

다음 Page의 설계 추천은 설계 지원 요청자가 제시한 다음의 설계 기준들을 기준으로 추천 제시된 설계 사양들입니다.

유입수 유량 : 50 m<sup>3</sup>/hr (13.9 l/s)

유입수 온도 : 70°C

유입수 중 오염 가스 성분 : 암모니아 오염 농도 NH<sub>3</sub> 기준 1,457 mg/l  
(1,200 mg/l; N 기준)

NH<sub>3</sub> 제거 효율 : 90%

## Air Stripping of Nonreactive Volatile Solutes

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for Alltrist (Scenario 2, using air recycled through scrubber)

Water Flow	13.9 L/s	Outlet Air Flow Rate	20,000 Am <sup>3</sup> /h
Solute	Ammonia	Water Viscosity	0.4 cP
Influent Concentration	1,457 mg/L (as NH <sub>3</sub> )	Solute Diffusivity in Water	6.9E-05 cm <sup>2</sup> /s
	= 1,200 mg/L (as N)	Solute Henry's Law Constant	6.38 atm-mol/mol
Air / Water Ratio	400 m <sup>3</sup> /m <sup>3</sup>	HTU <sub>L</sub>	121 mm
Solute Content of Inlet Air	44 ppm <sub>v</sub>	HTU <sub>G</sub>	818 mm
Liquid Temperature	70 °C	Stripping Factor	1.64
Atmospheric Pressure	1,013 mbar	HTU <sub>OL</sub>	621 mm
Inlet Static Pressure	0 mbar	Expected NTU	3.99
Tower Diameter	1500 mm	Calculated NTU	3.99 ✓
Packing Height	3100 mm	Effluent Concentration	146 mg/L (as NH <sub>3</sub> )
Safety Factor	1.25		= 120 mg/L (as N)
Liquid Holdup	4.3%	Removal Efficiency	90%
Liquid Retention Time	17 sec	Pressure Gradient	2.0 mbar/m
Packing Type	LANPAC XL	Packing Pressure Drop	6.0 mbar
Packing Volume	5 m <sup>3</sup>	Theoretical Fan Power	4.2 kW

Water Flow Rate	50 m <sup>3</sup> /h	Cross-Section Area	1.8 m <sup>2</sup>
	= 833 L/min	Gas Molecular Weight	26.8 g/mol
	= 46,296 mol/min	Gas Density	0.96 kg/m <sup>3</sup>
Solute Removed	1,093 g/min	Liquid Density	1,000 kg/m <sup>3</sup>
	= 64 mol/min	Superficial Gas Velocity	3.1 m/s
	= 65,591 g/h	Gas Loading	10,826 kg/m <sup>2</sup> -h
Air Flow	20,000 m <sup>3</sup> /h	Liquid Loading	28.4 m <sup>3</sup> /m <sup>2</sup> -h
	= 15,920 Nm <sup>3</sup> /h	T	70 °C
	= 11,845 mol/min		= 343 K
Solute in Exhaust Air	5,507 ppm <sub>v</sub>	P <sub>T</sub>	1.00 atm
x <sub>1</sub>	1.54E-03 mol/mol	μ <sub>L</sub>	0.36 cP
x <sub>1</sub> <sup>*</sup>	8.63E-04 mol/mol	D <sub>L</sub>	6.92E-05 cm <sup>2</sup> /s
x <sub>2</sub>	1.54E-04 mol/mol	D <sub>G</sub>	0.32 cm <sup>2</sup> /s
x <sub>2</sub> <sup>*</sup>	6.89E-06 mol/mol	HTU <sub>G</sub>	82 cm
(x-x <sup>*</sup> ) <sub>lm</sub>	3.47E-04 mol/mol		
NTU Discrepancy ×10 <sup>3</sup>	0.000		
y <sub>1</sub> <sup>*</sup>	9,833 ppm <sub>v</sub>		

# Scrubbing Ammonia using Sulfuric Acid

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for Alltrust (air stripper off-gas)

