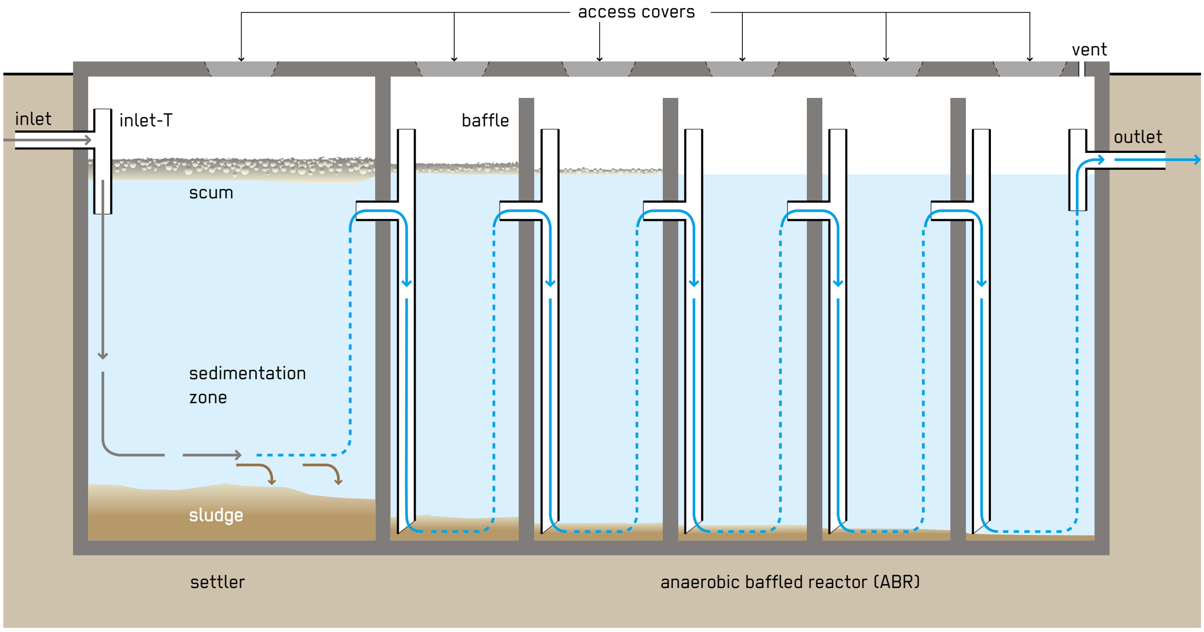
Anaerobic Baffled Reactor (ABR)

Phase of Emergency	Application Level / Scale	Management Level	Objectives / Key Features
Acute Response * Stabilisation ** Recovery	* Household ** Neighbourhood City	* Household ** Shared ** Public	Excreta containment, Solid / liquid separation, BOD reduction
Space Required	**Technical Complexity**	**Inputs**	**Outputs**
** Medium	** Medium	● Blackwater, ● Greywater	● Effluent, ● Sludge, ● Biogas



The Anaerobic Baffled Reactor (ABR) treats many different types of wastewater and can be considered an 'improved' Septic Tank **(S.13)** that uses baffles to optimise treatment. Treatment of the wastewater takes place as it is forced to flow upward through a series of chambers, where pollutants are biologically degraded in an active sludge layer at the bottom of each chamber.

ABRs can treat raw, primary, and secondary treated sewage and greywater (with organic load). The principal working process is anaerobic (in the absence of oxygen) and makes use of biological treatment mechanisms. The upflow chambers provide enhanced removal and digestion of organic matter. Biochemical oxygen demand (BOD) may be reduced by up to 90 %, which is far superior to its removal in a conventional Septic Tank **(S.13)**.

Design Considerations: Small-scale, stand-alone ABRs typically have an integrated settling compartment, but primary sedimentation can also take place in a separate Settler **(T.1)** or another preceding technology, e.g. a Septic Tank **(S.13)**. ABRs should consist of at least 4 chambers (as per BOD load), more than 6 are not recommended. The organic load should be < 6 kg/m³ * / day BOD, the water depth at the outlet point is preferably about 1.8 m; a maximum of 2.2 m (for large systems) should not be exceeded. Hydraulic retention time should not be less than 8 hours, and 16–20 hours is a preferred range. Upflow velocity ideally ranges around 0.9 m/h, velocities above 1.2 m/h should be avoided. Accessibility to all chambers (through access ports) is necessary for maintenance. The tank should be vented to allow for controlled release of odorous and potentially harmful gases. Where kitchen wastewater is connected to the system, a grease trap must be positioned before the settler component to avoid excess oil and grease substance entering and hindering treatment processes.

Materials: An ABR can be made of concrete, fibreglass, PVC or plastic, and can be prefabricated. A pump might be required for discharging the treated wastewater where gravity flow is not an option.

Applicability: Roughly, an ABR for 20 households can take up to several weeks to construct, much quicker (3–4 days) if reinforced fibre plastic ABR prefab modules are used. Once in operation, 3–6 months (up to 9 in colder climates) is needed for the biological environment to establish and maximum treatment efficiency to be reached. Therefore, ABRs are not suitable for the acute response phase of an emergency but are more suited for the stabilisation and recovery periods. They can also be a long-term solutions. The neighbourhood scale is most suitable, but it can also be implemented at the household level or in larger catchment areas and/or public buildings (e.g. schools). Even though ABRs are designed to be watertight, it is not recommended to construct them in areas with high groundwater tables or where there is frequent flooding, alternatively prefabricated modules can be placed above ground. ABRs can be installed in every type of climate, although the efficiency will be lower in colder climates.

Operation and Maintenance: ABRs are relatively simple to operate; once the system is fully functioning, specific operation tasks are not required. To reduce start-up time, the ABR can be inoculated with anaerobic bacteria, e.g. by adding Septic Tank sludge, or cow manure. The system should be checked monthly for solid waste, and the sludge level should be monitored every 6 months. Desludging is required every 2–4 years, depending on the accumulation of sludge at the bottom of chambers reducing treatment efficiency. Desludging is best done using a Motorised Emptying and Transport technology **(C.2)**, but Manual Emptying **(C.1)** can also be an option. A small amount of sludge should be left to ensure the biological process continues.

Health and Safety: Effluent, scum and sludge must be handled with care as they contain high levels of pathogens. During sludge and scum removal, workers should be equipped with proper protection personal protective equipment (boots, gloves, and clothing). The effluent should be treated further (e.g. **POST**) if reused in agriculture or otherwise discharged properly.

Costs: The capital costs of an ABR is medium and the operational costs are low. Costs of the ABR depend on what other conveyance technology and treatment modules used, and also on local availability and thus costs of materials (sand, gravel, cement, steel) or prefabricated modules and labor costs. The main operation and maintenance costs are related to the removal of primary sludge and the cost of electricity if pumps are required for discharge (in the absence of a gravity flow option).

Social Considerations: Usually, anaerobic treatment systems are a well-accepted technology. Because of the delicate ecology in the system, awareness raising on eliminating the use of harsh chemicals for the users is necessary.

Strengths and Weaknesses:

(+) Low operating costs
(+) Resistant to organic and hydraulic shock loadings
(+) High reduction of BOD
(+) Low sludge production; the sludge is stabilised

(−) Requires expert design and construction
(−) Low reduction of pathogens and nutrients
(−) Effluent and sludge require further treatment and/or appropriate discharge
(−) Long start-up time

→ **References and further reading material for this technology can be found on page 192**