



# OPPORTUNITIES FOR PROCESS AND QUALITY OPTIMIZATION OF SEMI-DRY CONCRETE

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INTERNATIONAL PRESTRESSED  
HOLLOWCORE ASSOCIATION

BUILDING TRUST



# PROCESS AND QUALITY OPTIMIZATION OF SEMI-DRY CONCRETE OVERVIEW



**Challenges**



**Concrete**



**Admixtures**



**Case Study**

**Opportunities/Solutions**

# PROCESS AND QUALITY OPTIMIZATION OF SEMI-DRY CONCRETE

## INTRODUCTION SIKA IN SEMI-DRY CONCRETE

- Sika® is a **globally active** company
- specialty chemicals
- Full range supplier



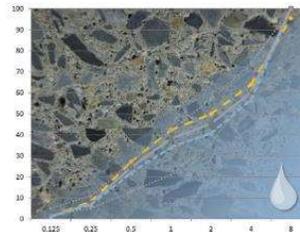
- Profitability } of semi-dry
- **Reputation** } concrete industry



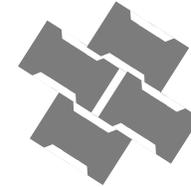
- Origin in the **improvement of concrete quality**
- Developing, producing and selling concrete admixtures



- Economic and efficient application of SikaPaver®-Products
- **Good concrete composition**



- Process additives SikaPaver®
- application field small precast elements industry
- **Improve production and performance**



- Central R&D Laboratory in Leimen/Germany
- **Optimization of the various semi-dry concrete technologies**



# PROCESS AND QUALITY OPTIMIZATION OF SEMI-DRY CONCRETE

## PERSONAL INTRODUCTION



- **Jorg M. Schrabback**  
Dipl.-Ing. (FH) / civil engineer
- since 1994 concrete technologist with focus on optimization and consulting of semi-dry concrete and the required admixtures.
- 1999 to 2015 internationally active with focus on precast concrete products and cement technology.
- Extensive practical experience led to intensification of research regarding mold filling behavior, compaction and durability of semi-dry concrete since 2016.
- Responsibility: Germany
- Hobby: Support International

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# SOCIETY, ENVIRONMENT & ECONOMY

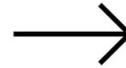
## FUTURE CHALLENGES FOR CONCRETE PRODUCERS



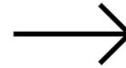
GLOBAL  
MEGATRENDS



FUTURE LAWS  
& REGULATIONS



CONSTRUCTION  
PROBLEMS



### FUTURE CHALLENGES

#### Carbon Neutrality

- Cement production efficiency
- Alternative binder systems
- Clinker reduction in concrete

#### Resource Efficiency

- Increased recycling rate
- Renewable raw materials
- Enhanced service life

#### Productivity Increase

- Automation & Digitalization
- Prefabrication
- Modular construction

# PROCESS AND QUALITY OPTIMIZATION OF SEMI-DRY CONCRETE

## CHALLENGES OF HOLLOW CORE SLAB PRODUCTION AND QUALITY

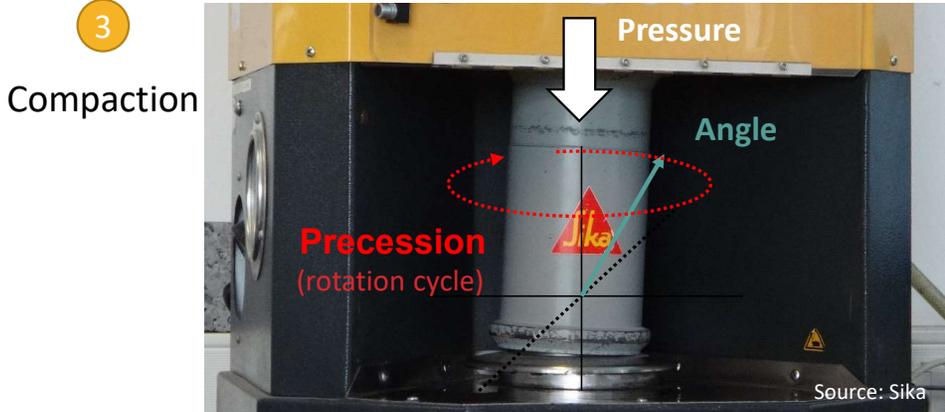


- Fast extrusion
- Intensive compaction
- Smooth surface & flank finish
- Shape keeping/ green strength
- Strength development

