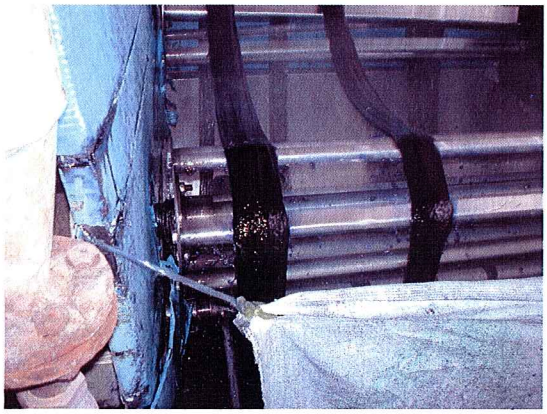
Development of process technology for treatment of Wastewaters from Greeting Knit Wear in Tirupur, India.

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The project – an overview

Background

Textile industries create difficult waste waters from the dyeing and washing steps. Many of the dyes are chosen since they are stable against bleaching from UV-light, washing procedures etc, and therefore it is a challenge to microbially degrade such compounds. These aromatic compounds have a tendency to intercalate with the nucleic acids and are therefore regarded as potentially hazardous.

The aim of the project.

The project is focused on microbial degradation of the toxic chemicals present in wastewater in order to initially release the water to local recipients, and in a later stage to reuse the water within the factory.

Identification of the problems:

The streams of wastewater from different stages in the production process have been analysed (Table 1) and based on these analyses several problems have been identified.

- High COD concentrations in all effluents. Applying the rules of thumb for the nutrient requirements of aerobic and anaerobic treatment (C:N:P = 100:5:1 and 250:5:1, respectively), it is clear the proprietary pollutant is organic matter (COD).
- high concentrations of dyes in the dyeing solutions
- dyes present in the washing solutions
- high pH in 3 streams
- low pH in 1 stream
- surfactant present in the washing solutions
- the present process involves precipitation using ferrous sulphate and lime and the precipitate is stored within the premises of the company. The precipitate contains high concentrations of dyes and is regarded as hazardous waste
- the wastewater treatment ponds at the premises hold alkaline water with relatively low toxicity

The targets for the present project:

The intentions are to develop, first a laboratory scale process for treatment of synthetic wastewater with a composition regarding critical components identical to that of wastewater. When a functioning labscale process is established, pilot studies will begin. A pilot plant shall be built on site, but the budget for this installation is not included in this application. Following are the main targets of the project:

- efficient degradation of textile dyes within the procion group of dyes
- removal of surplus hydrogen peroxide
- control of toxicity of water prior to, during and after treatment

Expected results of this project:

A strategy for efficient treatment of wastewater from textile industry, more specifically from Greetings Knit Wear, Tirupur, India

Identification of organisms that can be used when constructing bioreactors for treatment of textile dyes.

Identification of organisms that can be used to eliminate surplus hydrogen peroxide.

A strategy for treatment of textile industrial wastewaters that can be applied at many different textile industries.

Table 1: All samples were filtered using 0.45 μm filter prior to analysis. When needed, the samples were also diluted with deionized water prior to analysis.

Parameter	Solar evaporation fng I	Solar evaporation fng III	Treated water	Wash water	Dye bath water
pH	10.03	9.56	1.57	8.97	10.34
COD (mg/l)	2806	2240	684	780	2262
NH_4-N (mg/l)	ND*	4.28	3.41	8	2.44
NO_3-N (mg/l)	2.76	3.27	3.2	0.28	1.57
PO_4-P (mg/l)	1.61	3.69	0.48	1.69	2.13

* ND = not detected

Methods to be applied:
Bioreactors will be used since then high densities of the active organisms can be maintained. Some different inexpensive carrier materials will be used for spontaneous colonization of suitable microorganisms, some of which have been isolated and multiplied in laboratory fermenters prior to establishing the culture for wastewater treatment.

