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Combined abiotic and biotic waste water treatment originating from pulp and paper mill industry

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In 1995 the german pulp and paper mill industry used up more than 300 million cubic metre water. The high water consumption makes it necessary to recirculate processes waste water. For this reason exist a demand to new economical practicable waste water treatment technologies – also applicable for other waste waters. In lab-scale we coupled electrolytic (iron and aluminium sacrificial anodes) and biological (biofilm reactor) treatment stages to purify original waste water observed by DOC (dissolved organic carbon). As preliminary test we applied a screening-program of microbial degradation (BOD – biological oxygen demand in Sapromat) with different supplementations of nutrients. The juvenile biofilm layer upon immobilisation units has been build up in adaptation to the original waste water.
The combined methods acquired degradation rates of more than 95% of the organic load (DOC). Electrolysis moiety was 20% of DOC-decrease and the advantage of filtration the influent waste water for the biofilm reactor. The applied screening program with Sapromat acquired microbial degradation from 75% - by special nutrient addition.

Waste water

The raw wastewater has its origin directly out of paper mill factory and was sampling from the influent in the community sewer system. Whereas transport waste water has been cooled by 4°C.

Electrolysis

After microbiological and chemical analysis (DOC, BOD, pH-value, etc.) the wastewater treated electrolytic with sacrificial anodes (iron and aluminium – in alteration). After filtration step the DOC decreased for 20% - related to origin wastewater. Beside the property of DOC reduction resulted the separation of the insoluble fraction out of waste water caused by filtration.

Screening

A special screening program with BOD furnished the optimum of nutrient balance. Several dose rates of inorganic nutrients in different samples leads to results shown in diagram 1 - composition and other results in table 1.

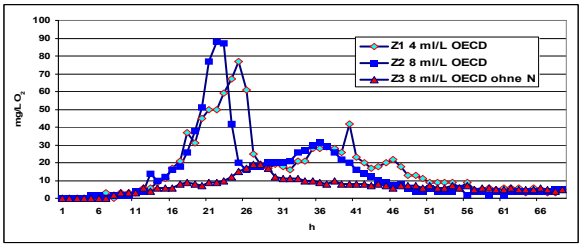

Diagramm 1: Chronological progress of oxygen consumption with different nutrient supplementations

Batch	BOB_{start}	DOC_{start}	DOC_{end}	Decomposition	pH_{start}	Supplementation
	mg/L	mg/L	mg/L	%	pH_{end}	
1	1155	690	153	78	7 / 8,2	OECD[1]
2	1024	690	145	79	7 / 7,9	OECD[2]
3	484	690	435	37	7 / 7,9	OECD[3]
4	142	690	600	13	7 / 8,2	only N-addition
5	565	690	450	35	7 / 8,2	only P-addition

N = nitrogen; P = phosphorus; OECD [1] = 4 ml/L; [2] = 8 ml/L; [3] = without N; Table 1: Composition and results of Screening-batches in Sapromat

Waste water

Electrolysis

Screening

Build up of an adaptated biofilm

Biofilmreactor DOC-degradation

Build up of an adaptated biofilm

The specific building up of an adaptated biofilm is a very important step. Properties of the first (juvenile) biofilm must include the degradation potential to organic compounds of waste water and stable the efficiency of the adult biofilm. These organic compounds are not always suited for the first building up of biofilm. For this reason the addition of qualified organic and inorganic nutrients is necessary. The synthetic nutrients are added in a whole C:N:P-ratio of 100:12:1 to the waste water. If the DOC increases to a stable final value the step of building up is closed.

Biofilmreactor - on-line DOC-degradation

The pretreated waste water will be leaded over the adaptated biofilm for a period higher than the hydraulic residence time (165 min.) of the biofilmreactor. DOC has been measured continuously at effluence of biofilmreactor.
The progress of DOC shows diagram 2.

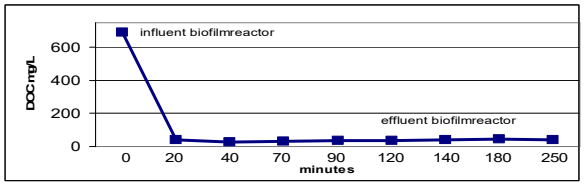

Diagram 2: Degradation of electroytic pretreated waste water in biofilm reactor