

SAFER AND QUICK ACCESS

TO

MIST ELIMINATORS

Mr. Paul M. Hennessey
Director, Technology
OTTO H. YORK COMPANY, INC.
42 Intervale Road
Parsippany, N.J. 07054 U.S.A.
Phone: (201) 299-9200
Fax: (201) 299-9401

Mr. Philip Van Dessel
Senior Sales Engineer
OTTO YORK N.V.
Terlindenhofstraat 36 - Bus 6
B 2170 Merksem, Belgium
Phone: 32-3-647-2847
Fax: 32-3-647-2879

Abstract

Introducing the Type "D" Safety Scrubber - A versatile mist elimination system for sulfuric acid dry towers.

This major advancement in vessel design boasts significantly improved safety and operating benefits in maintenance, reliability, turn around time, and turn down capability; plus it provides efficiency never before achievable with standard mesh pads. This paper explains these benefits and illustrates how the new design actually precludes the necessity for men to enter the vessel when maintenance is necessary on the DEMISTER[®]!

In addition to the vessel, the DEMISTER itself may have an advanced two-stage design which appreciably reduces the costly acid carryover that corrodes ducts, heat exchanges and burner plenum while selectively collecting solids on the lower pad which can quickly and easily be cleaned.

Illustrations and photographs of the Safety Scrubber are included, plus information on the efficiency, safety and benefits of this innovative system.

Type "D" Safety Scrubber

An overriding concern of the chemical process industries today is for the health and safety of its employees. A goal embraced by every progressive company is to assure every working man and woman in the organization a safe and healthful working environment. Success in this endeavor provides for the welfare of both the individual and the company. Those involved with the production and use of sulfuric acid must be especially cognizant of the hazards of this familiar commodity.

Every operator of a sulfuric acid plant is acutely aware of the dangers inherent in handling such a highly reactive material, in particular, the dangers involved with personnel entering vessels where the hot acid creates an extremely hazardous environment for those who must work there for reasons of maintenance and repair. Operators are all too familiar with the corrosive effect of sulfuric acid on skin, mucosa and eyes as well the physiological response to the inhalation of sulfuric acid mist. Many governmental authorities set threshold limits on sulfuric acid aerosols of 1 mg/m³, above which it becomes noticeable by odor, taste, and with obvious irritation in the pulmonary passages.

What these hazards add up to is a very serious problem involving the health, welfare and moral of employees who operate sulfuric acid plants. With the necessary protective equipment for working inside a dry tower or an absorption tower a worker is, at best, uncomfortable, apprehensive and somewhat frustrated in attempting to achieve professional workmanlike results while inhibited by heavy rubber protective clothing covering 100% of his body and breathing through a respirator or from an external air supply. Additionally, the workmen will be on surfaces made slippery by acid and the slime which collects in these towers.

Since entering a drying or absorption tower to inspect, clean, repair or replace mist elimination equipment is a high risk assignment for maintenance personnel it is necessary to have elaborate procedures to maximize the safety of the operation. Entry permits normally require all lines to be blanked, pumps locked out, environment checked for temperature and tested for oxygen and hydrogen, that the proper protective clothing is being used, that those entering are on a tether, that there is a "buddy" at the manway to monitor those inside, that emergency equipment is available, and that everyone involved is properly instructed. Although these steps are necessary some are occasionally skipped at risk of serious injury or even death.

The inside of towers and tanks is considered a "Confined Space" and statistics are kept in the U.S. on injuries in confined spaces.

INJURIES DUE TO CONFINED SPACES
DATA FROM U.S.A.

- . NIOSH Study Over A Three Year Period
 - 78 Deaths Per Year, Average
 - 64 Injuries Per Year, Average
 - 92 Confined Space Accidents

- . OSHA Review of Reported Accidents
 - 173 Deaths Resulting From 122
Confined Space Accidents

Figure 1

Responding to the need to minimize or eliminate these hazards the engineers at the Otto H. York Company, Inc. have designed the mist elimination sections of dry towers and absorption towers to allow complete access to the mist elimination elements from outside the tower. Since the elements can all be extracted for examination, repair or replacement from outside the tower there is no reason for personnel to enter the tower for these purposes.

