Recycling of exhaust vapour condensate from sewage sludge incineration

In response to the current laws, the trend in Germany is increasingly towards the thermal recycling of sewage sludges.
Prior to incineration, the sewage sludges are normally dried. Depending on the drying process used, the result is a considerable amount of exhaust vapour condensates, that in some cases are contaminated with high levels of dissolved and particulate organic materials and nitrogen compounds.
The levels of contamination vary depending on the drying process, the amount of drying and the sewage sludge used.

Exhaust vapour condensate

The operating sites of the sewage sludge incineration plants are often away from the locations of the sewage plants, which means that separate treatment of the exhaust vapour condensate is necessary. With the aid of modern waste water treatment technologies, the condensates can be cleaned sufficiently to allow them to be drained off into municipal sewage systems or re-used as process water. This requires the exhaust vapours to first have the dust removed from them via a mechanical exhaust vapour filter. Most of these have water-repellent filter hoses or filter cartridges, and are cleaned with compressed air at defined intervals. After coarse solids have been removed, the exhaust vapours are condensed and sent onward for waste water treatment. For this, the Gütersloh-based company RWT GmbH has developed a system concept in collaboration with the company A3 GmbH that can convert the exhaust vapour condensate into a usable form. The core of the system for treating the exhaust vapour condensate is a combination of ultrafiltration and a downstream reverse osmosis system.

Ultrafiltration

Here, ultrafiltration separates out all the particulate materials. With a pore width of approximately 50 nanometres, even the finest particles and colloids are held back. Ideally, ceramic Multibore tubular membranes (aluminium oxide) are used here. These can withstand high mechanical loads and can be flowed over and flowed through at high speeds. This crossflow operation of the ultrafiltration gives rise to high shear forces, which prevent the deposition of substances that are held back. The filtration efficiency of this system is very high, to the extent that only a very small proportion of concentrate occurs. In addition, the good thermal resistance of the ceramic membranes ensures that - in contrast to polymer membranes - they can be used for long periods where condensate temperatures are >50 °C. Furthermore, the good chemical resistance ensures that the membranes age only slowly and have a long service life, even when subjected to frequent chemical cleaning.

Ultrafiltration with ceramic Multibore tubular membranes

Reverse osmosis

The filtrate from the ultrafiltration is sent onward to the next stage of the reverse osmosis system. The water must first be cooled down to temperatures of < 40 °C so as not to damage the polymer membranes used in the reverse osmosis and to guarantee good retention at the membranes. The pores of the reverse osmosis membranes are so small that dissolved substances such as organic compounds and ammonium can be retained effectively. The permeate treatment is a two-stage process as standard, and ensures very high retention rates of the substances mentioned above. The entire system produces only a very small proportion of waste water. Due to the high concentrations of the water constituents and the system's high yield, a high operating pressure (around 40-70 bar) is required on the infeed side of the reverse osmosis, and this can be generated by a piston pump. Doses of conditioning agents such as anti-scalants and biocides are added in order to prevent the formation of deposits as much as possible. Chemical cleaning operations are performed at defined intervals. This is done by an automatic cleaning station.

Permeate-stepped reverse osmosis plant

The ammonium content is significantly reduced in the permeate from the reverse osmosis system. A further reduction can also be achieved by a cation exchanger for fine cleaning. This removes the cations remaining in the permeate, such as ammonium, and they are replaced by hydrogen ions.

Summary:

The modern treatment technology is operated fully automatically via a freely programmable controller and requires only minimal manpower effort. Generally speaking, the treatment system is characterised by modern and efficient system technology and comparatively low operating costs.

The process steps above enable problematical water such as exhaust vapour condensate to be treated until it is of a good industrial water quality. Only a small amount of waste water is produced at the same time. In order to avoid the need to dispose of the concentrated waste water, it can be sent for incineration.

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