MPI Materialprüfinstitut Hellberg GmbH

Laboratory for slip testing of all kinds of floorings

Research and development for concrete and geopolymer

Presentation at the Geopolymer Camp

Rheological improvement and water reduction with the MPI - Concrete mixing system.

presented by
Christo M. Costerus
Technical Director of the MPI Hellberg GmbH

MPI Hellberg GmbH – Artlenburger Landstr. 39-41 – 21365, Adendorf
Telefon: +49 4131 8843 947 / Telefax: +49 4131 8843 948 / Email: info@mpi-gmbh.de
Germany

MPI Materialprüfinstitut Hellberg GmbH

New innovative technology
of the two-step concrete production
using the MPI Concrete technology:

1. Suspension mixing with energetically
   - ❖ modified water and
   - ❖ a colloidal mixer

2. Mixing of the aggregates and the suspension in a homogenizer

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Mixing concrete in a way our ancestors already did…..

The following aspects have been fully disregarded so far:

- Influence of the characteristics of the water used
- Different requirements of the components as far as the mixing technology and the mixing techniques are concerned, not to forget the time and energy which are needed to fully decompose the components

The MPI *Technology* consists of:

- Water treatment by electrodynamics and electrical impacts
- Suspension mixing technology (colloidal mixer)

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The Presentation

- MPI *Concrete Technology*
- MPI *Water Treatment*
- MPI *Colloidal Mixing*
- MPI *Technical Equipment*
- Effects and Advantages
- **Summary**

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MPI *Water Treatment Technology*

Water treatment by electro-dynamical and electrical impacts

The MPI-water treatment facilities can be optimally adjusted to all types of water (as well recycled water) suitable for the concrete production.

The MPI-water treatment effectuates:

- Breakup of a large number of water-molecule-clusters (reduction of the bondage by hydrogen bridges between the molecules)
- Changes in the electrical charge of the water

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MPI *Concrete Technology* practice

Effectiveness of the MPI water treatment

Cement per m³	**300 kg CEM III/A 42.5N-NA**
Fly ash per m³	**60 kg**
Plasticizer based on cement	**0.35 % SIKA VC1051**

		Reference „0“-mix	MPI WTS-mix
Spread	**5 min**	**495 mm**	**580 mm**
Slump	**5 min**	**140 mm**	**200 mm**
Spread	**60 min**	**385 mm**	**505 mm +31.2%**
Slump	**60 min**	**80 mm**	**200 mm +150.0%**
28d-compr. strength		**27.6 N/mm²**	**28.4 N/mm² + 3.5%**

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MPI *Concrete Mixing* Technology

Suspension Mixing Technology (colloidal mixer)

The MPI-CCT suspension mixing process effectuates:

- Breakup of agglomerates
- Complete activation of all cement particles – Possible reduction of the cement content or substitution of cement by other binding agents
- Reduction of the water demand – Reduction of the water/binding agent-ratio
- Faster disintegration of plasticizers – Less demand for plasticizers
- Crushing of cement particles (wet milling) – Increase of the reactive surface

