

Technical Description

The specification defines technical conditions that have to be fulfilled by the Scrubber Package Unit of the Monochloroacetic acid (later called MCAA), which is planned to be placed at the Instalation of production of MCAA, on the PCC SA Chemical Plant in Brzeg Dolny.

The Scrubber Package Unit will be used to purify the air from solid and gas particles containing the MCAA dust.

The Scrubber Package Unit will consist of main elements mentioned below:

- Venturi/Jet Scrubber with a vessel (stage I),
- filled column with a vessel (stage II),
- pumps (for stage I and II, two pieces per stage),
- heat exchangers (for stage I and II) - HOLD - To be confirmed by the supplier,
- necessary automation (gauges, control valves etc.) - devices responsible for controlling parameters with extracted signals to DCS 4-20 mA (HART),
- after the filled column will be placed a blower.

The absorption system must operate on a semi-continuous basis, due to the periodic collection of absorption liquid from the system. The liquid is used to dilute the product - 100% MCAA at the main production plant. This process takes place periodically every ~24h, and is based on the simultaneous transfer of 100% MCAA and the insertion of absorption liquid at a rate of ~3.5m³/h which takes ~3h, resulting in an absorption liquid intake of a sumeric amount of 10.5m³/24h.

Therefore, the absorption system should be designed with sufficient store capacity for the absorption liquid to provide continuous operation of the system to ensure the possibility of continuous dosing of demineralized water. For this purpose, it is assumed that sufficiently large vessels will be built for circulating systems of the I and II absorption stages. It is assumed that the level of liquid in these tanks will vary within certain ranges - rising during periods of absorption operation without absorption liquid withdrawal, with a simultaneous increase in the concentration of MCAA in the absorption liquid, and decreasing during periods of absorption liquid withdrawal - to dilute the product on the main facility. It was assumed that the vessels should operate in the fill range of 15 to 90% (to be agreed with the supplier) nevertheless the pumping systems should ensure a proper work for the fill range of 10 to 90% (to be agreed with the supplier).

The composition of the stream directed to the absorption, and the overview draft of the unit package are shown below.

The composition of the stream to the absorption:

- 15 kg/h MCAA (solid)
- 15 kg/h MCCA (vapor)
- Total stream flow (air/MCAA): 11600/10000/8200 kg/h (max/nor/min)
- Temp: around 30-35 °C
- Pressure: -0,025 - 0,05 barg (To be agreed with the supplier - pressure drop on Scrubber Unit Package).
- Washing liquid - demineralised water (30 °C). It is required to withhold the washing liquid for up to 24h (I and II stage).

The delivery includes the following items:

- Venturi/Jet Scrubber with a vessel (stage I),
- filled column with a vessel (stage II),
- Documentation, drawings, manuals, pressure drops for the appliances (see page 2).

The supplier provides guidelines for or confirms:

- The diameter and height of the column filling (stage II) - an example of a column calculation using Raschig Super Rings #0.6 is given on the page 5 (it is possible to use another type of filling, maintaining the specified air purification parameters - 15.75 mg/Nm³ MCAA).
- Solids were assumed to be absorbed on the first stage, while off-gases were assumed to be absorbed on the second stage (up to a value of 15.75 mg/Nm³ MCAA). The supplier must determine what amount of degas will be absorbed on the first stage (Jet/Venturi) and whether the column height given in the sample calculation can be optimized (e.g., reduced or confirmed).
- Quantities of circulated washing liquids, especially the maximum concentration of washing liquid in the stage II vessel/minimum fresh water supply.
- the need to install heat exchangers,
- method of regulation, automation/measuring devices,
- vessel of the filled column (placing of the column on the vessel),
- pumps,
- purified air blower,
- foundations/steel structure,
- construction materials,
- pipelines inside the scrubber unit package,
- the possibility of directing the steam stream from the pipelines to the scrubber,
- control of the DCS of the MCAA plant.
- insulation holders