**„We can find solutions, if we understand the challenges in detail!“**

# PROCESS AND QUALITY OPTIMIZATION OF SEMI-DRY CONCRETE

## LABORATORY TRIALS FOR RESEARCH AND DEVELOPMENT



# PROCESS AND QUALITY OPTIMIZATION OF SEMI-DRY CONCRETE

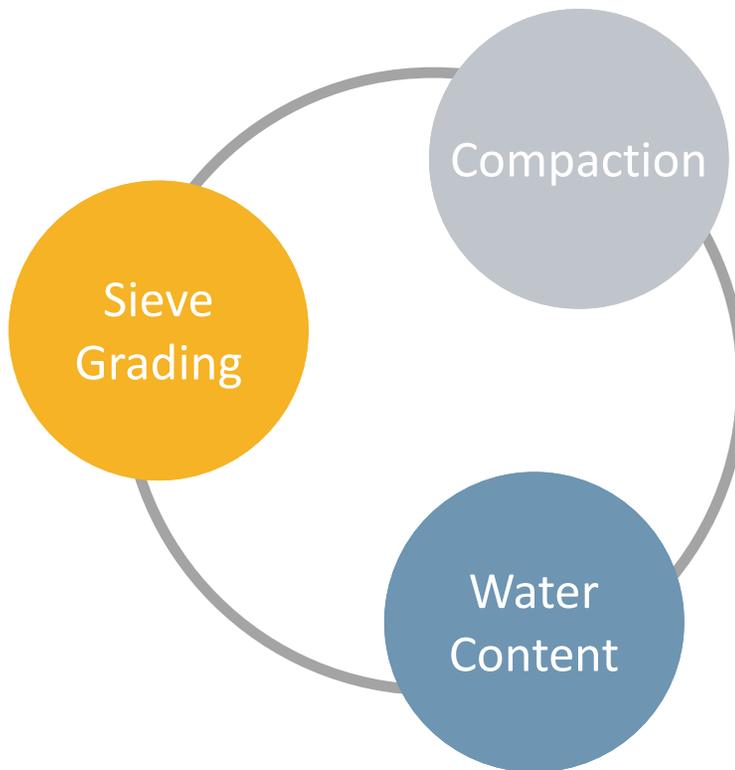