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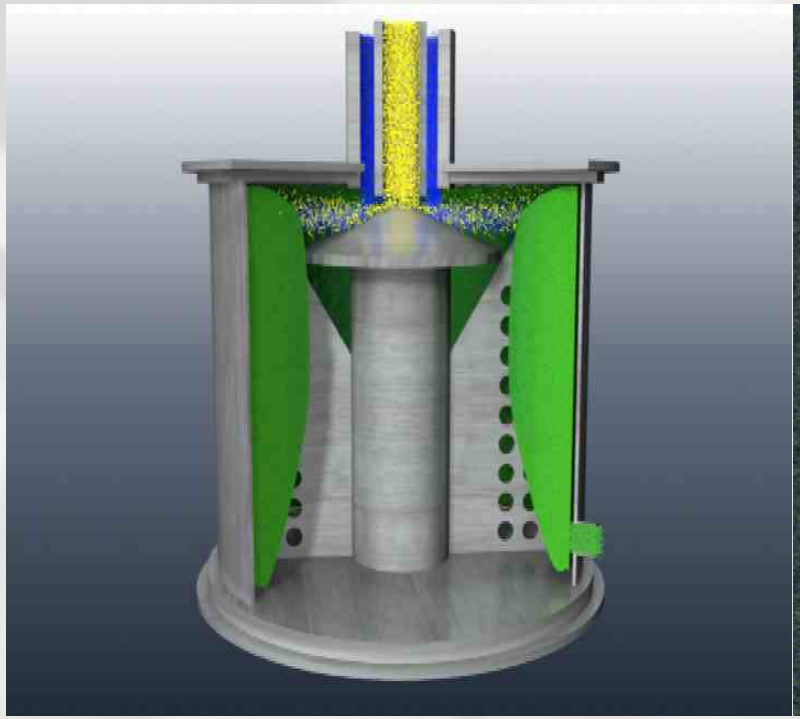
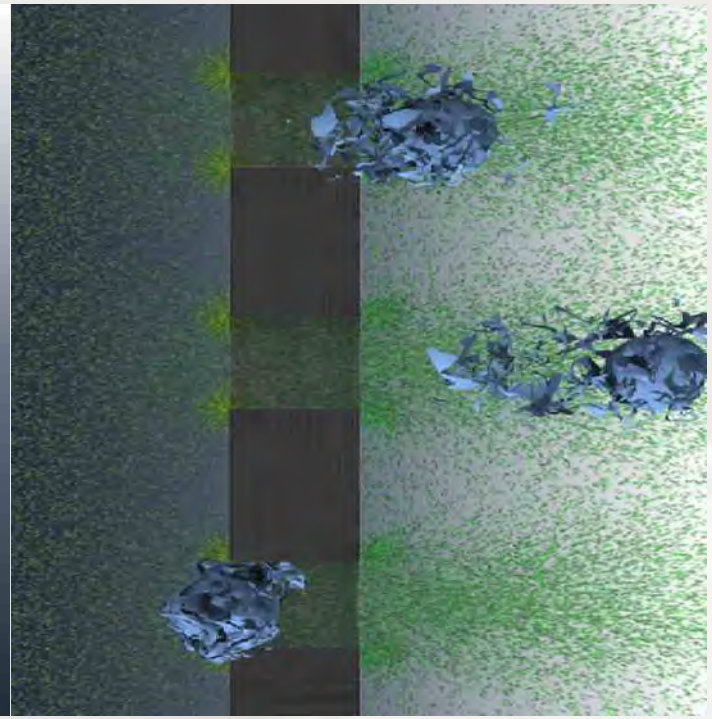
MPI *Mixing Technology*

Colloidal suspension/slurry mixer

Disintegration of agglomerates - Shearing and cavitations processes





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MPI *Concrete Technology* practice

Approval of increased early strength and upgrading of cement

Cement „0“-mix per m³	**390 kg CEM I 52.5R**
Plasticizer based on cement	**1.1 % BASF ACE 430**

WTSCCT-mix	**Reference „0“-mix**	**MPIC**
Spread 5 min	**>600 mm**	**>600 mm**
7.75h-compr. strength	**2.5 N/mm²**	**22.6 N/mm²**
		+820.8 %

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MPI *Concrete Technology* practice

Approval of increased early strength and upgrading of cement

Cement „0“-mix per m³	**450 kg CEM I 42.5R**
Plasticizer based on cement	**0.4 % BASF ACE 430**
Should be compressive strength	**15 N/mm² after 8h**

	Reference „0“-mix	**MPIC WTSCCT-mix**
Spread 5 min	**460 mm**	**435 mm**
8h-compr. strength	**5.5 N/mm²**	**16.0 N/mm²**
%		**+190.6**

