

Investigation of Corrosion Behaviour of Plastic Mould Steels under Oxygen Free and Oxygen Saturated Conditions

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Introduction

- Steels for plastic injection moulds are available in different alloy compositions.
- Mechanical properties, such as wear resistance and hardness, are the most important properties.
- Corrosion resistance of these steels is also an important property, which is why there are high-alloy steel compositions.
- Open and closed systems for cooling of moulds → influence to the oxygen content.

Project Idea

- Investigation corrosion behaviour of various typical plastic mould steels under high and low oxygen conditions.
- Developing of a mould tempering device that controls the oxygen content in a closed water-based liquid system

Experimental

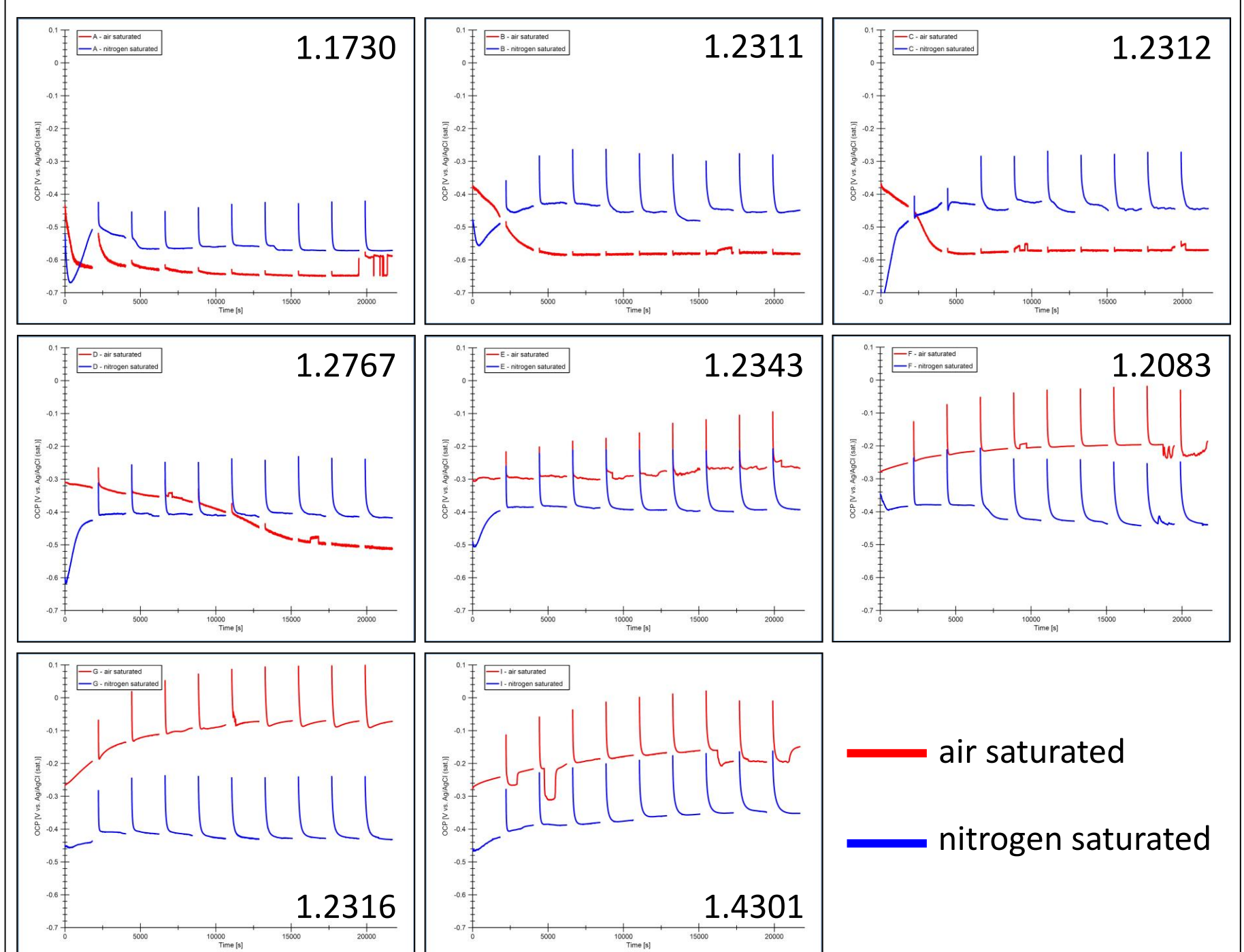
- Investigated plastic mould steels:

