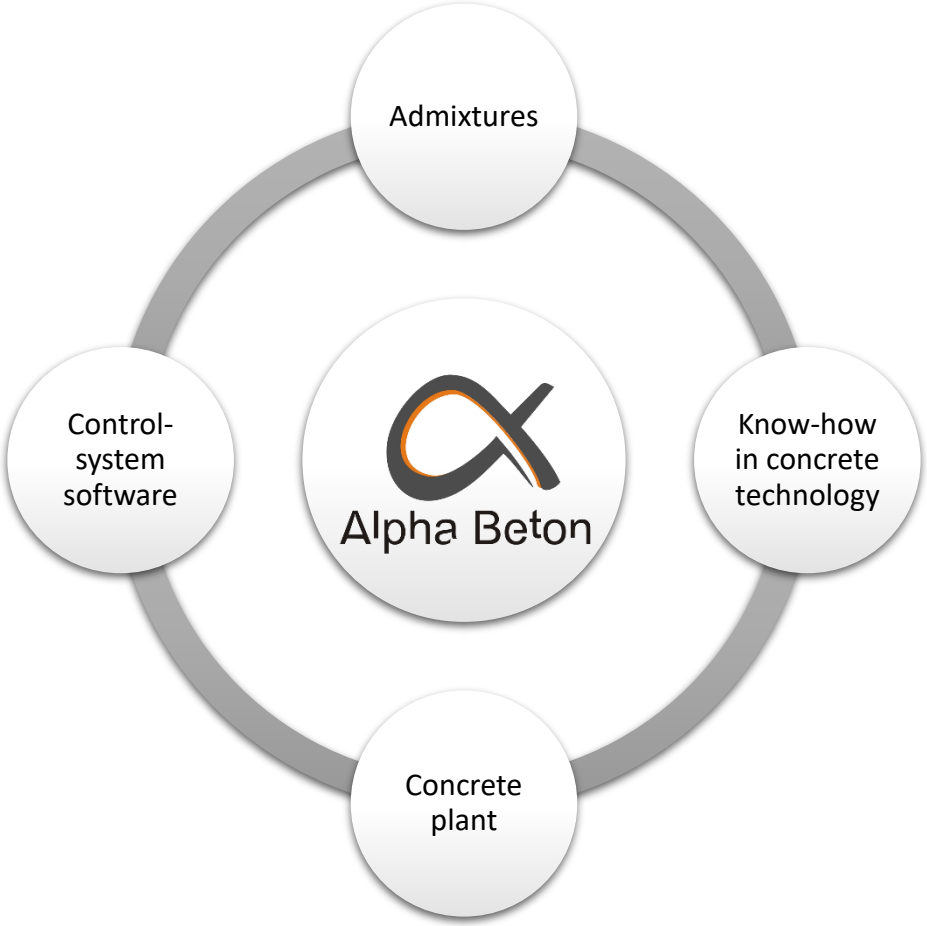
ALPHA CONCRETE

ARNOLD TRENKWALDER

Alpha Concrete - Idea



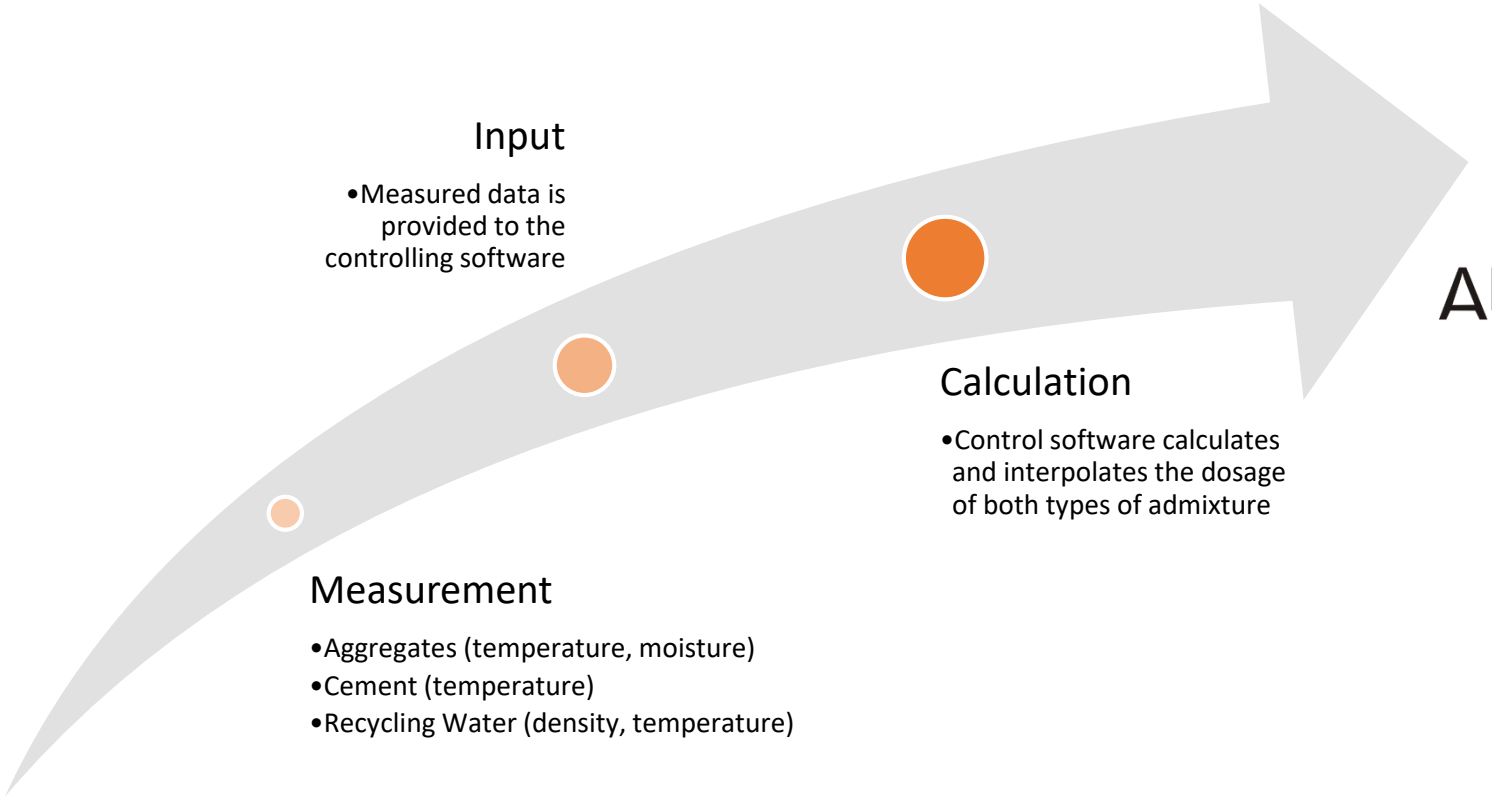
History of concrete production/control-systems

- 1960s Hand controlled concrete production
- 1970s Punch-card controlled production
- End of 1980s Control system via PC/microprocessor-control-unit
- 1990s Microprocessor-control-unit is state of the art
- 2016 Alpha Concrete

PCE superplastizicer products:

- Standard PCE:
  - An universal PCE based superplastizicer for all types of application
  - Initial-flow-components and slump-retaining-components are always in a persistant ratio
  - Higher PCE dosage → More initial-flow, therfore more slump-retention
- Alpha Concrete PCE:
  - Two component system
  - Inital-flow-component and slump-retaining-component are two seperate products → demand-driven operation is possible

Alpha Concrete - Process



Input

- Measured data is provided to the controlling software

Calculation

- Control software calculates and interpolates the dosage of both types of admixture

Measurement

- Aggregates (temperature, moisture)
- Cement (temperature)
- Recycling Water (density, temperature)