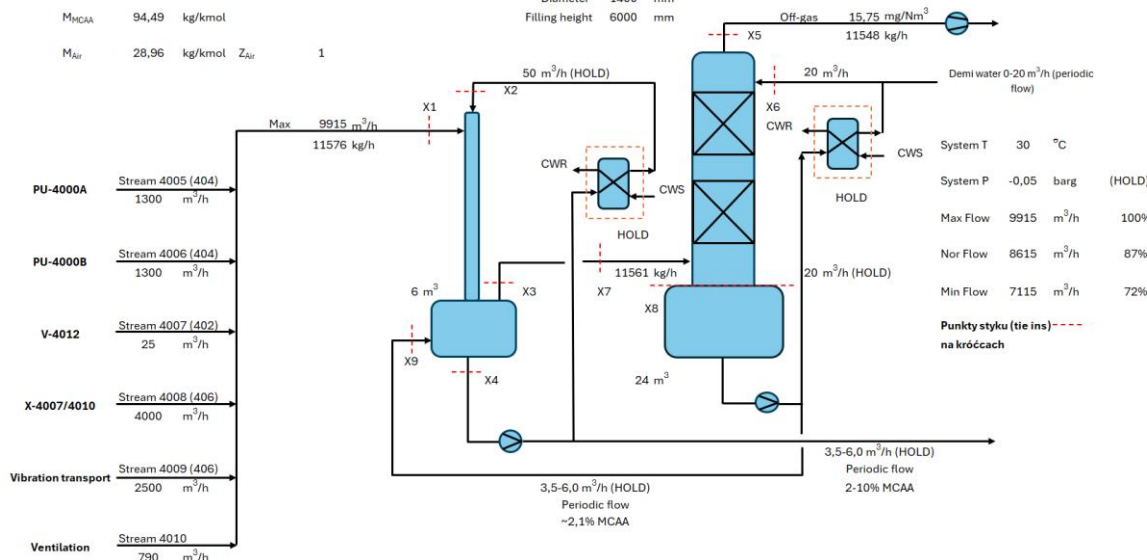
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S.Kaplański	22.07.2024		Date:	22.07.2024	25.09.2024	09.10.2024	22.10.2024				
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D.Szerstniuk	22.07.2024		Detailed Project of the Construction of Monochloroacetic Acid Solidification Plant Release for a tender request								
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Draft

Monochloroacetic acid vapor scrubber
[79-11-8]

M_{MCAA} 94,49 kg/kmol
 M_{Air} 28,96 kg/kmol Z_{Air} 1

Diameter 1400 mm
Filling height 6000 mm



Flow	Gas/Solid	Temp [°C]	Pres. [barg]	ρ Air [kg/m³]	MCAA [%m]	Air/W [%m]	Case 1 - Nm³/h		Case 2 - m³/h Selected	
							F [kg/h]	MCAA [kg]	F [kg/h]	MCAA [kg]
4005	G	30	0	1,16	0,4	99,6	9195	86,8	8285	33,1
4006	G	30	0	1,16	0,4	99,6	1688	6,7	1514	6,1
4007	G	30	0	1,16	3,4	96,6	32	1,1	29	1,0
4008	S	30	0	1,16	0,2	99,8	5169	10,3	4658	9,3
4009	S	30	0	1,16	0,2	99,8	8231	6,5	2911	5,8
4010	G	20	0	1,20	0,0	100,0	1021	0,0	951	0,0
Suma	G/C.st.	30	0	-	0,3016	99,7	26328	61	18347	55
Outlet G	G	0	0	1,29	0,001219	99,9988	20266	0,25	18292	0,22
Outlet L (Jet)	G	20	3	-	4,3	-	-	-	10000	-
Outlet L (Column)	L	20	-	998,2	0,444 1,998	99,56 98,00	10000	44,4	2000	40,0

Off-gas specification		
Outlet G	15,75	mg/Nm³
	3,74	ppm vol
	12,19	ppm wt
	0,001219	% wt

Specification of Column Fluid Case 2		
Outlet L (Column)	2,00	% mas
	19,95	g/l
	0,72	% mas
	7,20	g/l

The drawing (page 2) shows a single connection to the vapor column for purification (collector). If possible, more connections are required (separate plugging of the stream from the V-4012 vessel, DN50 - glass lined steel pipeline). To be agreed with the supplier.

The following standards apply (where applicable):

Automation:

- Delivery of the plant equipment in accordance with the SUT-C technical standard, control will be from the DCS.

Electrics:

- Delivery of the plant equipment in accordance with the technical standard SUT-E.

Mechanics:

- Delivery of the plant equipment in accordance with the technical standard SUT-M.

Documentation should be done in accordance with PCC standards: SUT-C, SUT-E, SUT-M, and SDT.

At the end of the project, the subcontractor is required to prepare the As-built Documentation (if applicable).

