United States Environmental Protection Agency | Office of Water Washington, D.C. | EPA 832-F-00-019 September 2000

Wastewater Technology Fact Sheet
Ammonia Stripping

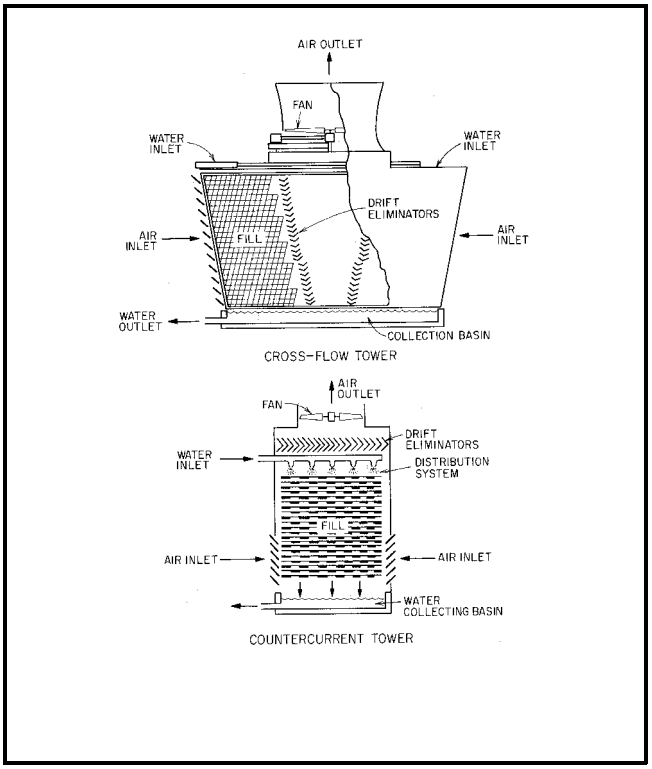
DESCRIPTION

Ammonia stripping is a simple desorption process used to lower the ammonia content of a wastewater stream. Some wastewaters contain large amounts of ammonia and/or nitrogen-containing compounds that may readily form ammonia. It is often easier and less expensive to remove nitrogen from wastewater in the form of ammonia than to convert it to nitrate-nitrogen before removing it (Culp *et al*., 1978).

Ammonia (a weak base) reacts with water (a weak acid) to form ammonium hydroxide. In ammonia stripping, lime or caustic is added to the wastewater until the pH reaches 10.8 to 11.5 standard units which converts ammonium hydroxide ions to ammonia gas according to the following reaction(s):

$$NH_4^+ + OH^- \leftrightarrow H_2O + NH_3$$

Figure 1 illustrates two variations of ammonia stripping towers, cross-flow and countercurrent. In a cross-flow tower, the solvent gas (air) enters along the entire depth of fill and flows through the packing, as the alkaline wastewater flows downward. A countercurrent tower draws air through openings at the bottom, as wastewater is pumped to the top of a packed tower. Free ammonia (NH_3) is stripped from falling water droplets into the air stream, then discharged to the atmosphere.



Source: Culp, *et. al*, 1978.

FIGURE 1 TWO TYPES OF STRIPPING TOWERS

APPLICABILITY

Ammonia stripping works well with wastewater that has ammonia contents between 10 to 100mg/l. For higher ammonia content (more than 100mg/l), it may be more economical to use alternate ammonia removal techniques, such as steam stripping or biological methods. Air stripping may also be used to remove many hydrophobic organic molecules (Nutrient Control, 1983).

ADVANTAGES AND DISADVANTAGES

The following advantages and disadvantages should be considered when comparing ammonia stripping with other ammonia removal systems.

Advantages

- The operation is relatively simple and not affected by wastewater fluctuation if pH and air temperature remain stable.
- Ammonia stripping is a mechanical procedure and creates no backwash or regeneration.
- Ammonia stripping is unaffected by toxic compounds that could disrupt the performance of a biological system.
- Ammonia stripping is a controlled process for selected ammonia removals.

Disadvantages

- Water must be re-pumped to the stripping tower. Pumping requires higher maintenance and power requirements.
- Scale formation can be removed hydraulically in most cases but not all, resulting in a need to pilot test at most locations.
- Ammonia stripping cannot be performed in freezing conditions (unless sufficient heated air is available). Fogging and icing result in a significant reduction in ammonia removal.
- While ammonia is usually discharged to the atmosphere at low level (6 mg/m^3), this may be unacceptable in certain locations due to air quality concerns or regulations.
- Ammonia stripping does not remove nitrite and organic nitrogen.
- Air pollution problems may result from ammonia and sulfur dioxide reaction.
- Air stripping often requires the addition of lime to control pH, which may create operation and maintenance concerns.
- Noise may be a problem.
- High pH wastewater will corrupt the wood packing of the stripping tower.