Material cost reduction* **3.15 €/m³ + CO_2-reduction**

*Cement 42.5 R 75.00 €/t – Cement 52.5 R 82.00 €/t

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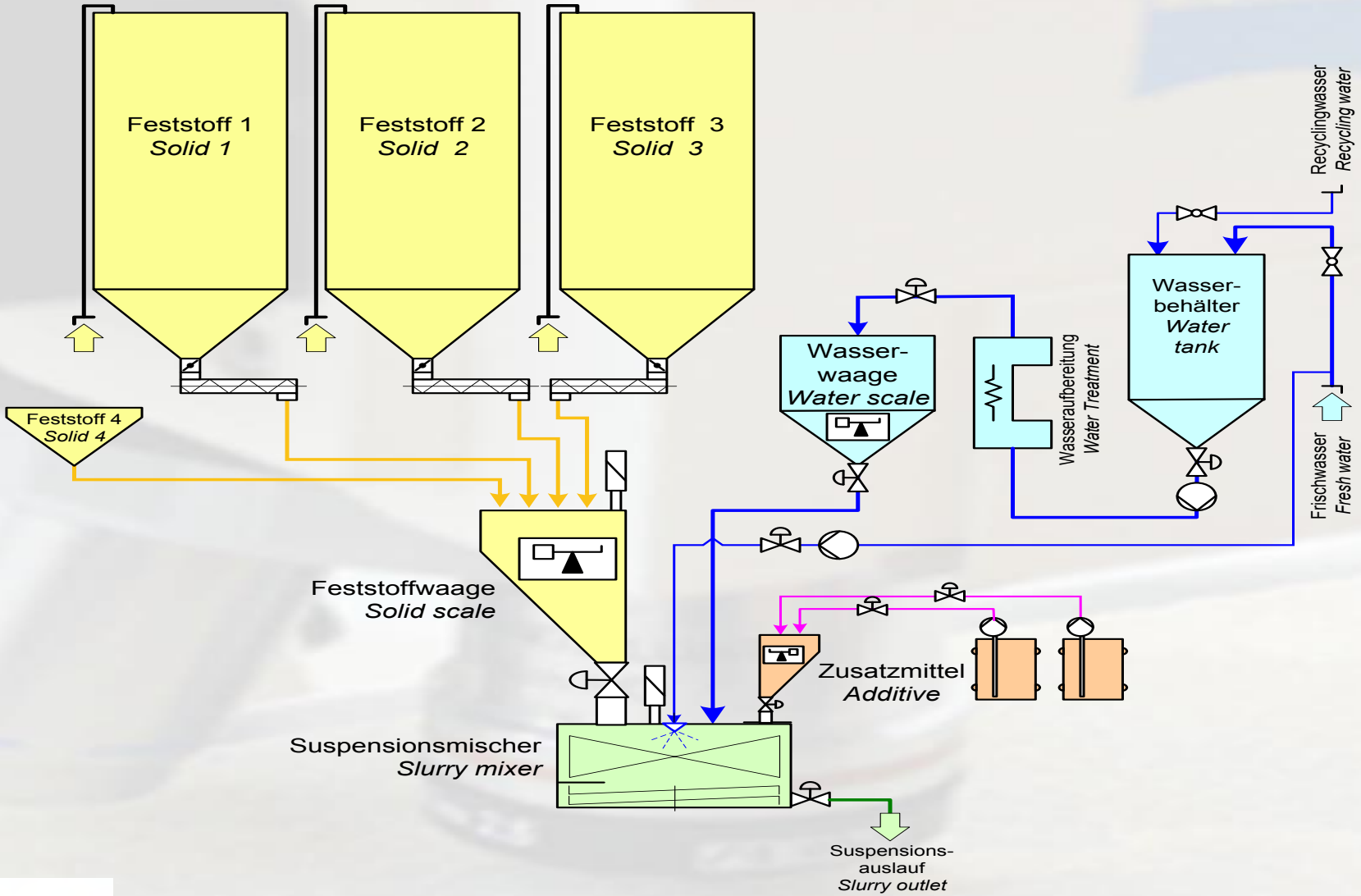
Procedure plan*



