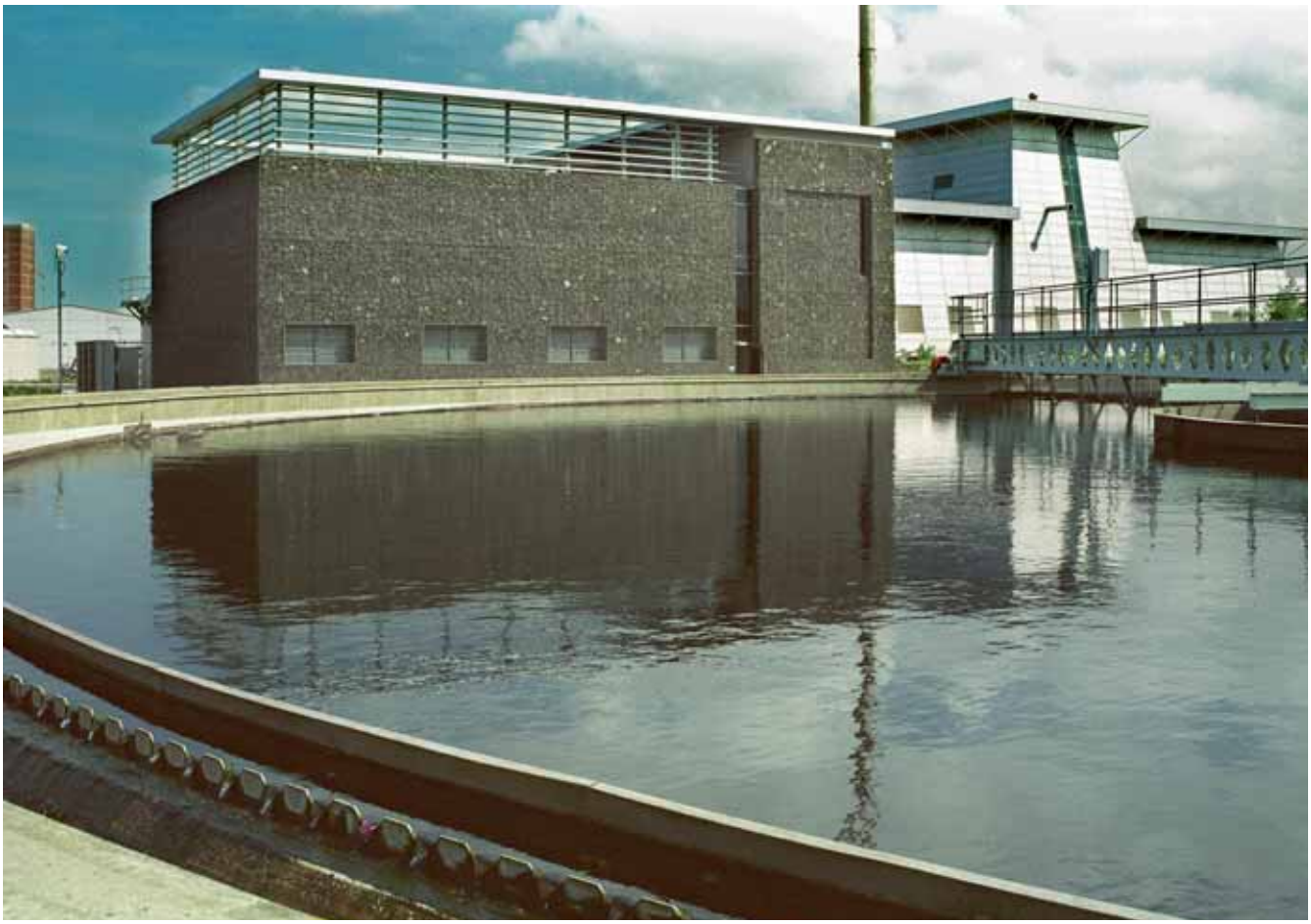
Belfast Wastewater Treatment Works
new scrubber effluent treatment plant

Sewage sludge at the Belfast, Northern Ireland Incinerator is burnt in a fluidised bed reactor that has two wet scrubbers in its gas cleaning system. The effluent from these scrubbers contains hydrochloric and sulphuric acids and a 'cocktail' of heavy metals. The mercury content in the effluent is well above the limits laid down by the WID for the effluent to be returned untreated to the WwTW. A new Scrubber Effluent Treatment Plant (SET) was, therefore, constructed to ensure that the scrubber effluent returned is compliant with the Waste Incineration Directive.



