GEOPOLYMER FOR USE IN ELECTRIC INFRASTRUCTRE

FREDERIC HERMANN THOLE

- Materialtester for Concrete
- Chemical Process Engineer
- Focus on new products

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TECHNOLOGY LEADER

- Largest manufacturer of concrete products and precast elements for liquid-tight surfaces (WHG)
- 2018: World's most modern facility for the production of concrete products commissioned
- World's first sorting robot for paving stones

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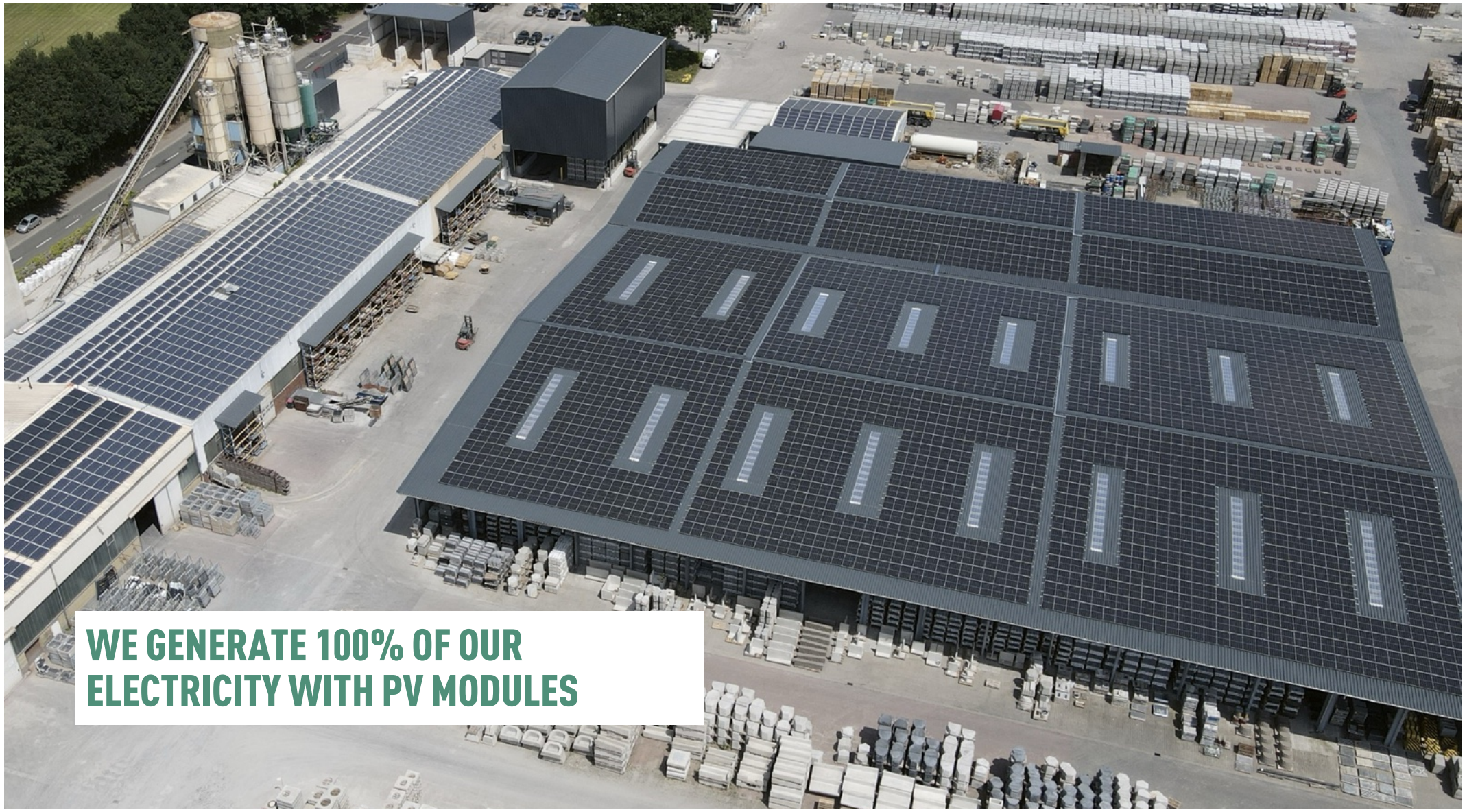
5 CONCRETE-
EXPERTS

225 M²
LABORATORY

30 YEARS
OF EXPERIENCE FOR
PREFABRICATED
CONCRETE


WE GENERATE 100% OF OUR
ELECTRICITY WITH PV MODULES

PRODUCER OF FUNDATIONS FOR ELECTRIC CHARGING STATIONS

150 TONS RECYCLING USED PER DAY, 45 % PER PRECAST ELEMENT

MEGAPROJECT MIXING PLANT

- Kortmanns new mixing plant
- 5 Mixers
- 42 Sand/Gravel silos
- 11 Binder silos
- State-of-the-art mixer
- Investment volume €16 mil.

