

SOLVING THE RHEOLOGY CHALLENGE OF THE CONCRETE with PCE Admixture for Improving the Pouring and Finishing of the Precast Tunnel Lining Segments

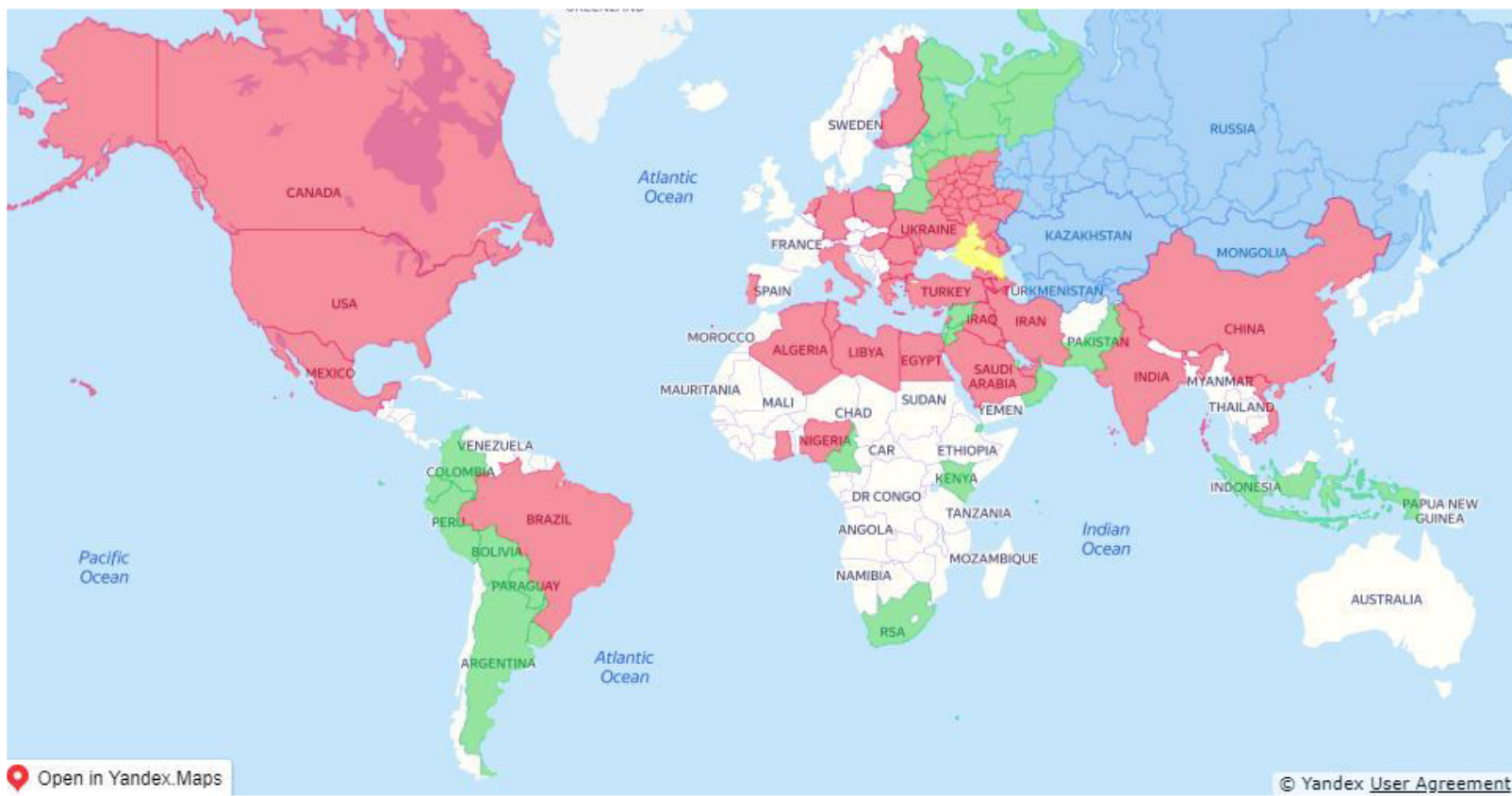
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for online Colloquium Rheology of Building Materials, March 10, 2021

