Application Level:

☐ Household
☒ Neighbourhood
☒ City

Management Level:

☐ Household
☐ Shared
☒ Public

Inputs: ☐ Blackwater   ☐ Brownwater
☐ Greywater

Outputs: ☐ Effluent   ☐ Sludge
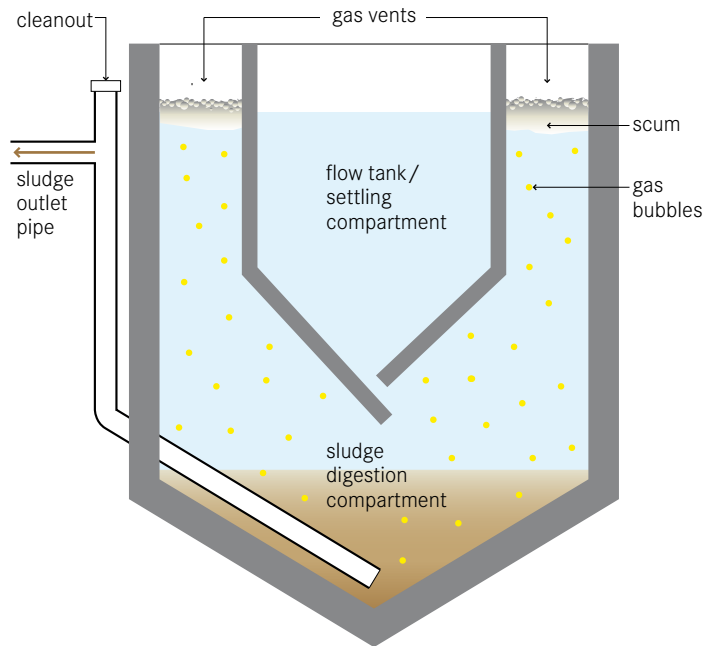
The Imhoff tank is a primary treatment technology for raw wastewater, designed for solid-liquid separation and digestion of the settled sludge. It consists of a V-shaped settling compartment above a tapering sludge digestion chamber with gas vents.

The Imhoff tank is a robust and effective settler that causes a suspended solids reduction of 50 to 70%, COD reduction of 25 to 50%, and leads to potentially good sludge stabilization – depending on the design and conditions. The settling compartment has a circular or rectangular shape with V-shaped walls and a slot at the bottom, allowing solids to settle into the digestion compartment, while preventing foul gas from rising up and disturbing the settling process. Gas produced in the digestion chamber rises into the gas vents at the edge of the reactor. It transports sludge particles to the water surface, creating a scum layer. The sludge accumulates in the sludge digestion compartment, and is compacted and partially stabilized through anaerobic digestion.

Design Considerations The Imhoff tank is usually built underground with reinforced concrete. It can, however, also be built above ground, which makes sludge removal easier due to gravity, although it still requires pumping up of the influent. Small prefabricated Imhoff tanks are also available on the market. Hydraulic retention time is usually not more than 2 to 4 hours to preserve an aerobic effluent for further treatment or discharge. T-shaped pipes or baffles are used at the inlet and the outlet to reduce velocity and prevent scum from leaving the system. The total water depth in the tank from the bottom to the water surface may reach 7 to 9.5 m. The bottom of the settling compartment is typically sloped 1.25 to 1.75 vertical to 1 horizontal and the slot opening can be 150 to 300 mm wide. The walls of the sludge digestion compartment should have an inclination of 45° or more. This allows the sludge to slide down to the centre where it can be removed. Dimensioning of the anaerobic digestion compartment depends mainly on sludge production per population equivalent, on the targeted degree of sludge stabilization (linked to the desludging frequency) and the temperature. The digestion chamber is usually designed for 4 to 12 months sludge storage capacity to allow for sufficient anaerobic digestion. In colder climates longer sludge retention time and, therefore, a greater volume

is needed. For desludging, a pipe and pump have to be installed or access provided for vacuum trucks and mobile pumps. A bar screen or grit chamber (see PRE, p. 100) is recommended before the Imhoff tank to prevent coarse material from disturbing the system.

Appropriateness Imhoff tanks are recommended for domestic or mixed wastewater flows between 50 and 20,000 population equivalents. They are able to treat high organic loads and are resistant against organic shock loads. Space requirements are low.
Imhoff tanks can be used in warm and cold climates. As the tank is very high, it can be built underground if the groundwater table is low and the location is not flood prone.

Health Aspects/Acceptance As the effluent is almost odourless, it is a good option for primary treatment if subsequent treatment takes place, e.g., in open ponds, constructed wetlands or trickling filters. Gases produced in low quantities may, however, generate odours locally. Pathogen removal is low and all outputs should be treated. Appropriate protective clothing is necessary for workers who may come in contact with the effluent, scum or sludge.

Operation & Maintenance Operation and maintenance are possible at low cost, if trained personnel are in charge. Flow paths have to be kept open and cleaned out weekly, while scum in the settling compartment and the gas vents has to be removed daily if necessary. Stabilized sludge from the bottom of the digestion compartment should be removed according to the design. A minimum clearance of 50 cm between the sludge blanket and the slot of the settling chamber has to be ensured at all times.

Pros & Cons
+ Solid-liquid separation and sludge stabilization are combined in one single unit
+ Resistant against organic shock loads
+ Small land area required
+ The effluent is not septic (with low odour)
+ Low operating costs

- Very high (or deep) infrastructure; depth may be a problem in case of high groundwater table
- Requires expert design and construction
- Low reduction of pathogens
- Effluent, sludge and scum require further treatment

References & Further Reading

– Alexandre, O., Boutin, C., Duchène, Ph., Lagrange, C., Lakel, A., Liénard, A. and Orditz, D. (1998). *Filières d'épuration adaptées aux petites collectivités*. Document technique FNDAE n°22, Cemagref, Lyon, FR.
Available at: www.fndae.fr

– Herrera, A. (2006). *Rehabilitation of the Imhoff Tank Treatment Plant in Las Vegas, Santa Barbara Honduras, Central America*. Master thesis, Department of Civil, Architectural and Environmental Engineering, University of Texas, Austin, US.
(Case study providing general information about Imhoff tanks and insights into implementation and operational problems. Recommendations for O&M are provided.)

– McLean, R. C. (2009). *Honduras Wastewater Treatment: Chemically Enhanced Primary Treatment and Sustainable Secondary Treatment Technologies for Use with Imhoff Tanks*. Master thesis, Department of Civil and Environmental Engineering, Massachusetts Institute of Technology, Cambridge, US.
(Case study including a detailed description of the functionality of the Imhoff tank)

– Ulrich, A. (Ed.), Reuter, S. (Ed.), Gutterer, B. (Ed.), Sasse, L., Panzerbieter, T. and Reckerzügel, T. (2009). *Decentralised Wastewater Treatment Systems (DEWATS) and Sanitation in Developing Countries. A Practical Guide*. WEDC, Loughborough University, Leicestershire, UK.
(Comprehensive handbook about planning and implementation of decentralized wastewater treatment options. It includes case studies and Excel spreadsheets for design calculations.)

– WSP (Ed.) (2008). *Philippines Sanitation Sourcebook and Decision Aid*. Water and Sanitation Program, Washington, D.C., US.
Available at: documents.worldbank.org/curated/en/home
(Basic information about low-cost decentralized sanitation technologies for decision makers. Presents fact sheets about 23 selected options, including the Imhoff tank.)