

SLUDGE MANAGEMENT IN INTEGRATED RECYCLED FIBRE BASED PAPER MILL

ABSTRACT

Graphic paper mills with integrated production of recycled fibre with de-inking process generate large amounts of sludge. Limited possibilities for sludge recovery in other sectors and high costs for sludge treatment are the main reasons for sludge energy recovery with heat and electricity cogeneration being one of the best available techniques for sludge management. Waste activated sludge (WAS) has poor dewatering properties and without drying or mixing it with primary sludge, biomass or other fuels, it is not possible to utilize it for energy recovery. To define the most efficient treatment option for WAS reduction and internal energy recovery of the entire WAS quantity, the aerobic and anaerobic degradability of WAS samples and the anaerobic degradability of different mill effluents were investigated. With anaerobic or aerobic WAS digestion the total WAS quantity was reduced only by 23–26%. WAS pre-treatment with alkali hydrolysis or ozone solubilised 5–12% of WAS solids, releasing inhibitory substances, such as vinyl crotonate, which inhibit WAS biodegradation and decrease the efficiency of WAS biological solids reduction to 16–24%, and methane production from 124 to 87 m³t⁻¹ COD_{fed}. Dehydration properties of solids residue after alkali hydrolysis decreased as well. The most efficient treatment option for WAS reduction (55–65%) was the anaerobic pre-treatment of the effluent from de-inking process or mill effluent after primary treatment and the elimination of suspended solids. The average efficiency of COD reduction was 67.6% for de-inking effluent and 64.8% for mill effluent. With this solution it is possible to produce 440–496 m³ of biogas per t of COD removed. The addition of 18 v/v.% of municipal wastewater before anaerobic treatment increased the WAS reduction to 78% with a positive impact on the treatment costs due to reduced need for nutrients supply and for cooling the process wastewater. The effluent emissions and biological treatment efficiency remain at the same level with the anaerobic pre-treatment as with the aerobic stage, but the volume of aeration tanks can be reduced by up to 80%. The anaerobic pre-treatment of the studied wastewater effluents enables a complete energy recovery of the entire mill primary sludge and WAS, a reduction of biological wastewater treatment operational cost by up to 58% (environmental taxes included) and mill conventional energy demands by up to 2.7%, resulting in total mill cost savings of up to 5.2 € per ton of paper.

Keywords: anaerobic digestion, aerobic digestion, de-inking, paper mill sludge, paper mill effluents.