INTRODUCTION

POLYPLAST GROUP OF COMPANIES IN GLANCE



POLYPLAST NOVOMOSKOVSK



POLYPLAST NORTH-WEST



POLYPLAST URALSIB



POLYPLAST SOUTH



- **16 workshops**
- **Production of 230,000 ton of admixtures per year**



- **>30 distribution offices in Russia**



- **56% share of the market** in Russia

- **>10 distribution offices in CIS**

- **3 trade offices in the world**

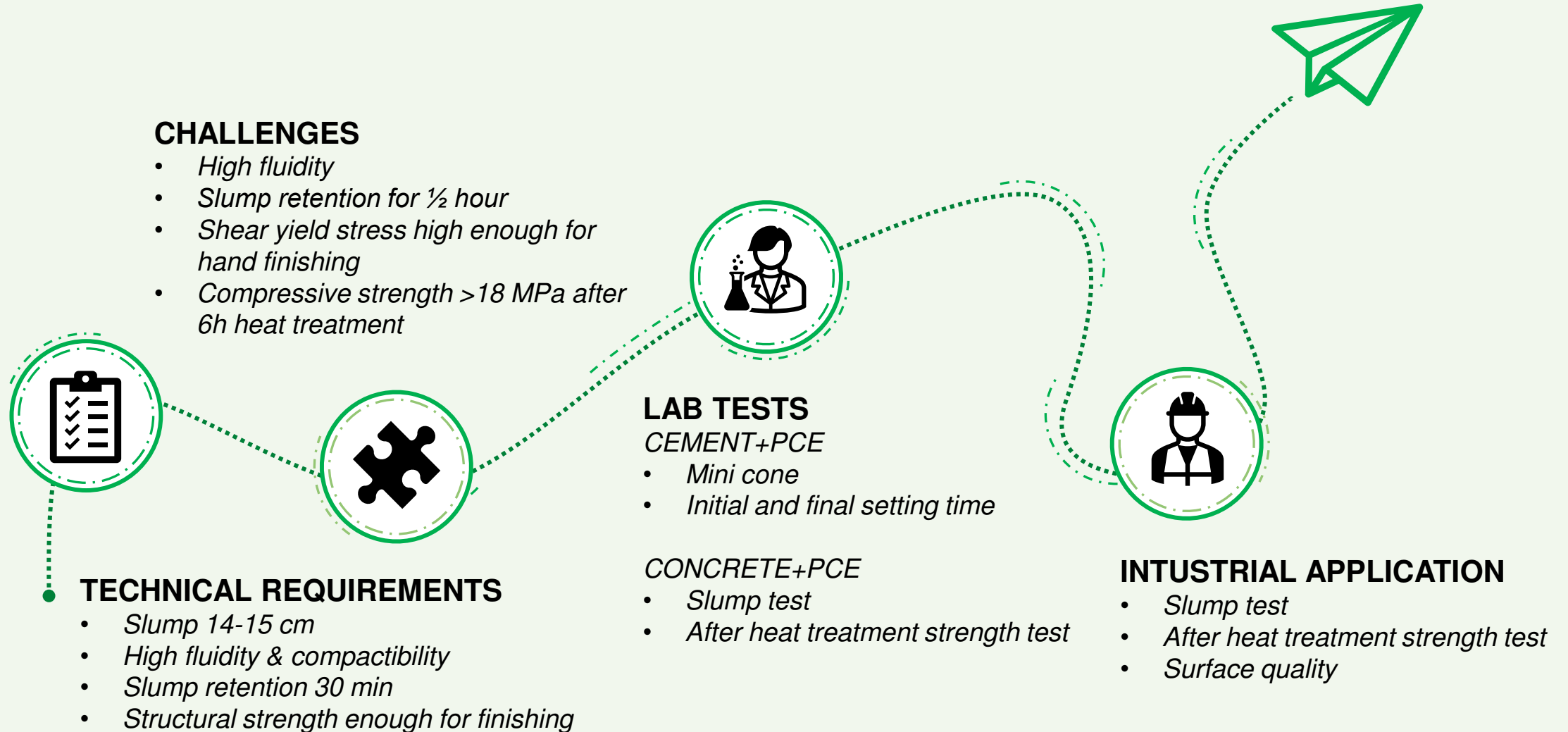
- **Sales into 57 countries** in the world