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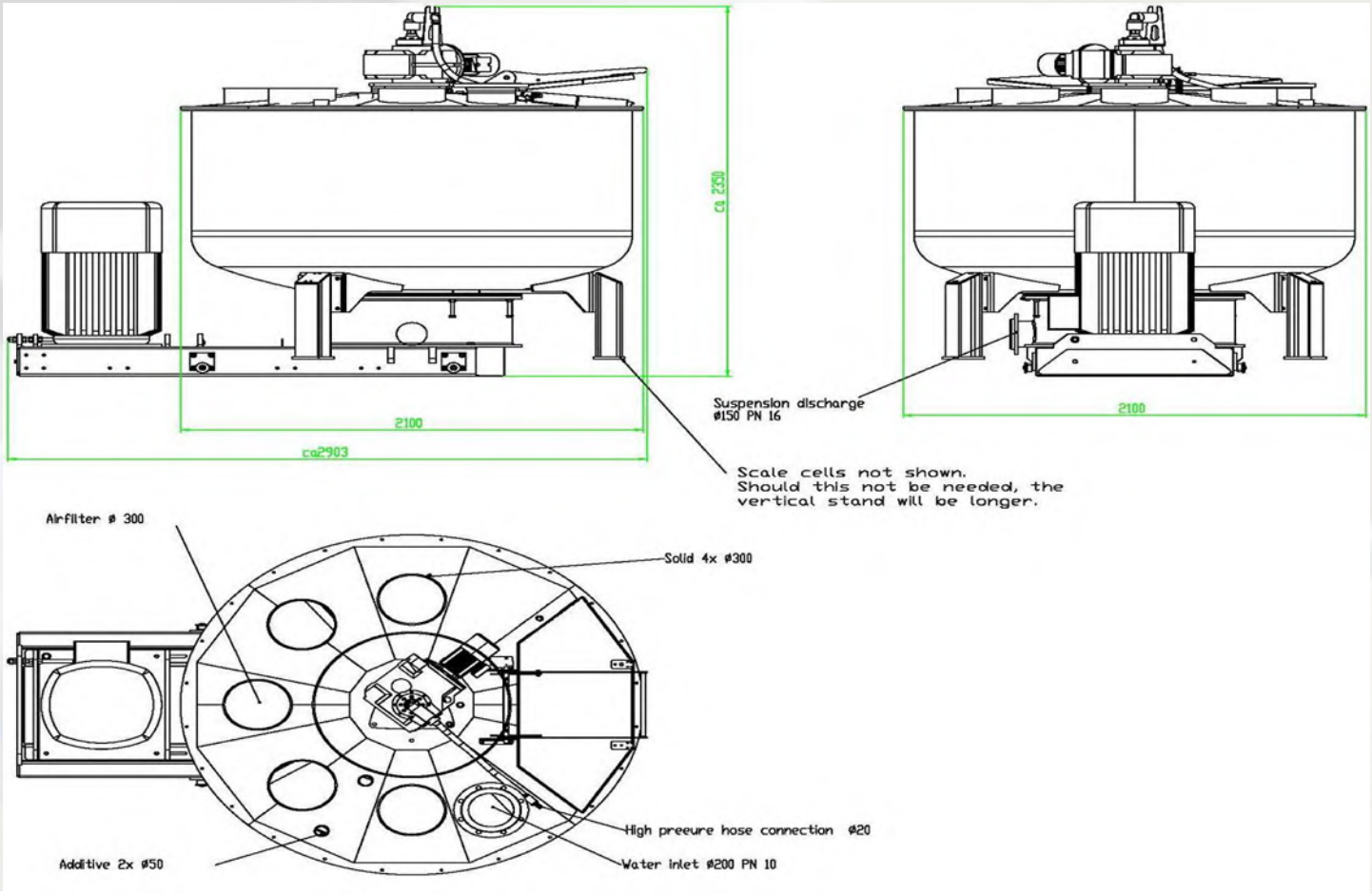
Colloidal Mixing System CCT

