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TESTING
Baustoffprüfgeräte

Test Evaluations of a Fully Automatic Mortar Mixer with Torque Measurement for Determining Water Demand

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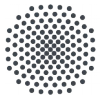
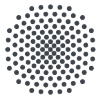
Mix Design of Self Compacting Concrete

- Requirements Regarding the Mixer
- Mix Design
- Determining the Water Demand als a Function of the Superplasticizer Content
- Rheological Properties of the Mortar
- Transferability of the Mortar Mixes to Concrete
- Sedimentation Stability of the Concrete
- Summary

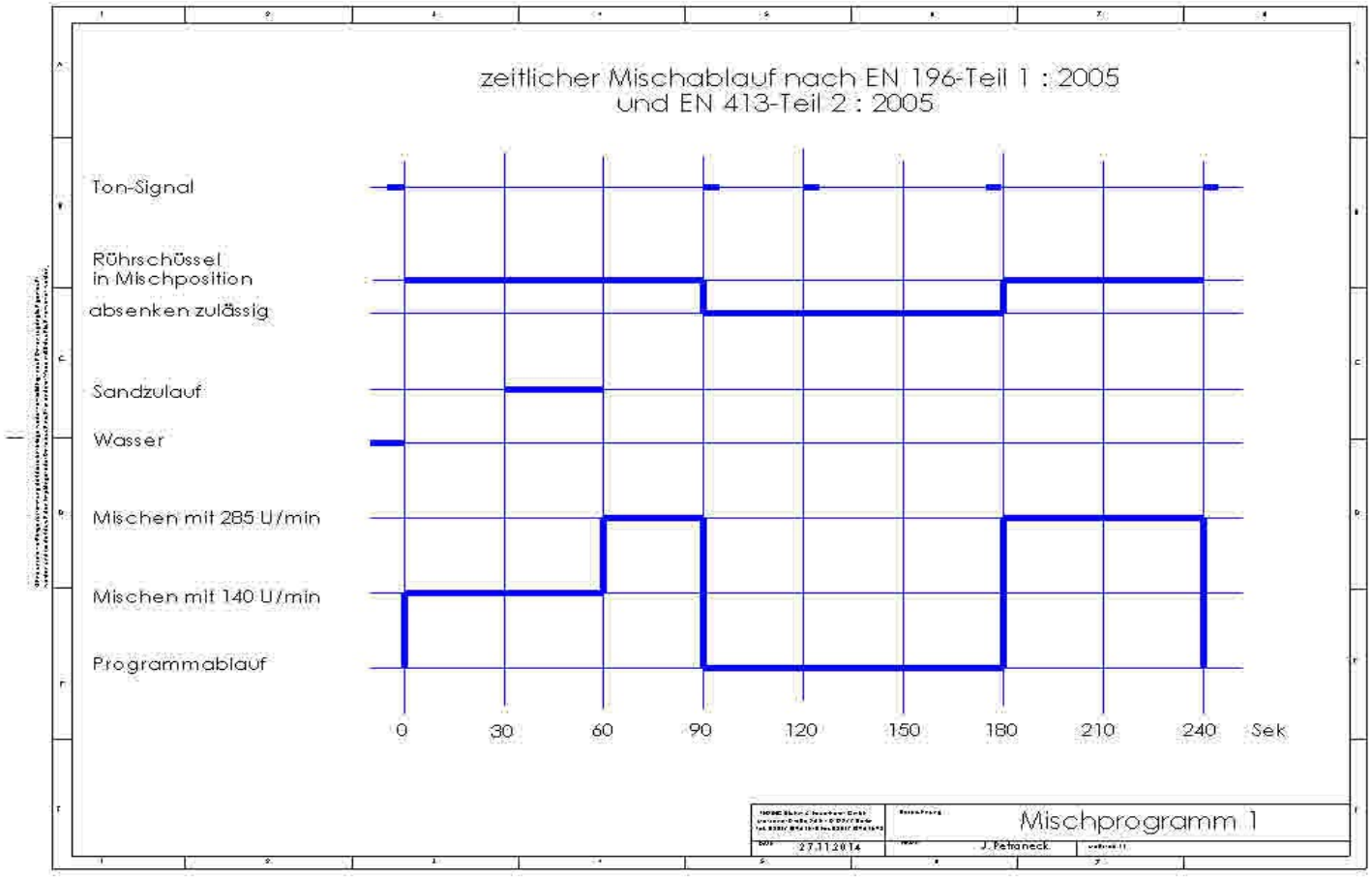


Requirements Regarding the Mixer

- The cement industry defined additional requirements for a automatic mortar mixer
- Calibratable ultrafine load cell
- Integrated automatic sand dosing system
- Full automatic water dosing system
- Additive dosing system for a maximum grain size of up to 4 mm



Requirements Regarding the Mixer



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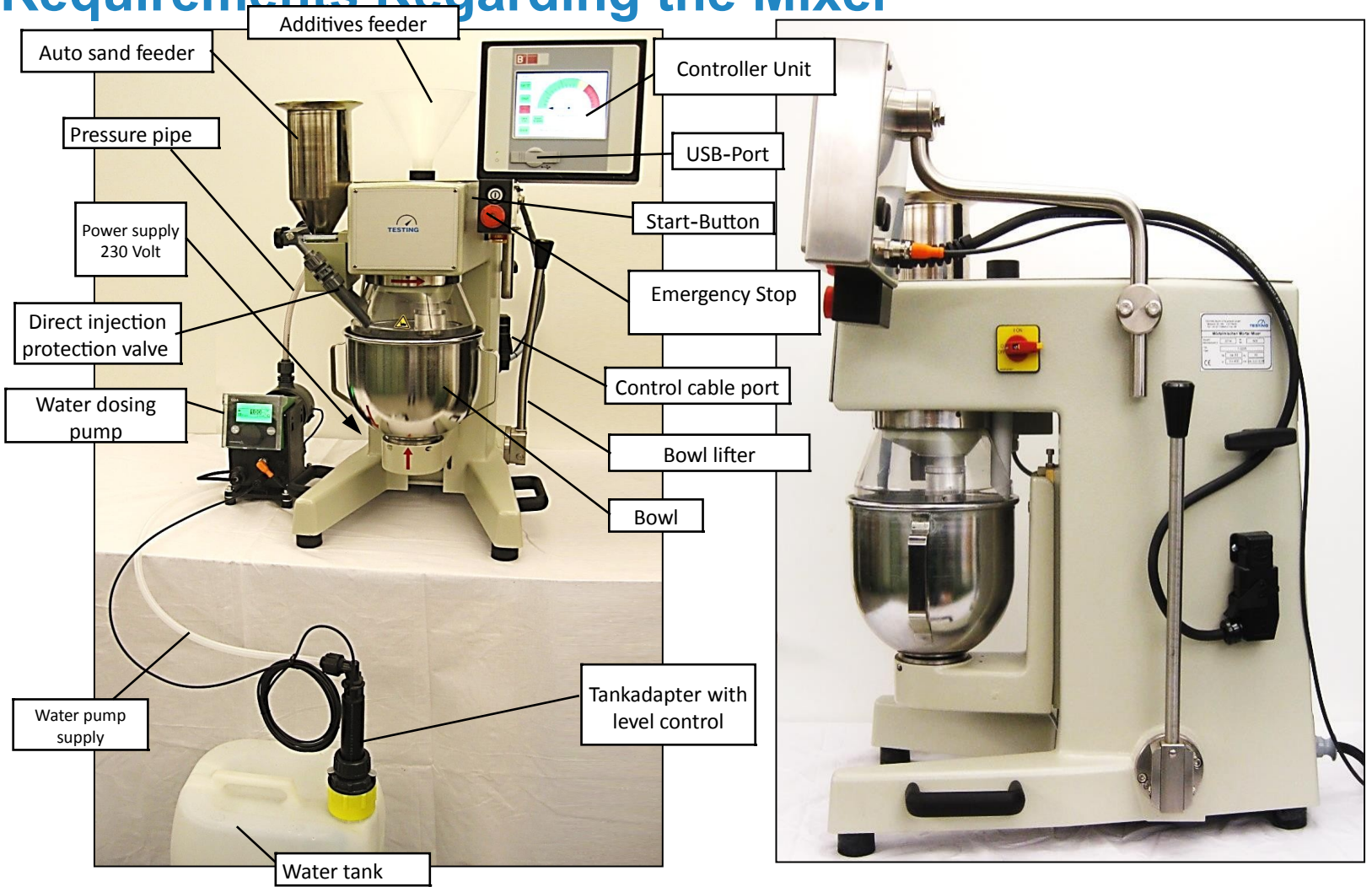
Requirements Regarding the Mixer



