# EPA Facts About
# *Air Stripping*

June 1992

## What is air stripping?

Air stripping is a process used to remove volatile or certain semi-volatile organic compounds from contaminated groundwater or surface water. Organic compounds are those that contain carbon and are usually associated with life processes. Volatile organic compounds, or VOCs as they are called, are chemicals which tend to vaporize rapidly when heated or disturbed in any way. An example would be the gasoline fumes that you smell as you fill the tank on your car. In air stripping, these vapors are transferred from the water in which they were dissolved into a passing air stream. This air stream can be further treated to allow for the final collection and re-use or destruction of the VOCs.

## How does air stripping work?

Air stripping is used to remediate (clean up) groundwater or surface water that has been contaminated by VOCs. This method of remediation is often accomplished in a packed tower that is attached to an air blower. This "packed tower" is simply a large metal cylinder that is packed with material. The water stream is pumped into the top and the air stream is pumped into the bottom. The material in the tower is designed to force the water stream to trickle down through various channels and air spaces. Meanwhile, the air stream is being forced into the bottom and flows upward, exiting at the top. This is called "counter-current" flow. As the two streams flow past each other, the VOCs tend to vaporize out of the disturbed water stream and are collected in the air stream.

Figure 1 presents a diagram of the air stripping process. The contaminated surface water or groundwater is pumped from its source and is collected in large pre-treatment storage tanks. The water is then pumped into the top of the tower and leaves from the bottom. It is collected and sent on to be treated further if this is necessary. The air stream is also collected and treated to remove or destroy the VOCs.

The air stripper is an example of a liquid-gas contactor. The most efficient type of liquid-gas contactor is the packed tower. Inside the packed tower, the packing material provides more surface area for the water stream to form a thin film on. This allows much more of the air stream to come into contact with the water stream. Selecting packing material that maximizes this wetted surface area will improve the efficiency of the air stripper. Smaller packing material sizes generally increase the area available for stripping and improves the transfer process. Once the packing material has been selected, it can be packed in two different ways. First, it could simply be dumped into the top of the tower to fill it up. This is called random packing. In the second method, the packing material is arranged on trays attached at certain levels inside the tower. These trays are made of metal gauze, sheet metal, or plastic. This is called structured packing. Random packing is generally less expensive, but the structured packing allows for easier maintenance.

There are several variations of the packed tower. In one, the "cross-flow tower", the water stream flows down through the packing in the same way as the counter-current tower. The air stream, however, is pulled across the water by a fan, instead of being forced upward through the tower. The "coke tray aerator" is a simple, low maintenance process that doesn't use a blower for the air stream. The water stream is simply allowed to trickle through several layers of trays. This produces a large surface area in contact with the surrounding air. Another method, "diffused aeration stripping", uses basins instead of a tower. The water stream flows either from the top to bottom of the basin or from one side to the other while air is dispersed from the bottom of the basin and allowed to "bubble-up" through the water. These fine bubbles tend to disturb the liquid and carry some of the VOCs away when they leave the liquid at the top. Finally, "rotary air stripping" uses the centrifugal force caused by a rotating cylinder instead of gravity to pull the liquid through the packing material. The use of centrifugal force seems to be more efficient because the liquid is spread in thinner layers over the packing material. The revolving motion also tends to disturb the liquid a great deal. Both of these factors increase the efficiency of this type of air stripper. The biggest advantage, however, is the smaller size of the device. A small rotary device can strip the same amount of water as a much larger packed tower.

