors would have used to make soap, according to Vyki Sparkes, a curator at the Museum of London. They would have heated up animal fat then mixed it with ash to create a soapy substance, but the same chemical reaction occurs in pipes when dumped cooking oil produces free radicals, which then bond with grit from the streets.
- In 2017, engineers cleared a giant 250m-long fatberg in Whitechapel. It's thought to be the largest discovered in the UK to date, and weighed a staggering 130 tonnes.
- Unsurprisingly, fatbergs don't smell great. A fatberg found in Sidmouth, Devon, was described as having "a heady combination of rotting meat mixed with the odour of an unclean toilet", while others say they resemble the stench of vomit.
- Handled incorrectly, even small amounts of fatberg can kill. This is because there are a number of diseases that can lurk inside sewage. They may also conceal needles or other sharps, and flies can hatch from them.

'Any technology that can reduce the number or duration of sewer entries would be gratefully received'
Thames Water

< waste build-up in pipes, and water companies are racing to destroy fatbergs.

Currently, vanquishing the monsters is a hands-on job. Water and suction are still commonly used to clear blockages in smaller sewers. The hard lumps of fats and matted non-biodegradable materials are known in the water industry as 'rags', which can grow to the size of a double-decker bus or weigh as much as three elephants.

However, due to the complexity of the trunk sewer network and the rock-like hardness of giant fatbergs, these so-called concrete-bergs must be dug out by humans, according to a Thames Water spokesperson. "This requires a team of engineers to make an entry into the sewer, often walking many metres underground to locate and work on the problem at hand."

Call in the drones

More high-tech solutions from drones to swimming robots are also employed around the world to keep ageing sewer networks operational for another century.

For example, Flyability's durable Elios 2 drones are used to collect visual data inside sewer pipes. The Swiss company, which

makes collision-tolerant drones that can be flown without direct line of sight, has partnered with wastewater inspection software provider WinCan. Patrick Thévoz, founder and CEO of Flyability, says the partnership offers an all-in-one solution to inspect, analyse, store, and share their data in a standards-compliant way. Using drones to collect visual data including points of interest photos, the software can be used to obtain automatic calculations of observation distances and upload data to the cloud so engineers can collaborate with colleagues. "The added value is huge in terms of cost and time savings, as well as in terms of safety, since inspectors can collect visual data remotely instead of in person," he adds.

Similarly, Deep Trekker's remote-controlled submersibles with wheels can be guided through sewers to inspect them. The rugged pipe crawlers have a cast aluminium and stainless-steel frame and are fitted with a camera. They can be steered through pipes with diameters from 15cm upwards, using a handheld console. The handy gadgets have been used by municipal service teams, including one from the City of Independence in Canada, to save money, as they need only pressure-clean pipes when necessary.

Artificial intelligence and computer vision are among the new weapons used to fight fatbergs. Sewer AI's AutoCode software harnesses AI to automatically detect conditions in sewer pipe inspection videos, which it says enables utilities and engineers to inspect more pipe for less money, while increasing the accuracy of their data.

In the future, it seems likely that robots and drones will do more of the legwork to monitor sewers and locate fatbergs. But there

Deep Trekker's CCTV pipe crawler could help inspect sewers



are exciting machines in the pipeline that could potentially destroy them too.

Battle of the beasts

GE Research's new autonomous Pipe-worm (Programmable Worm for Irregular Pipeline Exploration) was primarily designed for military applications, but the large, flexible 'worm' also has vast potential for a variety of innovative industrial pipeline monitoring, inspection, and repair jobs. It could even be used to demolish fatbergs.

The robot has been put through its paces and has successfully navigated twists and turns of more than 100m of pipe, managing changes in diameter and altitude. It's been shown to move through pipes without disrupting normal operations, and even against fast-flowing liquids. The technology is based on the company's original underminer robot called the Earthworm, which is capable of tunnelling through hard soil. It's the push and pull of the Pipe-worm's powerful artificial muscles, enabled by hydraulics, that make it perfect for heavy-duty jobs such as the cleaning of sewers.

"GE's Pipe-worm takes the concept of the plumber's drain snake to a whole new level," says Deepak Trivedi, a soft robotics expert at GE Research who led the development of Pipe-Worm. "This AI-enabled autonomous robot has the ability to inspect and potentially repair pipelines all on its own, breaking up the formation of solid waste masses like fatbergs." The design could be adapted to feature drills to cut through stubborn pieces of fatberg, GE says.

The team added cockroach-like whiskers to the Pipe-worm's body to give it greatly enhanced levels of perception, so it can make

OBJECTS STRANGEST SEWER FINDS



Wedding rings are sometimes found in sewers amid the effluent, as (predictably perhaps) are shoals of dead goldfish. More surprisingly, there are bullet casings and coins dating back to the reign of Queen Victoria.

In 2019, Thames Water engineers carrying out an inspection came across a deadly metre-long cobra that had slithered into Basingstoke Sewage Works. Such snakes are native to the South American tropics, sparking the theory this one was kept as a pet nearby and was either dumped or escaped. A heroic engineer picked up the snake (which was lethargic because of the cold), and put it in a bag, before the RSPCA completed the rescue.

Sewage works manager Kenny Masters says: "We see some weird and wonderful things thanks to some of the bizarre objects that end up in the sewers – but a metre-long cobra slithering across the footpath in front of us is definitely up there."

sharp turns or negotiate its way through dark, unknown portions of a pipeline network. These whiskers are incredibly sensitive at detecting even the slightest changes in the air and environment around them.

Working alongside the whiskers, artificial intelligence enables the worm to automatically identify turns and junctions, as well as map a pipe's diameter, orientation, and other characteristics in detail. It can then use this information to create a map of a pipeline network in real time.

GE is talking to a number of 'commercial entities' to evaluate the technology and intends to pilot Pipe-worm in the coming months.

Anything but a flash in the pan

While the idea of fleets of intelligent submersibles and drones monitoring waste, and helpful robo-worms battling fatty build-ups beneath our cities might sound fanciful, water companies are desperate for help to banish fatbergs.

Thames Water told *E&T* that human sewer entries are inherently dangerous and are only undertaken when no alternatives are available. "The best way to mitigate against accidents is to never make a manned entry and so any technology that can reduce the number or duration of entries, while performing the task at hand, would be gratefully received," its spokesperson says.

So far from being a far-fetched plot to rival the likes of *Godzilla*, sewers could become a new battleground of robots versus monsters. And, thanks to an alliance of hard-working humans and new technology, there is light at the end of the tunnel. ■