MEK Removal from Wastewater by Air Stripping with Q-PAC® Mist Elimination by #2 NUPAC® 35% Capital Cost Savings

Introduction

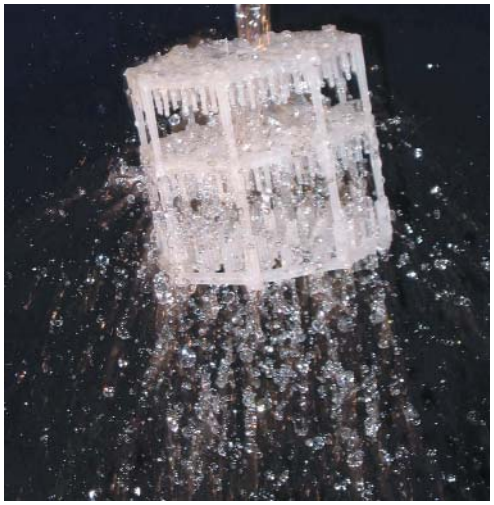
MEK (methyl ethyl ketone or 2-butanone, C_4H_8O, CAS No. 78-93-3) is a widely used industrial chemical. It is a clear, colorless, volatile liquid that is highly soluble in water. It has many uses in a wide variety of industries. Over 1 million pounds (2.2×10^6 kg) of MEK is used by industry in the United States per year.

MEK Air Stripping Tower Design

MEK has traditionally been a difficult organic species to strip from water. In a counter-current stripping tower, water with organic species flows down through the tower over a packing as air flows up through the tower. The packing is used in the tower to increase air / water contact. In this way, maximum water to air mass transfer is achieved, so the organic species is transferred, or *stripped*, out of the water and into the air.

A centralized wastewater treatment facility in the mid-Atlantic region of the United States accepts dozens of tanker trucks as well as ocean going barges each day that are the primary sources of the water treated at the facility. After treatment, the treated water is discharged into the municipal sewer system. The wastewater contains MEK, BETX (benzene, ethylbenzene, toluene and xylene) as well as other trace organic pollutants. As a result, the local water treatment authority has imposed a strict limit of < 1 mg/L of MEK in the water that may be sent to sewer. To achieve this water quality the facility investigated the various treatment technologies available to remove MEK from its process water in order to comply with the local regulatory requirement. This problem was discussed with Lantec Products, Inc. and it was agreed that the best water treatment option was an air stripping tower. The advantage of an air stripper designed to achieve high removal of MEK was that such a tower would also remove BETX compounds at even higher efficiency.

Because MEK is very soluble in water, a high air / water ratio (A/W) must be used in an air stripper to achieve mass



Q-PAC® High-Capacity Tower Packing
US Patent #5,458,817
Worldwide patents pending

transfer of MEK from water to air. Q-PAC® is uniquely suited for this type of air stripper due to its very high void fraction, 96%+. This is the highest void fraction of any commercially available packing product. Also, with minimal pressure drop, a much higher A/W ratio is possible in an air stripper packed with Q-PAC® vs. conventional packings. When placed in the tower, Q-PAC® combines high flow capacity with rapid mass transfer thanks to its regular structure of grids and rods that act as "drip points" that break the liquid stream into millions of small droplets.

Another important aspect is that the design of Q-PAC® is essentially 'self cleaning'. Fouling of the packing in air strippers has been traditionally considered an inevitable draw-back of air stripping technology. However, Q-PAC®, with all rounded surfaces, has proven to be extremely resistant to solids build up. Therefore, from a long term maintenance aspect, Q-PAC® also offers a great advantage in an air stripping project.

Consider the design of the air stripper with Q-PAC® at the aforementioned facility vs. what would have been required had a 'conventional' packing been used:

Design Parameters	
Water Flow	150 gpm (34 m^3/hr)
Water Temperature	55ºF (13ºC)
MEK Inlet Concentration	15 mg/L

Air Stripping Tower Design

	Q-PAC®	**Conventional Packing**
Air/Water Ratio	**3,000 cfm/cfm (m^3/m^3)**	2,000 cfm/cfm (m^3/m^3)
Tower Diameter	**12 ft (3658 mm)**	14 ft (4267 mm)
Gas Velocity	**530 fpm (2.7 m/s)**	260 fpm (1.3 m/s)
Air Flow	**60,000 scfm (95000 Nm^3/hr)**	40,000 scfm (63000 Nm^3/hr)
Packed Depth	20 ft (6096 mm)	20 ft (6096 mm)
Packing Volume	**2,270 ft^3 (64.3 m^3)**	3,080 ft^3 (87.3 m^3)
Packing ΔP	2.0 in WC (5 mbar)	2.0 in WC (5 mbar)
Mist Eliminator #2 NUPAC®	**depth 12 inches (305 mm)**	mesh pad
MEK Removal Efficiency	**99.3%**	97.3%
BETX Removal Efficiency	99.9%	99.9%

Design Discussion - Unique MEK Air Stripper with Q-PAC®

As previously mentioned, air stripping of methyl ethyl ketone requires a very high air / water ratio. This is quite different vs. other organic species air stripper designs, such as chlorinated hydrocarbons, benzene or other similar nonpolar organic species. When stripping these species, A/W ratios of 30 - 125 are typical, depending upon the given application. But, again, when stripping highly soluble species (MEK, NH_3, MTBE, etc) a very high A/W must be used. Therefore, in this type of air stripper design, the superficial gas velocity becomes a very important design parameter.

Note above that the gas velocity is 530 fpm in the Q-PAC® design, more than double what is practical in a traditional packing design, 260 fpm. The open structure and low pressure drop of Q-PAC® allows for this design - and also allows for the passing of 60,000 scfm through a 12 ft diameter tower, vs. 40,000 scfm through a 14 ft diameter tower - at the same ΔP of 2.0 in WC across the same depth of packing! The reduction in tower size results in a major capital expense savings, with improved MEK stripping efficiency due to the higher A/W ratio made possible by Q-PAC®.

Mist Elimination with #2 NUPAC®

#2 NUPAC® has proven to be a very effective mist eliminator media. Mist particles generated during stripping are easily captured in a small bed of this packing. The packing drains well and is a very cost effective alternative to mesh pads and chevron blades.

Advantages of #2 NUPAC® as Mist Eliminator

Drains Well	Cost Effective	Easy to Install/Remove
Hard to Foul	Effective up to 700 fpm (3.6 m/s)	Biogrowth Easily Washed

Capital Expense Savings

Had a 14 ft diameter tower, with over 3,000 ft^3 of packing been required, the cost of the project would have easily been 35% - 40% higher vs. the Lantec Products design.

#2 NUPAC®
US Patent #5,498,376
Worldwide patents pending