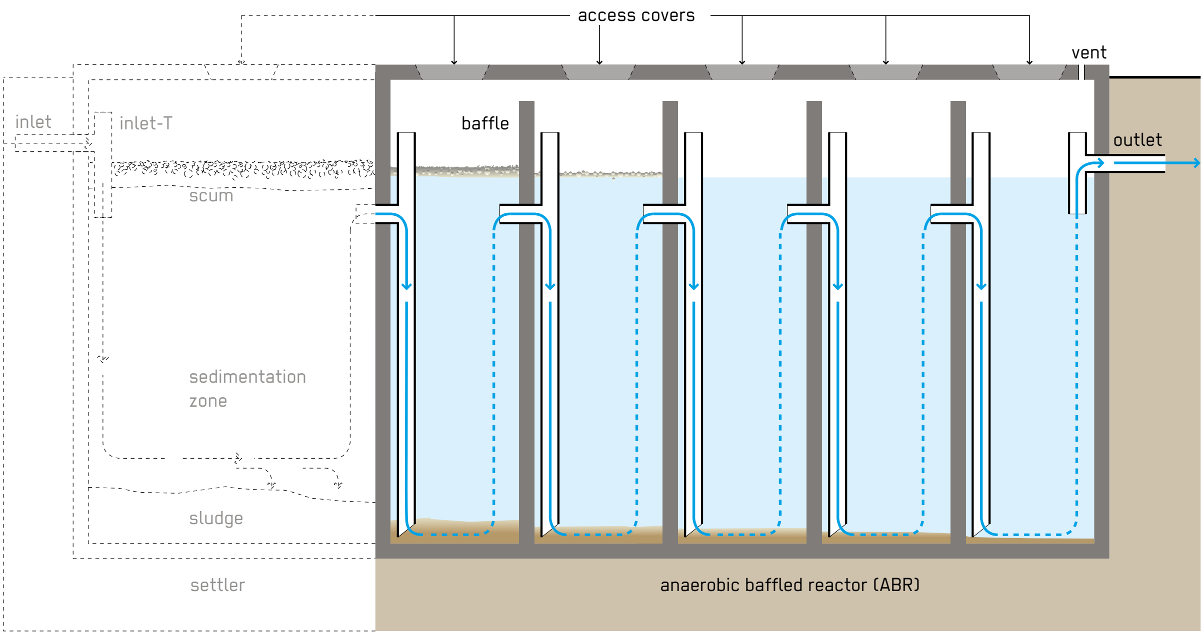
Anaerobic Baffled Reactor (ABR)

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



The Anaerobic Baffled Reactor (ABR) can treat 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, secondary treated sewage, and greywater (with organic load). The principle process is anaerobic (in the absence of oxygen) and makes use of biological treatment mechanisms. Up-flow 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. Septic Tanks **S.13**). ABRs should consist of at least four chambers (as per BOD load); more than six chambers are not recommended. The organic load should be less than 6 kg of BOD/ m^3/day. The water depth at the outlet point should be about 1.8 m, and a depth of 2.2 m (in case of big systems) should not be exceeded. The hydraulic retention time should not be less than eight hours, and 16–20 hours is a preferred range. The up-flow velocity ideally ranges around 0.9 m/h, values higher than 1.2 m/h should be avoided. Accessibility to all chambers (through access covers) is necessary for maintenance. The tank should be vented to allow for controlled release of odorous and anaerobic gases. Where kitchen wastewater is connected to the system, a grease trap must be positioned before the Settler component in order to prevent excess oil and grease substances from entering and hindering treatment processes.

Materials: An ABR can be made of concrete, fibreglass, PVC or plastic, and prefabricated units are available. 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. If reinforced fibre plastic ABR prefabricated modules are used the time required for construction is much less (3–4 days). Once in operation, three to six months (up to nine in colder climates) are needed for the biological environment to become established and maximum treatment efficiency to be reached. ABRs are thus not appropriate for the acute response phase and are more suitable for the stabilisation and recovery phases as a longer-term solution. Implementation at the neighbourhood scale is most suitable, but the technology can also be implemented at the household level or in larger catchment areas and in 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 six months. Desludging is required every two to four years, depending on the accumulation of sludge at bottom of chambers, which reduces treatment efficiency. Desludging is best done using Motorised Emptying and Transport technology **(C.2)**, but Manual Emptying and Transport **(C.1)** can also be an option. A small amount of sludge should be left to ensure that 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 personal protective equipment (boots, gloves, and clothing). If the effluent will be reused in agriculture or directly used for fertigation it should be treated further. Alternatively it can be discharged appropriately.

Costs: Capital costs of an ABR are medium and operational costs are very low. Costs of the ABR depend on what other Conveyance and Treatment technology it is to be combined with, and 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 filter treatment systems are a well-accepted technology. Because of the delicate ecology in the system, users should be instructed to not dispose of harsh chemicals into the ABR.

Strengths and Weaknesses:

(+) Low operating costs
(+) Resistant to sudden loads of organic material or flow increases
(+) 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 193**