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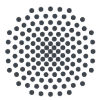
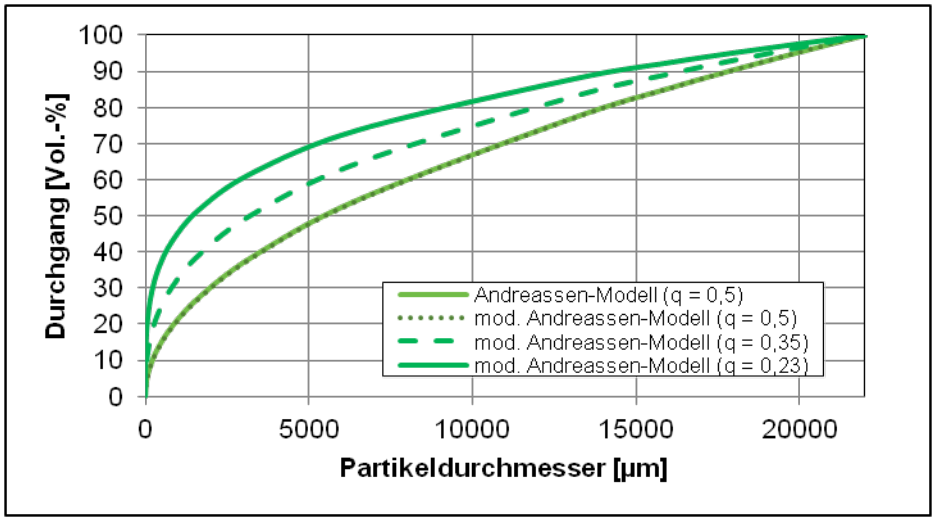
Requirements Regarding the Mixer

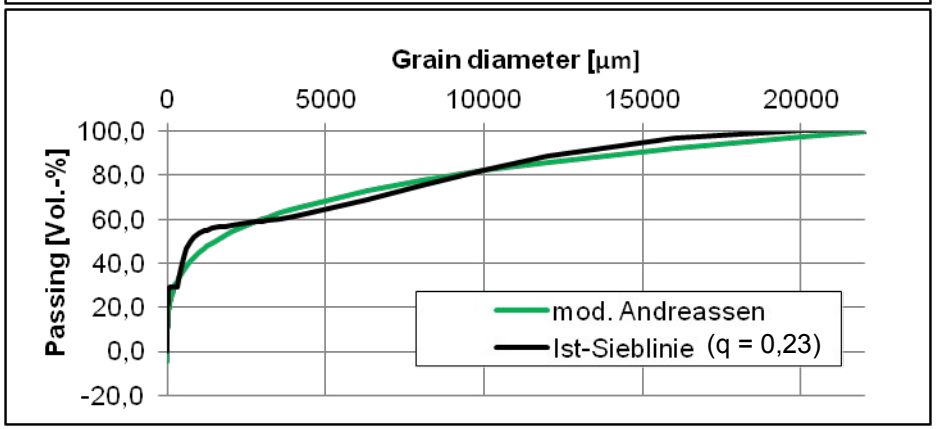
- Construction materials research required specified higher demands to the torque mixer
- Resistance can be recorded permanent during the mixing
- The control unit comprises a programmable logic controller
- Supply individual water amount at any stage

