HyNet Hydrogen Production Plant 1 – Technical Note

EPR Response 14d - Specification of WWTP-Wastewater Buffer Storage

Summary

CWW BAT Conclusion 9: Provide a detailed description of the flexibility features and infrastructure serving the water treatment facilities, to ensure, in the case of off-spec effluent from the MBR, the stable operation of the hydrogen production plant (i.e. preventing the need for shut-downs and start-ups with the associated potential environmental impacts) and prevent uncontrolled emissions to water. Where appropriate, amend the design to include sufficient buffer storage capacity for off-spec waste water.

Background

The process configuration of the wastewater and raw water supply and treatment facilities is highly complex and integrated. The demineralisation plant will need to be consistently fed with good quality effluent from the biological treatment membrane bio-reactor to ensure it can reliably operate.

According to the description of the operating techniques provided in the Application Supporting Document, we understand that off-spec treated waste-water from the biological treatment may lead to the need for stopping production from the demineralisation plan and in turn shutting down the HPP. We refer to the description provided in table 3-18: 'Were the HPP to incur a serious outage such that the MBR could not process the recycled effluents to the necessary specification, the HPP would be shut down and the waste waters tankered off site for treatment. Within the HPP design there is no fixed facility for the transfer of dirty process waters to the refinery for treatment.'

As required by CWW BAT conclusion 9, we would expect the proposal to include appropriate buffer storage capacity for wastewater incurred during other than normal operating conditions along with ancillary equipment to enable recycling and reprocessing of any off-spec effluent, whilst operational continuity of the HPP can be sustained by the raw water supply.

Response

1. Sparing and Flexibility (Operation and Maintenance)

   The Wastewater Treatment Plant (WWTP) that will be provided in Phase-1 is sized to handle 100% flowrate from combined Phase 1 and Phase 2. With majority of Site civil works completed in Phase-1, this WWTP needs to handle drainage from larger area. Hence it will have capacity for combined Phase 1 and 2 flow rates.

   All pumps in wastewater treatment system are spared. They will be 1 working + 1 standby in Phase-1. They would operate as 3 working + 1 standby after installation of additional pumps in Phase-2. Small pumps are spared as 1 working + 1 standby for both Phase 1 and 2.

   The tanks are not spared. Large tanks whose maintenance cannot be competed in standard 30-day period will have space earmarked for additional tank to be constructed in future.

   The packaged equipment in WWTP shall have their own in-built redundancy philosophy to meet the specified availability criteria (Per Basis of Design Pre-FID Phase, 5194812-000-30EA-2-0001, Rev. 08).

   The MBR feeds the Clarified Water Tank (10-BAF-T-004). Water from this tank, after passing though Dual Media Filtration Plant (10-BAF-U-003), is stored in Filtered Water Tank (10-BAK-T-001). Water from here is then pumped to Water Demineralisation Plant (10-BAB-U-001). If MBR is down, feed to Water Demineralisation Plant will not stop.

   River Dee water is also pumped to Clarified Water Tank. Additionally, the buffer storage volumes in Clarified Water Tank and in Filtered Water Tank will ensure constant feed to the Water Demineralisation Plant.

2. Buffer Storage

Refer simplified representative sketch shown below of wastewater path to the Membrane Bioreactor-MBR:

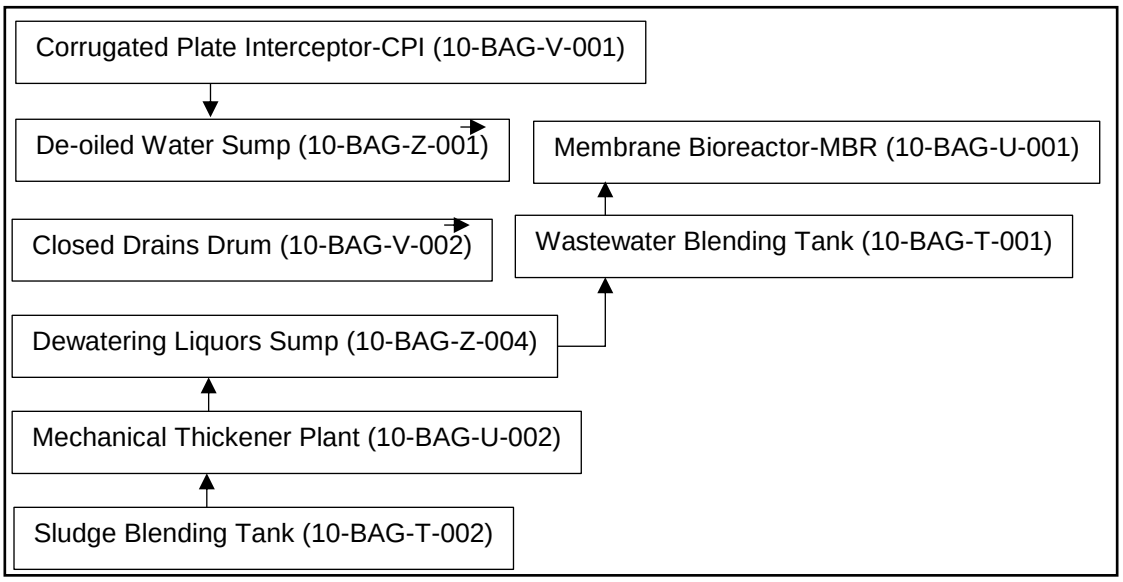

Figure 2-1: Wastewater path to MBR

There will be capacities available in following equipment that can be used as buffer storage for the wastewater:

1. Wastewater Blending Tank (10-BAG-T-001)
2. De-oiled Water Sump (10-BAG-Z-001)
3. Closed Drains Drum (10-BAG-V-002)
4. Dewatering Liquors Sump (10-BAG-Z-004)
5. Sludge Blending Tank (10-BAG-T-002)

Sections below identify storage capacities of each equipment. These storage capacities provide the buffer storage for wastewater when MBR is non-operational.

2.1. Wastewater Blending Tank (10-BAG-T-001)

Per UFD (5194812-000-49DG02-4-0006-01, Rev. 06), streams 3111 and 3406 are inlets to the Wastewater Blending Tank.
Hence total actual input flowrate to tank = 52.78 m^3/hr + 55.75 m^3/hr = 108.53 m^3/hr (Water Balance, 5194812-300-49EL-4-0002, Rev. 03)
The working capacity of this tank is 1040 m^3 (Equipment Datasheet-Site Built Tanks, 5194812-000-45ED-4-0029, Rev. 03). This translates to an approximate buffer of 1040/108.53 = 9.6 hr (when tank is at low level)
This tank is large, hence after the storage capacity has been fully utilized, if not pumped out using Wastewater Pumps (10-BAG-P-001A/B), will need tank transfers. However, it is expected that MBR outage will be shorter in duration than the retention time of this tank. Hence, tank transfer requirement probability is very low.

2.2. De-oiled Water Sump (10-BAG-Z-001)

Per UFD (5194812-000-49DG02-4-0012-01, Rev. 04), stream 3401 is the inlet to the De-Oiled Water Sump.
Hence total actual input flowrate to sump = 5.0 m^3/hr (Water Balance, 5194812-300-49EL-4-0002, Rev. 03)
This sump is 2.7 m wide and 3.6 m deep. Hence, it's total capacity is 2.7 X 2.7 X 3.6 = 26.244 m^3 (Equipment List, 5194812-000-45EL-4-0001, Rev. 06). With 85% operating volume, the working volume is 26.244 m^3 X 0.85 = 22.3 m^3.
This translates to an approximate buffer of 22.3/5 = 4.5 hr (when sump is at low level)