Steel number	C	Si	Mn	P	S	Cr	Mo	Ni	V
1.1730	0,444	0,298	0,78	0,014	0,0013	0,036	0,016	0,036	
1.2311	0,378	0,265	1,5	0,022	0,0029	1,84	0,172	0,065	
1.2312	0,369	0,32	1,67 (1,6)	0,019	0,07	1,85	0,216	0,025	
1.2767	0,418	0,244	0,363	0,0067	0,0027	1,4	0,241	4,11	
1.2343	0,363	1,0	0,402	0,012	0,0038	5,0	1,19	0,132	0,323
1.2083	0,358 (0,36)	0,329	0,574	0,026	0,0056	12,68	0,099	0,312	
1.2316	0,347	0,372	0,688	0,026	0,007	15,45	0,902	0,703	
1.4301	0,049	0,551	1,51	0,047 (0,045)	0,0024	18,55	0,415	7,84 (8,0)	

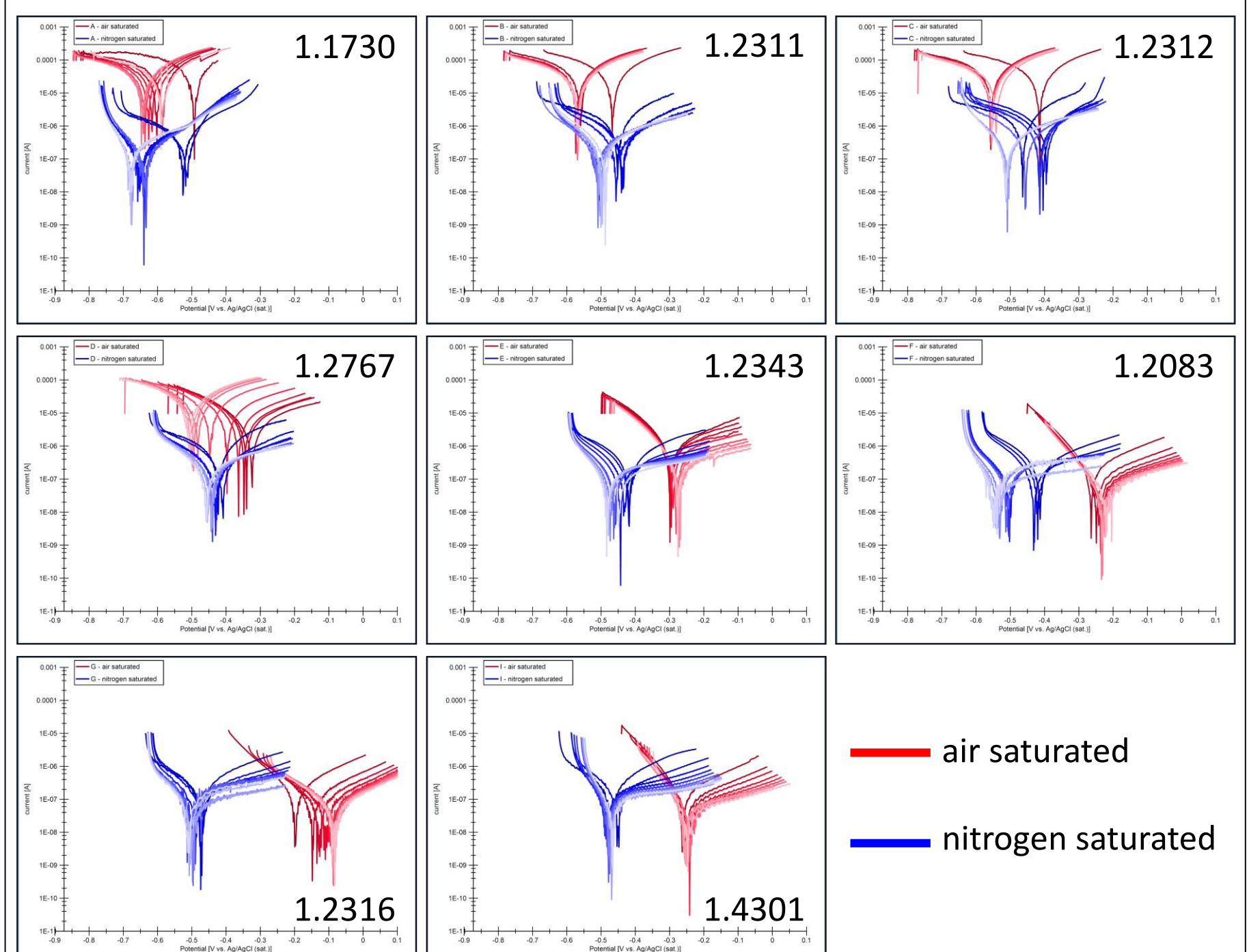
- Electrochemical investigations
 - 30 min OCP with following potentiodynamic measurement
 - 10 times repetition
 - Tap water, water hardness adjusted to dH°=5
 - Temperature 50°C
 - Air saturated → 100% O₂-saturation
 - Nitrogen saturated → 0 – 0,5% O₂-saturation

