

Table 1 Emission substances

Table 1 shows emission substances from KM CDR Process™ in HMUK project in the UK.

Substance name			MW	Boiling Point	HMUK	Remark
Degradants name	CAS No	Formula	g/mol	°C	mg/Nm3 (10% O2)	
Total primary amine	-	-	-	-	<1.3	
Total secondary amine	-	-	-	-	<1.5	
Total tertiary amine	-	-	-	-	<0.4	
Total nitrosamine	-	-	-	-	4.8µg/Nm3	
Total nitramine	-	-	-	-	0.4µg/Nm3	
Total ammonia	-	-	-	-	3.5	
Total aldehyde	-	-	-	-	12.1	
Methylamine	74-89-5	CH ₃ NH ₂	31.06	<u>40</u>	<0.1	Remark [1]
Ethylamine	75-04-7	CH ₃ CH ₂ NH ₂		<u>39</u>	1.0	
Dimethylamine	124-40-3	(CH ₃) ₂ NH	45.09	<u>40</u>	<0.1	Remark [1]
Diethylamine	109-89-7	(CH ₃ CH ₂) ₂ NH	73.14	<u>55</u>	<0.1	Remark [1]
Ethylmethylanine	624-78-2	CH ₃ CH ₂ NHCH ₃	59.11	<u>35</u>	0.3	Remark [1]
Monoethanolamine	141-43-5	H ₂ NCH ₂ CH ₂ OH	61.08	<u>170</u>	<0.1	Remark [1]
Diethanolamine	111-42-2	HN(CH ₂ CH ₂ OH) ₂	105.14	<u>217</u>	<0.1	Remark [1]
N,N-dimethylethylenediamine	108-00-9	(CH ₃) ₂ NCH ₂ CH ₂ NH ₂	88.15	<u>107</u>	<0.1	Remark [1]
Ammonia	7664-41-7	NH ₃	17.03	60	3.5	It is calculated for HMUK conditions.
N-(2-hydroxyethyl)acetamide	142-26-7	CH ₃ CONHCH ₂ CH ₂ OH	103.12	<u>167</u>	<0.1	Remark [1]
N-(2-hydroxyethyl)formamide	693-06-1	HCONHCH ₂ CH ₂ OH	89.09	<u>181</u>	<0.1	Remark [1]
N-Nitrosodimethylamine (NDMA)	62-75-9	(CH ₃) ₂ NNO	74.08	<u>153</u>	0.6µg/Nm3	Remark [1]
N-Nitrosodiethylamine (NDEA)	55-18-5	(CH ₃ CH ₂) ₂ NNO	102.14	<u>177</u>	0.2µg/Nm3	Remark [1]
N-Nitrosomethylethylamine (NMEA)	10595-95-6	C ₃ H ₈ N ₂ O	88.11	<u>170</u>	2.8µg/Nm3	Remark [1]
N-Nitrosodiethanolamine (NDELA)	1116-54-7	C ₄ H ₁₀ N ₂ O ₃	134.14	<u>114</u>	0.2µg/Nm3	Remark [1]
N-Ethyl-N-(2-hydroxyethyl)nitrosamine (EHEN)	13147-25-6	CH ₃ CH ₂ N(CH ₂ CH ₂ OH)NO	118.13	<u>103 (*)</u>	0.6µg/Nm3	(*) Boiling point 103 deg C at 0.4kPa. Remark [1]
1-Nitrosopiperazine (NPZ)	5632-47-3	C ₄ H ₉ N ₃ O	115.13	80-85	0.1µg/Nm3	Remark [1]
1,4-Dinitrosopiperazine (DNPZ)	140-79-4	C ₄ H ₈ N ₄ O ₂	144.13	no information	0.2µg/Nm3	Remark [1]
N-Nitrosomorpholine (NMOR)	59-89-2	C ₄ H ₈ N ₂ O ₂	116.12	<u>225</u>	0.1µg/Nm3	Remark [1]
2-(ethylnitroamino)ethanol		CH ₃ CH ₂ N(CH ₂ CH ₂ OH)NO ₂	134.13		0.2µg/Nm3	Remark [1]
1-nitropiperazine	42499-41-2	C ₄ H ₉ N ₃ O ₂	131.13	no information	0.2µg/Nm3	Remark [1]
Formaldehyde	50-00-0	HCHO	30.03	<u>100</u>	2.1	It is calculated for HMUK conditions.
Acetaldehyde	75-07-0	CH ₃ CHO	44.05	<u>21</u>	9.9	It is calculated for HMUK conditions.
Ethylethanolamine	110-73-6	C ₄ H ₁₁ NO	89.14	<u>169</u>	0.5	It is calculated for HMUK conditions.
Ethyldiethanolamine	139-87-7	C ₆ H ₁₅ NO ₂	133.19	<u>251</u>	0.3	Remark [1]
Piperazine	110-85-0	C ₄ H ₁₀ N ₂	86.14	<u>146</u>	0.2	Remark [1]

Remark [1]

This is calculated based on Test data and adjusted based on HMUK process data.
Adjustment includes process parameter compensation (temperature, pressure), gas composition,
effect of MHI emission countermeasures including acid wash and MHI proprietary demister.
If the emission is lower than 0.1, it is set as <0.1 mg/Nm3 for safety