Effect of pH: since several streams are alkaline (Table 1), it would be attractive to operate at a high pH, since then less neutralization will be used. There are however also some streams with neutral or acidic conditions, such that they can be used for dilution of the waste streams, thereby reducing pH somewhat. The organisms available at present will be tested, but there will also be ongoing isolation in order to search for organisms that are even more adapted to the conditions in the wastewater.

Monitoring of degradation: It is important to register how the dye compounds are degraded since if only one or two bonds are degraded, colour may disappear but still there will be aromatic compounds present in the wastewater. If that happens, reaction conditions must be optimized such that complete mineralization takes place.

Degradation can be monitored by making mass balances and registering consumption of oxygen and production of carbon dioxide. The degradation process will also be monitored using modern analytical techniques such as HPLC and GC, and when needed GC-MS or LC-MS. All these pieces of equipment are available at the laboratory in Lund, and therefore it is important to create a good platform with regard to analysis when carrying out the laboratory experiments. To identify some indicator substance is highly desirable, since then one can estimate the progress of the process by simply follow the fate of the indicator molecule.

Preliminary tests indicate that the most effluents should be compatible for biological treatment is their toxicity could be decreased. This results should however be confirmed.

Toxicity testing: The wastewater will be tested prior to, during and after the treatment in the bioreactors with regard to toxicity. These tests will be chosen among a number of different toxicity tests often used when evaluating wastewaters.

The microorganisms involved: It is known that some fungi are very competent to produce enzymes that are capable to modify compounds that normally are regarded as very recalcitrant. After the initial modification, bacteria may continue the degradation until complete mineralization is obtained. A range of different fungi will be evaluated with regard to their ability to produce the necessary enzymes for the initial catalytic steps.

Combined physical-biological treatment: It has been shown that UV-treatment in presence of specific catalysts (e.g. titanium dioxide) is efficient to initiate modifications of recalcitrant molecules that afterwards are more easily degraded by bacteria. When dealing with polyaromatic hydrocarbons it was clearly seen that the more complex structures were those preferentially modified by UV and that they were degraded in the subsequent biological step. Since sunshine is abundant in India, such a treatment will also be evaluated.

Time frame: It is planned that work will be on-going for one year involving laboratory work with both model (synthetic wastewater) and real wastewater. A postdocfrom India will be involved in the project. Most of the work will be carried out in Lund, but there will of course be visits to Greetings Knit Wear Tirupur in order to plan for the pilot plant that will be the next step and that needs to be installed at the premises of the company at Tirupur.

Collection of dyeing solution before treatment

The washing water

The project is planned to involve one postdoctoral scientist for one year together with supervisors in Lund.

Estimated budget:

Postdoc fellowship à 15.000 SEK/ month	180.000:-
Supervision (20% of an assoc. prof.) 7.000 SEK/month + lkp	127.680:-
Analyses	40.000:-
Travels India – Sweden return 3 times	36.000:-
Subtotal:	383.680:-
Administrative charges (university overhead + tax)	215.820:-
SUM	**599.500:-**

Earlier experiences:

The Department of Biotechnology in Lund has a long experience of similar projects. Work has been carried out regarding cleaning up waste water from a coke-factory in Egypt, natural rubber processing in Thailand, mine waters in Bolivia, pesticide containing waters in Nicaragua and many more similar projects. There is also experience from degradation of polycyclic aromatic compounds from coal tar in Sweden, processing of leachate water from waste deposits and degradation of textile dyes in Tanzania and of recalcitrant organic chemicals in Sweden.

Analyses always constitute an important part of a project and analytical protocols are usually established during the initial phase of a project. This will happen here as well.

High cell density reactors constitute a fundamental building block when constructing this type of processes. Cell immobilization/adhesive growth of cells has been studied and used for more than 30 years by the applicant and his co-workers.

Some references of relevance. For a more complete list, please contact and a list will be sent.

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