Belfast WwTW: New scrubber effluent treatment plant *Photo courtesy: Ferguson McIlveen :LLP*

Consulting Engineers Fergus McIlveen's brief for the design and construction of a plant, built within the grounds of the Belfast WwTW, covered both the modifications required to the incinerator's scrubbers and a new SET Plant.

The incinerator's scrubber system comprises both a quench and a packed scrubber. Final effluent from the WwTW was used to directly cool and clean the gases flowing through the quench scrubber; in the packed scrubber, the final effluent was used as a coolant in a heat exchanger to cool the circulating liquor. Excess liquor from the packed scrubber and the total flow through the Quench scrubber were piped to the WwTW. Considerable time and effort was put into developing a design that would be efficient and robust enough to meet potential stricter WID requirements in the future.

Only one site in UK

When Fergus & McIlveen was first approached to act as consultants for the SET plant, there was only one site within the UK with a SET plant operating. This was at Shell Green in Widnes. A visit was made to this site and valuable knowledge gained to assist in planning the design route that would be adopted for the Belfast plant.

It was recognised that the flow of effluent through the scrubbers at some 190m^3/h would be too high for the SETP to treat efficiently and the scrubber effluent would need to be concentrated before it was delivered to the SETP. This was achieved by changing the flow through the quench scrubber from a once through system to a circulating system, Cooling was achieved by reducing the temperature of the circulating liquor by passing it through a heat exchanger. The same quantity of WwTW final effluent was still used but instead of flowing through the quench scrubber, was now used as a coolant in the heat exchangers.

There is a considerable quantity of water in the gases as they enter the scrubbers (the sewage sludge cake enters the incinerator with a

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Photo courtesy: Ferguson McIlveen :LLP

moisture content of about 68% W/W). Most of this water condenses within the scrubber system. The excess water is bled off at a controlled rate and piped across to the SETP for processing.

The SET plant was designed to treat a scrubber effluent flow of 17m^3/hr; this flow allows for any future increase in the incinerator capacity. This flow is bled from the scrubber circulating water; it is corrosive having a temperature in excess of 25 degsC and a pH of approximately 2.0. A large buffer tank located outside the SETP building ensures that the effluent flow through the plant is maintained at a constant rate and uniform temperature. Additional cooling to the effluent is available from a bank of air blast coolers.

Treatment process

The treatment process comprises pH adjustment, dosing, coagulation, flocculation and settlement/clarification. The settled solids are removed from the process and dewatered in a plate press where a comparatively dry sludge is produced; this sludge is initially stored on site in big bags for later disposal to a landfill site specialising in hazardous waste.

The process is monitored from the incinerator control room; the plant responding automatically to maintain the parameters keyed into Programmable Logic Controller (PLC) by the plant operator. Flow rate, mercury concentration, temperature and pH levels in the cleaned effluent from the SETP are continuously monitored and recorded before being piped to the adjacent wastewater treatment works.

Sodium hydroxide (NaOH) is used to neutralise the pH level of the scrubber effluent piped to the SETP. The precipitation and removal of mercury and other heavy metals from the effluent is based upon dosing with the chemical compound TMT 15. TMT 15 is a 15% aqueous solution of Trimercapto-s-triazine, trisodium salt ($C_3N_3S_3Na_3$, CAS-Rn 17766-26-6).

Maintenance of plant and equipment within the building is assisted by a gantry crane. The inside of the building provides adequate room for the plant with space for future expansion.

The plant has undergone three performance tests, each of 21 days duration at different times of the year, with a further test planned for Spring/Summer 2006. The results to date indicate that it is performing well within spec and the outstanding mercury removal is notable.

The plant was designed and constructed to provide a flexible, versatile system and, as a result of this flexibility, DRD Water Service staff have been able to modify the dosing regime and process conditions to optimise performance and provide significant savings in operating costs. ■

Note: *The Editor & publishers wish to thank Fergus & McIlveen LLP, for preparing the above article.*