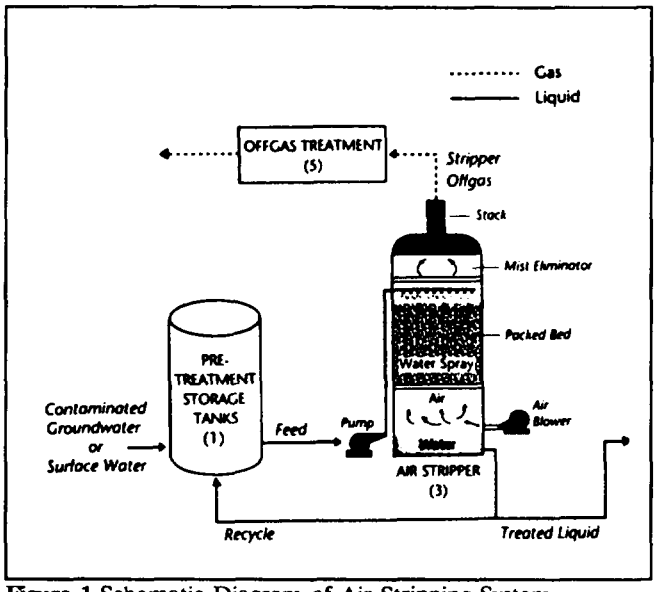

Figure 1 Schematic Diagram of Air Stripping System

## What are the applications of air stripping?

Air stripping is used to remove volatile organic contaminants from liquids. These organic compounds include 1,1,1-trichloroethane, trichloroethylene, dichloroethylene, chlorobenzene, and vinyl chloride. Stripping is only partially effective in some cases. In these cases, stripping must be followed by another process to remove the remaining contaminant. The equipment used in air stripping is relatively simple, allowing for quick start-up and shut-down. The modular design of packed towers allows for easy maintenance. These factors make air stripping well suited for hazardous waste site operations.

An important factor to consider when looking at air stripping as a remediation option is the air pollution impact. The gases generated during an air stripping may require the collection and treatment of the waste air stream. Often, computer modeling of the air stripper is required before operations can begin. These models are used to predict the stripper impact on the surrounding atmosphere.

## How well does air stripping work?

Air stripping has been successfully used to treat water that has been contaminated with volatile organic compounds (VOCs) and semi-volatile compounds. Air stripping has been shown to be capable of removing up to 98 percent of VOCs and up to 80 percent of certain semi-volatile compounds. The method is not suitable for the removal of some low-volatility compounds, metals, or inorganic contaminants. Air stripping has commonly been used with pump-and-treat methods for treating contaminated groundwater. In this method, the groundwater is removed from the ground by pumps, treated in the packed tower and often returned to the same area.

## Where have air strippers been used?

An air stripping system was installed at the Sydney Mine site in Valrico, Florida. The packed tower was 42 feet tall, four feet in diameter, and contained a 24-foot section of packing material. The packing material was 3.5-inch diameter (baseball-sized) polyethylene balls. The average water flow rate was 150 gallons per minute.

Air stripping was also used at a municipal well site in the city of Tacoma, Washington. Five towers were installed in this operation. Each tower was 12 feet in diameter and was packed with one-inch saddle shaped packing material to a depth of 20 feet. The average water flow was 700 gallons per minute for each tower. The towers consistently removed 94 to 98 percent of the contaminants.

## Are residues generated by air stripping?

The primary residues created with air stripping systems are the waste gas coming from the top of the tower and the treated water coming from the bottom. The gas is released to the atmosphere only after it is treated to remove or destroy the contaminants. The treated water may require further treatment if it contains other contaminants that were not removed during the air stripping. If the water requires further, it is treated on-site or stored for transportation to another treatment facility. Once an acceptable level of contaminants has been removed from the water, it can either be sent to a sewage treatment facility, released to a surface water body, or returned to its source if it was removed from the ground.

For more information about Air Stripping, you may contact EPA at the following address:

*U.S. Environmental Protection Agency*
*ATTN: Superfund Hotline*
*401 M Street, S.W.*
*Washington, D.C. 20460*
*1-800-424-9346 or 1-800-535-0202*

**The information in this fact sheet was compiled from Engineering Bulletin, Air Stripping of Aqueous Solutions, October, 1991.**