Mauritius Research Council

Application of Ultrafiltration for Treatment of Dyehouse Effluent for Reuse

Final Report

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APPLICATION OF ULTRAFILTRATION FOR TREATMENT OF DYEHOUSE EFFLUENT FOR REUSE

ASSESSMENT OF THE EFFICIENCY OF THE ULTRAFILTRATION SYSTEM (FINAL REPORT)

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INTRODUCTION

Following the successful mounting and testing of the ultrafiltration (UF) system, an operation and sampling programme was devised. Samples tested were the final softening baths of:

- An optical white process
- A cotton reactive dyeing

For each bath the filtration process was studied over a 5-day period and samples were collected at regular intervals for analysis. In all 15 samples were collected for each bath.

1.0. FILTRATION TESTS USING THE UF SYSTEM

The final softening bath from each selected from each selected process was collected into the addition tank of the dyeing machine. The effluent was then pumped into the ultrafiltration apparatus and the resulting permeate collected into the addition tank of another dyeing machine. The retentate was discharged into the effluent open channel. Figure 1 is a schematic representation of the UF system and shows the flow rate of the different water streams

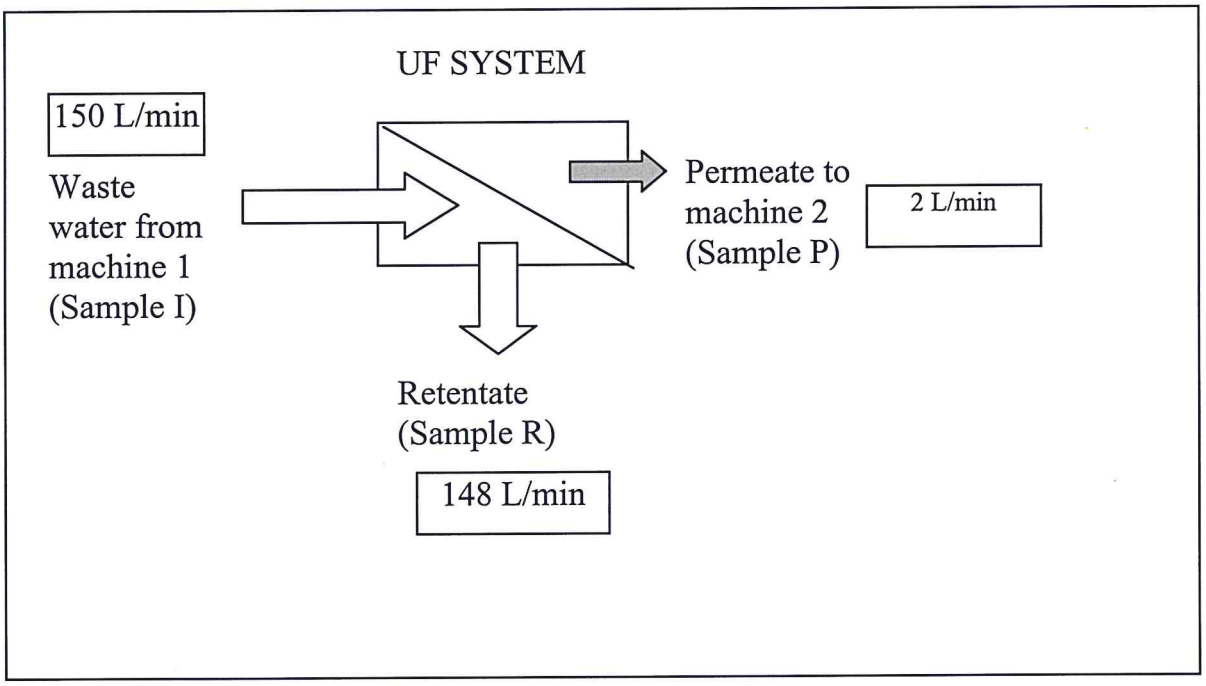


Figure 1: Schematic representation of UF system with the flow rate of the different water streams

More detail of the UF system is given in appendix 1 together with the mode of operation shown in appendix 2.

