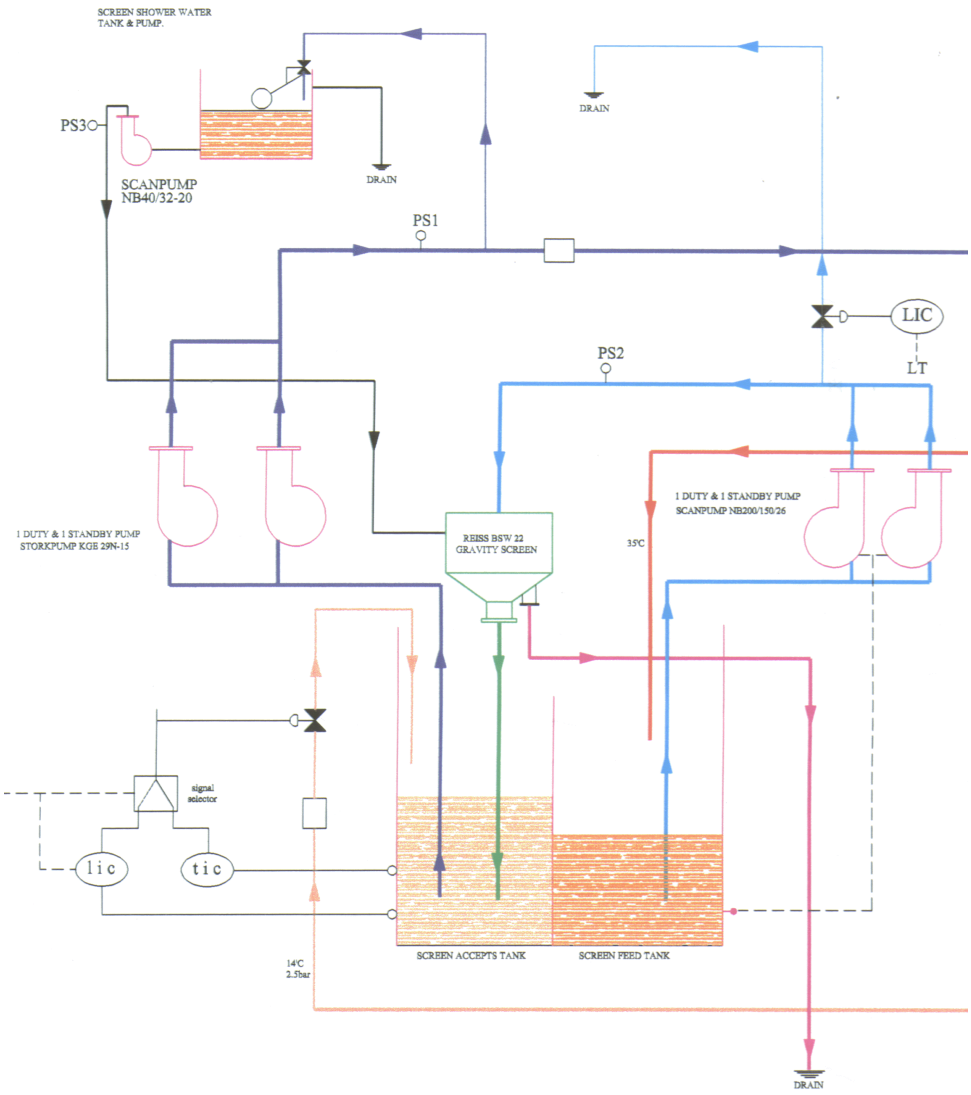
ISC Project Note – No. 17

Water Conditioning Plant Design for Paper Mill

Our client had a requirement to reduce loading on the mill's effluent plant. The solution was to re-cycle a significant proportion of the gland sealing water for the vacuum pumps. This was achieved by re-circulation through a filter and direct cooling with a fresh water supply (see line diagram below). Pre-owned pumps of similar size to that required were to be used.



The design challenge was to ensure that appropriate pump impeller design and valve sizes were selected to obtain the specified operating points and dynamic performance. Of specific concern were the controllability of water temperature and levels in the two vessels within the plant. Traditional design methods concentrate on static operating conditions. However, *dynamic behaviour determines stability* and tests the physical limits of the plant.

Industrial Systems and Control Limited
50 George Street
Glasgow
G1 1QE

tel. +44 141 553 1111
fax +44 141 553 1232
e-mail iscmail@isc-ltd.com
web site *www.isc-ltd.com*

It was felt that used alone, traditional static calculation design methods carried too much risk. The client asked ISC to check the plant design's performance and recommend changes required using a more rigorous design method. The work was conducted early in the plant's design phase to enable the results to be utilised.

The approach taken was to build a mathematical model with differential equations. Once built in to a simulation environment these accurately characterise the physical behaviour of the plant. This ensures that dynamic as well as static behaviour is appropriately represented.

The first step taken was to determine the model boundaries. Then the energy storage points within the plant boundaries were represented by the differential equations. Specifically these were for the kinetic energy of water masses in pipe/pump sections and potential energy of water masses stored in system vessels.

Once built, the model was run in the simulation environment to emulate different operational scenarios.

An interesting discovery was that, as designed, the steady state flow through the screen feed pump was higher than required for the plant. Correct flow could be achieved by regulating with a valve or, for better energy efficiency, changing the pump impeller design. Additionally the system outflow control valve used to regulate one of the tank levels was too large as originally sized. A smaller valve in this location gave a far superior dynamic response.

While typically applied as a plant/control design tool, modelling is also an effective technique for investigating process problems, operating limits and behaviour under different conditions.

The techniques discussed have been successfully used on a broad range of process industry applications from small-scale food plants to large-scale nuclear power plants.

ISC Limited supplies process control consultancy services to all of the major process industries. The services supplied include control design for new plant, process troubleshooting, training and technology transfer.

For a direct client reference and more information contact:

Andy Clegg or Andy Buchanan at ISC Limited tel. - +44 141 553 1111

Industrial Systems and Control Limited
50 George Street
Glasgow
G1 1QE

tel. +44 141 553 1111
fax +44 141 553 1232
e-mail iscmail@isc-ltd.com
web site *www.isc-ltd.com*