

FUTURE-PROOFING FUJAIRAH'S WASTEWATER SERVICES

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It has been two years since TANQIA – the first privately held wastewater collection and treatment utility in the UAE and Middle East – last spoke with Euroasia Industry. Since then, the pioneering utility has significantly expanded its network, connecting thousands more people and properties, while driving down the cost of its wastewater services via an array of innovative means. Ibrahim Elwan, Executive Chairman of the Board, reveals more regarding TANQIA's revised investment programme for ramping up capacity at its state-of-the-art plant, alongside its vital role in Wastewater Treatment Plant (WWTP) design and construction for the future.

Over the past 30 years, the underground water reserves of the United Arab Emirates have decreased and their salinity increased due to excessive pumping, and unless the depleted reserves are recharged with excess desalinated water, the UAE will become one of the top 10 most water-scarce countries in the world. At the current rate of underground water usage, the UAE will deplete its natural freshwater resources in about 50 years – without factoring in population, and commercial and industrial growth in the region. The

country currently has one of the highest per capita water consumption rates in the world – and while changing consumption habits is clearly half of the battle, optimising the water treatment system and improving the efficiencies and quality of treated wastewater both have a vital role to play in a comprehensive policy for management of the country's overall water resources.

Most importantly, the role of treated wastewater needs to be enhanced by improving its current quality standard to

the fourth stage, with a view to producing a suitable substitute for underground and desalinated water in non-potable uses, and even potable water, through micro- or ultra-filtration, ultra-violet treatment and, where necessary, by subsequent chlorination. Doing so would effectively reduce investment in desalination and contribute to better overall management of water resources.

TANQIA – which means 'purify' in Arabic – encapsulates in one word the mission of a company that has become a refer-



ence point in its area of the world – and beyond – for how efficiently and reliably wastewater systems can operate, even in challenging climatic conditions. The privately-owned wastewater treatment specialist was granted a 33-year concession in 2004 by the Government of Fujairah for the exclusive rights to design, finance, construct, own, operate and maintain, and expand the wastewater system for a concession area, encompassing the city of Fujairah, the towns of Qurayya and Mirbah, and the hamlets between them.

As of September 2016, TANQIA's wastewater collection network (WWCN) had reached 434km, connecting more than 6,500 properties (about 18,330 customers) and servicing a total population of approximately 100,800. TANQIA's achievements have not gone unnoticed, as evidenced by recent accolades that include 'Best Infrastructure Utility Service Provider in the UAE 2015', awarded by the Global

Banking & Finance Review, and 'Best Environment, Social and Governance (ESG) Utility Management Team in the Middle East for FY2016', bestowed upon the company at the Capital Finance International Awards this year.

Ensuring the lowest feasible tariff

Peak volume of wastewater collected and treated by TANQIA has increased at an average annual rate of 11.2 per cent over the past seven years, currently standing at about 21,100 cubic metres per day (m³/day). "This unprecedented growth in water consumption and generation of wastewater would have required capital investment to increase – by 2014 – the installed treatment capacity of the wastewater treatment plant," advises the company's Executive Chairman, Mr Elwan. "However, TANQIA has been constrained by the need to keep at all time tariffs for its wastewater services below the tariffs

for potable water." Mr Elwan remarks that the prospect of customers paying more for wastewater treatment than for potable water would, at any time, be viewed as "untenable in economic and social terms".

As a result, in order to maintain wastewater tariffs and the pricing of its effluent at pre-agreed fixed levels relative to the tariffs of potable water, increases in tariffs for wastewater services are made only in tandem with the increase in tariffs for potable water. In order to maintain this relative relationship, TANQIA decided to postpone expansion of the installed treatment capacity of its WWTP until the loan from Royal Bank of Scotland (RBS) – secured by TANQIA in 2005 under the guarantee of the Government of Germany to finance the greenfield wastewater collection and treatment system – is retired in mid-2017.

Mr Elwan elaborates on the thinking behind the move: "The objective of TANQIA's long-term least-cost strategy ➤

Dr Ibrahim I. Elwan,
Chairman



is to minimise the sum of the capital cost for new capacities or expansions, and the sum of both the O&M [operation & maintenance] costs of existing and new capacities. Fulfilment of this objective ensures the lowest feasible tariffs for wastewater services," he explains, going on to note that new trains of 8,000 m³/day will be added only when the capacity in place is fully utilised, including the planned reserve margins.

Ramping up capacity

TANQIA's revised investment program calls for the addition between 2017 and 2029 of four trains of 8,000 m³/day each. This will increase the current capacity of 16,000 m³/day to reach 48,000 m³/day. "The increases will be phased to ensure demand for services is met at least cost," Mr Elwan advises.