2.0 FILTRATION TEST

2.1. FINAL SOFTENING BATH OF AN OPTICAL WHITE PROCESS

The results are given in figure 2

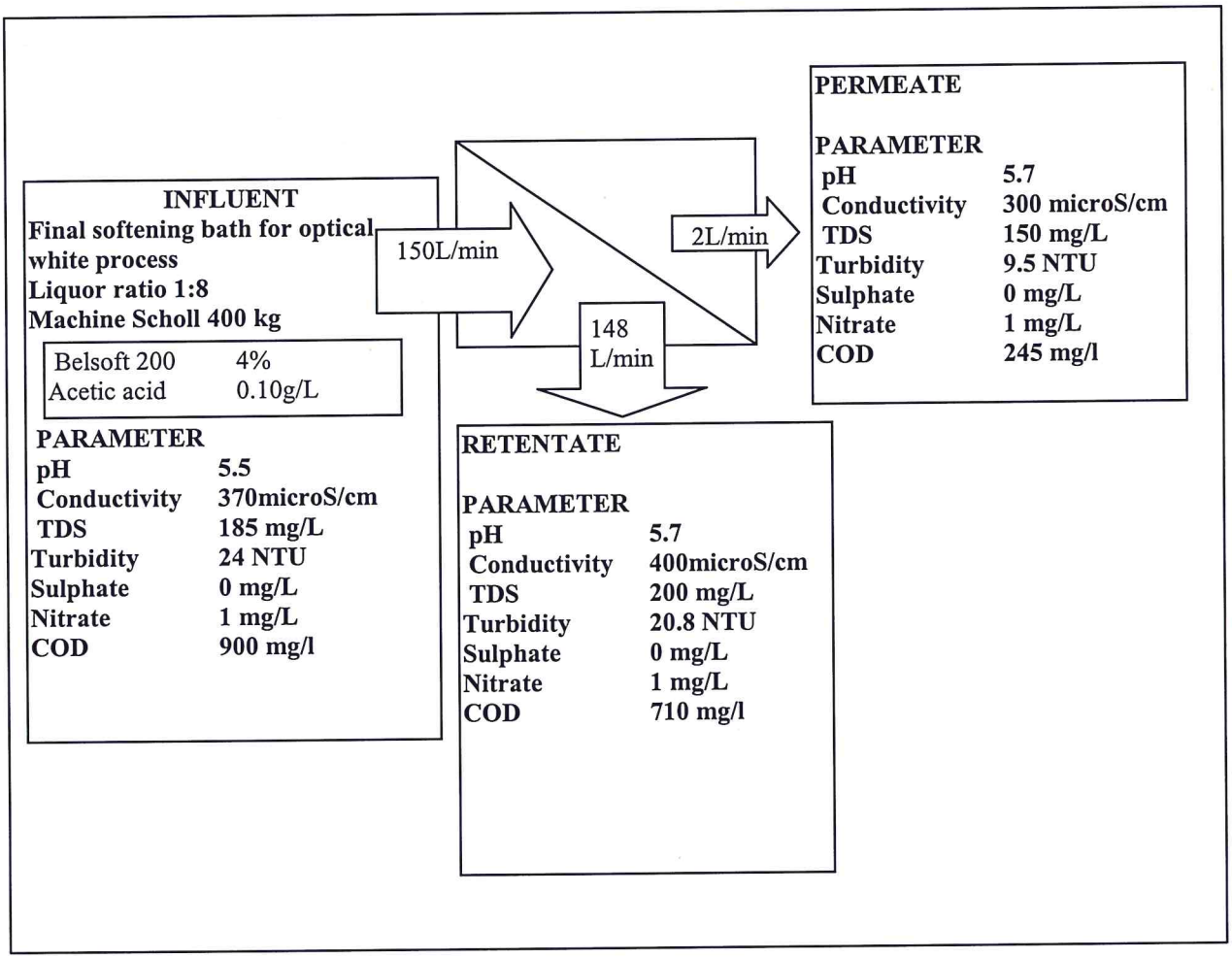


Figure 2: Filtration results for optical white process

From the results obtained, the COD of the final softening bath is relatively high due to the presence of acetic acid and residual softener. It is important to note that in the case of optical white process, only part of the softener is 'fixed' on the fibre. The retentate obtained has got a slightly lower COD due to the pre- filtration through the 10 microns filters before entering the UF module. The permeate obtained has got a COD of 245 mg/L (73 % reduction). This water could easily be reused as utility water (e.g. floor washing).

