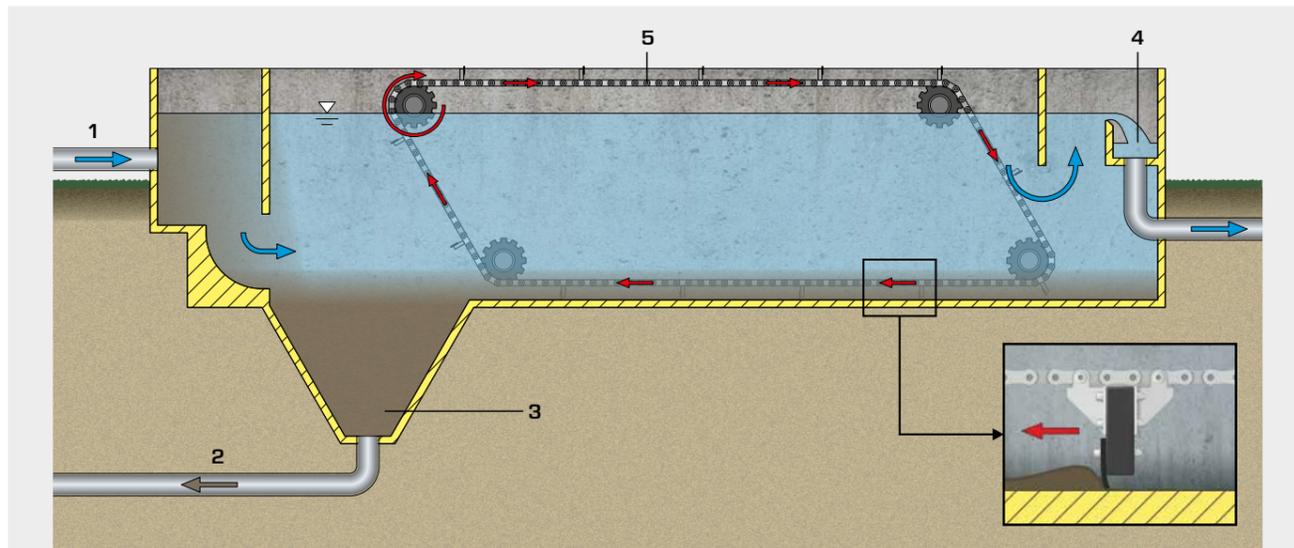


Basic knowledge Sedimentation

Mechanical process engineering in many cases utilises gravity to separate different phases. Gravity can be used to separate a solid phase off from a fluid. When solid particles are suspended in a fluid, gravity causes them to sink. For this to happen, the density of the solid must be greater than that of the fluid. The process is termed sedimentation. Fluid is the umbrella term for gases and liquids. It is used because most physical laws apply equally to both.

In terms of the **separation of solids from gases** the phrase "dust separation" is also used. The solid phase may, on the one hand, be a usable material, on the other hand, it may be an unwanted material (gas purification). In gravity separators the gas flow is routed at slower velocity through a separator channel. On their way, the particles sink and are collected.

In practice the **separation of solid/liquid mixtures** (suspensions) takes place in sedimentation tanks through which the suspension continuously flows. The shape of the base may be rectangular or circular. In rectangular tanks the suspension flows in on one side and flows out over the rim on the opposite side. On the way, the solid particles sink to the bottom of the tank. The tank floor is positioned at an angle to aid discharge of the solid material. There are also devices by which the settled solid (sludge) can be cleared from the tank bottom. Sedimentation tanks are mostly used in water treatment.



Sedimentation tank:

1 wastewater inlet, 2 sludge extractor, 3 sludge hopper, 4 clean water overflow, 5 sludge scraper

The **settling velocity** of the particles is the key variable in the design of sedimentation tanks and separator channels. It is directly related to the particle size, the particle shape (flow resistance) and the difference in density between the fluid and solid. If the particles in a suspension are very fine, or if the difference in density between the fluid and solid is slight, the settling velocity is very low. A technically useful separation by