Detached Unit CCT2200



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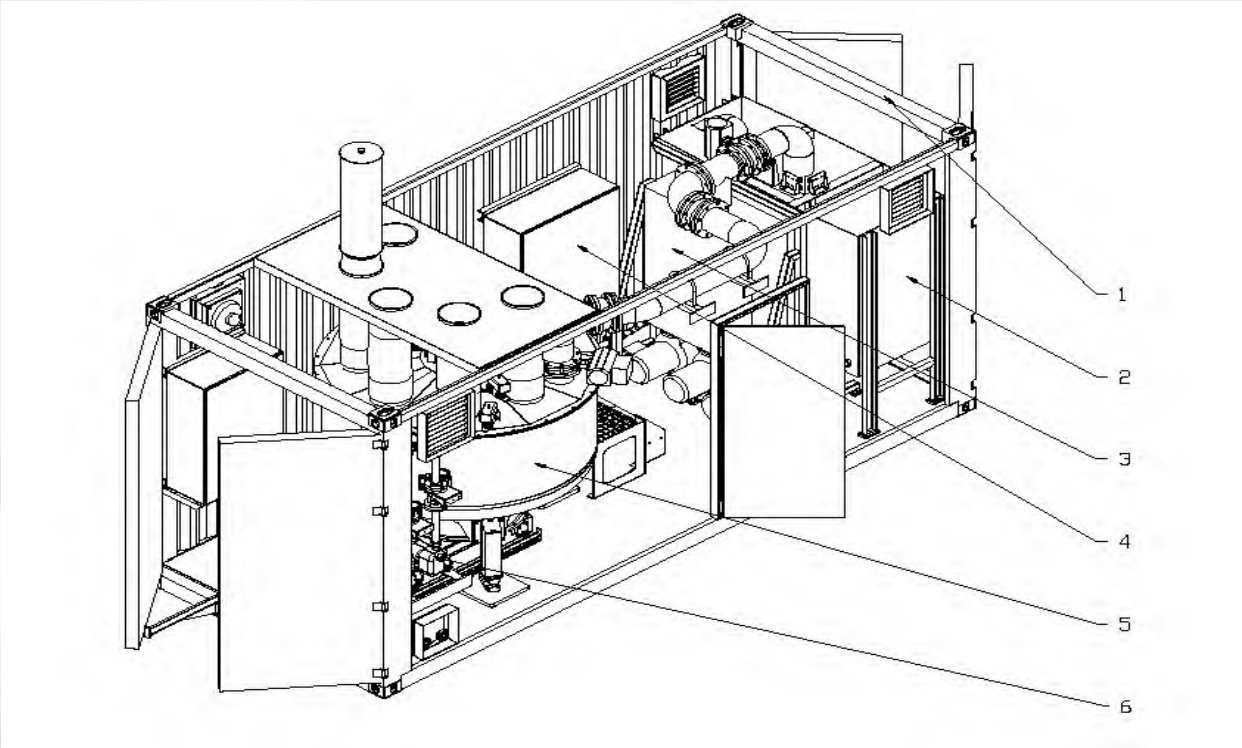
System drawing
MPI “Suspension station”

Container-system

1. **Container**
2. **Water tank**
3. **Water treatment**
4. **Controller (PLC)**
5. **Mixer**
6. **Additive dosage**



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MPI *Concrete Technology*

„Container-Castle“ at the RMC plant of „Holcim Beton und Zuschlagstoffe GmbH“ in Geesthacht (Hamburg)

Testing of the fresh concrete characteristics

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MPI *Concrete Mixing Technology*

The combined MPI contained equipment
2.200 (2,500) liter-suspension mixer + water treatment system

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MPI *Concrete Technology*

The MPI *Concrete Technology*
leads to an increased workability
and an improvement of quality, e. g. :

- less differences between the mixtures
- higher equality of colours
- higher early strength, higher strength and increased durability
- less pores and reduction of efflorescences
- better workability and compactability
- less segregation and bleeding
- improved pumpability

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MPI *Concrete Technology*

The MPI *Concrete Technology*
leads to a reduction of costs:

- reduction of cement and/or lowering of the w/c-ratio
- exchange of cement against other materials
- upgrading of the cement
- less additives and pigments
- normal concrete can be transformed into a SCC
- less mixing time (higher output)
- less energy consumption and abrasion
- earlier stripping of the mould for prefabricated concrete parts
- **reduction of CO_2-emissions**

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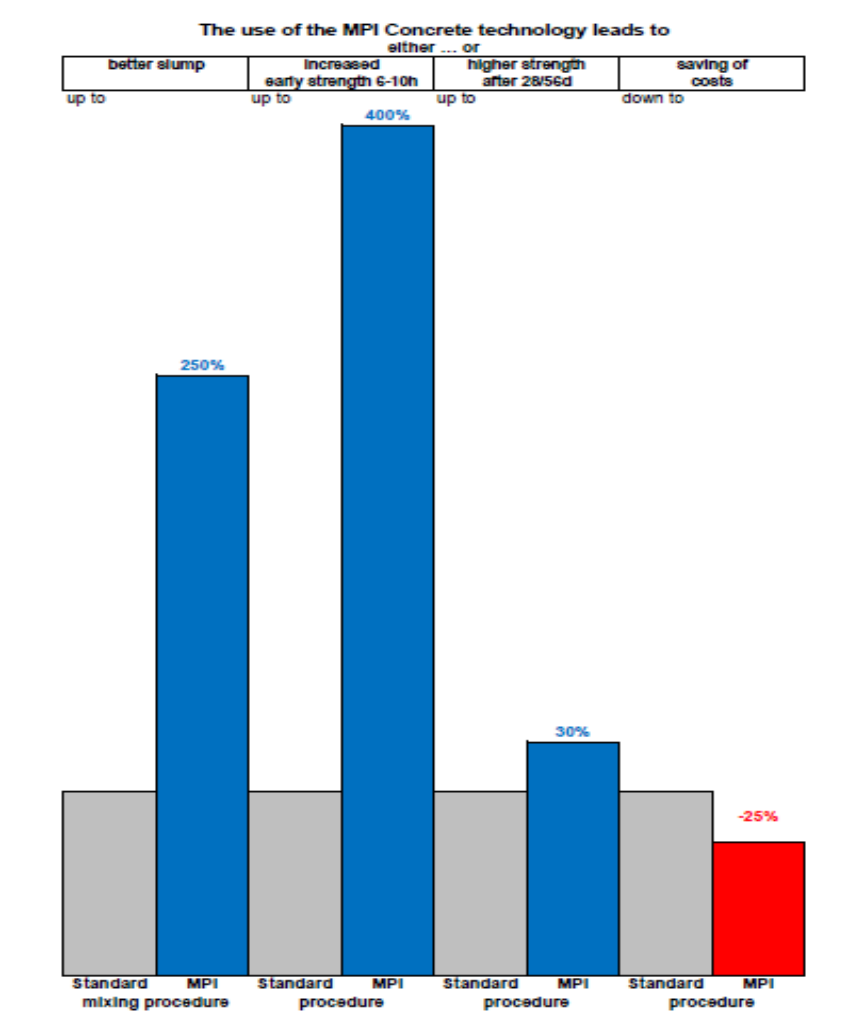
Effects of the MPI *Concrete Technology*



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MPI *Concrete Technology* practice