## MAIN INFLUENCING FACTORS

### **Finer** Sieve Grading

- Higher water demand
- Weaker Compaction

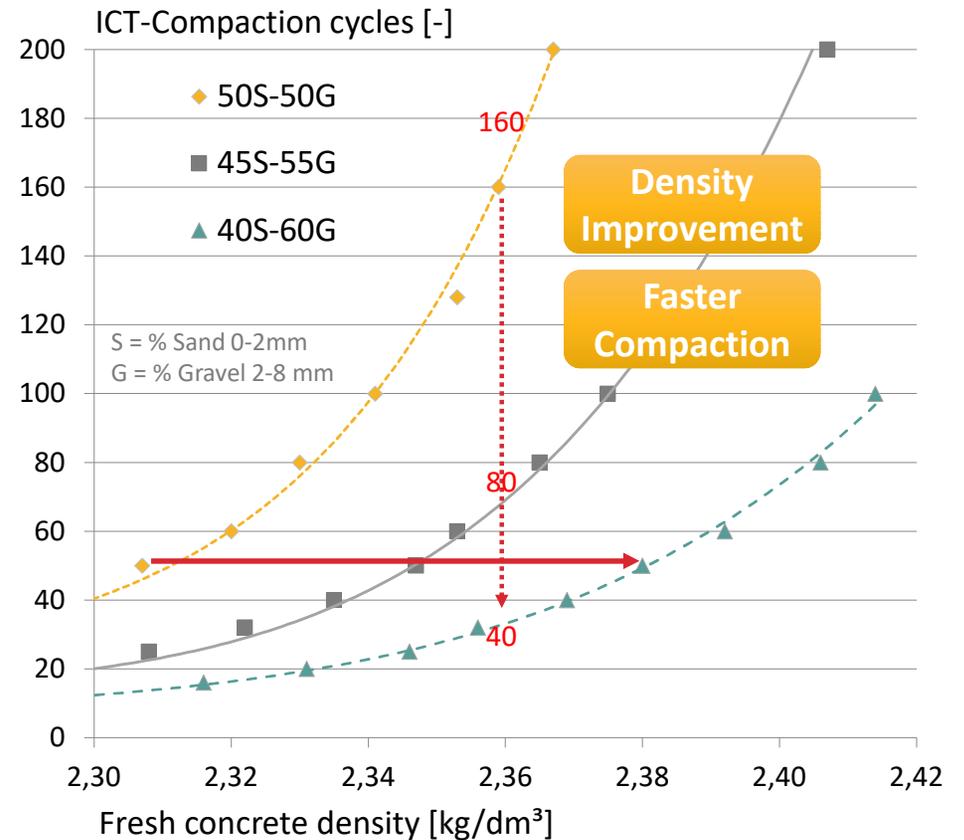
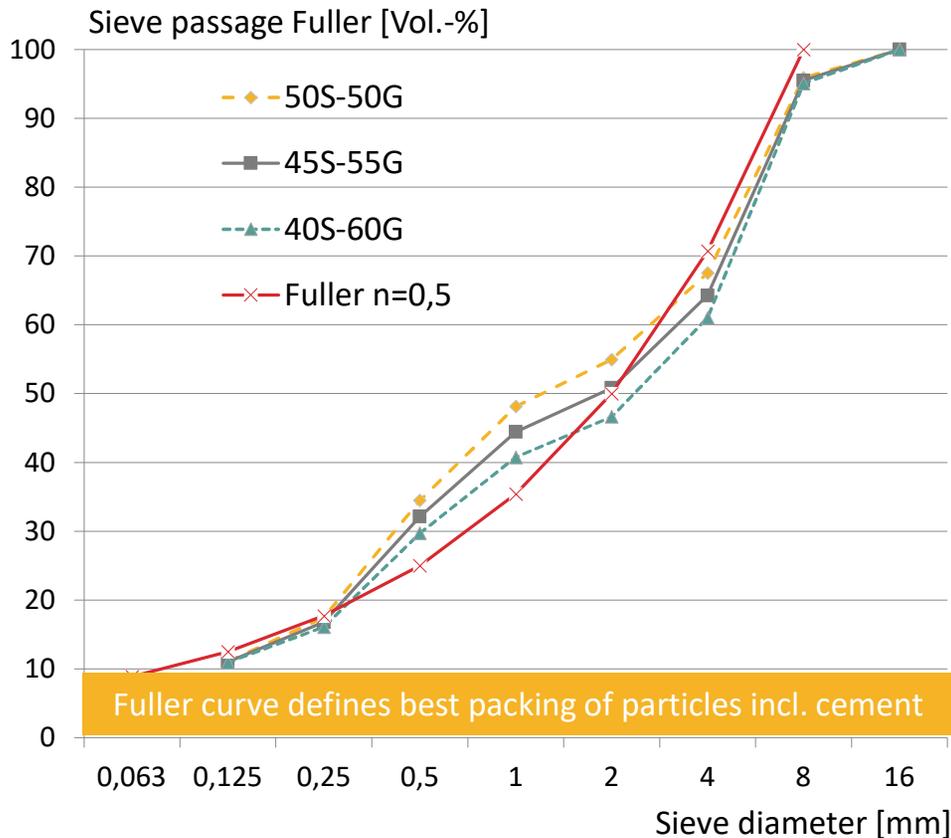
### **Coarser** Sieve Grading