- **3 Research centers**

- **10 chemical and concrete laboratories**

ROADMAP ADOPTING THE PCE ADMIXTURE



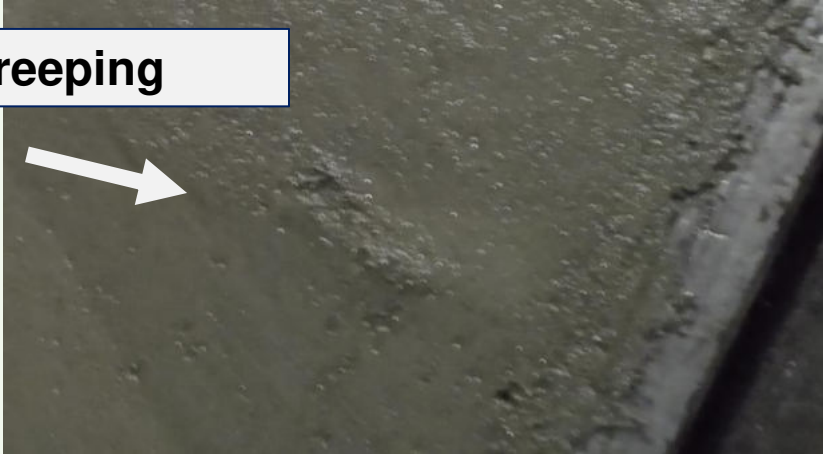
TECHNICAL REQUIREMENTS FOR PRECAST CONCRETE SEGMENTS PRODUCTION

Concrete:	<i>B45 F200 W12</i>
Taking-off Strength:	<i>> 18 MPa</i>
Temperature of Fresh Concrete:	<i>15-24°C</i>
Time from concrete mix preparation to molding:	<i>15-60 min</i>
Concrete Slump:	<i>14-17 cm</i>
Air entrainment:	<i>2-3%</i>
Delay time from pouring of concrete till extrados finishing of the segment:	<i>8-20 min</i>
Heat treatment:	<i>~20min+6h(45°C) + test hot cubes</i>
Strength of hot concrete just after heat treatment:	<i>18 MPa (30%)</i>
4 hours strength:	<i>35,4 MPa (60%)</i>
Handling strength 100%:	<i>in 7 days</i>



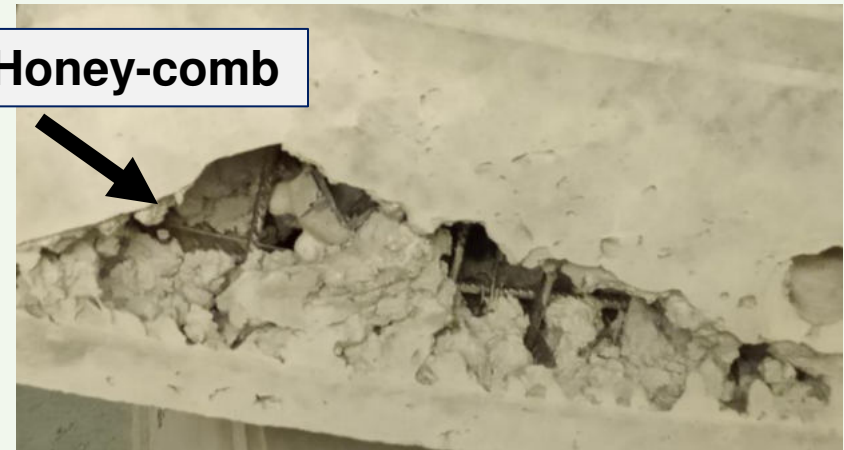
CHALLENGES IN PRODUCTION OF THE PRECAST TUNNEL LINING SEGMENTS

Creeping



Cause:	Solution:
Too high slump	Reduction of slump or plasticizer dosage
Bleeding	Check aggregates humidity
Strong plasticizing and long-lasting effect of plasticizer	Crystalline silica flour
Overdosage of plasticizer	Fiber
	Air-entraining admixture

