CERAMIC HOLLOW FIBER MEMBRANE TECHNOLOGY FOR HIGHLY AGGRESSIVE INDUSTRIAL WASTEWATER TREATMENT APPLICATIONS

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Crossflow membrane technology has gained more interest recently with an important focus in treating high total suspended solids (TSS) concentration and oily wastewater applications to recover the valuable products and reduce total waste volume. Ceramic membranes have become increasingly interesting for use in aggressive wastewater types such as high temperatures (>60˚C), heavy metals removal, algae dewatering, specialty chemicals (used in biofuels) separation when polymeric membranes often fall short. Ceramic Hollow Fiber Membranes (CHFM) show the advantage of a high volumetric filtration area and high flux rates compared to other ceramic membranes with different geometric membrane designs. In addition to the hollow fiber structure, Microfiltration (MF) and Ultrafiltration (UF) membrane pore sizes (30-130nm) are developed for treating various wastewater types for achieving high flux while meeting the permeate water quality requirements.

CHFM's performance parameters resulting from pilot tests are given with respect to the effect of membrane pore size, crossflow velocity, transmembrane pressure, the separation characteristics and the cleaning efficiency while achieving highest solids concentrations (>10%) and stable operational flux conditions. The present study is focused on CHFM's pilot tests with three different industrial wastewater qualities and it shows significant filtration performance advantages and huge potential for cost savings in terms of total cost of solution.

The first application deals with metal finishing industry wastewater filtration of high organic suspended solids with oily compounds and produce reusable clean water for further reusing in the production process with further treatment. The CHFM filtration performance shows high permeate quality (turbidity <1NTU) and stable filtration flux in operation. CHFM's MF and UF membranes demonstrate flux values of 100-340LMH while concentrating wastewater from 1.2% to >11% solids thereby reducing total wastewater volume.

In the second application, the CHFM's are tested in an algae dewatering application. During the filtration performance tests using MF and UF membranes, a stable flux with no in increase in TMP as concentration increased. The different pore size membranes fluxes range from 150-250 LMH with retentate microalgae TSS concentration factor of 30x. The TSS results show a significant pre-concentration of algae from 0.15% to a dry weight percentage of 5%.

The third application is dewatering of an anaerobic digester biomass wastewater using microfiltration and ultrafiltration CHFM's. The feed wastewater stream is highly organic (COD~10,000ppm) with TSS ~ 1.5%. The crossflow filtration of 80nm and 30nm shows stable flux performance in the range of 100-130 LMH with high concentrations of biomass up to TSS >8%. The filtration performance parameters resulting from experimental investigations show the

cleaning efficiency of the newly developed ceramic hollow fiber membranes compared to conventional dewatering technologies.