- Lower water demand
- Stronger Compaction



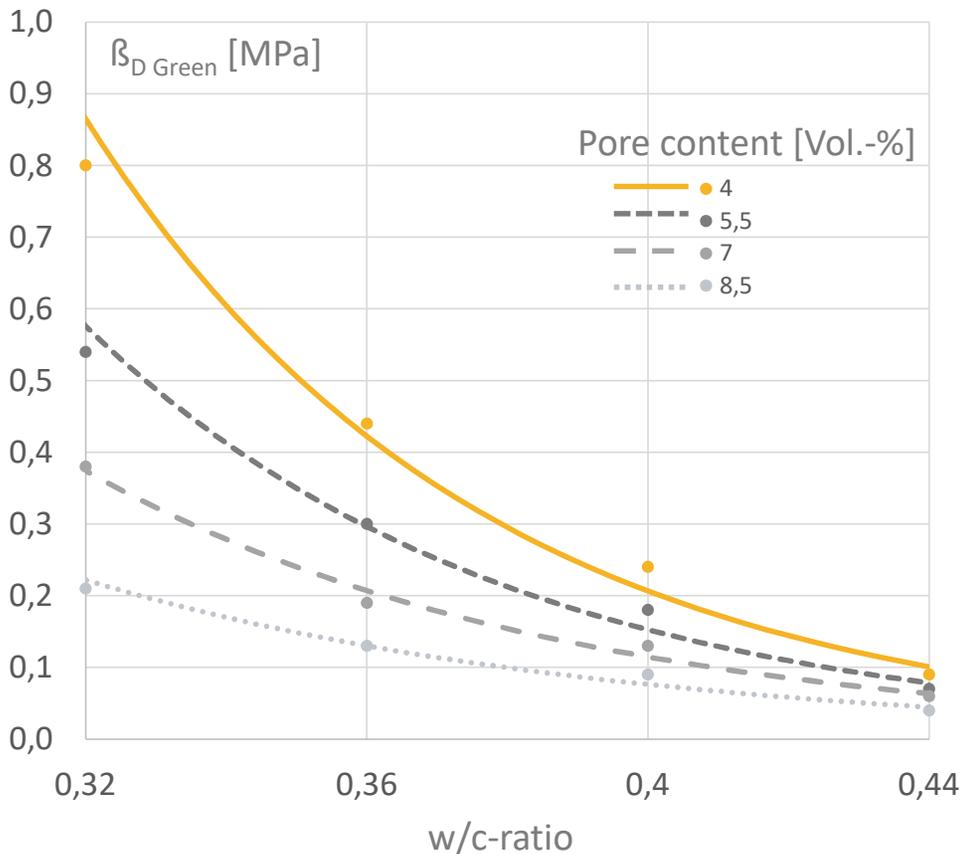
# PROCESS AND QUALITY OPTIMIZATION OF SEMI-DRY CONCRETE

## IMPORTANCE OF SIEVE GRADING



# PROCESS AND QUALITY OPTIMIZATION OF SEMI-DRY CONCRETE

## GREEN STRENGTH – SHAPE KEEPING



More water = lower green strength

More pores = lower green strength

Needed for early- and final-strength:

- High compaction (less pores)
- Sufficient water (hydration)