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			Release for a tender request								



Scrubber Package Unit

TECHNICAL SPECIFICATION / DATASHEET

Specification No: 8540-02.02-536		
Associated with PFD/P&ID No: 8540-01.06-532		
Page: 3	Pages: 5	Revision: D

GENERAL

Process number	PU-4015
Name	Scrubber Package Unit of Monochloroacetic Acid
Quantity	1
Drawing	

OPERATING DATA

	Unit of measurement	Przestrzeń / Komora	
		Venturi/Jet ⁷⁾	Kolumna wypełniona
Operating overpressure	[barg]	-0,025/-0,050 ²⁾	-0,025/-0,050 ²⁾
Operating temperature	[°C]	30 ¹⁰⁾	30 ¹⁰⁾
Volume	[m ³]	~6	~15,39 ³⁾ (+ 24 m ³ Vessel)
Content		Chloroacetic acid solution 10% (Max) ⁴⁾	Chloroacetic acid solution ~2% (Max) ⁴⁾
Density	[kg/m ³]	~1012	~1000

PROJECT DATA

Project regulations		<input type="checkbox"/> DT-UC-90/WO	<input type="checkbox"/> AD-Merkblätter	<input type="checkbox"/> EN 13445
Reception		<input type="checkbox"/> Buyer and	<input type="checkbox"/> Only Buyer	
	Unit of measurement	Space / Chamber		
		I	II	III
Design pressure	[barg]	-0,2/0,49	-0,2/0,49	
Design temperature	[°C]	60	60	
Test pressure	[barg]			
Type of test				
Weld quality factor	[%]			
Radiography	[%]			
Corrosion allowance	[mm]			

OTHER DATA

Localization	<input type="checkbox"/> Inside	<input checked="" type="checkbox"/> Outside			
Insulation	<input checked="" type="checkbox"/> Yes ⁶⁾	<input type="checkbox"/> No	Insulation thickness	50	[mm]
Weight of an empty column	[kg]	To be determined by the supplier			
Emergency mass	[kg]	To be determined by the supplier			
External surface protection	To be determined by the supplier				
Internal surface protection					

MATERIALS

		Space / Chamber		
		Venturi/Jet	Filled Column	n/a
Jacket		⁹⁾	⁹⁾	
Bottom / Cap		⁹⁾	⁹⁾	
Body:	flanges			
	seals			
	bolts/nuts			
Nozzle:	flanges			
	pipes			
	seals			
	bolts/nuts			
Internal components		⁹⁾	⁹⁾	
External components				
Supports				
Filling		⁹⁾	⁹⁾	

- 1) It is allowed to change the units in accordance with Appendix G2 (Technical Documentation Standard for PCC Rokita S.A.).
- 2) To be agreed with the supplier (pressure drops on the system and the Unit Package).
- 3) Real total column height to be confirmed by the Package supplier. D=1400 mm, L=10000 mm.
- 4) System: 1. Venturi - Air + MCAA particles and vapors / Water + MCAA solution. 2. Column - Air + MCAA vapors / Water + MCAA solution.
- 5) Equip all reserve spigots and inspection manholes with blanking flanges. Secure the others with caps.
- 6) Equip the column with handles for insulation. Insulation outside the scope of delivery.
- 7) Venturi scrubber (Nozzle), to be designed by the Unit Package supplier.
- 8) Column equipped with a demister (if possible within the scope of the filling supplier).
- 9) Material to be confirmed by supplier (e.g. PP, PE, PVDF, PTFE, PFA).
- 10) Final circulation temperatures, to be confirmed by the supplier.

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DATA FOR DESIGNED FILLING

OPERATING CONDITIONS

Load	<input checked="" type="checkbox"/> Constant	<input type="checkbox"/> Periodic	Scrubber operating in continuous mode, variable vapor load.	
Supply	<input type="checkbox"/> Liquid	<input checked="" type="checkbox"/> Vapor	Temp. 30-35 [°C]	
Supply	norm 10000 [kg/h]	min. 8200 [kg/h]	max. 11600 [kg/h]	See drawing page 2
Composition of the supply stream	Air/Water vapor + chloroacetic acid vapor + MCAA particles.			
Pure air	11548 [kg/h]	Stream of purified air. See drawing page 2.		
Composition of the purified air	15,75 mg/Nm³ MCAA			
Depleted liquid	3500-6000 [kg/h]	Periodic flow. See drawing page 2.		
Composition of the depleted liquid	Chloroacetic acid solution ~10% (I stage) and 2% (II stage)			
Washing water	20000 [kg/h]	Min. 0 kg/h. Max. 20000 kg/h. See drawing page 2.		
Plate numbering method	<input checked="" type="checkbox"/> from the top	<input type="checkbox"/> from the bottom		
Type of reboiler	<input type="checkbox"/> Termosyphon	<input type="checkbox"/> Kettle	<input type="checkbox"/> With forced circulation	