Honey-comb

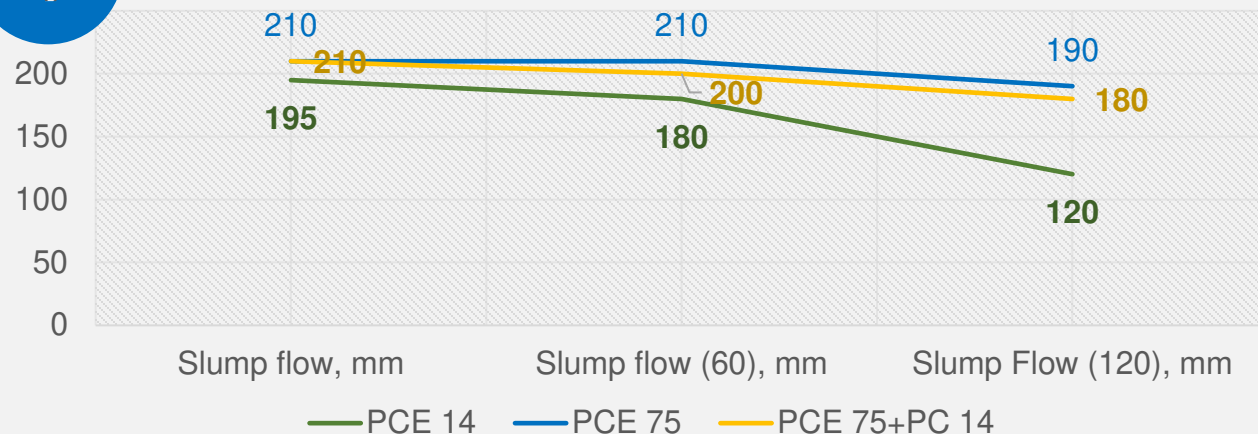


Cause:	Solution:
Stiff concrete	Increase slump
High viscosity of concrete	Check aggregates humidity
Pour vibration	Plasticizer with high flowability
Lack of fine particles	Admixture for setting regulation of cement
Fast setting of concrete	Correct the proportion of concrete

LAB TESTS FOR SOLVING THE CHALLENGES

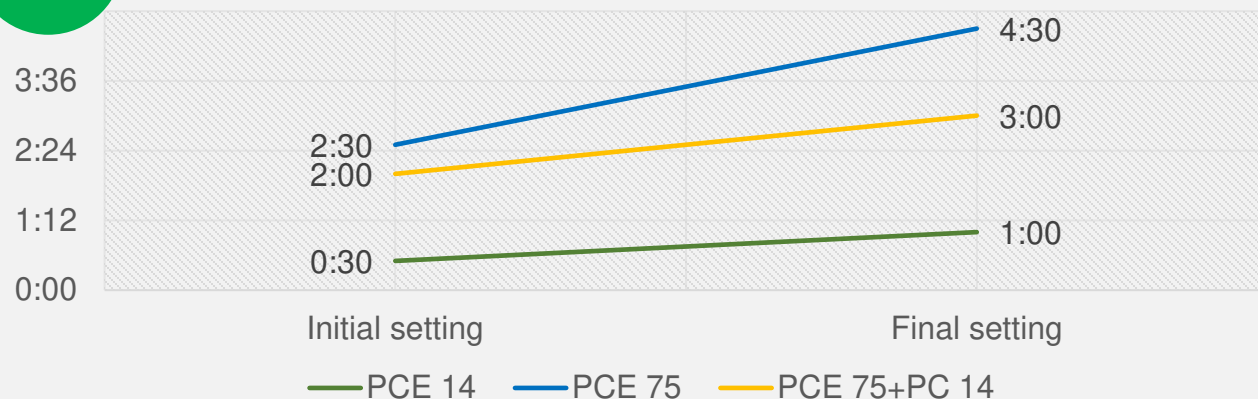
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Mini cone slump flow retention, mm