Results

- OCP-Measurements, timerow:

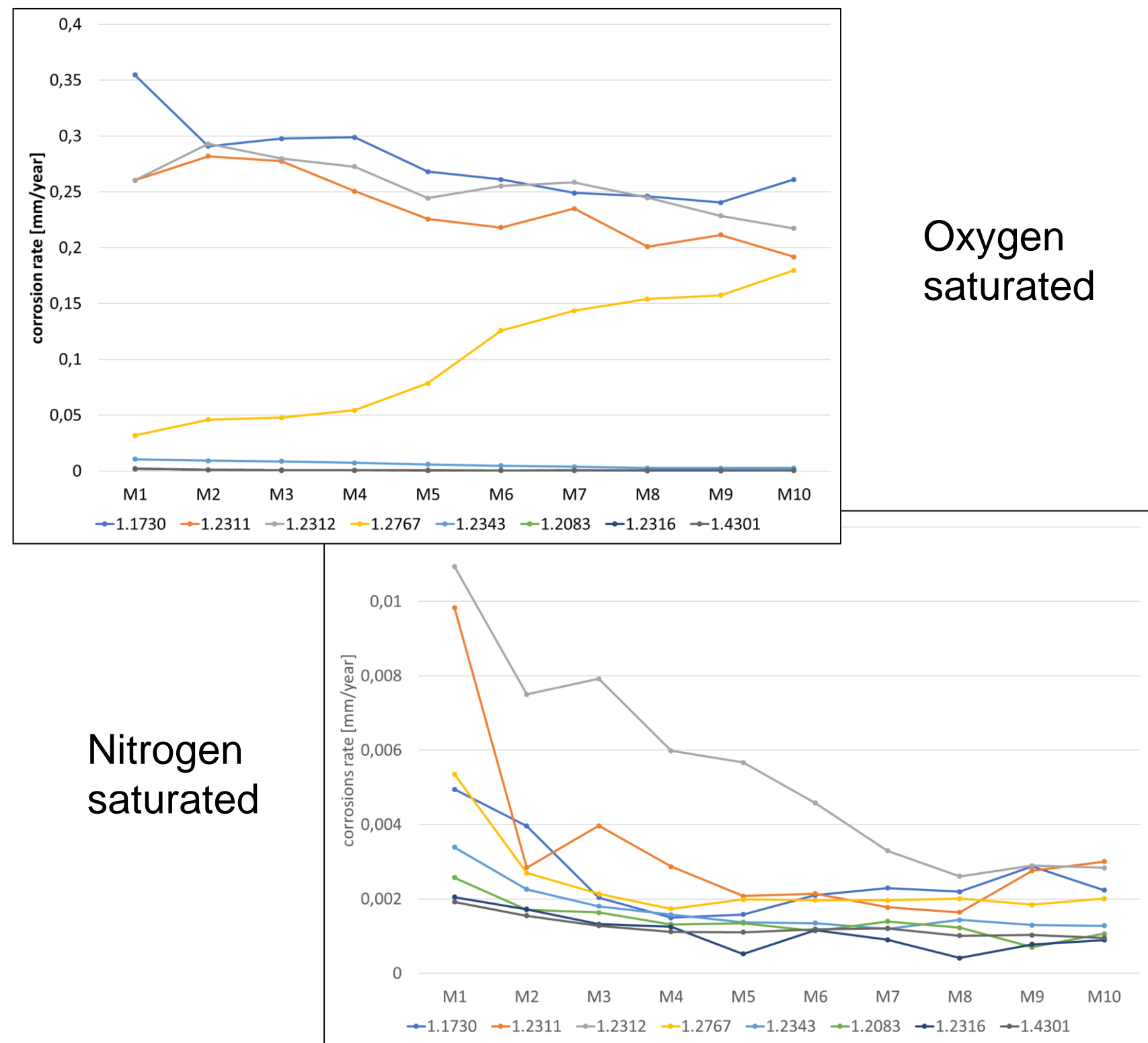


- Potentiodynamic