Concrete mix C 80/95 F5 GS16 **Mixes: 305** **Dates: 20.01.10** **Location: TCA**	**"0" Reference mix 305 C8**	**Mix 305 C12**
Mixer / mixing process	Compulsory CMC laboratory mixer	WTS + laboratory CCT-C mixer
Mix design		
Water [l/m³]	157	145
Type of cement	CEM I 52,5 R	
Cement [kg/m³]	400	360
Filler (fly ash) [kg/m³]	96	127
Plasticizer (PCE) [kg/m³]	each 0,5625% Duriment V565+V566	
Sand 0/2 [kg/m³] (trocken)	870	875
Grit 2/8 [kg/m³] (trocken)	317	320
Grit 8/16 [kg/m³] (trocken)	653	657
W/B-ratio (Slurry / Concrete)	- / 0,367	0,291/ 0,354
Tests with fresh concrete		
Density, fresh (Slurry / Concrete) [kg/dm³]	2,427	2,438
Luftporengehalt [%]	NN	NN
Concrete temperature [°C]	25,0	26,2
Spread after 5 min [mm]	680	600
Slump after 5 min [mm]	380	**440**
Tests with hardened concrete		
Compressive strenght after 12h [N/mm²]	7,5	**24,5**
Difference in compr. strength [%]	20 cm polystyrol cubes	**226,7%**
Compressive strenth after 24h [N/mm²]	5,7	**7,4**
Difference in compr. strength [%]	10 cm cubes	29,4%
Compressive strenth after 24h [N/mm²]	57,0	**61,1**
Difference in compr. strength [%]		7,3%
Compressive strenth after 7d [N/mm²]	85,0	**86,3**
Difference in compr. strength [%]		1,6%
Compressive strenth after 28d [N/mm²]	100,7	**101,6**
Difference in compr. strength [%]		0,9%

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MPI *Concrete Technology* practice

Concrete mix C 80/95 F5 GS16 Mixes: 310 Dates: 28.01.10 Location: TCA	**"0" Reference mixes 310 C1**	**Mix 310 C6**	**"0" Reference mixes 310 C5**	**Mix 310 C7**
Mixer / mixing process	Compulsory laboratory mixer	WTS+CCT-L + compulsory laboratory CME mixer	Compulsory laboratory mixer	WTS+CCT-L + compulsory laboratory CME mixer
Mix design				
Water [l/m³]	157,0			
Type of cement	CEM I 52,5 R			
Cement [kg/m³]	400			
Filler (fly ash) / slag [kg/m³]	96 fly ash		96 slag	
Plasticizer (PCE) [kg/m³]	0,375% Duriment 565 / 0,875% Duriment 566			
Sand 0/2 [kg/m³] (trocken)	870			
Grit 2/8 [kg/m³] (trocken)	317			
Grit 8/16 [kg/m³] (trocken)	653			
W/B-ratio (Slurry / Concrete)	- / 0,365	0,240 / 0,373	- / 0,365	0,240 / 0,373
Tests with fresh concrete				
Density, fresh (Slurry / Concrete) [kg/dm³]	2,459	2,430	2,451	2,432
Luftporengehalt [%]	NN	NN		NN
Concrete temperature [°C]	22,0	29,0 / 22,0	22,0	29,0 / 22,0
Spread after 5 min [mm]	700	**690**	670	620
Spread after 60 min [mm]	660	**680**	595	**660**
Slump after 5 min [mm]	320	320	350	200
Slump after 60 min [mm]	300	250	350	270
Tests with hardened concrete				
Compressive strenght after 7.5h [N/mm²]	2,3	**25,5**	9,4	**38,6**
Difference in compr. strength [%]		**1008,7%**		**310,6%**
Compressive strenth after 7d [N/mm²]	78,3	**83,7**	84,6	84,0
Difference in compr. strength [%]		6,9%		-0,7%
Compressive strenth after 28d [N/mm²]	89,7	**94,2**	92,2	**97,1**
Difference in compr. strength [%]		5,0%		5,3%

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MPI *Concrete Technology*

Your Chance to Change

Using MPI Concrete combined systems in plants for prefabricated concrete parts, ready-mixed concrete plants or directly on the construction sites, guarantees a cost-effective production of concrete, an increase of quality and of the output/ production capacity.
Both, the time required to produce a mixture of concrete and the time to fill a truck mixer can be notably reduced which means that, in a lot of cases, less truck mixers are needed.
The usually high energy consumption for the dry mixing can be reduced to less than a third. The wear costs of the existing mixing systems decrease to a minimum.
The period of redemption (ROI- return of investment) of an MPI Concrete system will normally be less than 18 months, depending on the production quantity and the site of operation.

The MPI Concrete technologies also play an important role in the range of activities to reduce the CO_2-emissions..

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