SAFER AND QUICKER ACCESS SYSTEM FOR MIST ELIMINATORS WITH YORK SAFETY SCRUBBER

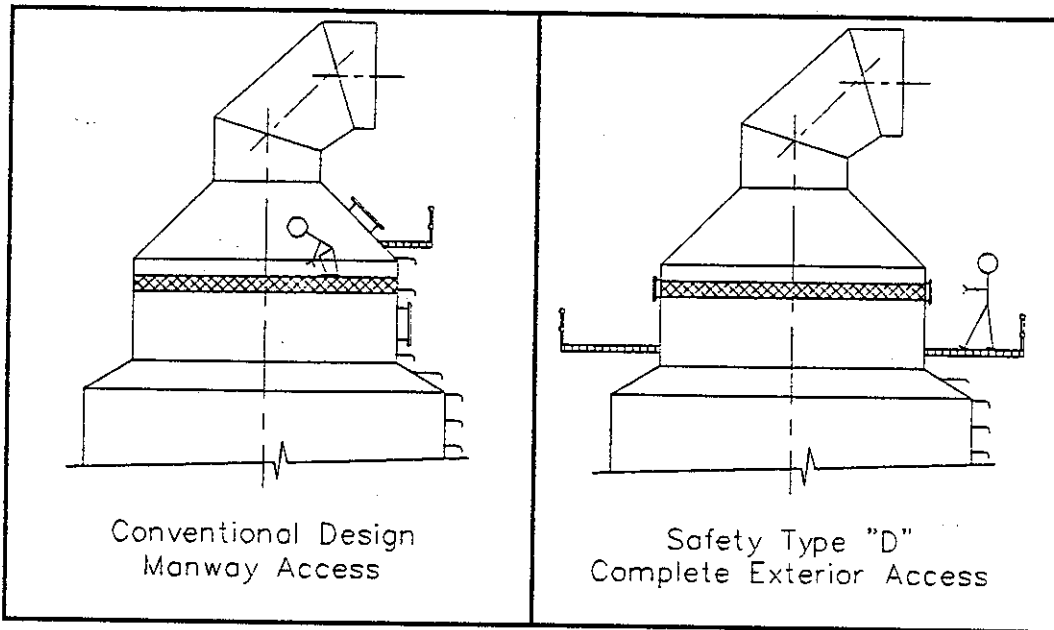


Figure 2

This accessibility is achieved with a rather unique design that allows individual mist eliminator elements to slide in and out without disturbing the adjacent elements. On larger vessels - over 3.0 meters in diameter - access is provided from opposite sides in order to keep the mist eliminator section to manageable lengths. Obviously, the proper platforming must be provided to pull sections up to 3.0 meters long. For dry towers the pads are usually horizontal, but can be on an angle for increased capacity. Either way, the simplicity of the installation results in a number of benefits. The most important benefit is obviously personnel safety, but there are also significant operational benefits which alone can make the system attractive.

The most obvious operating benefit is the reduction in down-time and lost production when inspection or maintenance is required on the mist eliminator. Time saved can be anywhere from several hours to a day or more and when demand for fertilizer is high every hour is important. Down-time can be even more painful in metallurgical plants when regulations on SO₂ emissions require a smelter to stop operation if the acid plant is not functioning.

Let us consider the normal safety procedures which consume valuable time when maintenance personnel must enter a tower to repair or replace mist eliminator elements.

1. Cool-down the vessel.
2. Blank-off lines
3. Lock-out pumps and blowers.
4. Test the atmosphere inside for O₂ and H₂.
5. Dress workman in protective equipment.
6. Bring safety equipment to manway locations.
7. Instruct mechanics in safe working procedures for vessel entry.
8. Two people always outside the manway and in continuous communication with those inside
9. Ventilate vessel at 6 to 10 changes per hour.
10. Vessel entry permits signed by management personnel.

The times for these functions are not all additive, but all consume man hours. It is only after all these steps are taken that men can be allowed to enter the vessel. Then the required work can be done. But those inside the vessel are encumbered by protective clothing and can not work nearly as fast as they could if the work could be accomplished on an outside platform with less elaborate protective clothing. The time required for this internal work, depending on the size of the tower, can stretch anywhere from 8 hours to several days. On the other hand, with external access it has been shown at installations of the Safety Scrubber that pads can be replaced in less than 4 hours. Time saved is directly convertible to benefits on the bottom line.

Quick access to the mist eliminators has additional benefits when a plant must operate at less than full capacity. In these conditions it is entirely feasible to blank-off one or more sections of the mist eliminator so that those remaining in service can operate at peak efficiency. By using an hour or two to blank-off a calculated number of sections a plant can operate at low levels without any penalties in terms of corrosion to down stream equipment or damage to the catalyst.

