Tai Po Water Treatment Plant

innovative design to meet project requirements

by
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The Stage 1 Water Treatment Plant at Tai Po, with a project value of approximately HK$1.94 billion (equivalent to £130 million) was built to meet additional water treatment requirements for the Metropolitan Area and North Eastern New Territories in Hong Kong. The plant successfully completed a major part of performance period in July 2004. Stage 1 of the plant is for an output capacity of 250MLD with some process units built with an uprated output of 400MLD to cater for future expansion.

Tai Po: Site overview *courtesy: Aker Kvaerner*

Process route

The principal source of raw water is from China abstracted from the Dongjiang and impounded in Shenzhen Reservoir. It is pumped by Muk Wu 'B' Pumping Station and then Tai Po Tau 'D' Pumping station to the treatment works inlet chamber. The process route is as follows:

* works inlet;
* contact tank for dosing - powdered activated carbon (PAC) and suitable for conversion to a pre-ozone contact tank;
* dissolved air flotation (DAF) plant complete with associated flocculation;
* primary aerated biological filters (PABF);
* manganese reaction tank;
* secondary rapid gravity filters (SRGF) with associated flocculation for direct filtration;
* chlorine contact tank;
* final pH correction;

Secondary processes include:-

* washwater recovery system with associated recovered water return system;
* sludge conditioning and thickening;
* sludge dewatering;
* chemical dosing systems.

Options are available such that the above processes can be used in various combinations depending on the prevailing raw water quality.

Construction Team

Gammon Construction Limited was awarded the contract for procurement, construction, installation, commissioning and performance testing of the works by 'Water Supplies Department, Hong Kong. *Aker Kvaerner* was the sub-contractor responsible for all process, mechanical, electrical, instrumentation, control and automation aspects of the project. *Black & Veatch* acted as Engineer for the project and were responsible for Civil design of the Works.

Works output

The treatment works will ultimately be arranged in three streams which will be completed in four stages. Each stream will have a nominal output of 333Ml/d with the potential for uprating to 400Ml/d. The process units and structures for stream 1 constructed under stage 1 are suitable to be uprated, with the plant under stage one designed to meet a nominal output of 250Ml/d.

Tai Po WTW innovative design approach

The project involved construction within a very confined space on a hillside due to the land restrictions within Hong Kong. The process contractor had sought means of reducing the original specified clarification and filtration rates to ensure the tight water quality design requirements were met.

The DAF flocculation system is a centrally fed double-cell system with two-stage stacked flocculators. This allowed greater clarification area to be used within the available footprint. This flocculator arrangement underwent extensive scale modelling to determine flow patterns and how best to feed water into the stacked flocculators to obtain an even distribution and prevent short circuiting.

The filter plants involve *Aker Kvaerner* licensed technology that allows removal of washout channels, providing more filter space within a given footprint. The original design allowed for 10 x 150m^2 filters, use of the *Aker Kvaerner* design allowed this to be increased to 12 x150m^2 filters within the same footprint.

The *Aker Kvaerner* PABF system is a down-flow biological filter process designed for removal of ammonia. The initial design concept based on earlier pilot plant work included for in-filter aeration only. Pilot trials were carried out to determine their detailed distribution lateral system configuration as this would cater for both backwashing and process air distribution. As a result of those trials, the system incorporated a pre-aeration system involving air injection into a 10m deep rise pocket to promote oxygen saturation in the feed water before the filters and hence reduce the load and aeration rates of the in-filter aeration system.

The ability to provide more filtration area within the given footprint allowed the use of more conservative filtration and in-filter aeration rates than originally required by the client although those rates have been validated by earlier pilot trial work.

The *Aker Kvaerner SRGF* filter system incorporates a multi layer anthracite/sand media design to provide for the specified facility to run the plant in a direct filtration mode during periods of good water quality. Additional manganese coated media of similar grading as the sand is also included to promote manganese precipitation following addition of chlorine upstream and a minimum 30 minutes contact time.

The sludge treatment facility incorporates a zero discharge philosophy due to the absence of a main foul sewer discharge. This system returns settled washwater supernatant, thickened sludge supernatant and press filtrate supernatant. The press filtrate undergoes further treatment by pH adjustment, settlement, chlorination and filtration to remove excess turbidity, ammonia and dissolved metals before being combined with other supernatant discharges. All combined supernatants are returned to the main inlet.

Plant performance

Performance tests and tests during commissioning have demonstrated successful operation of the plant producing water of the required standard. ■

Note: *The author of this article Subasish Dutt, is Technical Manager, Aker Kvaerner.*