Fundamentals of Mixture Proportioning



Grading-Curve-Optimized Mix Design





Modified Andreassen-Model:

$$\mathbf{P(d)\ [Vol.-\%]} = \frac{d^q - d_{min}^q}{D^q - d_{min}^q} \cdot 100$$

P(d)= fraction of the total solids smaller than size d
d = particle size [μm]
d_{min} = minimum particle size (0,2 μm)
D = maximum particle size (22000 μm)
q = distribution modulus

- Optimization of the grading curve reduces the water demand and increases the stability of concrete

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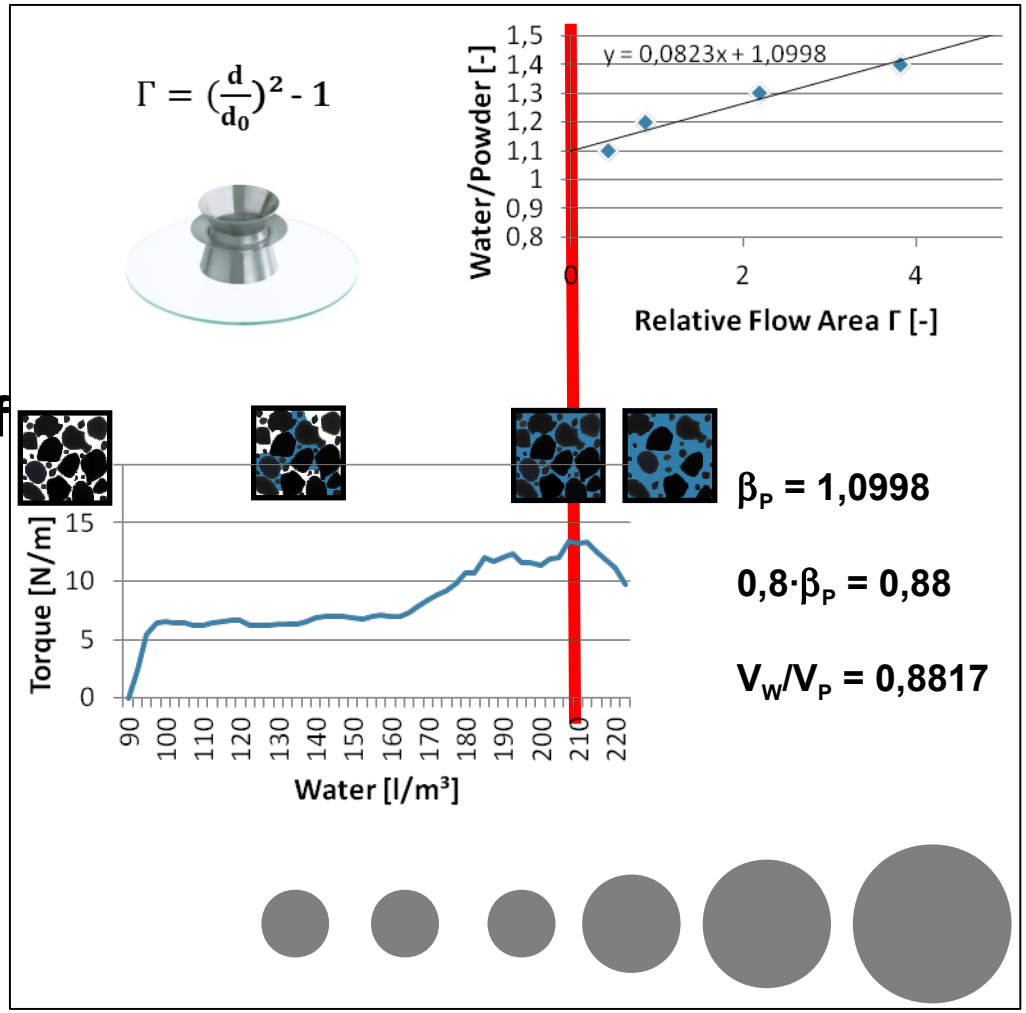
Mix Design by Okamura‘s Method

