Biological Wastewater Treatment

Merck Darmstadt

Bamag Deep Tank Bioreactor

At their Darmstadt chemicals and pharmaceuticals production site, Merck AG have been operating a biological wastewater treatment plant since 1965. As effluent limits were being further tightened (COD reduction, nitrogen and phosphorus elimination), the existing biological treatment plant had to be enhanced and extended to meet the latest regulatory standards. The deep-tank bioreactor unit engineered and built by Lurgi Bamag features flexible 2-stage operation and the integration of a high-load stage. The design data for the enhancement project were established by prior laboratory tests.

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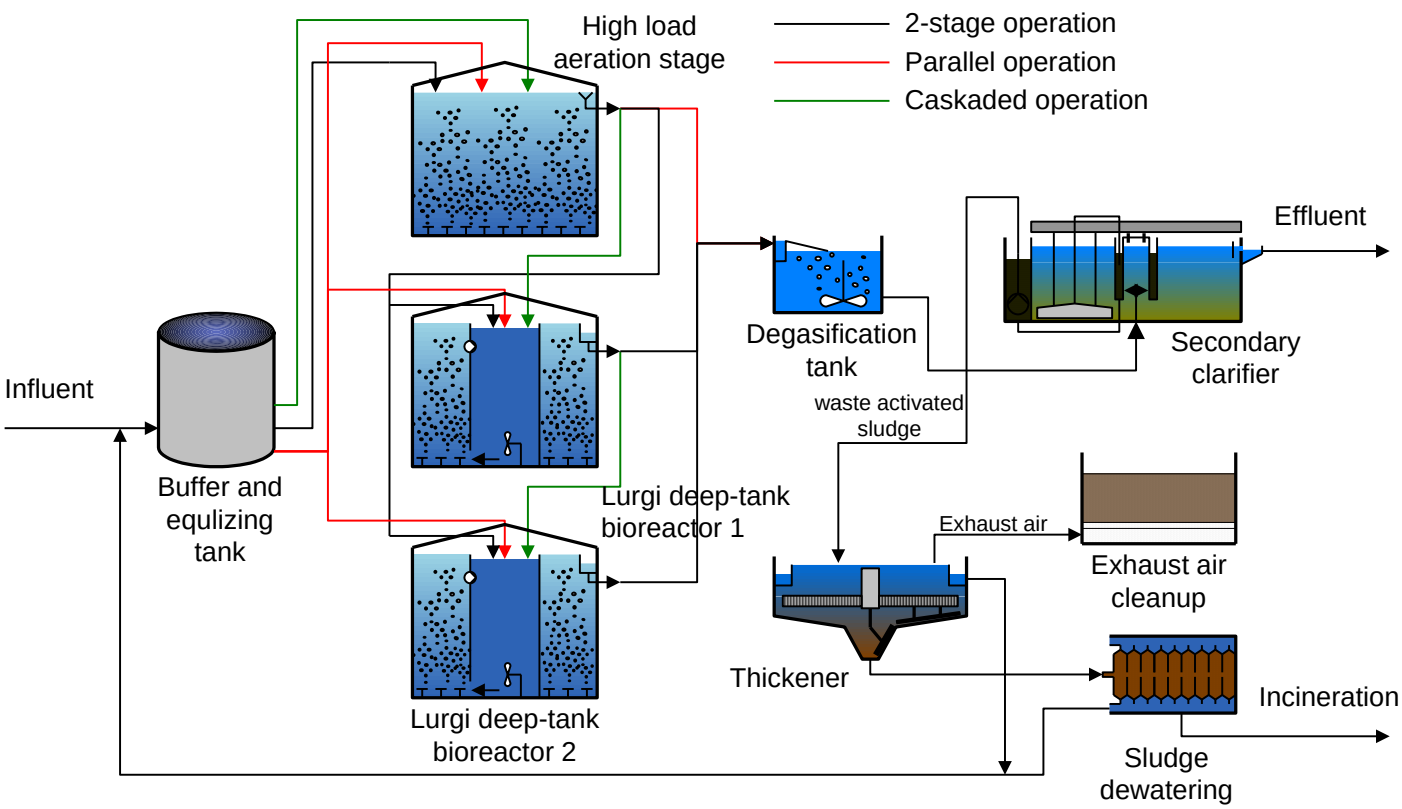

1. Objective

Industrial wastewater treatment

- Design data

Throughput	20,000 m³/d
BOD_5 load	15,000 kg/d max. 30,000 kg/d
COD load	25,000 kg/d max. 54,000 kg/d
Total N	1,000 kg/d
Total P	300 kg/d
Suspended solids	2,000 kg/d
pH	6.5 - 8.0

- Treatment criteria

BOD_5	≤ 30 mg/l
COD	≤ 200 mg/l
Suspended solids	≤ 50 mg/l

2. Plant concept

- Process steps

  Lurgi Bamag deep-tank bioreactor with integrated nitrification and denitrification, degasification, secondary clarification, sludge thickening and exhaust air cleanup.

- Brief description

  The greatly differing production effluent streams are first routed to an equalising tank to level out variations in concentration and flow.

  The original biological treatment unit is operated as high-load stage, removing readily biodegradable organic pollutants.

  In the downstream Lurgi Bamag deep- tank bioreactor, consisting of two identical aeration tanks with external nitrification and internal denitrification zones, the remaining, partly sparingly degradable organic constituents are biodegraded by an optimally adapted biocenosis using prolonged retention times and a low food-to-mass ratio.

  The selected arrangement permits parallel operation of the three aeration tanks, two-stage operation as well as the cascading of three aeration tanks. Thanks to this high operating flexibility, plant operation can be optimally adapted to the varying waste water rates and concentrations to ensure consistent compliance with the regulatory discharge limits.

  The treated effluent leaving the deep-tank bioreactor is freed from excess dissolved gases in a special degasification tank especially developed by Lurgi Bamag for this application. In the subsequent sedary clarifier, the waste activated sludge is settled and removed from the tank by means of suction scrapers.

  The waste activated sludge is thickened followed by dewatering in plate-and-frame presses.

  To forestall odour emissions, the thickener exhaust air is passed through an aerated tank filled with activated sludge where organic odorous substances are adsorbed and biodegraded.

3. Characteristic plant data

- 2 Lurgi Bamag deep-tank bioreactors

Volume	7,500 m³/tank
Ø	24.5 m
Depth of water	16 m
Space loading:	0.75 kg BOD_5/m³·d
Sludge loading:	0.25 kg BOD_5/kg·d
Aeration system:	jet aerators

- Degasification tank
- 3 secondary clarifiers

Ø	30 m
Depth of water	3 m
Clarification area	700 m²
Surface flow rate	< 0.4 m/h

- Sludge treatment
  Thickener
  Plate-and-frame press

4. Operating experience

The plant took up operation in 1993 after stepwise modification of the existing plant.

The plant is predominantly operated in the two-stage mode, i.e. with one high-load stage upstream of the parallel-connected Lurgi Bamag deep-tank bioreactors. The resulting low sludge loading results in a sludge index of about 50 ml/g and an average treated effluent COD of 100 mg/l, which has led to significant cost savings.

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