

Clearance of Biosolids Lagoons within an Environmental Protection Programme

Tim Evans has extensive experience of recycling wastewater biosolids from lagoons. In 1975, after researching soil chemistry in England and USA he joined Thames Water, the utility company that supplies drinking water and manages wastewater for a population of more than 12 million people in southern England, including London, to launch biosolids recycling within an environmental protection programme. Soil science was a great foundation because it comprises such a wide diversity of physical, chemical and biological elements all within a land use framework. The first programme (from 1976 to 1983) spanned two contracts and recycled more than 3 million cubic metres of biosolids from 8 major wastewater treatment works around London most of which used lagoons for biosolids storage and consolidation. Tim was asked by the company to return to biosolids management in 1988 for a major challenge, to clear Perry Oaks, which is destined to be the site of the fifth terminal for Heathrow Airport. A total of 4-million m³ of thickened biosolids have been cleared from the lagoons.

Perry Oaks was built in 1935 as a satellite to Mogden wastewater treatment works. Mogden treats the wastewater from a population equivalent of about 1.8 million people. It was a pioneer in developing the activated sludge secondary treatment process. Combined primary and secondary sludges are stabilised by mesophilic anaerobic digestion, which also creates methane-rich biogas that is burnt to generate electricity, though at Mogden it has also been used to run vehicles. The liquid digested sludge is pumped 11.5km to Perry Oaks for volume reduction and eventual recycling.

Volume reduction was designed to be by drying on underdrained sand beds. However the summers in England are not always conducive to drying and so earth-banked lagoons were constructed when the rate of drying could not keep pace with production. By the mid-1980s, when the drying beds were finally abandoned, only about 15% of the production was dried and the rest was lagoon consolidated. These lagoons ranged from 6m deep to 10m deep and from 50,000m³ to 500,000m³ capacity.

In 1935 Perry Oaks was in the middle of prime farmland that was growing fruit and vegetables for London. Farmers used to pay to collect biosolids to use on their fields. The fertility they created meant they could harvest 3 crops in 2 years. There was also a small private flying club at nearby Heathrow. During the Second World War this was developed and it has become the busiest international airport in the world. By 1988 BAA, which operates Heathrow, estimated that the four terminals would be unable to accommodate the increasing numbers of passengers. The government had already said that Perry Oaks and Heathrow were incompatible neighbours and so Thames Water agreed to clear the site so that when planning permission for the fifth terminal is agreed construction could start with the minimum of delay. Most of the lagoons were not "engineered structures" all had been dug to quarry the gravel and some were known to have uneven floors, but there were seldom "as constructed" drawings. We thought there were about 2½-million cubic metres of consolidated digested liquid biosolids at 10%DS in stock. At this concentration it is a non-Newtonian, thixotropic gel. Nobody in the company had experience of completely emptying this sort of lagoon. Every night another 3,500 m³ was pumped to the site from Mogden at about 2.2%DS and there was nowhere else for it to go. So maintaining an operational capability to receive digested liquid biosolids from Mogden throughout the clearance programme was essential.

BAA proposed a schedule to which they wanted the site cleared and Tim designed a programme of work by which it could be achieved. This included complete emptying of the lagoons and drying beds and using the biosolids as nutrient



Perry Oaks in the foreground (outlined in white) with the airport terminals in the background and the northern runway to the left

rich soil improver for farming and for land reclamation. He then wrote a re-measured contract based on the Institute of Civil Engineers 5th edition standard contract for the first phase of the work.

The 3-year contract was awarded by competitive tender and was completed on time and within budget. It was the model for succeeding contracts.

Four large dewatering centrifuges were commissioned in June 1994 to remove water from the incoming biosolids and make 'dewatered cake' at about 24%DS. This enabled clearance of the final lagoons and meant the start of a new phase of recycling i.e. reliably recycling about 3400m³ of cake per week, and deriving income from selling it. Charging for biosolids was a cultural step change for the company.

A total of 4-million cubic metres of thickened liquid biosolids were cleared from the lagoons and recycled to land. Operation of the site was transformed to mechanical dewatering, which occupied a smaller footprint, and income-generating sustainable recycling of 180,000m³ of dewatered cake per year. The project was completed to the agreed time-targets and budgets. The whole activity operated within an environmental monitoring system that received accreditation for its quality assurance programme in 1992. The site's operational capability was maintained throughout.