- Step 1-5: Content of air, coarse aggregate, fine aggregate and cement paste
- **Step 6: Water demand of the binder**
- Step 7: Mortar tests
- Step 8: Mixing of concrete and adaption of the superplasticizer content



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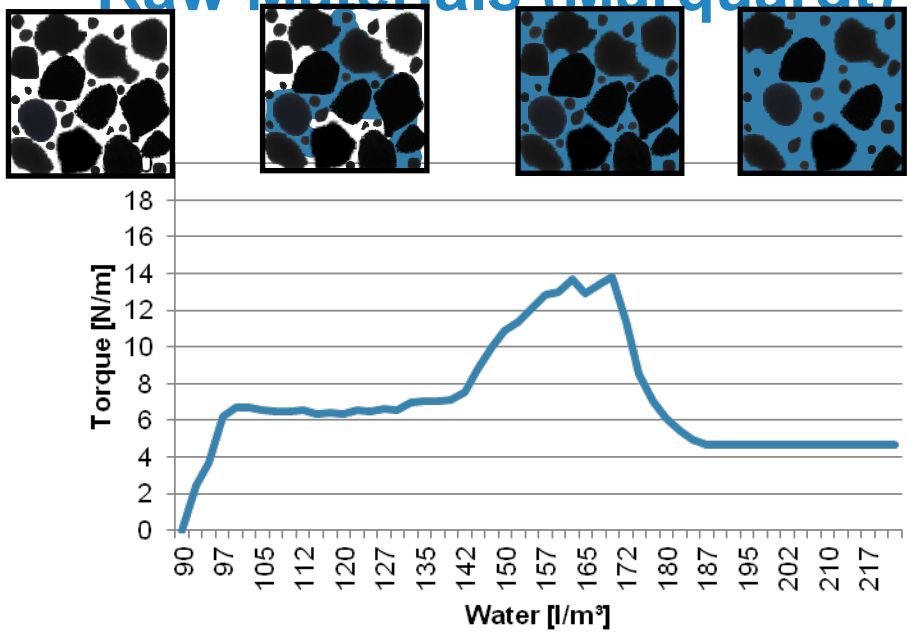
Mix Design Based on the Water Demands of the Raw Materials (Marquardt)



- Cement and additives: Determination as a function of the power consumption
- Aggregate: Centrifugation + correction factor

➢ Sum of the individual water demands yields the optimum water content during concrete production

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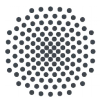
Mix Design Using Concrete-Like Mortar (Schwartzentruber/Catherine)

