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Sewage/Wastewater Treatment

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Process summary

A typical a sewage plant is normally arranged in what are termed Primary, Secondary and sometimes Tertiary treatment sections.

Beginning with Primary treatment, on entering the plant, the wastewater – from homes, drains and some industries - is first screened to remove any items that cannot be treated by the facility. These often comprise a ‘multitude of sins’ such as plastics/bottles/cans/diapers/rags etc. There may in fact be a double screening process a) to remove very large articles and b) to capture smaller ones. Having been screened, the wastewater then passes to grit tanks where, as the name implies, fine grit particles not captured by the screens are settled out and dispatched to landfill. The wastewater then passes to a primary sedimentation tank where suitably quiescent conditions enable the heavier suspended solids to settle by gravity. A specially designed scraper is usually employed to skim off any fatty material that floats on the surface. The contents of this tank are then separated into two distinct fractions. The uppermost liquid fraction, containing mainly dissolved material, is treated by aerobic microbial action whilst the gravity settled fraction – still containing ca 99% water - is subjected to anaerobic biological treatment.

Treatment of the uppermost liquid fraction is primarily concerned with removal of dissolved solids. This is achieved through contact with microorganisms, which convert the dissolved material into biomass. Two techniques are widely used for this purpose, referred to as activated sludge treatment and what are termed trickling filters or clinker beds. Some plants incorporate both these techniques in tandem.

In the activated sludge method, air (oxygen) is injected into the sludge tank to promote the growth of microorganisms, which break down the organic matter into a form that makes it easier to settle. The actual settling takes place in secondary or humus tanks from where the clarified water is eventually released; often via a (Tertiary section) disinfectant stage. Settled solids in the humus tank are returned to aeration to promote more biological activity.

The trickling filters on the other hand comprise a bed of clinker or similar material, which provides a large surface area on which the microorganisms can grow. The out-flowing liquor is again fed to a humus tank.

Returning to primary sedimentation, although settled, the sludge emerging from primary sedimentation is still predominantly liquid in form. As a consequence this ‘liquid sludge’ is usually thickened e.g. by gravity, centrifuge, drum or belt thickeners, primarily to reduce the load on the next process, that of biological digestion. Unlike activated sludge and trickling filter treatments, biological digestion is an anaerobic process, which significantly reduces the sludge quantity. A modicum of heat is applied to maintain optimum activity. Methane gas is also liberated from the process, which is used as fuel. On emergence from the digester, the sludge is chemically treated to assist in final dewatering. The chemicals may be of organic type, commonly referred to as polyelectrolytes, or (more traditionally) inorganic types such as alum, lime, ferrous sulphate and ferric chloride. The effect in each case is to induce the particles in the sludge to coagulate into a form that will be easier to dewater. Mechanical dewatering of the digested sludge may take place using filter presses, belt, screw or rotary presses or centrifuges. Alternatively the sludge may simply be dispatched to drying beds.

Filtration stages

1 Primary Treatment: Thickening of primary sludge. As reported above, the primary sedimentation slurry is usually thickened before feeding to the digester. This may be achieved by drum thickeners, settling tanks or by belt thickeners. Where appropriate, the thickened slurry may be further treated with flocculants at this stage and dewatered on multiroll filter belt presses for disposal to landfill/agricultural operations.

2 Secondary Treatment: Dewatering of digested sludge. Depending on local requirements, this process may be carried out on multiroll belt filter presses (two or three belts) or conventional filter presses (historically RVF filters have also been used, though probably quite rare now). Conventional presses achieve the lowest moisture content of the two, which may be critical in applications where the sludge is subsequently dried and/or incinerated, whilst multiroll presses are less expensive and generally easier to operate and maintain. [NB ‘power thirsty’ centrifuges are also used here and more recently screw presses and rotary presses are also gaining interest].

Choice of filter media in conventional filter presses will be determined largely by the conditioning treatment; in general terms monofilament fabrics with a smooth surface are preferred where organic flocculants are used and staple yarn constructions where inorganic treatments are used. Likewise, as belt filters rely on rapid sludge coagulation, organic polyelectrolytes will most likely be preferred to inorganic conditioners here. Even so, correct polymer dosing will be critical to efficient dewatering.