DESIGN CRITERIA

The following criteria should be considered when designing ammonia stripping systems. Optimum conditions are noted in parentheses.

- Hydraulic wastewater loading (0.1 to 0.2 $l/min/m^3$ or 1 to 2 $gal/min/ft^2$).
- Stripping air flow rate (32 to 54 $l/min/m^3$ or 300 to 500 $ft^3/min/gal$).
- Packing depth (6.1 to 7.6 meters or 20-25 ft).
- pH of wastewater (10.8-11.5).
- Air pressure drop (0.015" – 0.019" of water/ft).
- Blower type.
- Site and land requirements.
- Packing material (plastic or wood).
- Packing spacing (approx. 5 cm or 2" horizontal and vertical).
- Water temperature.
- Plant capacity.
- Ammonia concentration of the wastewater.
- Water distribution uniformity.
- Scale removal and ease of cleaning up.

The introduction of air into the system is the major design difference in the two basic types of towers. Air enters from the side in the cross-flow tower, which is less efficient than the countercurrent tower where the air enters from the bottom of the tower.

PERFORMANCE

Ammonia stripping performance is highly dependent on air temperature and air/water ratios. Efficiency decreases significantly as air temperature decreases. At 20EC (68EF), there is a 90 to 95% ammonia removal efficiency, while at 10EC (50EF), efficiency decreases to 75 percent.

Lake Tahoe EPA Research Project

Lake Tahoe found that the removal rate was 95 percent ammonia nitrogen at 11.5 pH using 53,460 l/m^3 (400 gal/ft^3) wastewater during warmer weather (Culp *et al.*, 1978). Erected in 1969, the 7.3 meter (24-foot) tower uses a cross-flow design to treat a flow of 28,390 m^3/day (7.5 MGD).

OPERATION AND MAINTENANCE

A routine O&M schedule should be developed and implemented for any ammonia stripping system. Regular O&M includes the following activities:

- Following all manufacturer O&M recommendations.
- Testing and calibrating equipment.
- Maintaining pumps and blowers.
- Inspecting the tower periodically for fouling.
- Maintain proper air and water flows.
- Proper pH adjustment with lime requires safe handling.
- Clarifying the influent before stripping.
- Monitoring and controlling noise from the stripping equipment.

Table 1 lists sources and solutions to noise problems.

COSTS

The cost of ammonia stripping depends on the manufacturer, the site, the capacity of the plant, the ammonia concentration of the wastewater, the flow rate desired, the types of blowers, and the water temperature (water temperature affects design which affects price). Price comparisons are possible with a specific set of design criteria. Operation and maintenance include power, materials, chemical, and labor.

TABLE 1 SOURCES OF AND SOLUTIONS TO POTENTIAL NOISE PROBLEMS

Noise Source	Possible Solutions
Motors	Proper installation, maintenance, and insulation
Fans	Reduction in tip speed and installation of exhaust silencers
Water Splashing	Water shielding of the tower packing and air inlet plenum

Source Culp *et al.*, 1978.

REFERENCES

Other Related Fact Sheets

Other EPA Fact Sheets can be found at the following web address:
http://www.epa.gov/owmitnet/mtbfact.htm

1. "Air Stripping" [http://www.scana.com/sce%26g/business_solutions/technology/ewtwair.htm].
2. Cornwell, David A., 1990. Air Stripping and Aeration. In Water Quality and Treatment: A Handbook of Community Water Supplies. Ed Pontius, Frederick W., AWWA 4th Ed. McGraw-Hill, Inc., NY.
3. Culp, Russel L.; Wesner, George Mack; and Culp, Gordon L., 1978. *Handbook of Advanced Wastewater Treatment*. 2nd Ed. Van Nostrand Reinhold Co., NY.
4. *Nutrient Control, Manual of Practice FD-7 Facilities Design*, 1983. Water Pollution Control Federation.

5. U.S. EPA, Wickramanayake, G.B.; Evers, D.; Kittel, J.A.; Gavaskar, A., 1991. *Bench-Scale Evaluation of Ammonia Removal from Wastewater by Steam Stripping.* EPA 600/2-91-046, Washington, D.C.

6. U.S. EPA, 1980. *Innovative and Alternative Technology Assessment Manual.* EPA 430/9-78-009, Washington, D.C.

7. Water Engineering & Management Ammonia Removal Suppliers [http://www.waterem.com].

ADDITIONAL INFORMATION

ResinTech, Inc.
Frank DeSilva
1980 Old Cuthbert Rd.
Cherry Hill, NJ 08034

Water Equipment Services
Mark Gorrell
6389 Tower Lane
Sarasota, FL 34240

For more information contact:

Municipal Technology Branch
U.S. EPA
Mail Code 4204
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

OWM MTB
Excellence in compliance through optimal technical solutions
MUNICIPAL TECHNOLOGY BRANCH