MECHANICAL DATA

Calculation diameter	top	1400	[mm]	bottom	1400	[mm]	To be confirmed by the supplier.	
Design diameter	top		[mm]	bottom		[mm]		
Quantity of theoretical plates								
Quantity real of plates								
Plate characteristics								
Fill type	Usypowe (Random Packing, IV generacji): np.: Raschig Super Rings #0,6 lub ekwiwalent (205 m ² /m ³).							
Ring sizes		2)	[mm]					
Fill height			[m]					
	top part	3,0	[m]	To be confirmed by the supplier.				
	bottom part	3,0	[m]	To be confirmed by the supplier.				
Required liquid distributor	<input checked="" type="checkbox"/>	Yes		<input type="checkbox"/>	No			
Distributor at the height of filling			[m]					
	top part	3,0	[m]	Reflux distributor				
	bottom part	3,0	[m]	Redistributor				
Welding technique								
Weld material								
Min weld quality factor			[%]					
Min corrosion allowance			[mm]					
Design regulations for plates								
	Sign	<input type="checkbox"/>	Yes	<input type="checkbox"/>	No			
Reception	<input type="checkbox"/>	Radiography		<input type="checkbox"/>	Magnetic	<input type="checkbox"/>	Liquid Penetration	<input type="checkbox"/>
Type of support								
Drawing number								
Heating insert	<input type="checkbox"/>	Yes		<input checked="" type="checkbox"/>	No			
	Type	<input type="checkbox"/>	Tube bundle	<input type="checkbox"/>	Coil			
Surface			[m ²]					
Specification number								
Empty column mass			[kg]	To be determined by the supplier				
Mass of the water filled column			[kg]	To be determined by the supplier				
Insulation thickness		50	[mm]					

LIST OF NOZZLES

Symbol	Purpose	Diameter DN [mm]	Nominal pressure PN [bar]	Flange norm	X [mm]	Y [mm]	Notes
X1	MCAA vapor inlet I	3)					
X2	Washing liquid inlet I	2)					
X3	MCAA vapor outlet I	2)					
X4	Circulation of washing liquid I	2)					
X5	Pure air outlet	2)					
X6	Washing liquid inlet II	2)					
X7	MCAA vapor inlet II	2)					
X8	Connection to the vessel II	2)					
X9	Washing liquid inlet II	2)					

NOTES	1) To be determined by the supplier. Example column calculation using Raschig Super Rings #0.6.						
	2) To be determined by the supplier.						
	3) PE 100 (SDR 11) pipeline with an external diameter of 500 mm (internal 409.2 mm).						
	X - Distance (height) from the base Y - Distance (length) from the major axis						

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Data for filling hydraulics (Stage II)

Example column calculation using Raschig Super Rings #0.6.

Absorption of 0-Load Absorbant (C2H3ClO2) from Air in Water.

Pressure bar 0.963

Gas

Air

Flow rate kg/h 11600
Density kg/m³ 1,10680
Mol Mass kg/kmol 29
Viscosity mPa.s 0.0185
Conc. -In Mass % 0,1293000
Conc. -Out Mass % 0,001218807
Temperature °C 30

Liquid

Water

Flow rate m³/h 20
Density kg/m³ 1000
Mol Mass kg/kmol 18
Viscosity mPa.s 1
Surface Tension mN/m 72
Conc. -In Mass % 2
Conc. -Out Mass% 2,07164
Temperature °C 30

Absorbent :

0-Load Absorbant

Molecular Mass kg/kmol 94,4956
Henry's Coefficient bar 0,000861
Minimum liquid flow rate m³/h 3,58E-03
Stripping factor -- 0
System factor -- 1
Diffusion coefficient of gas m²/s 1,059E-05
Diffusion coefficient of liquid m²/s 1,095E-09
Column Diameter mm 1400

Packing :

Raschig Super-Ring #0.6 Plastic

F - Factor Pa^{0.5} 1,99
liquid load m³/m².h 12,99
Flooding Factor % 71,5
System limit Pa^{0.5} 5,69
System limit % 34,98
Hold up m³/m³ 0,048
Dry Pressure drop mbar/m 3,04
Spec. Pressure drop mbar/m 3,8
Working range from % 28
Working range to % 119

		Calculated	Practical
Pressure drop	mbar	10,77	16,16
NTUol	--	0,002	
HTUol	m	0,37	
HTUol	m	1217,78	
Col. volume / NTUog	m ³	0,601	
NTUog	--	7,257	
HTUg	m	0,39	
HTUog	m	0,39	0,58
Nt	--	0,9	
HETP	m	3,15	4,72
Height	m	2,84	4,26
Volume Decrease	%		6,29
Bed Volume	m ³		6,97

Warnings :-

- Notes: 1. Optimally, the Venturi/Jet should remove essentially all of the solid contaminants (before the stream is delivered to the filled column).
2. The supplier will guarantee the given limit of MCAA in the purified air (15.75 mg/Nm³), as well as the defined flow rate (11.6 t/h).
3. The circulation of the washing liquid of the I and II stage shall be equipped with a mass flow meter with accurate measurement of density.
4. The supplier of the selected fill should verify the specified diameter of the filled column (stage II).
5. In the above calculations, pressure units are in bar(a).

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