GOAL: THOR – CEMENT-FREE COMPACT STATION

- Cement-free binder
- CO2 footprint must be reduced by 60%
- The costs must be offset
- Idea: Self-compacting geopolymer concrete (castable geopolymer)

EXPERIMENTS WITH THE GEOPOLYMER BINDER

- The basic idea is: If the binder flows, the system flows.
- Flowability tests were conducted with the following results:
  - Metakaolin flows considerably less well than granulated blast furnace slag.
  - Potassium silicate results in lower viscosity.
  - High flowability requires little or no shaking and is therefore particularly safe for the operator.

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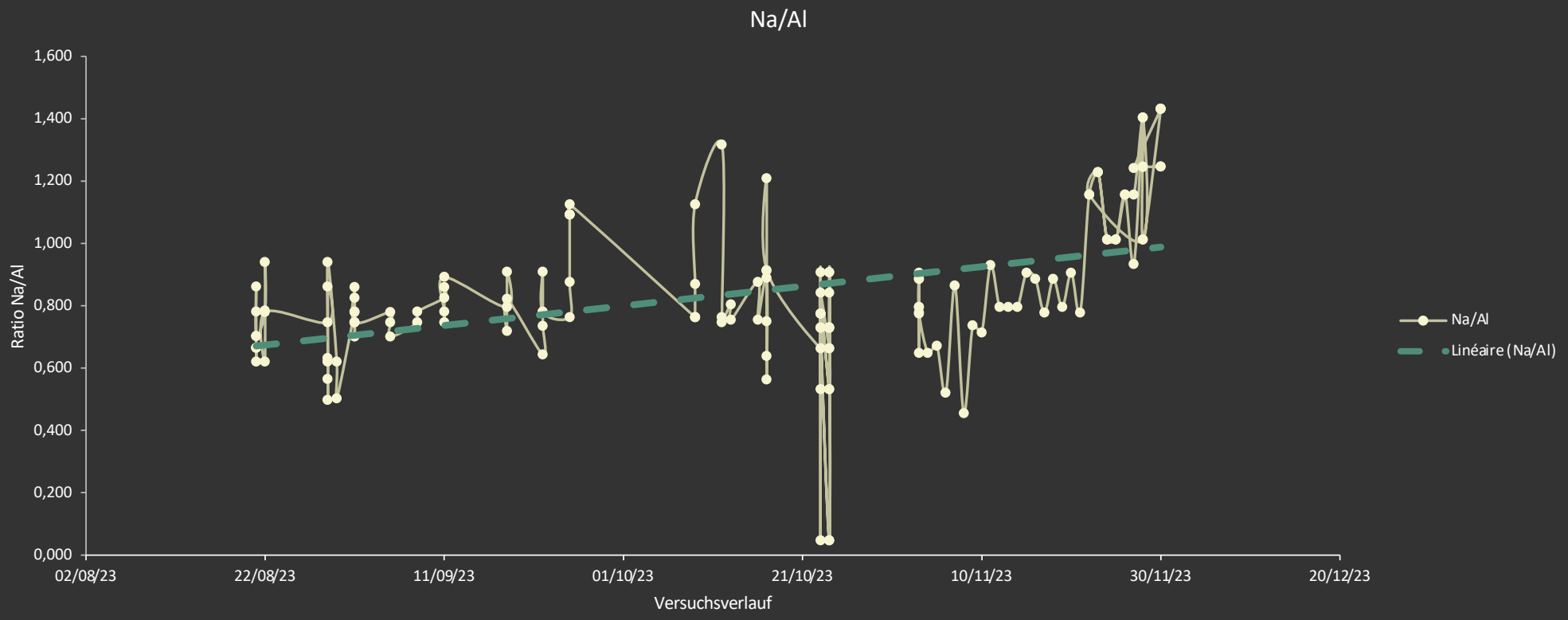
CONCRETE DESIGN