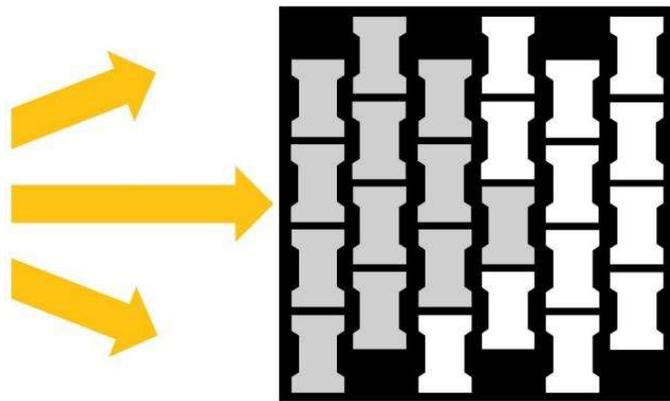
Needed for fast extrusion:

- High water content (lubricant film)
- High green strength (resistance against deformation)

→ **Compromise between fast compaction (high w/c) and high green strength (low w/c)**

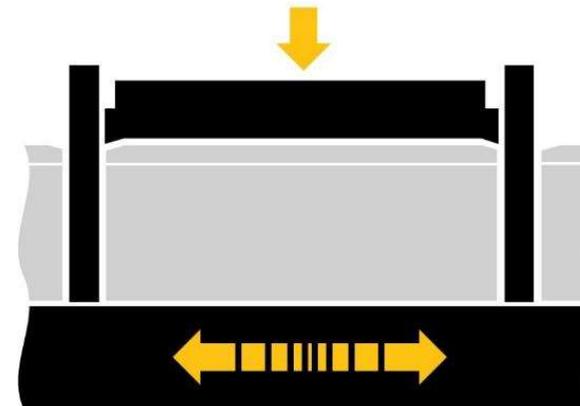
# PROCESS AND QUALITY OPTIMIZATION OF SEMI-DRY CONCRETE

## IMPORTANCE OF COMPACTION MOLD FILLING



### Filling of mold (e.g. paver)

- ca. 2 seconds
- up to 40 individual chambers
- filling cart (frame)



### Compaction of semi-dry concrete

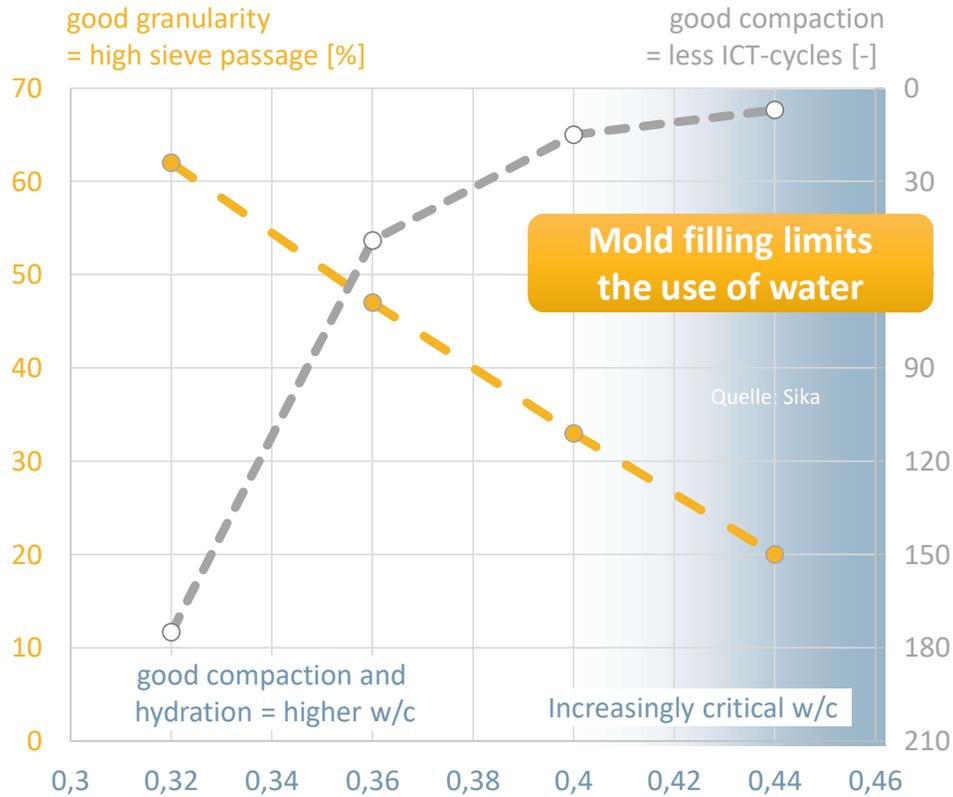
- ca. 3 seconds
- vibration and pressure