"Presently, doubling the installed treatment capacity of the WWTP is set for commercial operation in early 2021," the Chairman informs. This will be accomplished by completing the civil works for two trains each of 8,000 m³/day. The plan is for the electromechanical component for the first train to come into operation in the first quarter of 2018; and for the

electromechanical for the second train of 8,000/day by 2021, when the demand materialises. If the demand for wastewater services increases to the point where additional capacity is required, the installation of the electromechanical equipment would be advanced, and the reverse is true by postponing the installation. "Until then, TANQIA shall use the tank of the second train for short-term storage of effluent," Mr Elwan advises. "In the interim, TANQIA

shall continue to accommodate the daily peak flow of wastewater, when higher than the installed capacity, as the WWTP was actually designed with a 30-per-cent margin of safety." This balancing process requires an intensive maintenance program. It is also a balancing act that requires TANQIA to continuously be thinking years ahead in terms of boosting capacity, provided it is not to the detriment of the consumer in terms of higher

**Forecast Wastewater Generation and Accumulated
Installed Treatment Capacity**
m³/d



tariffs. Figure 1 displays the balance of historic and forecast influent generation and installed treatment capacity from 2008 through to 2032 (m3/day).

Monitoring progress

While TANQIA's operations demonstrate a fine balance, they are evidently informed by solid and regularly updated data, with numerous factors taken into consideration in terms of revising the forecast of wastewater generation, as Mr Elwan informs. "Those factors include major new water-intensive projects; population movements and growth; and government policy measures to promote conservation in water consumption."

Such factors are reviewed annually to determine the timing for each train coming online within each of the two expansions. "The timing for commercial operation of each train can be advanced or postponed depending on the growth of water consumption, and in turn, wastewater generation," TANQIA's Executive Chairman adds.

Efficient effluent distribution

At the time of Euroasia Industry's previous conversation with TANQIA two years ago, the design was for the Effluent Distribution Network (EDN) to provide an interconnected effluent network that would cover the main demand centres within the 92-square-kilometre concession area, and beyond. With the effluent pressure main connecting the plant to the city of Fujairah now in place, Mr Elwan describes the execution of the EDN as a project of two stages: "Stage One will receive the effluent at the gate of TANQIA's plant and deliver it via a new pipeline – yet to be constructed – that will take it across the northern segment of the concession area across Sharjah to the rural areas of Fujairah and around the towns of Bidya and Dhadna, where the bulk of Fujairah's demand for irrigation of farms can be found."

Strong demand exists for irrigation amongst the area's farming communities, with an estimated 3,879 farms covering 6,585 hectares (65,847,000 m²) of land. Effluent from the new distribution network is expected to satisfy part of the total demand for desalinated and ground water. Annually, it is estimated that TANQIA will provide 1.3 billion gallons of effluent, which will act as a substitute for the same volume of higher-value desalinated and underground water. The use of effluent for agriculture applications would rely





on experience worldwide – i.e., that of the World Health Organization (WHO) – alongside the UAE laws, and the experience of existing, well-established laws and proven practices on the types and methods of irrigations adopted at specified plants (i.e., those in the State of California, USA).

Since commencement of commercial operations, TANQIA has produced 10 billion (10,000,000,000) gallons of effluent, meeting the highest standards for application in industry and agriculture. In addition, TANQIA produced more than 8,800 tons of dry sludge, free of pathogens and odour, and suitable for direct application as a soil enhancer. Further demonstrating its sustainability credentials, the company's operations have generated 2.15 million cubic metres of biogas, used in the treatment of sludge, by maintaining digester temperature at 37°C.

"Then, Stage Two of the EDN would receive the effluent and proceed south to cover the rest of the Concession Area,

including the new Sheikh Mohamed Bin Zayed City (MBZ City)," he reports, adding that construction of the EDN will commence shortly, and that effluent delivered to MBZ City would be used for landscaping the roads and parks. TANQIA is now promoting the extension of the EDN to the planned new residential properties, especially single-family properties, for landscaping with specialised effluent meters. If approved and financed, it would be the first of its kind in the Emirate of Fujairah.

Impressive collection & connection

TANQIA's wastewater collection network has been expanded considerably over the years, with the company pursuing a "least cost expansion" strategy, according to the Executive Chairman: from the Greenfield System that moved into commercial operation in 2009 with a 309km wastewater collection network, to the current 434km on 30th September 2016 – connecting many new properties and providing waste-

water services to a larger number of customers (growing 3.2 per cent annually over the past 6.5 years, to reach 18,331 on 30th September 2016). Over the years, there has been strong growth, particularly in the number of multi-purpose and commercial properties connected in the concession area. As a result, there has been a favourable impact in terms of economies of scale on the cost of extending the network per connection. "The cost per customer connected has decreased in real prices compared to what it was under the Greenfield System, reflecting the increase in utilisation of the existing network and the rise over the years in the number of multi-purpose, large and special-purpose properties that have been connected."

On 30th September 2016, more than 100,000 persons in the concession area were connected to TANQIA's network, representing 83 per cent of the concession area's population. The rest of the population largely live in an area of the City of Fujairah designated for future demolition



and development of a new commercial city centre. Nevertheless, the lateral collection network is installed around the perimeter of the area pending completion of the development, ready for future connection of new commercial and multi-purpose properties. Until redevelopment, this segment of the population is still served by TANQIA, assures Mr Elwan: "Wastewater generated by properties not connected to the network is discharged in soakaway tanks evacuated by tanker trucks, and delivered to the plant for treatment."