DEVELOPMENT OF THE CHEMICAL COMPOSITION THROUGH 152 ITERATIONS



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BINDERSYSTEM - TEST OF AVAILABLE METAKAOLIN

Art	Produktname	SiO2	Al2O3	Fe2O3	CaO	Na2O	K2O
Metakaolin	Geoflash S (Xatico)	69,8%	21,6%	1,4%			
Metakaolin(Ferro)	Geoflash P (Xatico)	62,4%	30,0%	2,2%			
Metakaolin	temPozz M86, M88, M92	54,0%	43,0%				
Metakaolin	temPozz C90, C90f	52,0%	45,0%				
Metakaolin	Burgess Optipozz	58,0%	42,0%				
Metakaolin	SnowPozz	52,0%	42,0%	0,8%	0,5%	0,2%	0,2%
Metakaolin(Ferro)	Argical M1000/M1000C	59,0%	35,3%	5,0%			
Metakaolin	Argical M1200	55,0%	39,0%	1,4%	1,0%		1,0%
Metakaolin	Metastar 501	52,0%	45,0%	0,7%			
Metakaolin	Amberger Metakaolin	53,5%	39,4%			0,0%	
Metakaolin	Metamax	53,0%	43,8%				

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BINDERSYSTEM – STANDARD METAKAOLIN-SLAG BASED

Bindersystem [kg/m³]	Parts [%]
Silicate Na-Silikat Na2O: 16,9%	34,5±2
Metakaolin Al2O3: 43% - MK750	21±2
Slag Al2O3: 12%/2 - Slag	10±4
Filler (feldspar, basalt, ...)	34,5±20
water	< 5 %

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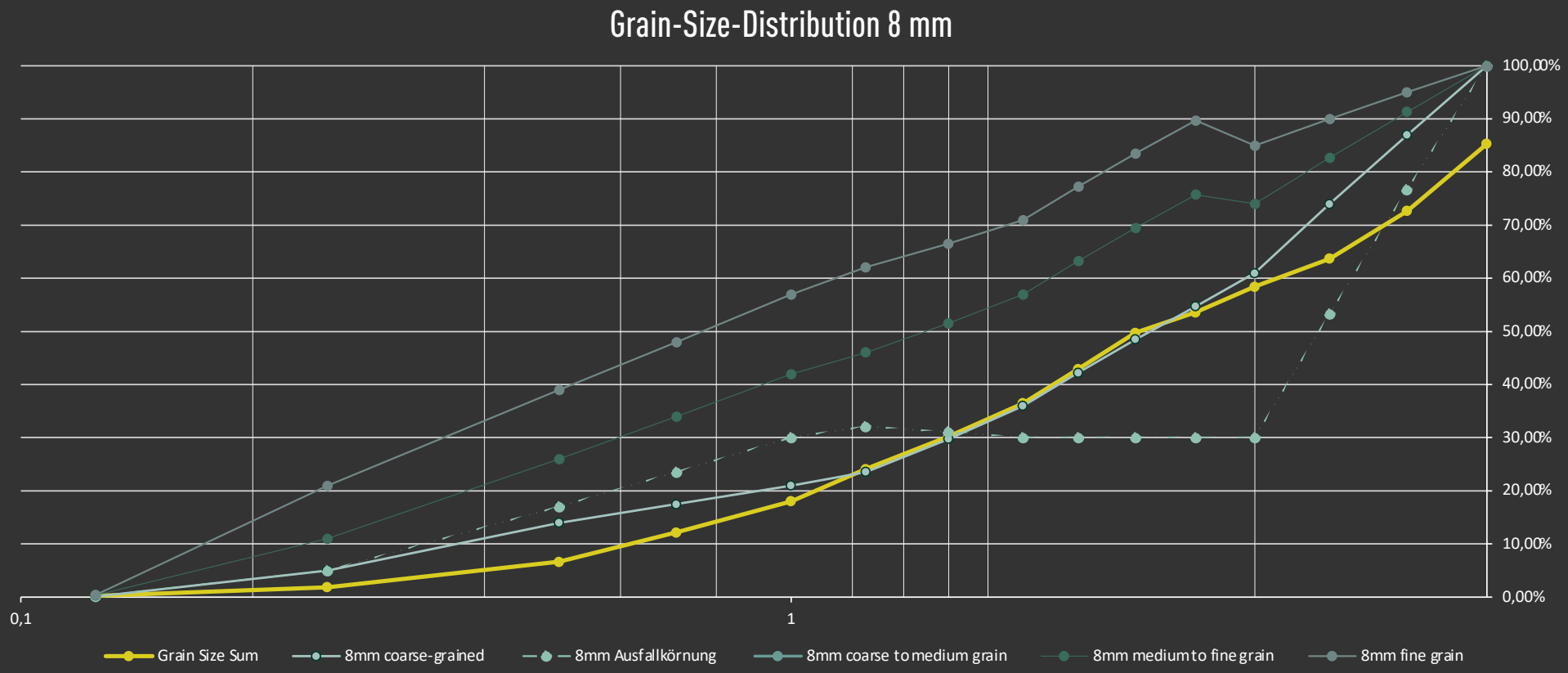
COMPOSITION OF THE CONCRETE



