



Water Degasification

CO₂ Removal / Air Stripping Explained

Background – *Water Chemistry Controls the Design*

A common method to adjust pH of water – typically well water intended for potable use – is to pass the water through a packed tower. Such towers intended to degas the water was also commonly called ‘air strippers’. This is because the water is passed down over a bed of ‘packing’ as air is blown into the bottom of the tower to pass up and out of the tower.

Note: as a result the water and air pass each other ‘counter currently’. This allows for the most efficient transfer of CO₂ from the water into the passing air that is possible.

But – it is also very important to consider the pH of the water being degassed. Both the initial pH of the water being treated, as well as the desired final pH of the degassed / treated water, will likely determine if a stripper tower / degassifier is practical. This is so because CO₂ when dissolved in water can assume 3 possible molecular forms, or mixture of these, dependent upon the pH of the water. The chemistry of CO₂ dissolved in water is a little complicated:

CO₂ + H₂O → CO₂ (dissolved) in H₂O, forms H₂CO₃, predominates at pH ~ 4

H₂CO₃ → H⁺ + HCO₃⁻; this is the predominate form of CO₂ in water at pH ~ 8

HCO₃⁻ → H⁺ + CO₃⁻²; this is predominate form of CO₂ in water at pH ~ 13

Please note: All of the above reactions are reversible.

Additional note: *Only dissolved CO₂ (or ‘free’ CO₂) can be removed by air stripping the water!*

Air Stripper / Degassifier Design Consequences

As a result of the pH dependence of which of the three forms CO₂, or mixture of forms, will be found in water, an absolute rule for air stripper / degasification design is:

As only ‘free’ CO₂ can be air stripped! Therefore, as a practical limit, the initial pH of the water to be treated must be no more than 6 and preferably less for this method of CO₂ removal from water to be practical!

And, as free CO₂ is removed from the water, the above chemistry lesson has the consequence that as the water passes down the tower, the pH of the water will rise. Therefore, another basic rule of water CO₂ degasification is:

As a practical consequence of the pH dependence of the various forms of CO₂ in water, the pH of the water leaving the tower can never be much greater than 7.

Water exiting a degassifier tower of pH slightly above 7 is sometimes achieved by adding several additional feet of packed depth in the tower. But to reach an exit pH of 7.5 is impractical.

Even a tower with a packed bed depth that would challenge Jack of “Jack and the Beanstalk” fame the pH of the water will not adjust higher.

Note: This is due to the ionic nature of both Bicarbonate and Carbonate ions. The electrical forces holding the ions in solution are simply too great to be overcome by any amount of air passing through any depth of packing.

Result: Practical Air Stripper / Degassifier Design

Raschig-USA can assist in such tower design. Design data that must be answer are:

- Inlet Water Flow Rate
- Inlet Water Temperature
- Inlet Water pH
- Dissolved Mineral Content – typically expressed in terms of hardness or Calcium and Magnesium content
- Desired / Target Outlet Water pH

With the above data, Raschig-USA can advise:

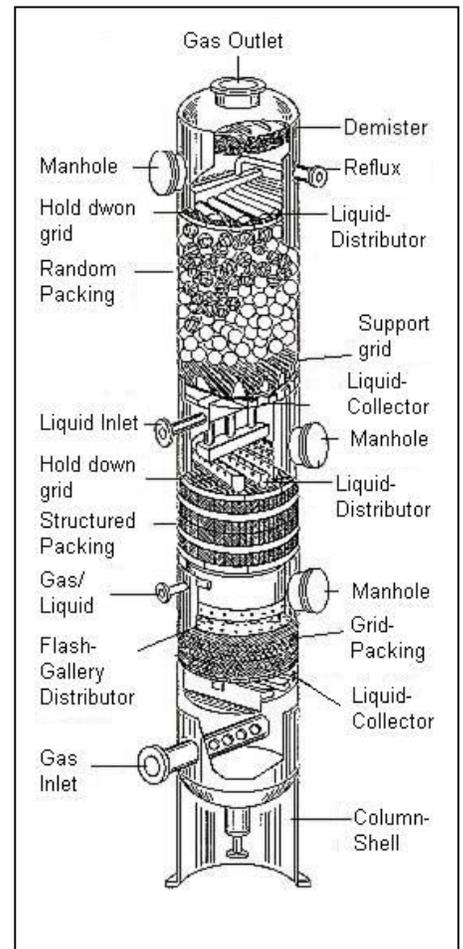
- Diameter of the tower required
- Packing depth of the random packing required
- Air flow required
- Pressure drop across the tower

What Raschig USA Can Supply to the Project

We would be pleased to design the packed bed required (tower diameter and packing depth) 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.

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, we will be pleased to quote these items.

Jaeger Tri-Packs® is a registered trademark of Raschig USA, Inc.



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

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