Financing a nation's progress

"As per the Concession Agreement, all expansions following completion of the Greenfield System was financed from TANQIA's internally generated revenue," advises Mr Elwan. "Such revenue includes that generated from connection charges – a one-time payment by owners of new properties to receive services," he explains. "And since 1st February 2009, the total capital cost of extending the network has amounted to AED 85 million (over US\$23 million)."

Mr Elwan points out that the success of TANQIA as a PPP utility financed

under a BOT structure would not have been possible without its supportive partners. "The government of Fujairah provided strong support for TANQIA by assuming the sovereign risks, alongside its involvement as a shareholder in the company, with 19 per cent of the paid-in equity; and via Mubadala, the wholly-owned investment vehicle of the government of Abu Dhabi, with 30 per cent of the paid-in equity."

Financing of the Greenfield System was provided by RBS, and guaranteed by Euler Hermes of the government of Germany. "Execution of the Greenfield System would not have been possible without the concessionary terms of the length of loan maturity and low interest rate of less than one per cent; and not to mention the strength added to the transaction by the trust that Germany's government placed in the new utility," he continues. "In addition, the financing by the Abu Dhabi Fund for Development (ADFD) – procured by the government of Fujairah for the execution of the broadened scope of works on the Greenfield Field System – was instrumental in completing that larger scope of project."

Sustainable advancements

Renewable energy was previously cited as a viable means of reducing energy costs at TANQIA's WWTP. And, since last speaking with Euroasia Industry, the company has further explored such sustainable opportunities that could also provide cost-saving opportunities for the operation of the wastewater system. "The cost of solar and wind energies was investigated to determine the optimal means for improving energy efficiency within the wastewater system. TANQIA decided on solar energy for reducing consumption of petroleum generated power, and a major initiative is currently underway to change the technology utilised for Expansion I of the treatment capacity," Mr Elwan reveals.

Technology currently in operation at the plant relies on mammoth rotors to deliver the oxygen required for biological breakdown of the influent. Installed at the surface of the biological tanks, the mammoth rotors rotate to introduce oxygen required for the bio-degradation of solid matter in the influent. However, as they are located at the surface, they require extensive operation to deliver and distribute oxygen throughout the tanks, ▀



making them heavy power consumers. In order to reduce the energy efficiency of wastewater treatment, TANQIA has selected a treatment process that involves blowers delivering larger volumes of air throughout the biological tanks – providing a significant improvement of oxygen transfer to the influent, and in turn, reducing the amount of power consumed when compared with the mammoth rotors.

Another initiative is the installation of a 10MW solar power plant, which will serve as the primary source of power supply for TANQIA's facility and shift power from the grid to back-up sources. "Two offers have been received from reputable international firms for the design and installation of the solar power generation system at the plant site, with a view to commencing implementation starting in the second quarter of 2017," the Chairman reveals, adding that in the first quarter of 2017, work will also commence on replacing the conventionally-powered lighting with solar-powered solutions at the WWTP and 30 pumping stations, thus driving a significant reduction in overall power consumption from lighting.

Beyond TANQIA's core operations, the Chairman also previously spoke of how the company was exploring potential ventures in the wider MENA region.

Since then, TANQIA Environment – a fully-owned subsidiary of Elwan Group – has signed an agreement with a major Egyptian industrial enterprise to manufacture solar-powered auto-treatment plants that can be installed in trains to treat Nile water for human consumption in Egypt. "These would be operated by TANQIA for villages across the country, to provide badly-needed drinking water," Mr Elwan advises.

Advancing future WWTP designs

Notably, TANQIA's WWTP in Fujairah – designed according to 2008's German Design Standards and equipped by Germany's most reputable manufacturers – is currently playing a key role in developing technologies for the future advancement of wastewater treatment plant design around the world. In 2012, TANQIA was selected as one of the utility partners for the so-called EXPOVAL project – a €7.5 million German-government-funded project that was awarded to major German utility, Emscher Wassertechnik. The utility enlisted collaboration from seven German universities recognised as leaders in the field of wastewater treatment-related R&D, alongside highly specialised industrial partners (involved in water analytics and sensor technology, for instance), together with

international wastewater treatment utilities like TANQIA. The purpose was to develop new and extended design algorithms able to reflect actual treatment results at plants running under extreme climatic conditions. TANQIA's WWTP was selected for the technology transfer-oriented R&D project as it met all requirements – not only in terms of process design and equipment quality, but also in its team's ability to meet the scientific standards of the R&D work in terms of operation, maintenance, testing and overall quality assurance and control.

Towards supporting the validation of the German team's technology at an industrial-scale operation, TANQIA's WWTP has, since the end of 2014, provided mostly online influent and effluent data, and substantial additional process-design-relevant readings of multiple parameters. This, in turn, provided the necessary input for the process simulation program being developed in the Ruhr-University in Bochum, Germany. The new algorithm for municipal WWTP design was presented during EXPOVAL Project's closing conference on 6th October 2016 in Essen and will be incorporated into the current internationally accepted biological WWTP Design Standard 'A131' – highlighting TANQIA's important role in advancing future WWTP design. □