

Severn Trent's Sludge Destruction plants upgrade to meet waste incineration directive

by
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Severn Trent Water currently operates two fluidised bed sewage sludge incinerators at Coleshill and Roundhill. The Coleshill Incinerator comprises two streams, each designed to incinerate up to 20,000 tonnes dry solids per year (TDS/yr). Roundhill Incinerator is a single stream plant with a design throughput of 15,000 TDS/yr. Both were designed to meet the German 1990 BimSchV.17 standards and comply with many of the Waste Incineration Directive (WID) requirements. Severn Trent Water employed Earth Tech Engineering Ltd, initially, on a Consultancy basis to review the existing plants and determine the work needed to ensure that both plants comply with WID (2005). Numerous other improvements were identified to increase the throughput of the plants by improving efficiency and plant reliability. Additional measures were also identified to raise compliance with Health & Safety.



Coleshill Sewage Sludge Incinerator

Photo courtesy Earth Tech Ltd

Earth Tech was subsequently awarded the main contract in December 2004, following a successful competitive tender. The contract comprised some 30 or more specified activities across both plants, including improvements to sludge dewatering and drying systems, chemical dosing systems, new WID compliant flue gas monitoring systems, and, at Coleshill, the whole original Distributed Control System (DCS) has been replaced with an Alan Bradley PLC based system. The latter being undertaken during two shut downs, with 24 hour shifts to ensure downtime was minimised.

The works

The works was organised into five sections, comprising a WID compliance section at each site and three non-WID related sections for the rest of the improvements. The WID sections were completed to schedule with both plants operational by the December 2005 compliance date. Subsequent sections have been either completed on time or are to programme, with completion due in June 2006.

This article focuses on the WID compliance works.

Scrubber Effluent Treatment

To meet the requirements of Annex 1V of the Directive, a scrubber effluent treatment (SET) plant was installed at Coleshill in conjunction with specialist contractor ACWa.

The SET plant comprises the following stages:

- * transfer pumping station;
- * neutralisation tank where the pH is raised to 8.5 with sodium hydroxide;
- * chemical dosing with TMT15 (tri-mercapto-s-triazine) to precipitate heavy metals and ferric and polymer to aid coagulation and flocculation;
- * settlement tank;
- * sand filter;
- * acid neutralisation tank;
- * effluent sampling, pH, temperature and flow measurement;
- * sludge from the settlement tank is dewatered by a centrifuge.

The SET plant was commissioned in December 2004 and was producing effluent to comply with WID limits by the contract deadline of 30th November 2005.

At Roundhill, it was considered that improvements in metals removal from the flue gas, particularly mercury, would result in lower concentrations of metals than WID limits in the effluent generated from the final polishing scrubbing stage.

Flue Gas Treatment

Coleshill broadly met the requirements of the air emissions of WID, while improvements were necessary at Roundhill to meet the required mercury concentration. Improvements to the Continuous Emissions Monitoring Systems (CEMS) were also required at both sites, including a new reporting software package in accordance with WID requirements.

Coleshill

At Coleshill, deviations from the WID air emissions on mercury were minor. A major contribution to mercury levels in the feed sludge was from mercury recycled back to Minworth STW in the wastewater from gas cleaning at Coleshill. Installation of the treatment process detailed above has effectively broken this loop. To supplement mercury removal from the flue gas, TMT 15 is dosed into the second stage caustic scrubber.

Roundhill

Prior to the project, operation of the flue gas treatment plant at Roundhill was a challenge. The spray drier absorber (SDA) was designed to remove the majority of the sulphur dioxide load. The original control system included a loop to control sulphur dioxide (SO_2) to the lime scrubber, by regulating the flow of dilution water to the lime slurry. This caused frequent nozzle blockages due to shock precipitation of lime salt crystals. To reduce maintenance, this loop was disabled, resulting in a variable load to the scrubber and occasional spikes in emissions.

Further operational problems were experienced with the SDA temperature control loop. These manifested themselves as wide swings in exit temperature and resultant wet ash in the bottom of the SDA, which was difficult to remove.

The solution was, effectively, to change the function of the spray drier, so that it acted as a cooler and removed hydrogen fluoride (HF) and hydrogen chloride (HCl). This was achieved by reducing the lime slurry concentration from the design 20% to a nominal low percentage (up to 5%) and disabling the SO_2 dilution water control loop. The lime scrubber was replaced with a packed bed caustic scrubber, designed to remove the full load of acid gases from the incinerator. These changes were implemented by Earth Tech, with a scrubber designed and installed by ACWa Air.

To remove Mercury, Powdered Activated Carbon (PAC) was selected for injection directly into the SDA, where it begins to adsorb mercury. It is then collected in the fabric filter, between the SDA and scrubber.

A layer of lime and carbon builds up on the fabric and then filters out further mercury, before being removed when the filters are cleaned. This process was run on a trial basis to prove the effectiveness on mercury removal from the flue gas and the effect on the effluent from the scrubber.

Design was started on a SET plant for Roundhill to meet the WID timescales, but the PAC dosing trial demonstrated that PAC addition to the SDA reduced both air and liquid mercury emissions below WID limits and thus, the SET Plant at Roundhill was not necessary. The SDA operating and control modifications and caustic scrubber were commissioned in September 2005. The previous operational issues have been resolved and the performance is within WID Annex V limits.■

Note: Richard Horton is Project Manager, and Julie Jeavons, Technical Specialist, both with Earth Tech.



Roundhill incinerator

Photo courtesy Severn Trent Water