We have made an extensive search for accident data relating specifically to sulfuric acid plants and while this information is not readily available we have reviewed related information from these sources:

1. U.S. Occupational Health and Safety Administration (OSHA)
2. State of Florida Division of Safety - Injury and Illness Survey (Florida has the highest concentration of acid plants in the U.S.A.)
3. Marsh and McLennon Insurance Co., (M & M) - Property Damage Reports with large losses.

These studies show unequivocally that the number and magnitude of accidents in the chemical process industry are increasing. Consequently, insurance premiums have been escalating while availability has been decreasing. Only those companies demonstrating strong safety records, good engineering and strict loss prevention practices can find reasonably priced coverage. In M & M's analysis, the number and size of accidents is primarily attributed to the aging equipment in the chemical process plants of the United States.

The best data we have relating to sulfuric acid plants is from the State of Florida, Division of Safety which reports that the number and severity of accidents in the phosphate fertilizer industry has a slight downward trend. That is the good news. The bad news is that the category of accidents which includes fatalities appears to be increasing.

A Contribution To Safety In Sulfuric Acid Plants

Common sense makes it obvious that elimination of a requirement to enter an acid tower is a major contribution to safety. This is accomplished by providing flanged openings through which sections of a DEMISTER can be inserted into their individual compartments. The plan view of such an arrangement is shown in Figure 3. The elevation view is shown in Figure 4.

CONCEPTUAL DIAGRAM OF YORK TYPE "D" SAFETY SCRUBBER - PLAN

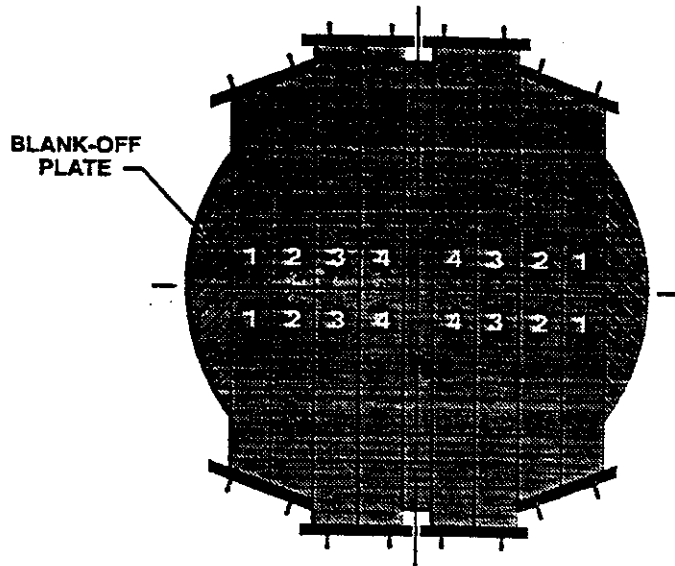


FIGURE 3

CONCEPTUAL DIAGRAM OF YORK TYPE "D" SAFETY SCRUBBER - ELEVATION

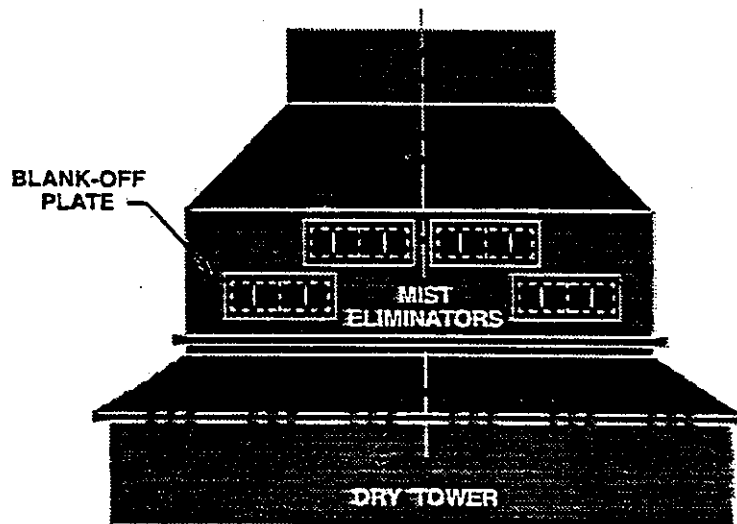


FIGURE 4

In special cases it may be desirable to design the Safety Scrubber as a two stage device particularly where the gas may contain fine solids as in some metallurgical plants. Such an installation is pictured in Figure 5.