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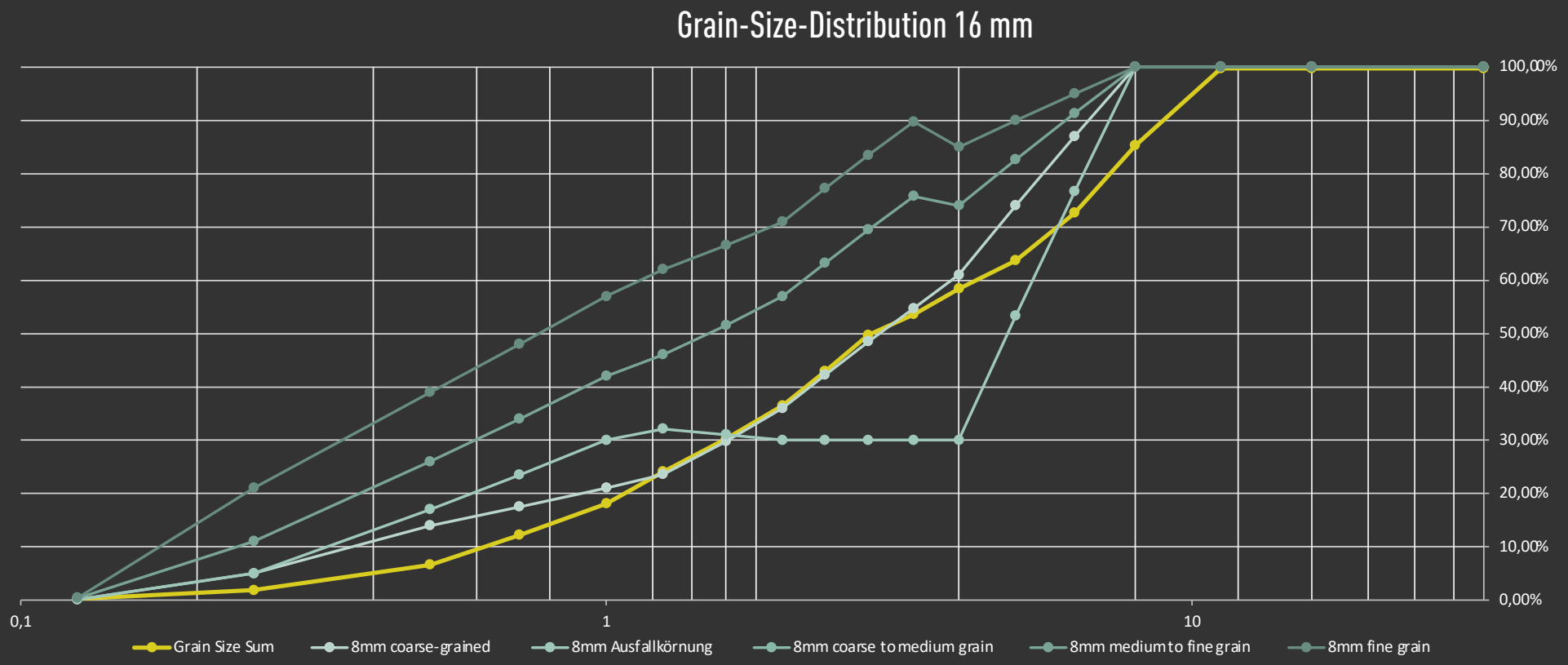
COMPOSITION OF THE CONCRETE