Dryer concrete = more even

Higher moisture = faster compaction

# PROCESS AND QUALITY OPTIMIZATION OF SEMI-DRY CONCRETE

## SIKA LABORATORY TEST-PROCEDURE GRANULARITY

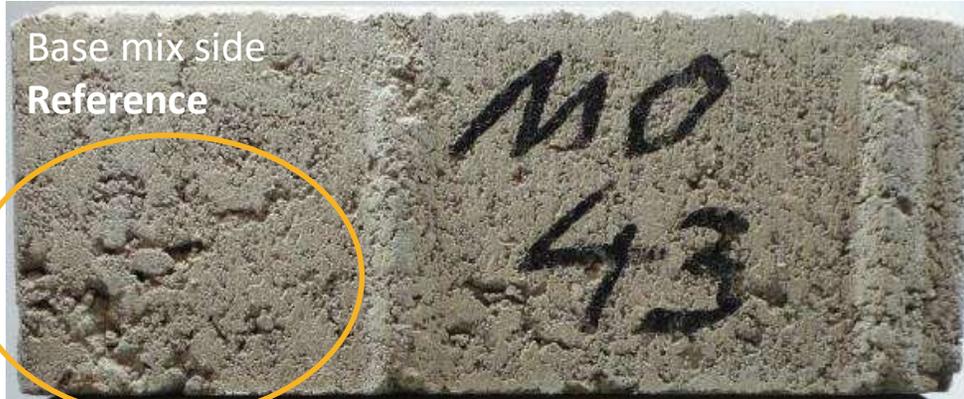


### „Granularity“ - Method to test material flow

- Dry flowing behavior
- Transport silo - filling chart
- Even concrete distribution across the mould (horizontal & vertical)