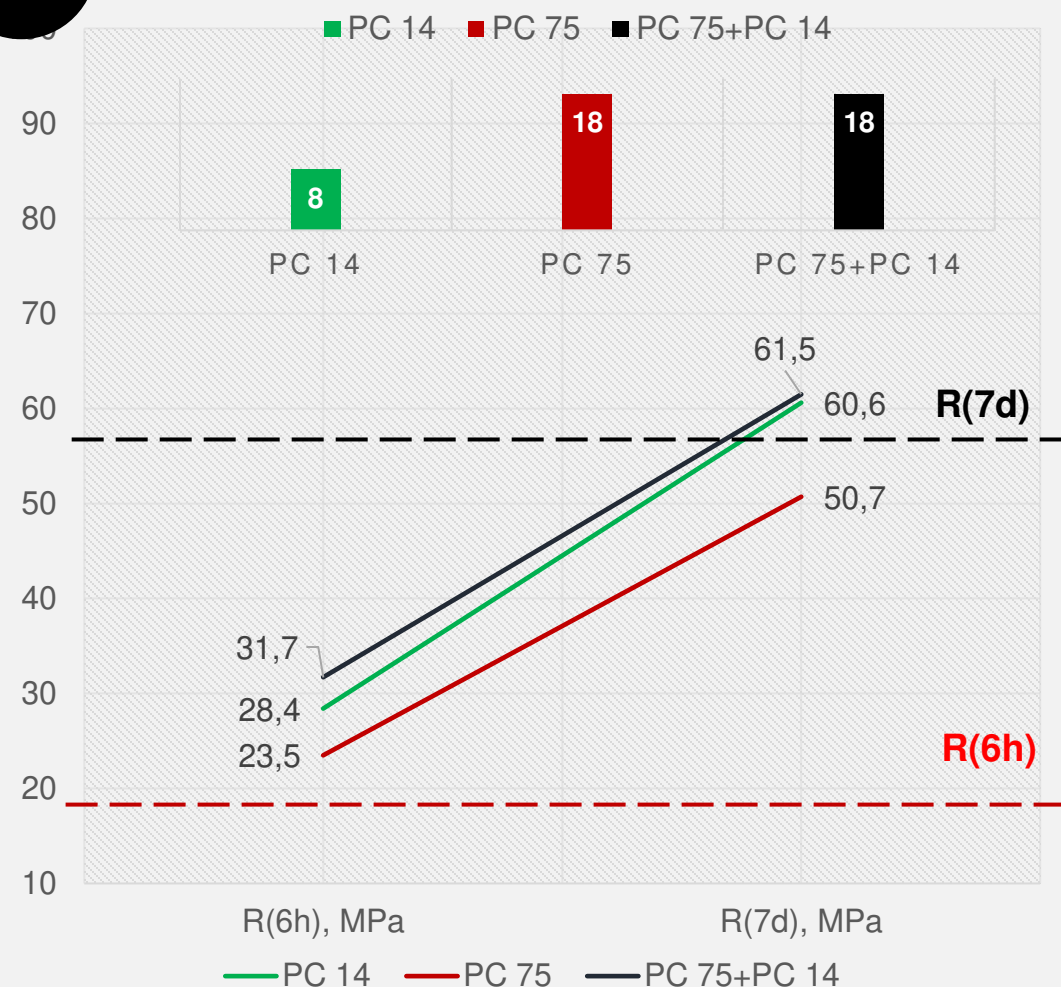
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Initial and final setting time of cement with PCE, hr:min



3

Strength of concrete with PCE



INDUSTRIAL APPLICATION

6m DIAMETER SEGMENTS WITH "POLYPLAST PC type S"

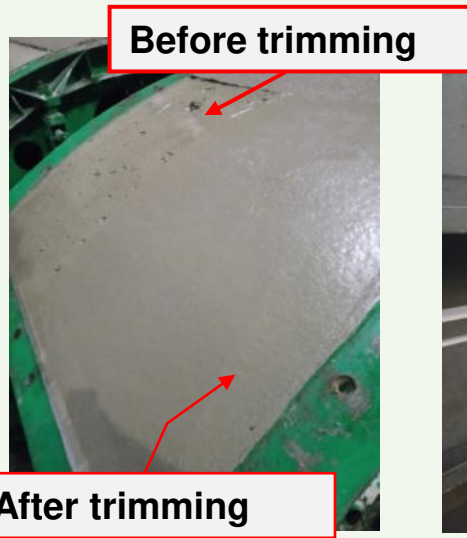


№	Date	Admixture	Concrete mix proportion for 1 m³						Slump, cm (retention)	Density of fresh concrete, kg/m³	Strength R _{сж} , MPa			
			Cement, kg	FA, kg	CA, kg	W/C	Admixture dosage by mass of C				Density of wet concrete, kg/m³			
							kg	%			In 6h (hot)	4h (chilled)	7 days	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Tula cement CEM I 52.5N, FA: sand F.M.-2,5-2,8, CA: granite, fraction 5-20 and 5-10, Concrete: B45 S3; Production technology: stationary; Heat treatment: 6h (45°C)											R(7)=57.6 MPa	49%	74%	112%
2/32	05/24/19	POLYPLAST PC type S	450	780	1070	0.3	2.1	0.47	16 (60)-15	2495	<u>28.4</u> 2528	<u>42.6</u> 2536	<u>64.61</u> 2533	



Pouring of fresh concrete with POLYPLAST PC type S
Good flow of concrete

Evgeniy Viktorov



Trimming of segments after pouring
No creep of mass after hand trimming

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Segments after demolding
Good surface



Cross-section of concrete segment
Good quality of pouring

THANK YOU!

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