2.2. FINAL SOFTENING BATHS OF OTTON REACTIVE DYEING

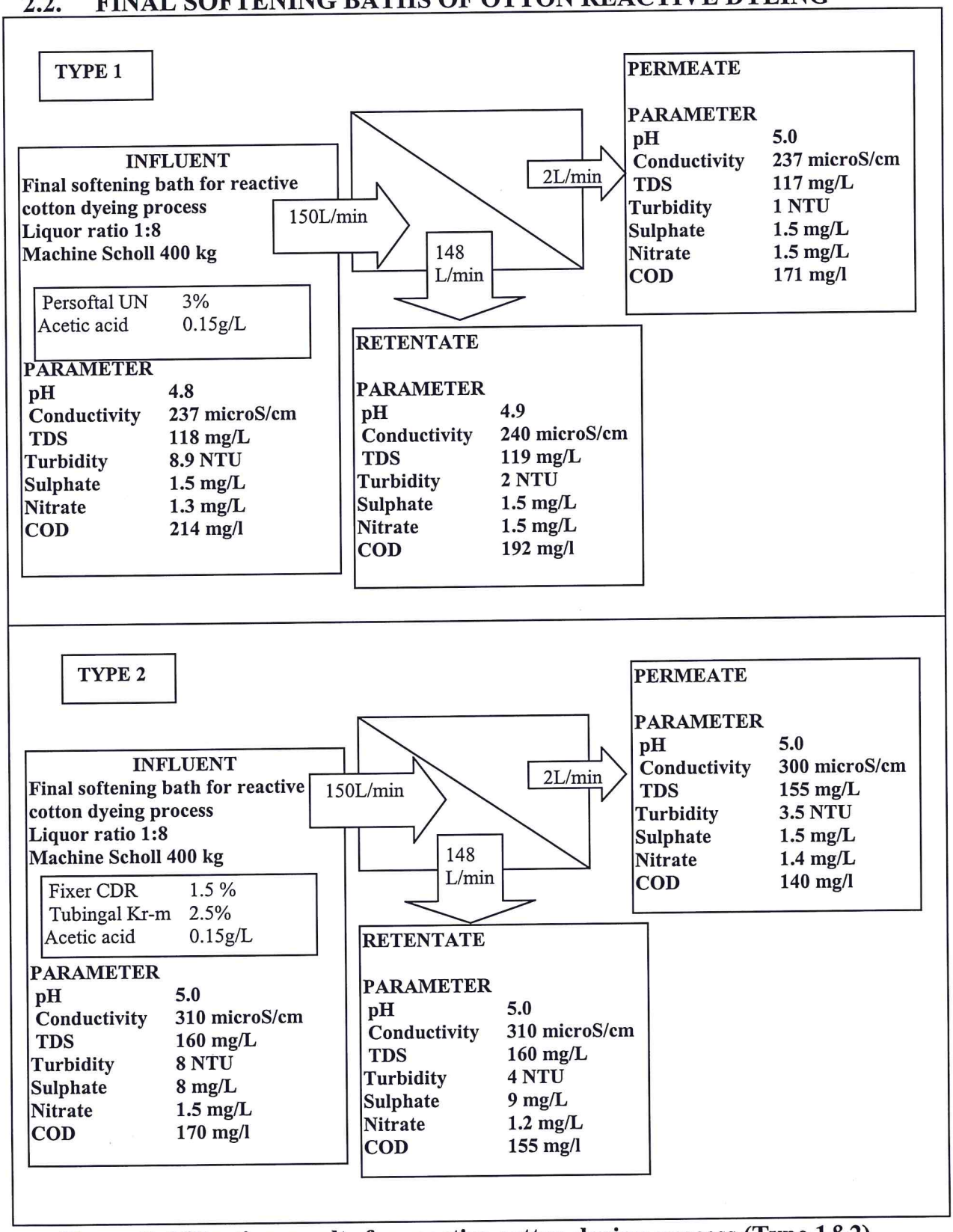


Figure 3: Filtration results for reactive cotton dyeing process (Type 1&2)