Air Flow	20,000 Am <sup>3</sup> /h	(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub> in Blowdown	27.8%
Inlet NH <sub>3</sub> Concentration	5,507 ppm <sub>v</sub>	NH <sub>4</sub> HSO <sub>4</sub> in Blowdown	2.0%
	= 4,184 mg/Nm <sup>3</sup>	H <sub>2</sub> SO <sub>4</sub> in Blowdown	0.008%
Liquid Recirculation Rate	20 m <sup>3</sup> /h	Total Nitrogen in Blowdown	71,871 mg/L (as N)
Blowdown Rate	0.76 m <sup>3</sup> /h	TDS in Blowdown	29.8%
Liquid Temperature	70 °C	HTU	190 mm
Atmospheric Pressure	1,013 mbar	NTU	4.90
Inlet Static Pressure	0 mbar	Outlet NH <sub>3</sub> Concentration	44 ppm <sub>v</sub>
pH in Sump	3.0		= 34 mg/Nm <sup>3</sup>
Make-up H <sub>2</sub> SO <sub>4</sub> Conc.	98%	Removal Efficiency	99%
Tower Diameter	1500 mm	Pressure Gradient	1.5 mbar/m
Packing Height	1400 mm	Packing Pressure Drop	2.1 mbar
Safety Factor	1.50	Liquid Holdup	2.4%
Packing Volume	2.5 m <sup>3</sup>	Liquid Residence Time	10 sec
Packing Type	LANPAC XL	H <sub>2</sub> SO <sub>4</sub> Consumption	198 kg/h
Theoretical Fan Power	1.2 kW		107 L/h

Air Flow Rate	15,920 Nm <sup>3</sup> /h	Cross-Section Area	1.8 m <sup>2</sup>
	= 11,848 mol/min	Gas Molecular Weight	26.813487 g/mol
NH <sub>3</sub> Removed	1,101 g/min	Gas Density	0.96 kg/m <sup>3</sup>
	64.7 mol/min	Liquid Density	1,174 kg/m <sup>3</sup>
blowdown	756 L/hr	Superficial Gas Velocity	3.14 m/s
	12.6 L/min	Gas Loading	10,826 kg/h-m <sup>2</sup>
Maximum NH <sub>3</sub> -N	18.9%	Liquid Loading	11.3 m <sup>3</sup> /h-m <sup>2</sup>
NH <sub>3</sub> -N	6.1% ✓	[H <sup>+</sup> ] <sub>1</sub>	1.00E-03 mol/L
	= 5.1 mol/L	T	343 K
Total Dissolved Solids	349 g/L	P <sub>T</sub>	1.00 atm
	= 29.8%	<b>Equilibrium Constants</b>	
H <sub>2</sub> SO <sub>4</sub> Added	262 g/L	H <sub>2</sub> SO <sub>4</sub> K <sub>2</sub>	1.20E-02 mol/L
Blowdown Density	1.17 g/mL	NH <sub>3</sub> K <sub>b</sub>	2.06E-05 mol/L
(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub> Satn. Index	-0.6	K <sub>w</sub>	1.86E-13 mol <sup>2</sup> /L <sup>2</sup>
Make-up H <sub>2</sub> SO <sub>4</sub> Density	1.88 g/mL	NH <sub>3</sub> Henry's Law Constant	7.9 atm-mol/mol
NTU	4.90	<b>Packed Section</b>	<b>top</b> <b>bottom</b>
ΔNTU×10 <sup>3</sup>	0.00000 ✓	pH	2.68      3.00
Δ[H <sub>x</sub> SO <sub>4</sub> ]*10 <sup>3</sup>	0.00000 mmol/L ✓	[H <sup>+</sup> ]	2.09E-03      1.00E-03
Acid Exhaustion per Pass	48.2%	[SO <sub>4</sub> <sup>=</sup> ] (mol/L)	2.27      2.46
Satd. y <sub>1,H2O</sub>	30.76%	[HSO <sub>4</sub> <sup>=</sup> ] (mol/L)	0.40      0.21
y* <sub>H2O</sub>	27.09%	[NH <sub>4</sub> <sup>+</sup> ] (mol/L)	4.94      5.13
y <sub>2,H2O</sub>	30.52%	[NH <sub>3</sub> ] (mol/L)	2.12E-05      4.62E-05
H <sub>2</sub> O Absorbed	29 mol/min	[NH <sub>3</sub> ] (mol/mol)	3.82E-07      8.32E-07
ΔNH <sub>3</sub> -N×10 <sup>3</sup>	-127.4098	y* (ppm <sub>v</sub> )	3.00      6.54
log(HTU <sub>H2O</sub> ) - log(HTU <sub>NH3</sub> )	1.8		