

**2.3.2 Oxygen Input** The main results and parameters for the oxygen input measurements are summarized in Table 2. Detailed measurements and evaluation protocols are attached in an appendix. The deviations within the individual measurement points are at max 0.4% and are considerably under the limits of 5% specified in the German Water Authority OWA data sheets. Of particular significance is the lower pressure drop for the polyurethane material in the aeration membranes.

Table 2: Parameters and results for the oxygen input measurements

Test No.		1	2
Water temperature Tw	°C	16.7	16.7
Conductivity K <sub>25</sub>	µS/c	717	717
Water Depth	m	5,00	5.00
Membrane operating depth	m	4,80	4,80
Tank Volume V <sub>BB</sub>	m <sup>3</sup>	2.863	2.863
Standardized air quantity	m <sup>3</sup> <sub>N</sub> /h	2.438	1.184
Air flow at exit point	m <sup>3</sup> /h	1.766	858
Blower Loading	m <sup>3</sup> /h	2,9	1.4
Pressure differential at the aerators	hPa	22	17
<b>Power absorbed</b>			
Blowers	kW	56,1	25.7
Mixing	kW	3,1	3,1
Total	kW	59,2	28.8
Specific mixer energy	W/m <sup>3</sup>	1.08	1.09
<b>Aeration coefficient kLa<sub>t</sub></b>			
Measuring point 1	1/h	8,303	4,565
Measuring point 2	1/h	8,274	4,546
Measuring point 3	1/h	8,309	4,546
Measuring point 4	1/h	8,277	4,535
Average	1/h	8,291	4,548
Max rel. deviation from average	%	0,2	0,4
<b>Oxygen input SOTR</b>	kg/h	287,4	157,7
Volume spec. oxygen input SOTR <sub>R</sub>	g/(m <sup>3</sup> /h)	100,4	55,1
oxygen input SSOTR	g/(m <sup>3</sup> N'm)	24,6	27,8
Spec oxygen utilization SSOTE	%/m	8,2	9,3
Oxygen yield SAE	kg/kWh	4.85	5,47
<b>Recalc. to standard salt concentration 1000 mg/l</b>			
Oxygen input SSOTR.1000	kg/h	301.7	165,5
spec. oxygen input SSOTR.1000	g/(m <sup>3</sup> N'm)	25,8	29,1
Oxygen yield SAE1000	kg/kWh	5,10	5,75

## 2.3 Results

### 2.3.1 Blower

The operating data of the blower and the efficiency figures derived from this are shown in Table 1. The specific blower input figures are considered as very favourable.

**Table 1: Operating data and characteristics of the blower**

Test Nr.		1		2	
Membrane operating depth	m	4,80		4,80	
Pressure at discharge port $P_{e,i}$	hPa	514		500	
Pipe line and exit losses $t \setminus P_v$	hPa	43		29	
Atmospheric air pressure $P_{amb}$	hPa	986		985	
Suction Temperature $T_{Ansaug}$	°C	29,0		31,0	
Ambient Temperature $T_{amb}$	°C	25,2		27,4	
Rel. air humidity $\varphi_p$	%	57%		57%	
Vapour pressure $p'$	hPa	18,3		20,9	
Density of the ambient air $P_{amb}$	kg/m <sup>3</sup>	1,131		1,118	
Blower Nr.		1	2	1	2
Frequency $f$	Hz	55,0	50,0	41,0	
Speed of main rotor $n_{G1}$	min <sup>-1</sup>	9.310	9.080	6.992	
Under pressure suction side $P_{e1}$	hPa	5	5	4	
Differential pressure	$\Delta p$	519	519	504	
Air volume $Q_L$	m <sup>3</sup> /h	1.923	915	1.391	
Standard air volume $Q_{LN}$	m <sup>3</sup> <sub>N</sub> /h	1.652	786	1.184	
Connected power $P_K$	kW	35,60	15,40	23,30	
Adiabatic efficiency	%	65,4	71,9	70,2	
Power absorbed from mains $P_{NETZ}$	kW	37,60	18,50	25,70	
Air quantity $Q_{LB}$ total	m <sup>3</sup> /h	2.838		1.391	
Standardised air volume $Q_{LN}$	m <sup>3</sup> <sub>N</sub> /h	2.438		1.184	
Mains power total $P_{NETZ}$	kW	56,1		25,7	
<b>Specific compression input</b>					
Ref. to membrane working depth $P_{L,h}$	Wh/(m <sup>3</sup> ·m <sub>hE</sub> )	4,12		3,85	
With reference to $P_{e2}$ $P_{L,pe2}$	Wh/(m <sup>3</sup> ·kPa)	0,385		0,370	

### 3 Summary and analysis

The guaranteed values for the oxygen input and the oxygen yield were checked by measurements of the oxygen input in clean water taken at the Treatment Plant at Hammelburg on 13.6.2013.

The guaranteed and the actual values achieved in practice are shown in Table 3. The measuring tolerances listed are those specified by the German Water authority DWA Data Sheet M209.

Table 3: Guaranteed and measured values together with the measurement tolerances on the oxygen input measurements.

		Guarantee	Actual	Tolerance
<b>At maximum air throughput</b>				
Oxygen input S0TR1000	Kg O <sub>2</sub> / h	244,3	301,7	± 15,1
Spec oxygen input SS0TR 1000	g /O <sub>2</sub> {m <sup>3</sup> N*m)	21,5	25,8	± 2,6
Oxygen input SAE1000	KgO <sub>2</sub> / kWh	3,70	5,10	± 0,41
<b>At 50% of max. air throughput:</b>				
Oxygen input S0TR1000	KgO <sub>2</sub> / h	142,2	165,5	± 8,3
Spec oxygen input SS0TR1000	gO <sub>2</sub> /{m <sup>3</sup> N*m)	24,5	29,1	±2,9
Oxygen input SAE1000	Kg O <sub>2</sub> / kWh	3,90	5,75	± 0,46

It can be seen that all the guaranteed values were achieved or considerably improved upon. The highly favourable oxygen input is partly the result of the relatively low pressure losses at the Diffusers.

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