VOC / Chlorinated Solvents in Water Removal Using Air Stripping

Air Stripper Design Basics

Trace VOCs (volatile organic chemicals), chlorinated solvents derived from dry cleaning fluids, gasoline additives such as MTBE (Methyl tert-butyl Ether) and other solvents and chemicals often are found in ground water. A common method of removal of such compounds from water is to air strip the water – i.e. – pass the water down over a packed bed in a tower as air passes up through the tower. In the tower the offending chemical is transferred into the passing air.

Most often the design of such a tower is based upon the known Henry's Law Constant of the offending chemical species. This paper is not intended to repeat the many excellent detailed explanations of the mathematics involved – rather this paper is intended to be a brief synopsis of how such air strippers are designed on a practical level.

Henry's Law Constants – Smaller to Larger

In a nutshell, the Henry's Law Constant of a chemical species reflects that species solubility in water. Numerous extensive tables of this constant are available. And often multiple values of the constant are found in the literature for the same species. As a brief example, please note the following Henry's Law constants (source, Max-Plank Institute, Dresden, Germany) in K/mol - atm:

Vinyl Chloride:	0.000082 – 0.038
Trichloroethylene:	0.099 – 0.10
Benzene:	0.12 – 0.21
Methyl Ethyl Ketone:	6.9 – 10

The practical effect of the above data is reflected in the typical Air / Water ratio (volume to volume, so this number is dimensionless) needed to achieve good mass transfer of the target species from water to air in the stripping tower:

Vinyl Chloride:	5
Trichloroethylene:	< 30
Benzene:	~ 80 to 120
Methyl Ethyl Ketone:	2000 + (or as high as possible)

Or, in layman's terms – the more soluble in water the species being stripped – the air volume needed to strip the species out of water increases proportionally. And in this example exponentially increases in the case of MEK that is extremely soluble in water.

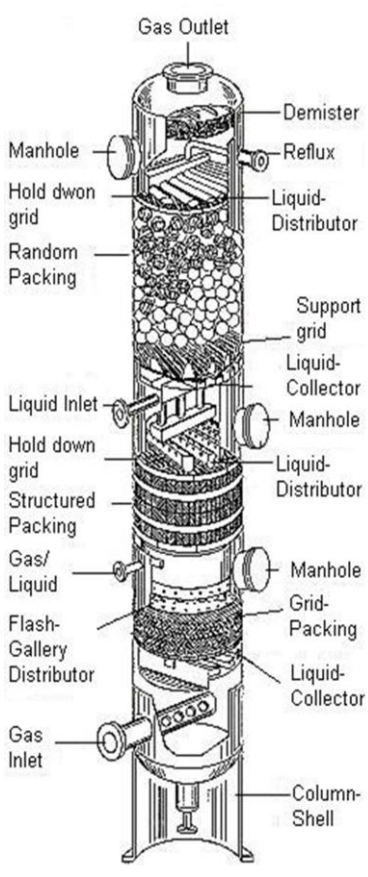
What Raschig USA Can Supply to the Project

We would be pleased to design the packed bed required and to quote the volume of random packing needed for that bed. Typically, 3.5" Jaeger Tri-Packs® are used. This packing allows for maximum air / water intimate contact within the tower. Also this packing is well established to be easy to pack very uniformly to form a consistent packed bed in a tower as well as to be fouling resistant. But based upon the specific needs of the project, other sizes of packing are available. Note this in the photo here.

Needed design data are:

Water Flow Rate
Water Temperature (and lowest possible, in this instance)
Maximum Possible Concentration of the species to be stripped
Required Removal Efficiency
Water Quality – pH, hardness, dissolved minerals such as iron, suspended solids, etc.

The last point above reflects that often when treating ground water in an air stripper consideration must be made for possible scaling of calcium and magnesium compounds as well as iron formation due to oxidation of Fe^{+2} to Fe^{+3}. Ferrous Oxide (FeO) is water soluble; Ferric Oxide (Fe_2O_3, rust) is not.



With the above data Raschig USA can return a design that specifies tower diameter, packing choice and packed depth, required air flow to achieve the stripping efficiency as well as the pressure drop across the tower.

Tower Internals: Raschig USA also carries a full line of liquid distributors, packing supports, mist eliminators and other tower internals. All of these items will be sized, if needed, based upon the specific needs of the project. If required in the project we will be pleased to quote these items.

Design assistance is complimentary and quotations are provided with no obligation to order.
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