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FIRST GOAL: THE „FLOWING“ BINDER

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BINDERSYSTEM

- Goal for the Geopolymer: achieve a Slumpflow of 200mm+

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BINDERSYSTEM

- Goal for the Geopolymer: achieve a Slumpflow of 200mm+

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BINDERSYSTEM

- The Geopolymer will now have a concrete like behaviour

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BINDERSYSTEM

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HOW TO VERIFY THE GEOPOLYMER CONCRETE

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BINDERSYSTEM

- The the freeze-thawsalt resistance

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MIXINGPROCESS &
REACTION KINETICS

DEVELOPMENT OF A BINDERMIXER

- The most difficult task was enforcing the mixing sequence.
- For this purpose, a new mixer/disperser was planned for the Geopolymer.
- Pictures of this next time.

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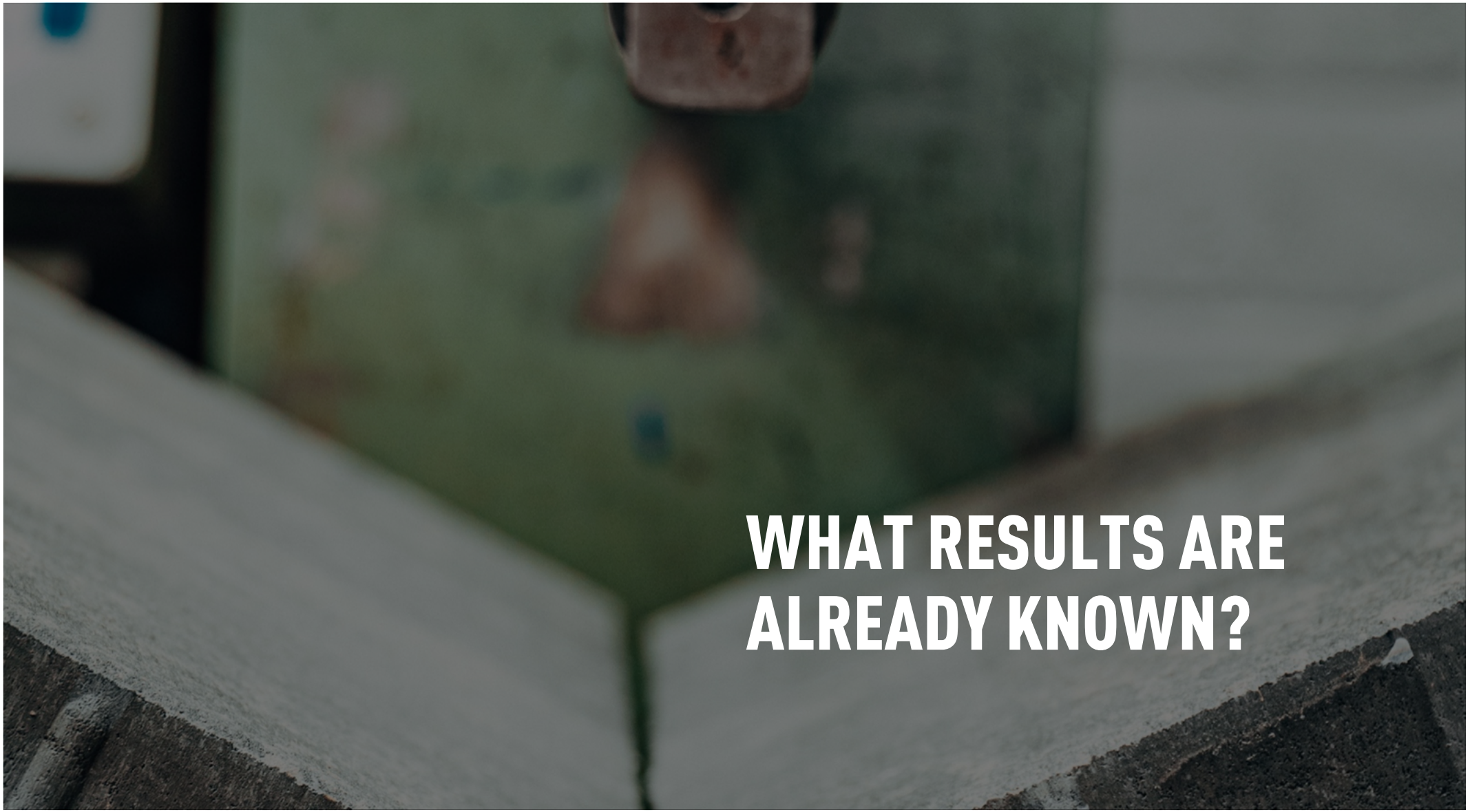
WHAT RESULTS ARE
ALREADY KNOWN?