The results obtained in these cases are different. The softeners used are reactive ones hence have more affinity for the fibre (only a small amount of residual softener will be present in solution). The COD of the influent water is mainly due to the acetic acid (CH_3COOH) which cannot be removed by the UF system. The resulting permeate has therefore a slightly reduced COD (20%). It should also be noted that tests were carried out on 2 types of baths (Type 1 & 2).
In type 1, only acetic acid and the reactive softener are used whereas in type 2, a fixer is also used. This chemical allows more softener to be fixed on the fibre hence the COD of the resulting influent bath is smaller.

3.0 DISCUSSION OF RESULTS

The use of UF to treat effluent for reuse either directly in the dyeing process or in the dye house as utility water has been documented. However, the factor that mitigates heavily against it is the low volume of permeate generated. From the tests carried out it was observed that less than 2 % of the filtered effluent was recuperated as the permeate. The hydraulics of the system should be modified so as to increase the efficiency of the permeate production and thus make the system more attractive from the point of view of cost. The improvement of the system can be brought about by reducing the feed (influent) of the UF apparatus followed by a re-injection of the retentate into the UF apparatus. This recycling will bring about concentration of some solutes (molecules $\geq 0.01\mu m$). This concentration process will increase the efficiency of the UF system and produces a higher volume of permeate. Figure 4 shows the modification. A potential benefit of this recycling process is the direct reuse of the concentrated retentate, after adjustment of salt and dyes in a dyebath. However, this would necessitate careful consideration in addition to proper planning of the dyeing processes.