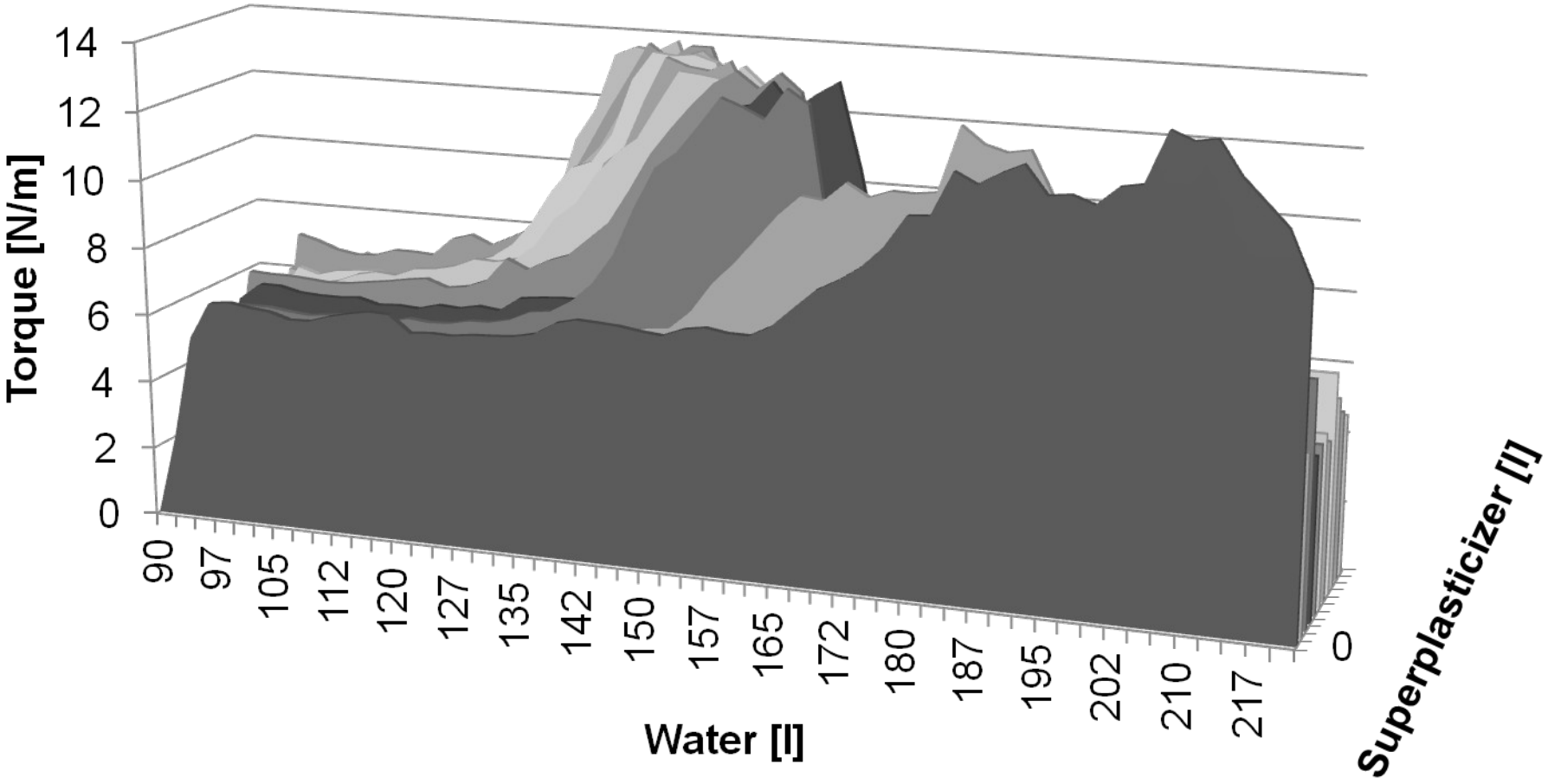
	8/16	2/8	0/2
			
Concrete:	450 kg	500 kg	700 kg
Concrete-Like Mortar:	→ 21,3 kg 0/2	→ 40,37 kg 0/2	**761,67 kg**