CONCRETE – RESULTS

Test	Results
Compr. strength (N/mm²)	40± 8 (3 days) ; 70 ± 9 (28 days)
Bulk density (kg/m³)	2,29 ± 0,8
Water absorption (M-%)	1,5±1
Slump-Flowtest – Concrete (mm)	640 ± 40
Funnel exit time (s)	13 ± 8

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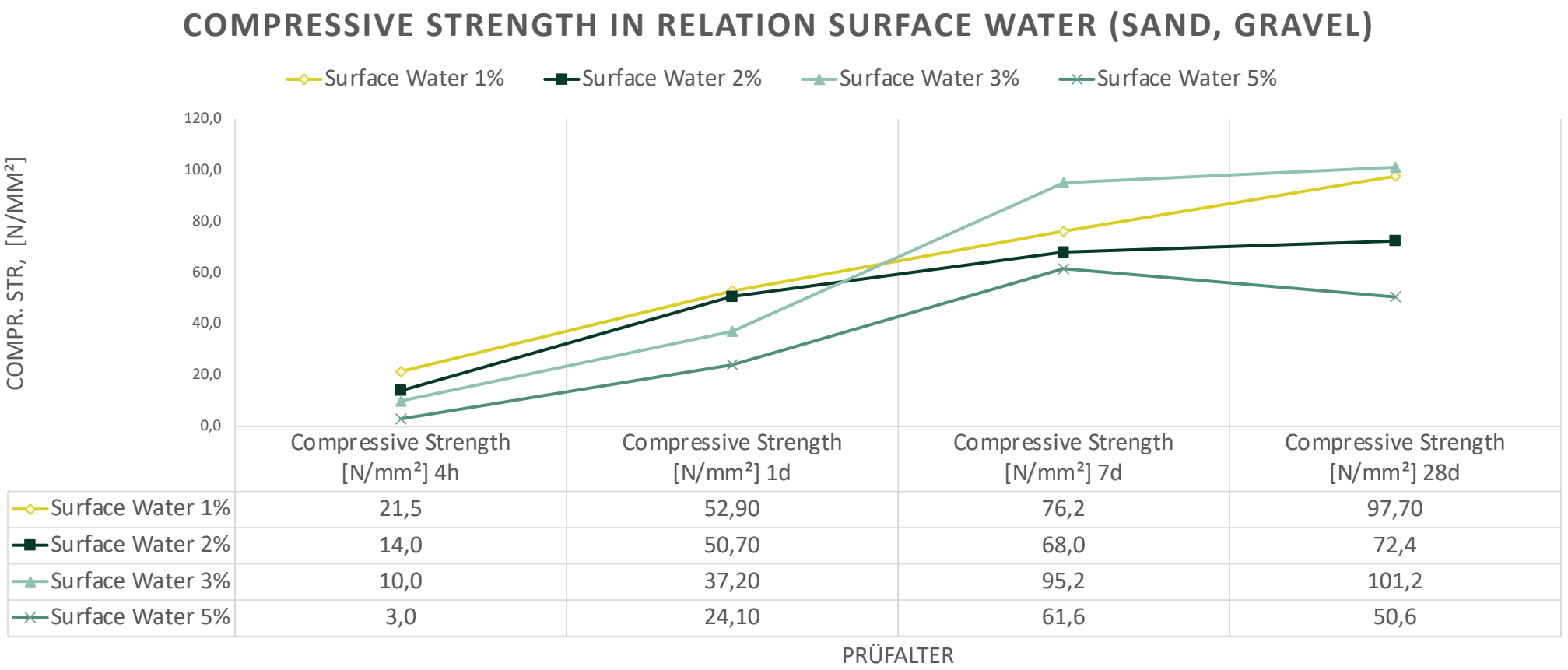
PROPERTIES – HOW MUCH WATER IS A PROBLEM?



