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Multi-duty Cl_2 Scrubber

COVEY CASE STUDY

Our client operates a facility using moderate quantities of chlorine gas which are unloaded from tankers. A scrubbing system was required that could cope with a wide range of operating conditions, which included:

- Idling conditions, small air flow, no chlorine.
- "Sniff gas" during unloading, small air flow containing modest chlorine level.
- Mild upset, similar flow but now all chlorine.
- System failure with more than ten times normal gas loading and all chlorine.

The unloading system had many safety measures built in and the extreme case was expected to be very rare, but capable of coming into operation automatically without having been tested for long periods.

The system was to be built using a series of three existing towers, but with new piping, tower internals and instruments. All three tower had large sumps and worked with recirculation of liquid from these sumps through the packing.

The first difficulty was the extreme range of flows. With the normal arrangement of counter-current flow through the towers (as in the previous configuration) the gas flow would cause flooding under system failure conditions (i.e. the gas flow would be too high to permit liquid to flow down the packing). We were able to overcome this by exploiting the irreversible reaction between chlorine and sodium hydroxide and using **co-current** downward flow in the first two towers. This arrangement could cope with the extreme flows, but with little loss of efficiency during normal operation.

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Calculations showed that even in mild upset conditions, just one of the towers was sufficient to scrub the residual chlorine to safe levels. Therefore a control strategy was devised whereby sodium hydroxide losses were minimised, but there was always sufficient sodium hydroxide in the system to accommodate an unloading system failure.

Normally substantially all of the scrubbing was done in the first tower, and this was controlled to discharge spent sodium hydroxide to maintain a constant concentration in the first tower sump. The second and third towers normally contained substantially fresh sodium hydroxide and flow was cascaded to maintain level in the first tower sump.

In the event of a system failure, chlorine would rapidly break through from the first tower, but would be substantially all absorbed in the other two towers. Sensors in these towers would rapidly detect the loss of sodium hydroxide strength and cause fresh chemical to be added to the system, but in fact the inventory of sodium hydroxide in the sumps would be sufficient under all envisaged conditions.