2.3. Closed Drains Drum (10-BAG-V-002)

Per UFD (5194812-000-49DG02-4-0006-01, Rev. 06), streams 3407 ,3409 and 3411 are inlets to the Wastewater Blending Tank.
Hence total actual input flowrate to tank = 28.34 m^3/hr + 3.3 m^3/hr + 24 m^3/hr = 55.64 m^3/hr (Water Balance, 5194812-300-49EL-4-0002, Rev. 03)
This tank has 2.5 m internal diameter and 4.0 m tan-tan length. Hence, its total capacity is ~ 20 m^3. With 85% operating volume, the working volume is 20 m^3 X 0.85 = 17 m^3.
This translates to an approximate buffer of 17/55.64 = 0.3 hr (when drum is at low level)

2.4. Dewatering Liquors Sump (10-BAG-Z-004)

Per UFD (5194812-000-49DG02-4-0012-01, Rev. 04), stream 3110 is the inlet to the Dewatering Liquors Sump.
Hence total actual input flowrate to sump = 52.78 m^3/hr (Water Balance, 5194812-300-49EL-4-0002, Rev. 03)
This sump is 3.7 m long, 3.0 m wide and 2.5 m deep. Hence, it's total capacity is 3.7 X 3.0 X 2.5 = 27.75 m^3 (Equipment List, 5194812-000-45EL-4-0001, Rev. 06). With 85% operating volume, the working volume is 27.75 m^3 X 0.85 = 23.6 m^3.
This translates to an approximate buffer of 23.6/52.78 = 0.44 hr (when sump is at low level)

2.5. Sludge Blending Tank (10-BAG-T-002)

Per UFD (5194812-000-49DG02-4-0012-01, Rev. 04), streams 3102, 3105 and 3107 are the inlets to the Sludge Blending Tank.
Hence total actual input flowrate to tank = 15.36 m^3/hr + 0.06 m^3/hr + 35.23 m^3/hr = 50.65 m^3/hr (Water Balance, 5194812-300-49EL-4-0002, Rev. 03)
This tank has 7.5 m internal diameter and 4.5 m height. Tt's working capacity is 148 m^3 (Equipment List, 5194812-000-45EL-4-0001, Rev. 06).
This translates to an approximate buffer of 148/50.65 = 3 hr (when tank is at low level)

The two main sources of wastewater to the MBR are De-Oiled Water Sump and Wastewater Blending Tank. De-oiled water sump has an approximate buffer of 4.5 hrs. The approximate buffer is 9.6 hr for the Wastewater Blending Tank. Additionally, Sludge Blending Tank feeding Wastewater Blending Tank also has 3 hr approximate buffer.
Hence, in case of a temporary outage of MBR, the wastewater treatment plant system tanks and sumps have buffer storage to keep the process plant running.

3. Off-Spec. Water from MBR

MBR outlet treated water will be continuously quality checked through an analyser installed on the outlet pipe. The treated water not meeting specifications will not be sent to Clarified Water Tank. It won't be routed to any drains (open or closed) either. This off-spec water will be sent off-site for treatment. Hence there would be no contamination due off-spec effluent water from MBR.

References:

1. UFD - Closed Drains Drum and Wastewater Blending Tank (5194812-000-49DG02-4-0006-01, Rev. 06)
2. UFD - Membrane Bioreactor (5194812-000-49DG02-4-0006-02, Rev. 01)
3. UFD – Corrugated Plate Interceptor and Sludge Dewatering (5194812-000-49DG02-4-0012-01, Rev. 04)
4. Water Balance (5194812-300-49EL-4-0002, Rev. 03)
5. Equipment Datasheet - Site Built Tanks (5194812-000-45ED-4-0029, Rev. 03)
6. Equipment List (5194812-000-45EL-4-0001, Rev. 06)
7. Equipment Datasheet – Water Treatment Packages (5194812-000-45ED-4-0001, Rev. 03)
8. Process Description - U300 Water System (5194812-300-49EL-4-0003, Rev. 03)
9. Basis of Design Pre-FID Phase (5194812-000-30EA-2-0001, Rev. 08)
10. U&ID – Clarification Plant (5194812-300-49DG10-4-0006-01, Rev. 05)