# PROCESS AND QUALITY OPTIMIZATION OF SEMI-DRY CONCRETE

## FINDINGS FIELD TESTING – FLANKS VS CUT-SECTION



More even Flanks



more even Material distribution



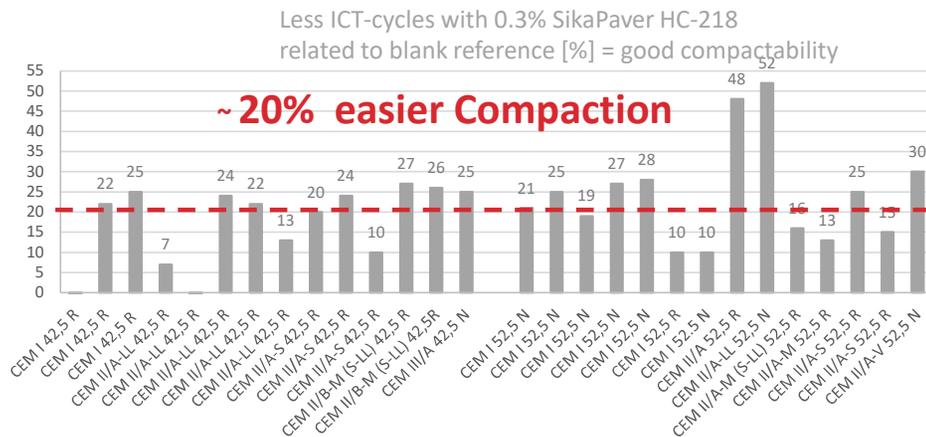
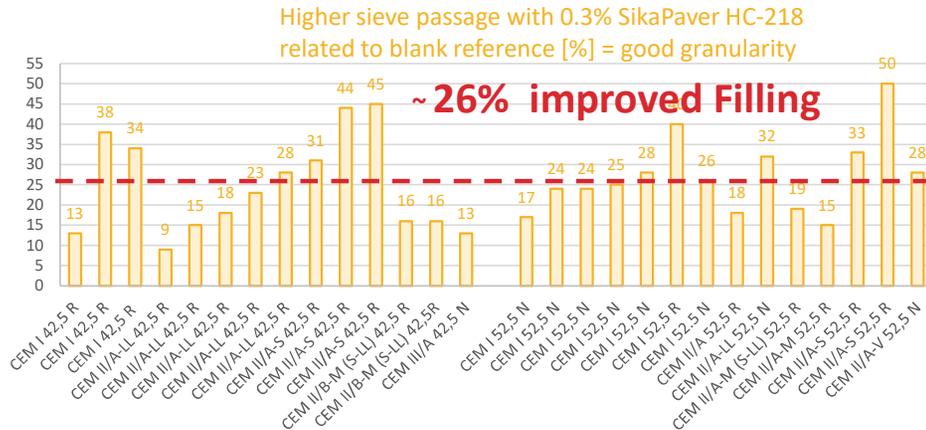
More even Structure



higher strength!

# PROCESS AND QUALITY OPTIMIZATION OF SEMI-DRY CONCRETE

## GRANULARITY VS COMPACTABILITY



- SikaPaver HC-218 has been optimized for a dosage of 0.3 M.-% of Binder (C + FA)
- Positive performance at > 30 different cements
  - Portland CEM I 42,5 R – CEM I 52,5 N/R
  - Blast furnace slag CEM II/A-S 42,5 R / 52,5 R
  - Limestone CEM II/A-LL 42,5R und B-LL 52,5 N
  - Fly ash CEM II/A-V 52,5 N
  - Composite CEM A/M (S-LL) 52,5 R, B/M (S-LL) 42,5 R
- Many influencing factors
  - Main criteria fineness (PSD)
  - Largest grain size should be small => good cement for easy compactable and granular semi-dry concretes

# PROCESS AND QUALITY OPTIMIZATION OF SEMI-DRY CONCRETE

## DEVELOPMENT OF TAILOR-MADE SOLUTION

### SikaPaver® HC-339

for Pre-stressed Hollow Core Slabs Production :

