UCRL-JC-125326 Abs

PERCHLORIC ACID HOOD SAFETY I: FAN SELECTION .

R. J. Kelly, Hazards Control Department, Lawrence Livermore National Laboratory, University of California, 7000 E. Avenue, L-143, Livermore, CA 94551

Laboratory use of perchloric acid poses special concerns, as it can react with a wide range of materials to form potentially explosive perchlorates. Use of perchloric acid at or near its boiling point ("fuming") produces acid vapors and mist which can condense and accumulate in laboratory hoods, forming unstable perchloric acid crystals or perchlorates. Typically, a wash-down system is installed in perchloric acid exhaust systems to allow the rinsing of the stack, fan, ducting and plenum.

Although it has been known for more than 40 years that a special exhaust system design is required when fuming perchloric acid, recent experience at the Lawrence Livermore National Laboratory (LLNL) suggest that standard industry design, especially for new hoods currently being marketed, may be inadequate. A study was undertaken of several perchloric acid exhaust fan designs to determine the safest and most reliable system.

LLNL possesses approximately 50 hoods originally designed for perchloric acid work. Until recently, all of these hoods have been exhausted by vane-axial fans. In the last year, two new types of fans, specified for perchloric acid exhaust systems by major vendors have been installed: the standard horizontal-axis centrifugal fan and the axial-centrifugal fan. Testing of the standard centrifugal fan arrangement, which requires two 90 degree duct bends, demonstrates that this design is difficult to wash down effectively, is prone to leaks and perchloric acid crystal formation, and when washed down in accordance with the manufacturer's instructions, ejects a plume of contaminated wash water 20 feet into the air.

In contrast, the axial-centrifugal fan seems to offer all of the advantages of both the centrifugal fan (energy efficiency, higher static pressure capability) and the older vane-axial fan (ease of wash-down, intrinsically leak-resistant housing). However, the fans we purchased arrived with several design defects, including a perchloric acid-incompatible gasket and an internal area which would tend to trap water. These were retrofitted and the system now performs effectively and safely.

The axial-centrifugal fan was judged to be the best overall fan for use in perchloric acid exhaust systems. Alternatively, the traditional vane-axial fan may be used where the static pressure requirements are not excessive. Although we do not have any at LLNL, many authors recommend the air ejector type of fan. However, the centrifugal fan, currently marketed for perchloric acid systems, is not well suited to this service.

This work was performed under the auspices of the U.S. Dept. of Energy at LLNL under contract no. W-7405-Eng-48.