Title:
Neuro-fuzzy system control for optimum process water recirculation in paper mills

Background/Problem
Dynamic processes that take place during papermaking may limit or restrict the availability of process water, thus temporarily overloading the effluent treatment plant and causing an increase in fresh water requirements. Buffer tanks serve to compensate for recirculated water availability and requirements. In the present state of the art, they are operated in an open-loop system at fill levels that fluctuate between predefined minimum and maximum levels. A closed-loop process water recirculation system that is responsive to the operating conditions opens up a significant optimisation potential. The development of such a control strategy is a fundamentally new approach that has yet to be put into practice in papermaking. In view of the complexity of the dynamic processes, however, classical control methods have hardly proved to be suitable. Fuzzy systems and neural networks, on the other hand, make it possible to emulate expert systems when solving complex problems. Numerous real-time or even contradictory requirements on the results of control may be integrated. Practice-oriented solutions can be developed with reasonable investment that even include the expert knowledge and experience from mill operators.

Research objective/Research results
The major goals of this research project are to safeguard water availability and to guarantee a uniform supply of water to thus ensure that the effluent treatment plant functions at optimum performance levels, thus complying with effluent discharge limits. In addition, investments for buffer tanks and effluent volume are to be reduced and odour problems caused by prolonged dwell times are to be avoided. The results gleaned from the submitted project shall serve as guidelines for developing fuzzy control strategies for a process water recirculation system in paper mills. A systematic approach will be developed for setting up such a fuzzy control system in each individual application.

Application/Economic benefits
A uniform effluent flow improves the performance of effluent treatment plants and can prevent limit values from being exceeded when effluents are discharged. Costs may also be saved when buffer tanks are purchased. If the trend towards reducing the specific effluent volume continues, more buffer capacity must be made available for recirculated water to avoid bottlenecks due to water shortages. The resultant capital expenditure requirements for buffer tanks can be reduced by installing the control system to be developed. The requested research project also aims at preventing non-specific additions of fresh water such as fresh water supplements when water buffers run low, thus reducing the effluent volume accordingly. It is possible to install a ready-made fuzzy control system in an existing process control system at relatively little extra expense. Developing the fuzzy control system, on the other hand, requires considerable outlay. In particular small and medium-sized enterprises, that cannot afford the high development costs, will therefore profit from the development of general criteria for structuring a fuzzy system and the definition of typical fuzzy rules that can subsequently be adapted to each individual case.

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Remarks
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