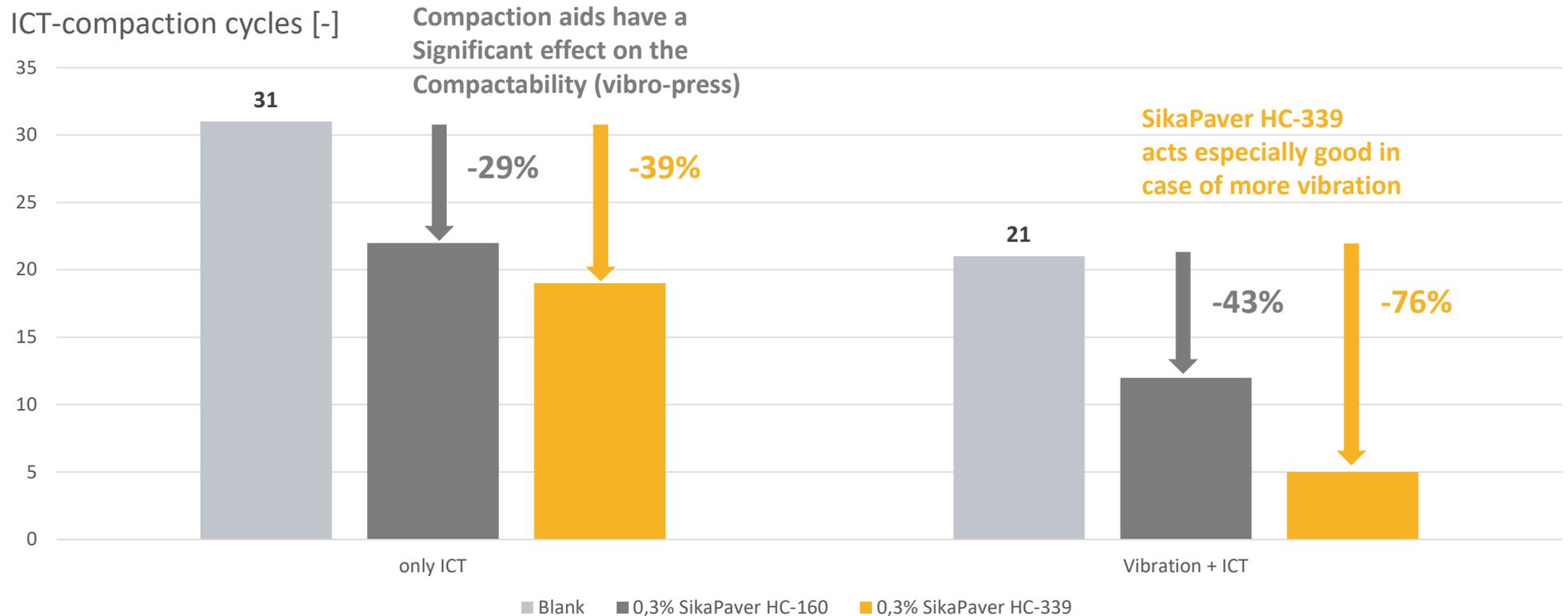
- ✓ More environmentally friendly mix designs (cement and aggregate optimization)
- ✓ Better compaction (higher density)
- ✓ Smooth flanks
- ✓ Faster casting
- ✓ Increased early compressive strengths
- ✓ Cutting of tendons earlier

**Development Target**



# PROCESS AND QUALITY OPTIMIZATION OF SEMI-DRY CONCRETE

## DEVELOPMENT OF TAILOR-MADE SOLUTION



# PROCESS AND QUALITY OPTIMIZATION OF SEMI-DRY CONCRETE

## FIELD TESTING OF TAILOR-MADE SOLUTION

### CASE STUDY

#### in Pre-stressed Hollow Core Slabs Production :

- ✓ Challenge: Replace river sand by crushed sand

#### Field Test Results:

- ✓ Fresh concrete showed a dryer appearance
- ✓ More intensive compaction & smooth flanks
- ✓ Improved shape keeping of the elements
- ✓ Plant operator called SikaPaver HC-339 a “*magic product*”

### Plant Experience



Source: Sika

# PROCESS AND QUALITY OPTIMIZATION OF SEMI-DRY CONCRETE

## CONCLUSIONS



- Solutions can be found, if we understand the technical background of the challenges
- Sieve grading optimization leads to process improvements
- Water is a critical point when targeting higher green strength
- Higher Granularity (dry flow behavior of concrete) leads to more even concrete distribution and easier compaction
- SikaPaver admixtures can improve granularity and compaction
- SikaPaver HC-339 improves process and quality of pre-stressed Hollow Core Slabs and enables more environmentally friendly mix designs

Gracias	ευχαριστώ	Danke	Grazie	Hva a	Obrigado	Kiitos	شكراً	谢谢
Thank you	Teşekkürler	متشكراً	Sa amat Po	Cám ơn	شكريه	Terima Kasih	Dank u We	Tack
நன்றி	Köszönöm	ありがとうございます ございます	ขอบคุณครับ	Mu Țumesc				
תודה	多謝晒	дякую	Ďakujem	спасибо				
благодаря	Tak	감사합니다	Děkuji	Dziękuję				

Thank you



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