Measurements

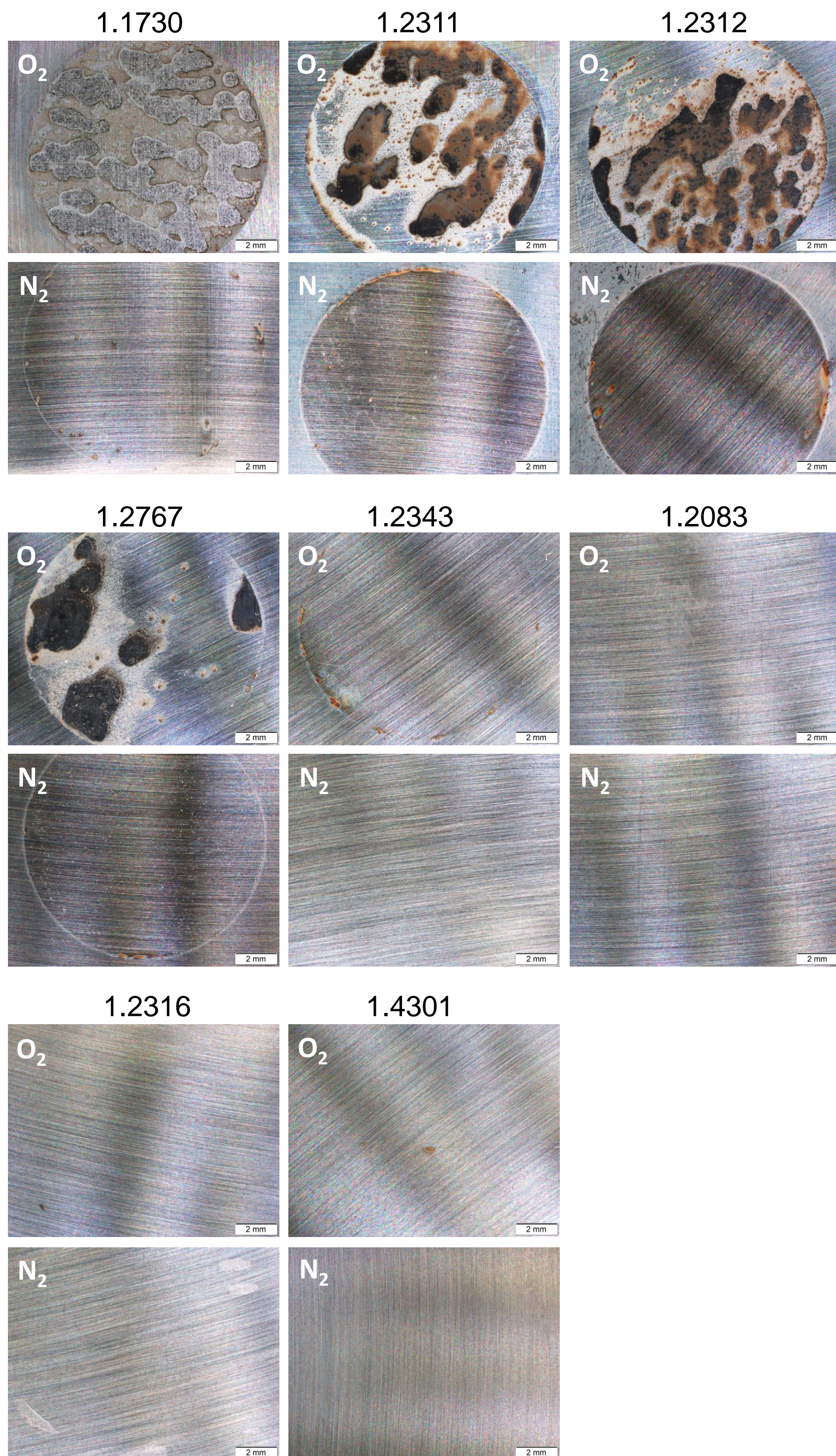


Results

- Calculated corrosion rate:

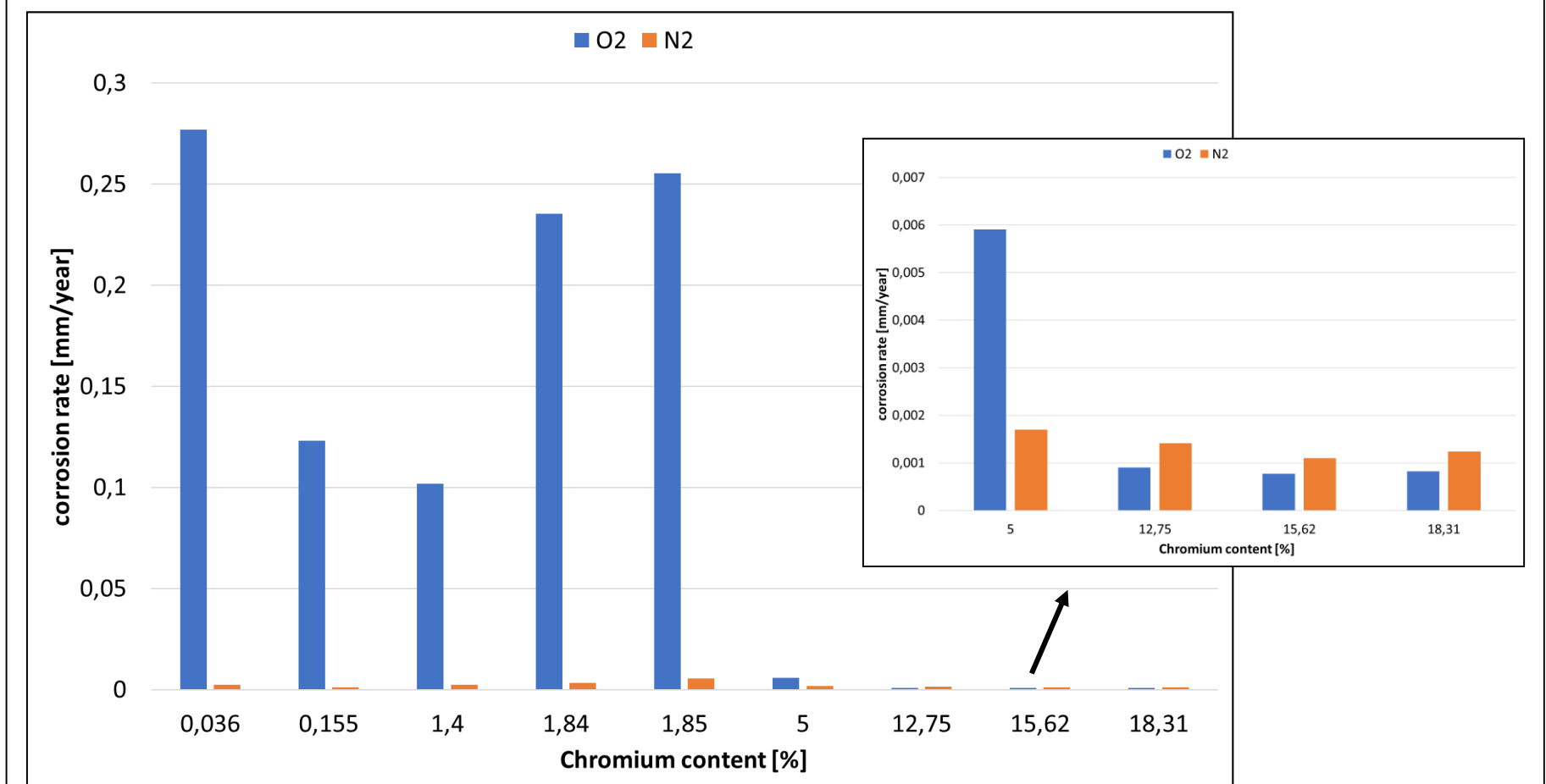


- Measurement Area:

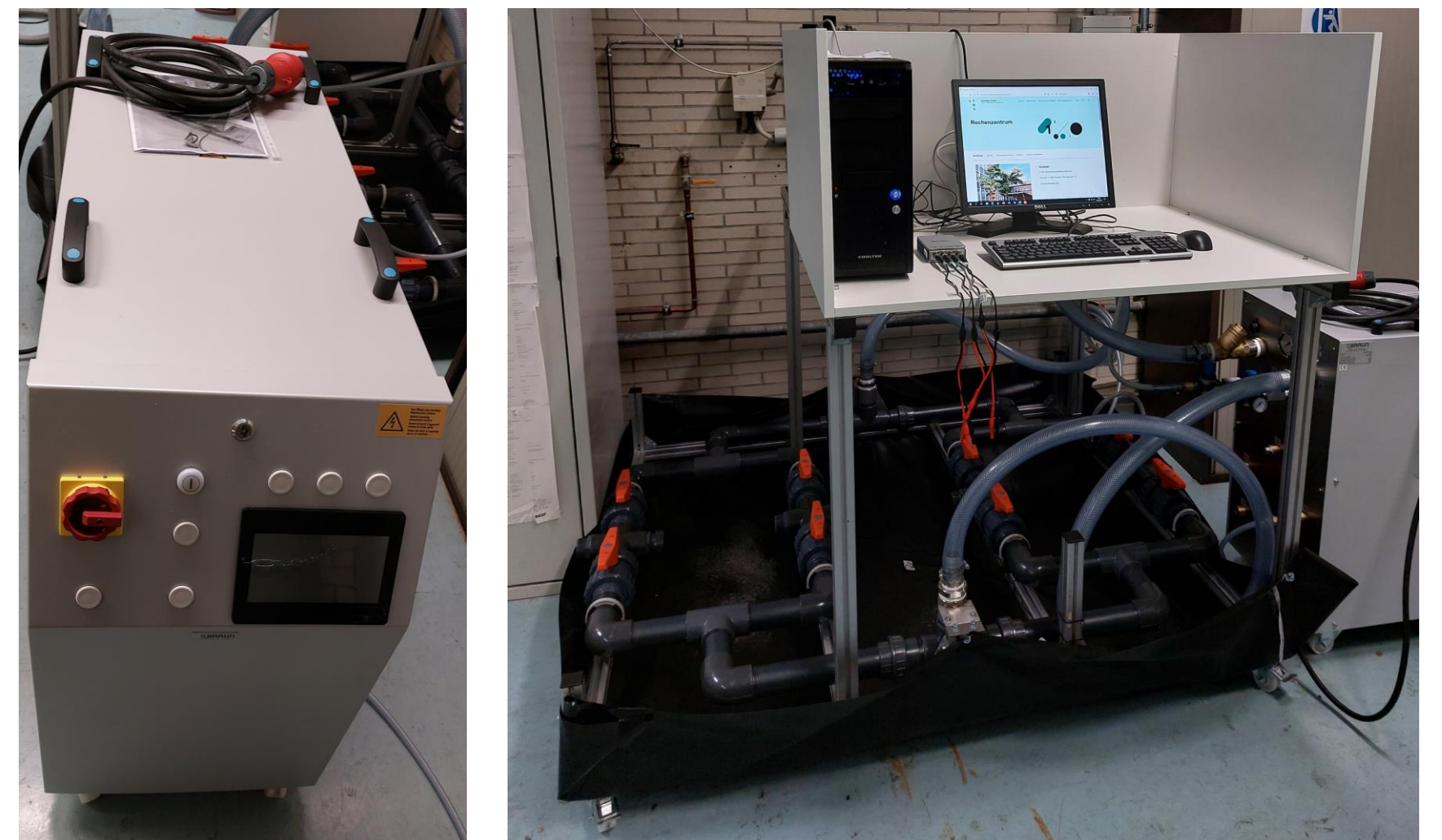


Results

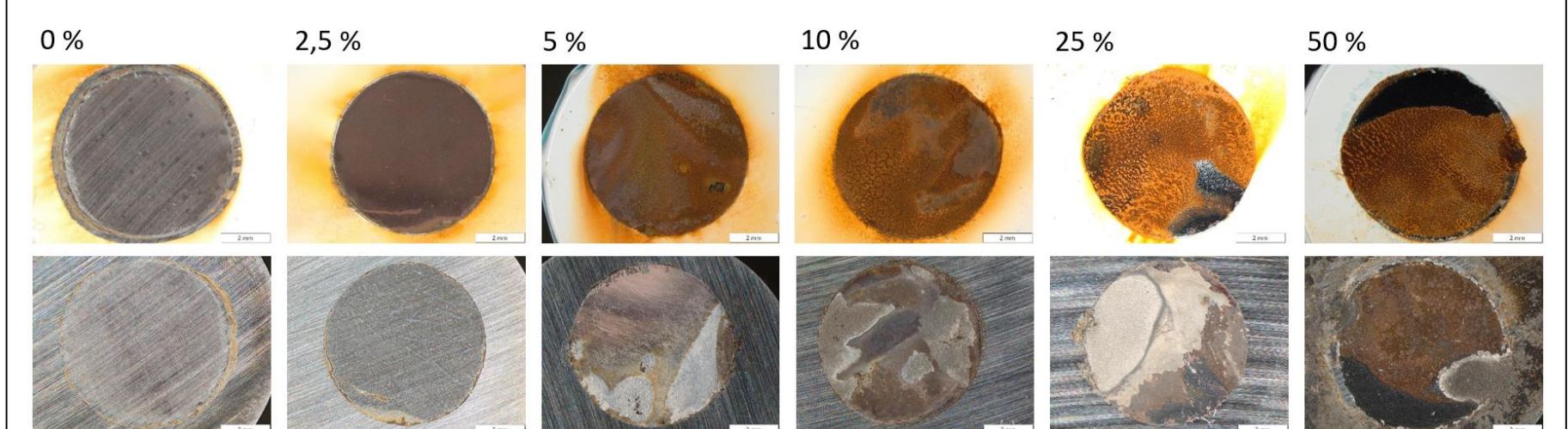
- Oxygen free conditions reduce the corrosion of steels with low chromium content:
 - OCP increase, Corrosion current decrease
- With higher chromium contents in oxygen free conditions:
 - OCP decrease, Corrosion current increase slightly



- Development of mould tempering device and test rig for corrosion experiments under different conditions.



- Control of oxygen saturation with injection of nitrogen.
- Testrow (1.2312) with different kind of oxygen contents in test rig with controlled oxygen concentration for 10 days:



- Corrosion attack decrease with increasing oxygen content

Conclusions

- Oxygen content of cooling water has an influence to the corrosion resistance of different kinds of plastic mould steels.
- For low chromium contents in the steel, an oxygen free environment could be positive for corrosion rate, at higher chromium contents it could also be negative.
- The developed mould tempering device could help to decrease the corrosion rate in plastic mould forms made of low alloyed steels with lowering the oxygen content of the cooling water.

Acknowledgements

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