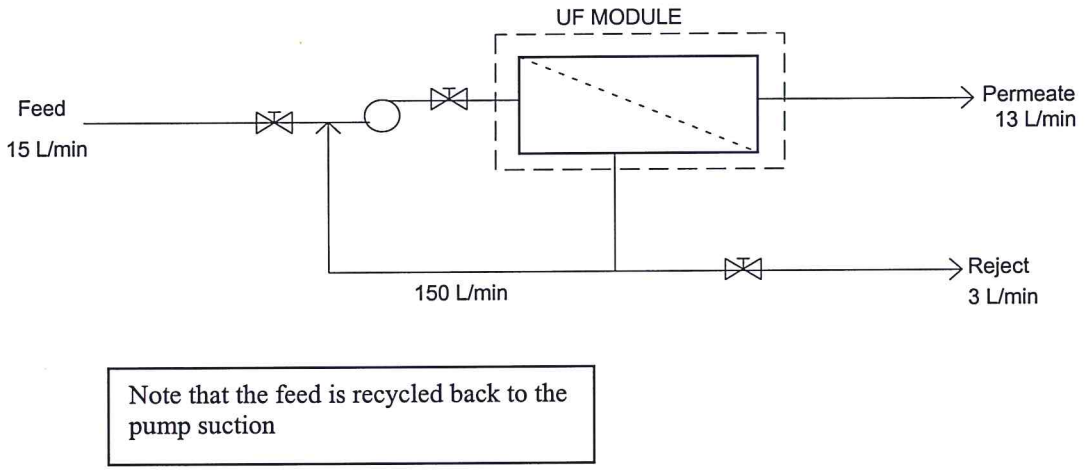


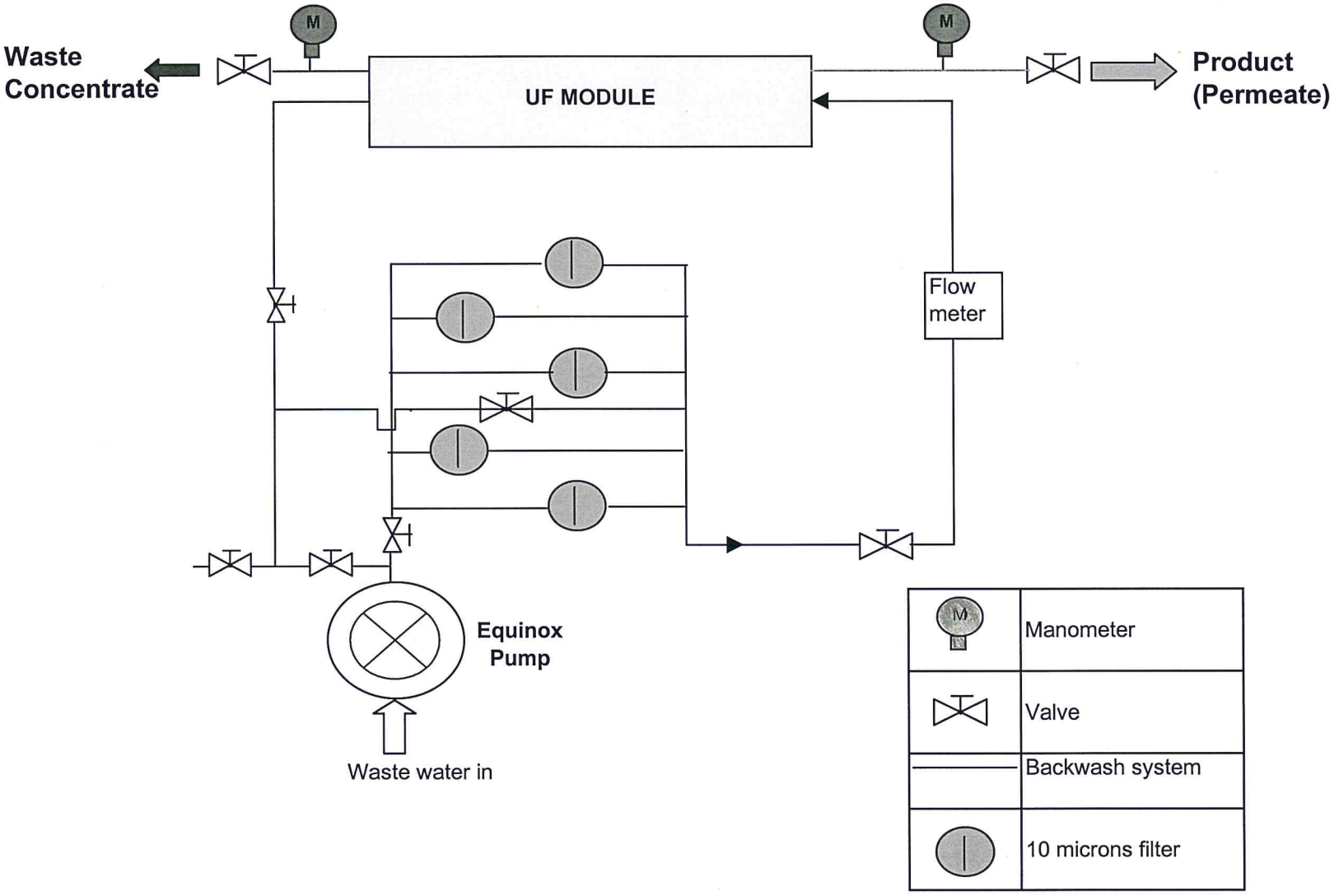
Figure 4: Schematic representation of the modification to be done on the system

This study has involved the following main stages

(i) Survey of the water use and wastewater produced by the factory
(ii) Survey of the chemicals used
(iii) Wastewater characterisation
(iv) Identification of the waste streams that could be reused and those that would need treatment
(v) Construction and testing of the UF system
(vi) Assessment of the efficiency of the UF system (Final Report)