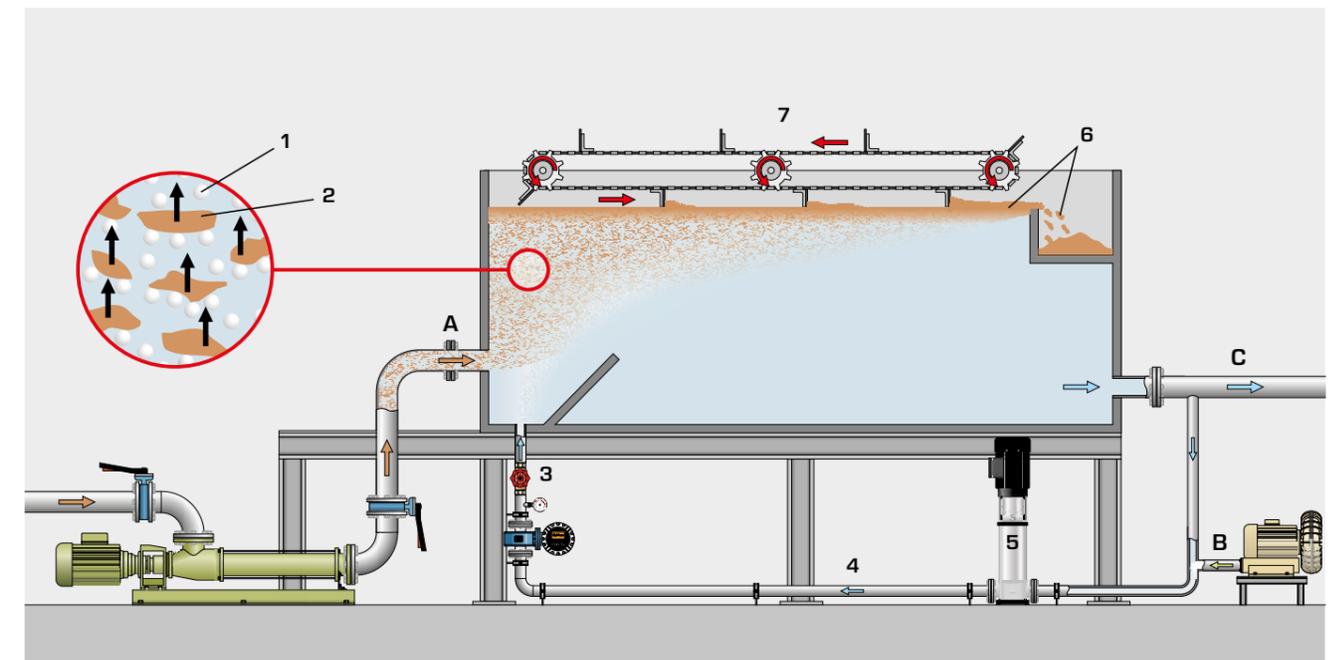
means of sedimentation is then not possible. Another variable influencing the settling velocity in liquids is the concentration of solid particles. At high concentrations, sedimentation is hindered. As the concentration increases, the so-called cluster settling velocity becomes less than the velocity of the single particles.

Basic knowledge Flotation

Suspended solids with a density close to or less than that of water can't be removed by sedimentation. Such solids would sediment only very slowly or would remain suspended. The aim of flotation is to increase the buoyancy of the solids. This is done by forming small gas bubbles that attach to the solids. This makes them rise to the surface of the water where they can be skimmed off. It is required that the solids should be hydrophobic. That means that they are more wettable with air than with water. The separated solids are termed float. The key factor

influencing flotation is the size of the gas bubbles. The smaller they are the less will be their rate of rise. This is compensated by larger numbers of small gas bubbles attaching to the solids than large bubbles.

The main process used in water treatment is **dissolved air flotation**. Another flotation variant is electro-flotation. The two processes differ primarily in the way the gas bubbles are produced.



Fundamental principle of dissolved air flotation:

1 air bubbles, 2 solids, 3 relief valve, 4 recycle water, 5 pump, 6 float, 7 scraper;
A raw water, B compressed air, C treated water

Dissolved air flotation

Dissolved air flotation uses the fact that the solubility of air in water increases as the pressure rises at constant temperature. Some of the treated water is saturated with air under pressure (recycle water). The recycle water is then injected into the flotation tank through a special valve that causes an instantaneous reduction in pressure (relief valve). The sudden relief to atmospheric pressure

causes the dissolved air to precipitate as a cloud of small bubbles. A scraper clears the float from the surface of the water. To improve the performance of the process, coagulants and flocculants may be added to the raw water. This helps to optimise the size of the solids so that more air bubbles can be attached to the solids.

Application examples

Industrial water treatment

- paper industry
- food industry
- oil refineries
- plastics industry

Domestic water treatment

- secondary clarification, if the activated sludge sediments very slow
- supplementing or replacing primary clarification