- Water demand and fluidity of concrete-like mortar and concrete are comparable

Test Evaluations



Determining the Water Demand as a Function of the Superplasticizer Content



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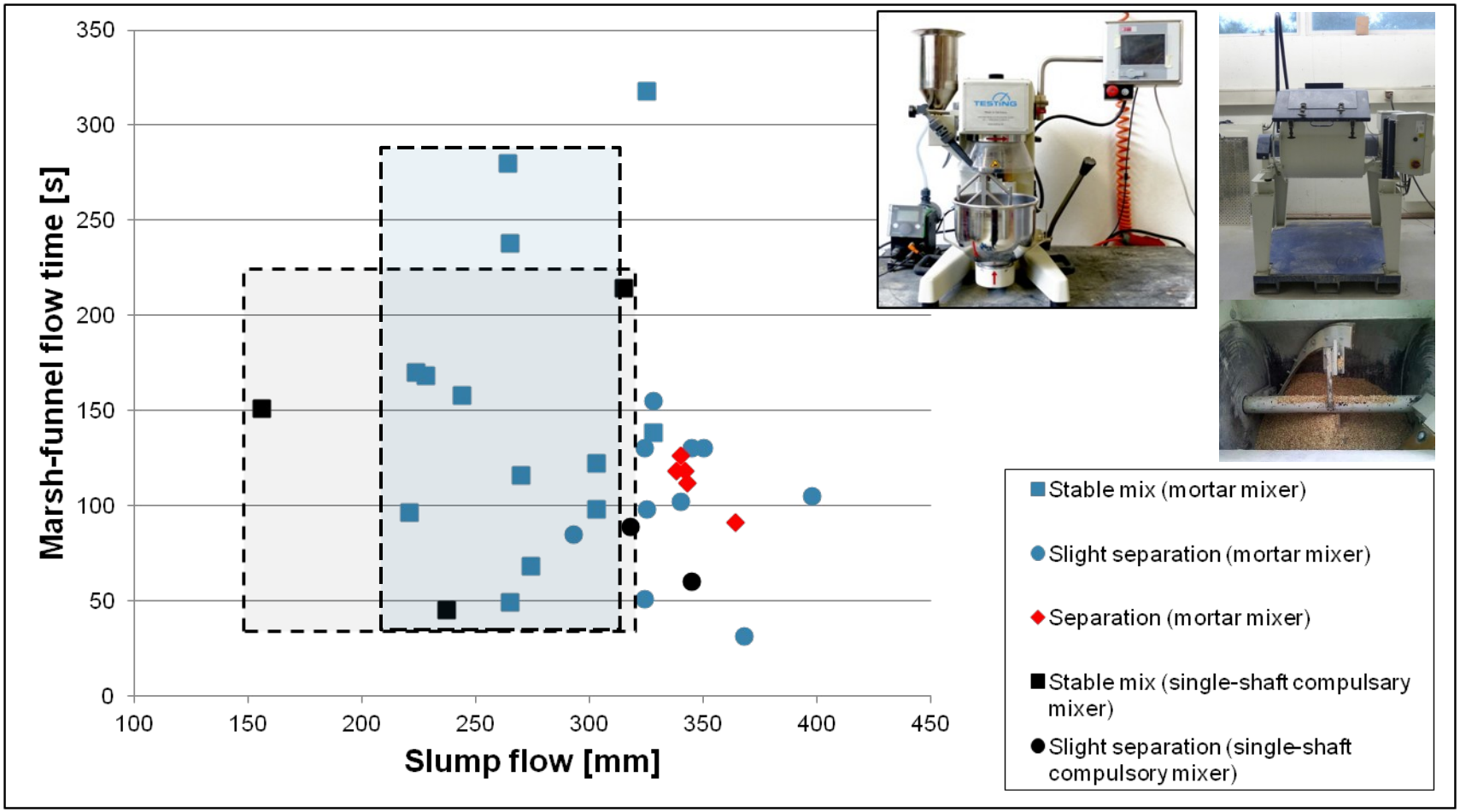
Rheological Properties of the Mortar



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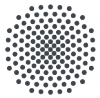
Transferability of the Mortar Mixes to Concrete

			SCC flow cone	
	Water [l/1000 l]	**Superplasticizer [l/1000 l]**	**t_{500} [s]**	**Slump flow [mm]**
Concrete-like mortar	212	2	2	740
			4[1]	530[1]
	165	4	2	900
			3[1]	900[1]
	142	5	6	900
			16[1]	770[1]
Concrete	188	3	9	650
			Not pourable[1]	410[1]
	165	4	15	730
			25[1]	580[1]

([1]) one hour after mixing

Sedimentation Stability of the Concrete

		Water [l/1000 l]	Superplasticizer [l/1000 l]	Discrepancy [mass %]
Concrete-like mortar	CEM III	210	2	10.1
		167	2.75	10.3
		140	3.75	10.2
	CEM I	212	2	10.4
		165	4	10.5
		142	5	7.0
Concrete	CEM I	188	3	7.6
		165	4	3.0



Summary

- The laboratory mortar mixer combines mixing and measuring
- Measuring the torque allows to determine the optimal water content during concrete production
- Water content depends on particle size distribution as well as superplasticizer content
- Transition to a different mixer or from mortar to concrete requires nonetheless certain adjustments

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Thank You! Danke!