Kirkcaldy WwTW

£4.4m scheme to tackle odour issues in Fife town

by
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Kirkcaldy, one of the largest towns in Fife, lies on a shallow bay on the northern shore of the Firth of Forth and is the largest settlement between Dundee and Edinburgh with a population of around 50,000.

Peat bed concrete demolition

Courtesy of Scottish Water Solutions

Existing works/Background

The wastewater treatment works (WwTW) located on the Pathhead coastline, was originally a large pumping station and sea outfall. Due to the close proximity to nearby residents and the Fife coastal walkway, all plant processes were enclosed and a peat-biofilter for the control of potential nuisance odours was incorporated.

In 2001 the site was converted into a secondary treatment plant incorporating course and fine inlet screens, grit removal, primary sedimentation, lamella separators, BAFF treatment and sludge storage and dewatering. Following commissioning of the new wastewater treatment works in November 2001 local residents began to complain of malodours.

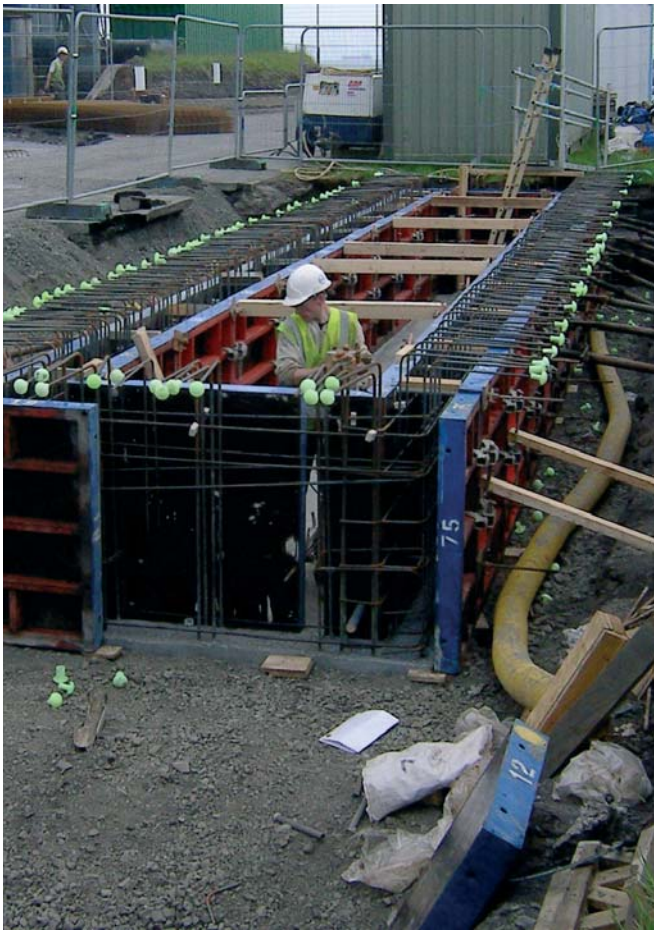
Since 2001, Scottish Water has made a number of improvements and additions to the site's odour abatement including incorporating a bioshell filter (for the treatment of odours from the lamellas) and four carbon filters to treat the BAFF and sludge treatment building ventilated air.

Scottish Water operational staff determined that the peat beds were responsible for a significant proportion of the odour complaints due

Kirkcaldy headworks

Courtesy of Scottish Water Solutions

Carbon Unit *Courtesy of Scottish Water Solutions*



Construction of the formwork for the MCC kiosk foundation *Courtesy of Scottish Water Solutions*

to peat media depletion. Peat media replacement is no longer viable as peat is considered a non-renewable resource - therefore a replacement abatement technology was required.

Scope of Project

Scottish Water Solutions (delivery partner to Scottish Water) was tasked with developing and implementing a scope that was capable of eliminating odours at the WwTW boundary.

The project team engaged the services an odour specialist to determine the extent of the problem. This involved extensive odour sampling and testing using GCMS (Gas Chromatograph Mass Spectroscopy), Olfactometry (air samples analysed by odour sensitive judging panels) and specific Draeger tube analysers (for chemicals such as H_2S, ammonia (NH_3) and mercaptans). As all of these techniques are based on 'grab samples' they only represent a specific point in time, meaning that odour levels during different times of the year may be unrepresentative of conditions at another time.