YORK TWO-STAGE TYPE "D" SAFETY SCRUBBER

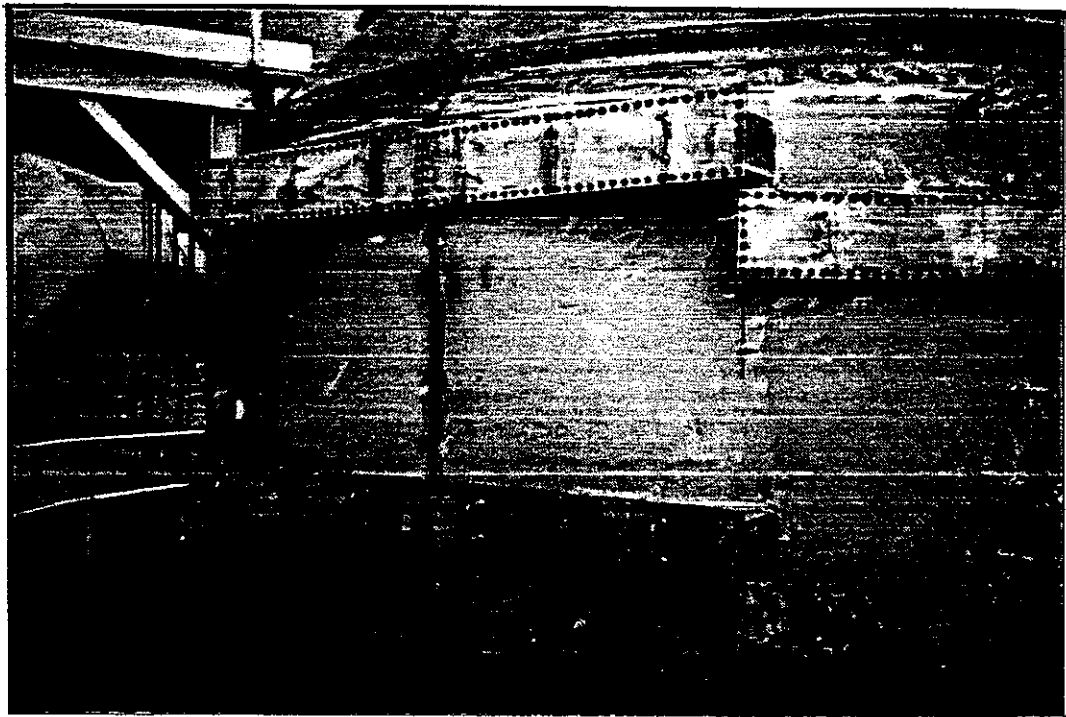


FIGURE 5

This unit is designed to preferentially collect solids on the lower DEMISTER pad while the upper pad provides a high degree of efficiency. This efficiency - 99.4% of 2 micron particles, 70% of 1 micron particles - is afforded by a proprietary mesh design using a combination of metal wire and a multifilament fluorocarbon. This combination can have a lifespan in concentrated acid service of five years or more; made possible by the use of highly resistant alloys such as SX^R or LEWMET^R. The selection of alloy for the mesh will depend on concentration and temperature of the acid, impurities in the acid and the desired life cycle.

Summary

Since a responsible company will put the health and welfare of its employees at the top of the company priority list it is fortuitous when other benefits of a design encourage the company to reinforce this priority. The Safety Scrubber is one such design. It provides:

- . A system where workers have reduced requirement for exposure to the hazards of entering a sulfuric acid tower.
- . A system where DEMISTERS can be serviced on platforms outside the towers in conditions for faster, easier repairs.
- . Reduced down time when DEMISTERS have to be serviced; usually four hours or less.
- . Turndown capability without loss of efficiency by blanking off DEMISTER sections to maintain optimum velocities through the remaining sections.
- . A boost to employee morale by reducing the hazards to which they are subject.
- . A salutary effect on insurance premiums because of a safer plant.
- . High efficiency with the proprietary mesh designs used in the Safety Scrubber. Essentially 100% of all mist droplets 2 microns in size and larger.
- . Long service life for the DEMISTER through the use of highly resistant materials such as SX, LEWMET, and certain fluorocarbons.

References:

1. OSHA Standard for Confined Spaces, 29CFR Parts 1910, Federal Register, January 14, 1993.
2. Florida Division of Safety, Statistical Unit, Occupational Injuries and Illnesses Survey, 1990.
3. D. G. Mahoney, Editor, "Large Property Damage Losses in the Hydrocarbon - Chemical Industries - A Thirty-Year Review", Fourteenth Edition. Marsh & McLennon Co.
4. John F. Rekus, "Invisible Confined Space Hazards Require Comprehensive Entry Program", Occupational Health and Safety, June, 1991.