Membrane bioreactor as polishing step in the treatment of galvanic wastewater – Abstract

In galvanic industry wastewater is formed as a byproduct in surface treatment processes of metallic compounds. The common primary treatment steps are flocculation and precipitation. Depending on the applied unit operations the filtrate of the subsequent chamber filter press usually contains significant amounts of COD, heavy metals (e.g. zinc, iron, chrome) and also filterable solids. In order to reach direct discharge quality a final treatment step is necessary.

In membrane bioreactors (MBR) biological wastewater treatment is combined with membrane technology. Organic compounds will be degraded under aerobic conditions and the activated sludge is confined in the biological system by micro- or ultrafiltration membranes.

Of course, heavy metals cannot be degraded by microorganism, instead the metals are removed from the wastewater through various mechanism such as incorporation of precipitated metals in sludge flocs, adsorption, binding and complexation of metal ions in extracellular polymeric substances (EPS) and diffusion of metal ions into the activated sludge flocs. These heavy metals can also have inhibiting or toxic effects on the biomass in a biological wastewater treatment system.

This article deals mainly with design, construction and operation of an MBR-plant as polishing step in the cleaning of galvanic wastewater.

The project started with a MBR pilot plant, which was installed and operated during a period of three months, in order to evaluate the fundamental suitability of this treatment process. The pilot test showed that the MBR-process is suitable to reach direct discharge quality for the filtrate from the chamber filter press. Based on the results from the pilot phase, a large-scale plant was designed, constructed and operated.

After one month of operation in the pilot phase the COD concentration in the outflow was below the limit value. During the start-up of the large-scale plant the COD-threshold value was met from right from the start.

During the pilot phase a series measurement of zinc inflow and outflow concentrations was conducted and a removal of 60% was achieved. An analysis of a sludge sample through an external laboratory during the start-up of the large-scale plant showed an incorporation in the biomass of 8.4 g Zn/kg DS. With a high specific sludge growth and at a COD-inflow concentration of 600 mg/l a Zn-removal of 2.5 mg Zn/l was calculated.

In order to remove the incorporated zinc, activated sludge has to be removed regularly from the system, this requires a good sludge growth. To achieve the sludge growth an easily degradable carbon source (acetic acid) was necessary. The nutrient contents (esp. phosphorus) in the inflow to the MBR is not sufficient for the growth of microorganism. Therefore, a liquid fertilizer was added in the pilot plant as well as in the large-scale plant.

It became already evident during the pilot phase, that a weekly cleaning of the membrane (acidic and alkaline) is necessary.

The experience with the MBR process as subsequent treatment step in the cleaning of galvanic wastewater shows that the technology can be easily adapted to different types of wastewater due to the simply controllable sludge age. The main advantages are the cost-effective construction, the freely selectable sludge age and furthermore the high degradation rates.

Additionally, this paper includes planning notes on pilot testing, membrane area selection, chemical cleaning, sludge production, heat balancing and foaming. Or experience as consulting engineers with type and configuration of membranes as well as the development of costs from 1993 until now are discussed, based on several large scale waste water projects in different fields of application like communal waste water, landfill leachate, liquid waste processing, biodiesel, soft drink production and surface water treatment from waste handling sites.

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