The next stage involved collating several years of meteorological data to determine what influence the prevailing wind has on odour dispersion in relation to the odour sensitive receptors. This data, in conjunction with local topography of the area allowed the creation of an Odour Dispersion model (a computer algorithm that predicts the dispersion of odour - measured in Odour Units - from a single or multiple point sources into the surrounding area). Once the model has been validated, it gives the designer a useful tool to predict the potential reduction of odour levels beyond the site boundary by simulating the effect of odour abatement equipment. It can also give an indication of the effects of parameter modifications such as stack height and stack position.

One of the major difficulties of determining odour levels at Kirkcaldy WwTW was due to the nature of the sewerage network. During

2-stage chemical scrubber system installed in Worthing, a similarly sized plant to that at Kirkcaldy *Courtesy of CSO Technik*

extended periods of little or no rainfall, sewage and solids tend to sit in some parts of the network until 'flushed' to the WwTW during a rainfall event. This means that sewage and corresponding odour levels can rise very sharply for short periods and remain low during dry weather. This was significant for two reasons: it meant correctly sizing the odour abatement plant was difficult and secondly that some odour abatement technologies (such as biofilters) were not suitable for this application as the microbiological mass internally needs a regular flow of nutrients.

In addition to the irregular peak odour loading and the fine operating threshold in the client's brief, the design team also had a limited footprint and planning restrictions within the existing site. Furthermore, the client would also not accept any existing odour abatement equipment being shut-down while the new equipment was installed.

Solution

The project team determined that a 2-stage chemical scrubber system with an activated carbon polishing unit was the best solution to meet all of the site specific considerations and the client's brief.

Due to the low H_2S and mercaptan levels within the headworks building (except during odour peaks), a stand-alone activated carbon polishing filter was designed as a 'first stage' to treat the headworks building and allow the demolition of the peat beds with little or no interruption to the site abatement. Both the stand-alone carbon unit and the chemical scrubber system were designed, supplied, installed and commissioned by CSO Technik Ltd.

The new 2-stage chemical scrubber consists of an alkaline hypochlorite scrubber followed by an alkaline scrubber and an activated carbon polishing unit to remove any residual volatile organic compounds not removed in the wet chemical scrubbing. Foul air is pulled from buildings throughout the WwTW and through the wet scrubber and carbon polishing filters by duty/standby extractor fans which ventilate to the atmosphere via a 12m high stack (to ensure efficient dispersion of the final treated air).

The first stage is an alkaline oxidation process using sodium hypochlorite and sodium hydroxide. Chemicals are dosed into the vessel and recirculated from a lower sump to maintain a pH of 9.5. This first stage removes up to 98% of H_2S and varying levels of other odorous sulphur compounds such as mercaptans. The second stage uses sodium hydroxide only and in addition to stripping out some odorous compounds, it serves to strip any residual chorine in the treated air that might otherwise lead to 'chemical odour' complaints.

The activated carbon stage acts as a polishing stage to remove any volatile organic compounds or mercaptans that may have passed through the first and second stages. Air is heated prior to passing through the carbon to dry the air and preserve the life of the carbon. During planned maintenance all foul air flows can bypass the chemical scrubbers and be treated through the carbon unit for short periods of time.

The replacement of the peat beds with the new carbon polishing filter was carried out in September 2008. Overseeing this operation (and the subsequent construction phase of the project) was Scottish Water's delivery partner Balfour Beatty Regional Civil Engineering (BBRCE). An almost immediate improvement in odour levels has been noticed by the residents since the replacement of the ageing peat beds. The demolition and disposal of the peat beds commenced in March 2009 and was successfully completed without any odour complaints - a considerable achievement given the odorous nature of the peat media.

Civil construction works were completed in July 2009. The new chemical scrubber vessels and chemical containment systems were delivered in July 2009 - at which point the mechanical and electrical installation phase commenced. The project commissioning is programmed for October/November 2009 - allowing a 28-day performance test to be complete before Christmas. The construction phase of the project is due for completion in December 2009. The total delivery cost is approximately £4.4m and the project is due for handover to the client in January 2010.

Note: ***The Editor & Publishers thank Michael Pratt, Project Manager with Scottish Water Solutions for providing the above article.***■