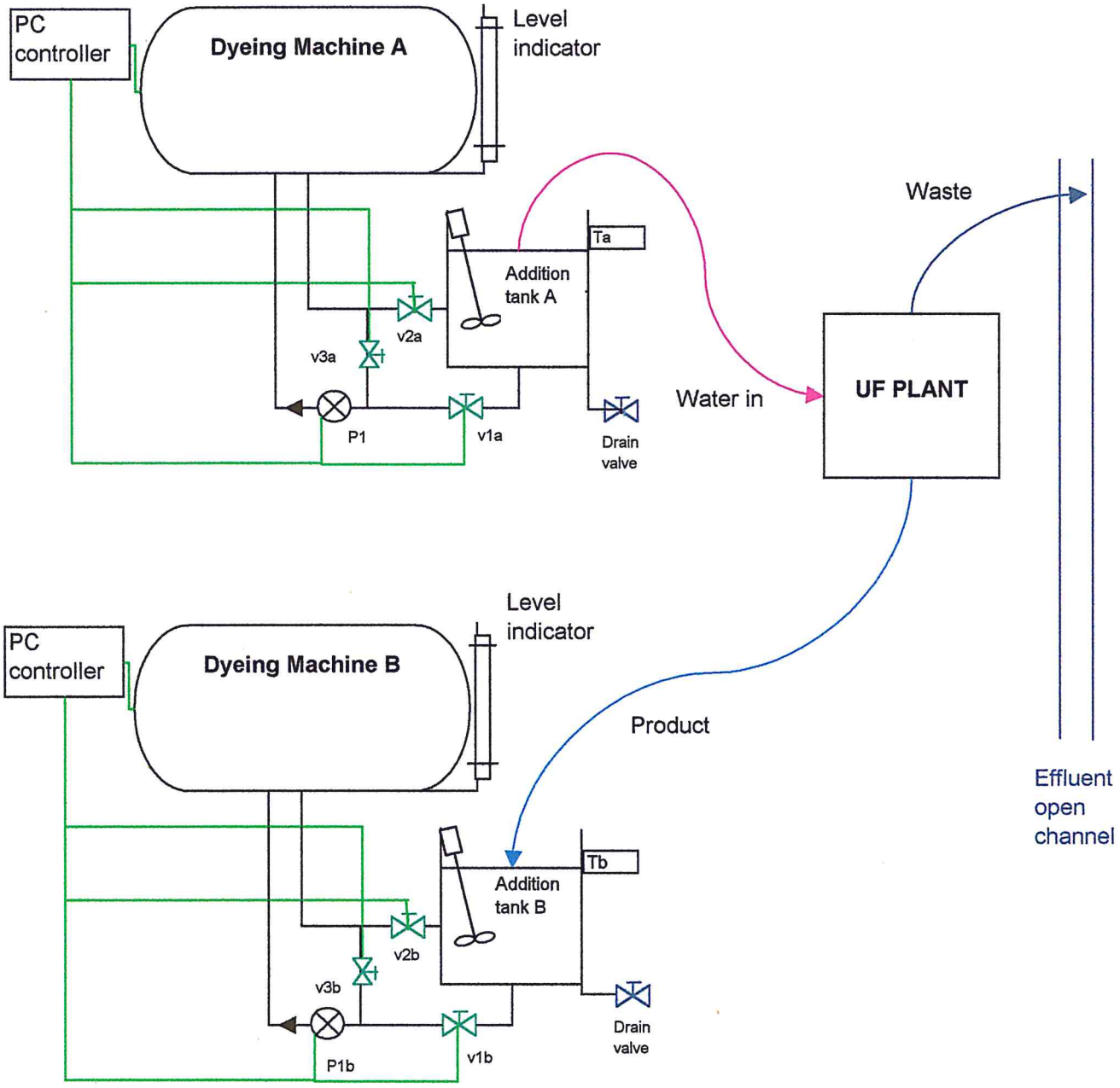
APPENDIX 1

SCHEMATIC REPRESENTATION OF ULTRAFILTRATION PLANT



APPENDIX 2

MODE OF OPERATION



Tb Ta	Gives the volume of water in addition tanks a & b and the respective temperature
	Valve (pneumatic)
	Pump (injection/circulation)
	Mixer

Remarks

1 The additions tank are usually used for dissolution and/or injection of chemicals and/or dyes in the machine. It also provides an easy sampling method

2 Dyeing of samples can also be carried out directly in these tanks (used as small dyeing machines)