	Compressive Strength [N/mm²] 4h	Compressive Strength [N/mm²] 1d	Compressive Strength [N/mm²] 7d	Compressive Strength [N/mm²] 28d
Surface Water 1%	21,5	52,90	76,2	97,70
Surface Water 2%	14,0	50,70	68,0	72,4
Surface Water 3%	10,0	37,20	95,2	101,2
Surface Water 5%	3,0	24,10	61,6	50,6

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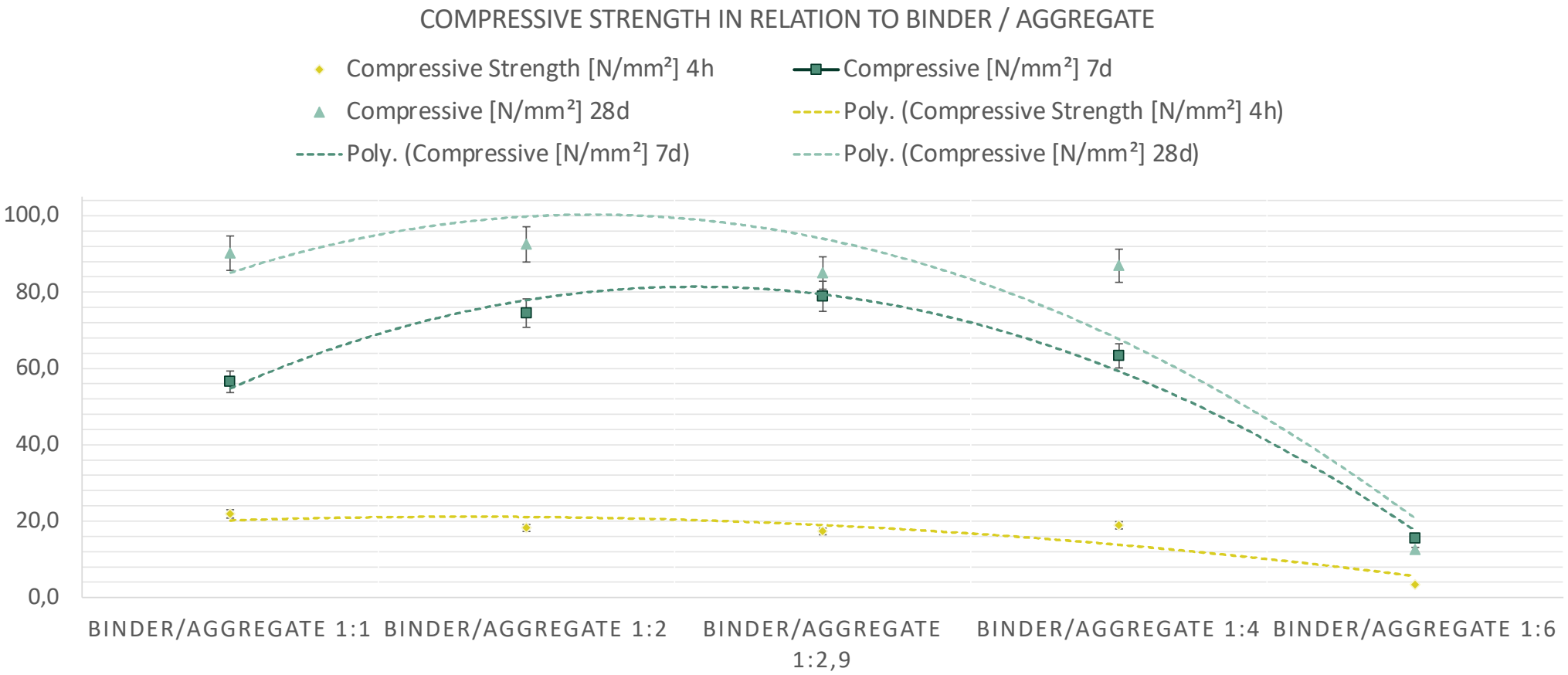
RESULTS – HOW MANY BINDER IN RELATION TO AGGREGATES ?



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CERTIFICATION PROCESS IN GERMANY

- Construction law requires a "certification of usability."
- This certification for a structural component can only be obtained from the DIBt (German Institute for Building Construction Technology)
- The DIBt is very cautious about alternative binders.
- The expert committee on binders required three meetings (meeting every 6 months) to reach an agreement.

- We have been in discussions with the DIBt for 1.5 years and have succeeded in implementing a performance-based test plan.

- The binder can now finally be tested

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WIR
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