General process description

klärofix® is a SBR – small waste water treatment plant, basically partitioned into two treatment steps. The partition is effected dependent on fixed minimum volumes, independent of the existing water surface.

The first mechanical primary treatment is responsible for the following tasks:

- Waste water can run in with a free fall. Coarse solids are sedimented in the especially voluminously designed primary treatment and are stored with the secondary sludge from the SBR reactor in the sludge storage.
- The primary storage is dimensioned for the cycle volume of the SBR reactor and is extended by an extra safety storage (tank) for the cycles of sedimentation and clear water discharge.

In the basic version no moving electrical aggregates are installed. The necessary charging resp. discharging transports of water are effected by means of lifting devices, operated by compressed air. However, in cases of unfavourable height conditions, alternatively waste water resistant sewage pumps can be used as well.

By means of a filling device operated by compressed air, the biological stage is charged with pre-treated waste water within a very short period of time with a defined minimum quantity (cycle volume).

- The aeration with compressed air provides the circulation and supply of oxygen for the biodegradation of harmful substances.
- In defined intervals circulation and supply of oxygen takes place, resp. rest periods are effected.
- The nitrification and de-nitrification phases are followed in case of an appropriate load by the settlement phase during which a clear water as well as a sludge layer are formed.
- The clear water layer is drawn off through the outlet by means of a compressed-air sewage lifting unit.
- Surplus activated sludge is brought into the primary treatment and is stored there together with primary sludge.
- In case of insufficient load, instead of the sedimentation phase, a holiday resp. energy-saving program is activated automatically, which is only interrupted when the necessary charging level in the primary treatment is reached.

Cycle strategy:

The control system of the waste water treatment unit (available as option) differentiates between the operating conditions of

- normal load cycle
- energy saving cycle

The cycle control takes place automatically and depends demand-oriented on the waste water inlet. Depending on the load, up to 3 cycles per day are effected.
The time or phase sequence within a cycle happens according to a rigid time schedule preset by the manufacturer. This schedule is deposited in the control system and protected by a password.
An air blower dimensioned depending on the respective hydraulic load is located together with the control system in a separate control cabinet outside the waste water.

Energy-saving cycle (option):

The cycle time is unlimited in time.
For reduction of operating cost and for guaranteeing the minimum waste water quantities in the individual filling loads, the cycle selection takes place according to the respective requirements by continuous charging level interrogation in the first step.

The same is set to a minimum charging volume corresponding to the cycle volume in the reactor. In case this quantity of waste water, depending on the defined number of inhabitants, does not exist, the control system is working in the energy-saving cycle unlimited in time.
The reactor content is periodically circulated. By means of the excess sludge lifter, purified water - cyclically cleaned as well - is fed to the primary treatment and admixed (circulation system). In case of no additional hydraulic load (during holidays), the cycle is operated without clear water discharge.
After approximately two days of energy-saving cycle at the latest (in case of new waste water supply earlier) the primary treatment reaches the filling mark h_{SPmax}, whereas the cycle will be interrupted immediately. A new normal load cycle starts with the sedimentation phase.

Normal load cycle:

Alternatively and as far as the control system does not differentiate between normal load and energy-saving cycle, preset 3.42 cycles per day are effected.
Contrary to the load-depending plant operation with energy-saving mode, the energy-saving cycle is omitted here. Basically, the operation takes place in the normal load cycle.
The duration of one cycle takes 7 hours, the cycle and the time-based sequence remain unchanged as at the load-depending normal load cycle.
Only after reaching the maximum filling mark (h_{SPmax}) in the primary treatment, the cycle starts with the

Sedimentation phase.

During the sedimentation phase lasting one hour, the reactor content separates itself horizontally into a sludge zone and a clear water zone. Incoming waste water is buffered in the safety storage (SSP) of the primary treatment. After 60 minutes of sedimentation, which is firmly preset, the

Clear water discharge phase starts.

Limited in height (h_{min}) by the vertical discharge opening of the air-operated lifting device, open on top, the purified water is conducted to the outlet of the waste water treatment plant. After termination, the

Excess sludge removal starts at once.

The duration of this phase is preset - depending on the conveying height. The lifting pump operated by compressed air conveys excess sludge accrued for storage in the primary treatment. The discharge area is determined by the construction of the removal opening. The cycle continues without delay with the

Filling phase.

The charging of the reactor takes place by means of an air lift pump. The same is constructed in the same way as the clear water discharge lifter. The open-ended discharge pipe is fixed in height (hSS acc. to scheme drawing). A special sludge preventing device (height = between hSS + 20 cm and hSS – 30 cm) prevents the swimming sludge from entering into the pipe opening. An emergency overflow outlet between primary treatment and reactor at the level of VSmax is also protected by a sludge protection device.

Mixing and reaction phase.

By means of a membrane disc fixed in the centre of the reactor bottom, air is blown in at regular intervals.
The aeration times are preset and are adjusted to the required purification efficiency.
The ascending bubbles generate turbulences which are mixing the content of the tank, consisting of activated sludge and waste water.
Furthermore, the tank content is enriched with oxygen which is necessary for degradation of harmful substances. After the preset duration of this phase, the normal load cycle ends.

Treatment process “sanitation” (optional)

The waste water to be sanitized is biologically treated in a SBR-plant to the most possible degree before the process of sanitation. Under certain conditions a biological treatment plant (DIN EN 12566-3) of another manufacturer could be connected with the klärofix® type “H” as well.
The still existing micro-organisms in the treated waste water will be eliminated by this module.
The water to be sanitized is buffered in a separate storage tank in order to be applied constantly via the module “H”. Either

- the clear water layer in the reactor (klärofix® type H - integrated)

or

- a separate tank (klärofix® type H – connected downstream)

can be used as a buffer.
The buffered water is conducted through module „H“ for disinfection. A few minutes before the sanitation process starts, the ultraviolet lamp is switched-on in order to have 100 % capacity from the beginning on.
The pump presses the water in the reactor inlet where a rotation flow is generated according to the construction. By means of the particularly effective UVC–radiation, the micro-organisms are killed definitely! The effectivity is depending on the UV-dose (J/m²) and the flow time.

Treatment process “precipitation of phosphate” (optional)

The phosphate is eliminated from the waste water by adding a precipitant to the SBR-reactor. This process step takes place after completion of the biological treatment process before the sedimentation phase.

The necessary precipitant is stored in an air-tight tank inside the empty space of the manhole taper or at the partition wall of the waste water treatment tank. The storage next to the control cabinet or in a separate room is also possible.

By default, the size of the storage tank is dimensioned for a supply of at least five months at normal operation. The size of the storage tank is depending on the number of inhabitants and amounts to 1.25 l/inhabitant.

A supply air pipe from the control cabinet as well as an outlet hose for the precipitant are conducted to the storage tank. The tank is pressurized for an exactly defined period of time by means of a separately switchable supply air pipe. The required quantity of the precipitant gets into the reactor by means of the connected dosing pipe.

This metered addition is effected automatically by the klärcontrol® system control by means of an additional magnetic valve in the klärofix® control cabinet. In comparison to the standard SBR plant, no additional control system is necessary. Alternatively, the addition of the precipitant might also take place by using an electric or pneumatic dosing pump.

The precipitant is distributed constantly in the reactor by means of the aeration device. The precipitant causes a change from dissolved compounds to solved compounds. The precipitate accrued is settling with the activated sludge and is removed from the water to be treated.

The sludge-precipitants-compound as well as excess micro-organisms are periodically discharged from the completed biological treatment process to the sludge storage by means of the automatically controlled secondary sludge recirculation.