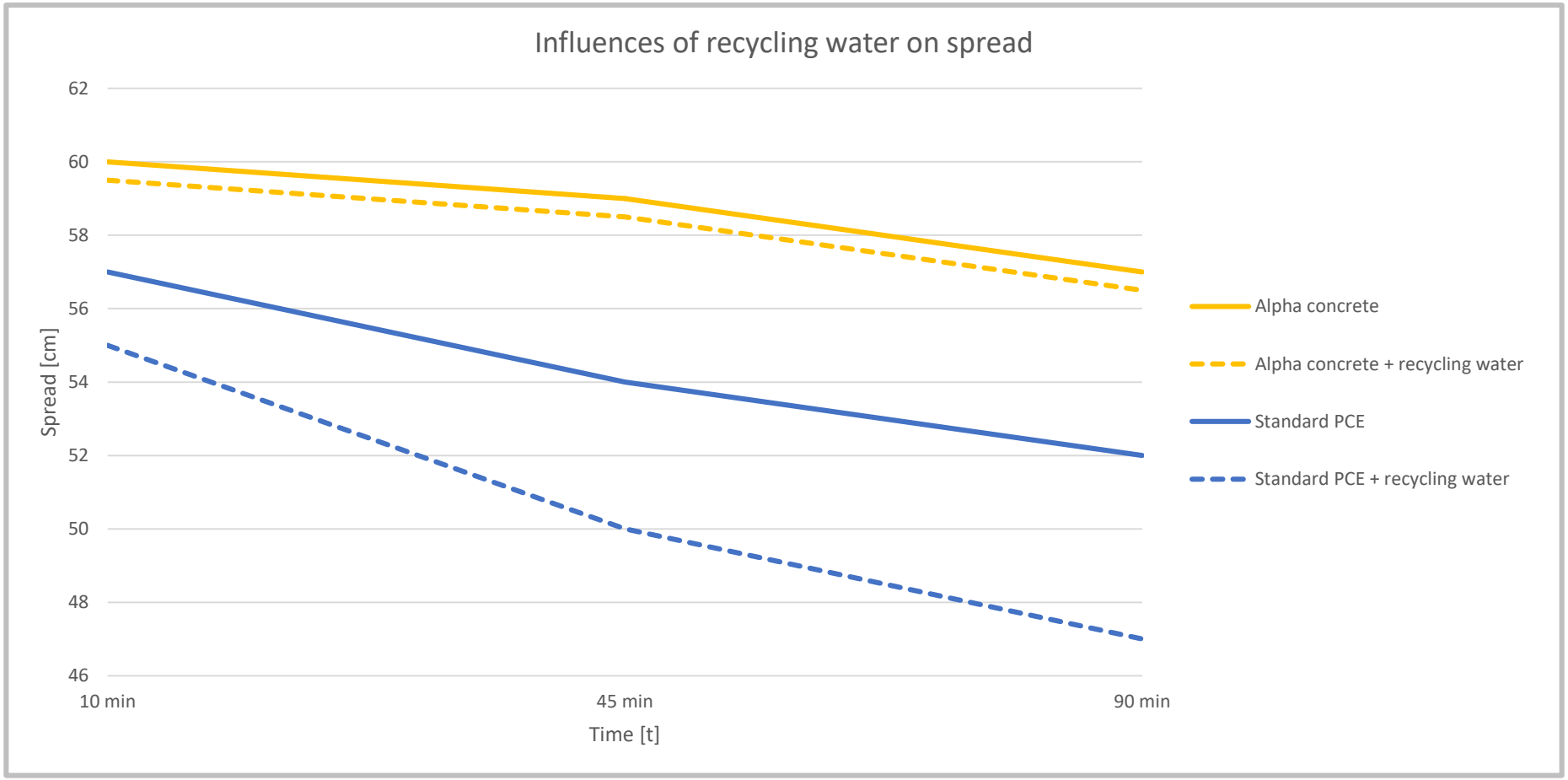
Alpha Beton

Problem – Recycling water

- Negative influences on fresh concrete properties
  - More solid content → higher demand for water
  - Slump retention deteriorated

Density of recycling water [kg/l]	Mass of solid content [kg/l]	Recycling water volume [l/l]
1,02	0,038	0,982
1,03	0,057	0,973
1,04	0,076	0,964
1,05	0,095	0,955
1,06	0,115	0,945
1,07	0,134	0,936
1,08	0,153	0,927
1,09	0,172	0,918
1,10	0,191	0,909
1,11	0,210	0,900
1,12	0,229	0,891
1,13	0,248	0,882
1,14	0,267	0,873
1,15	0,286	0,864

Problem – Recycling water



Alpha Concrete - Calculation

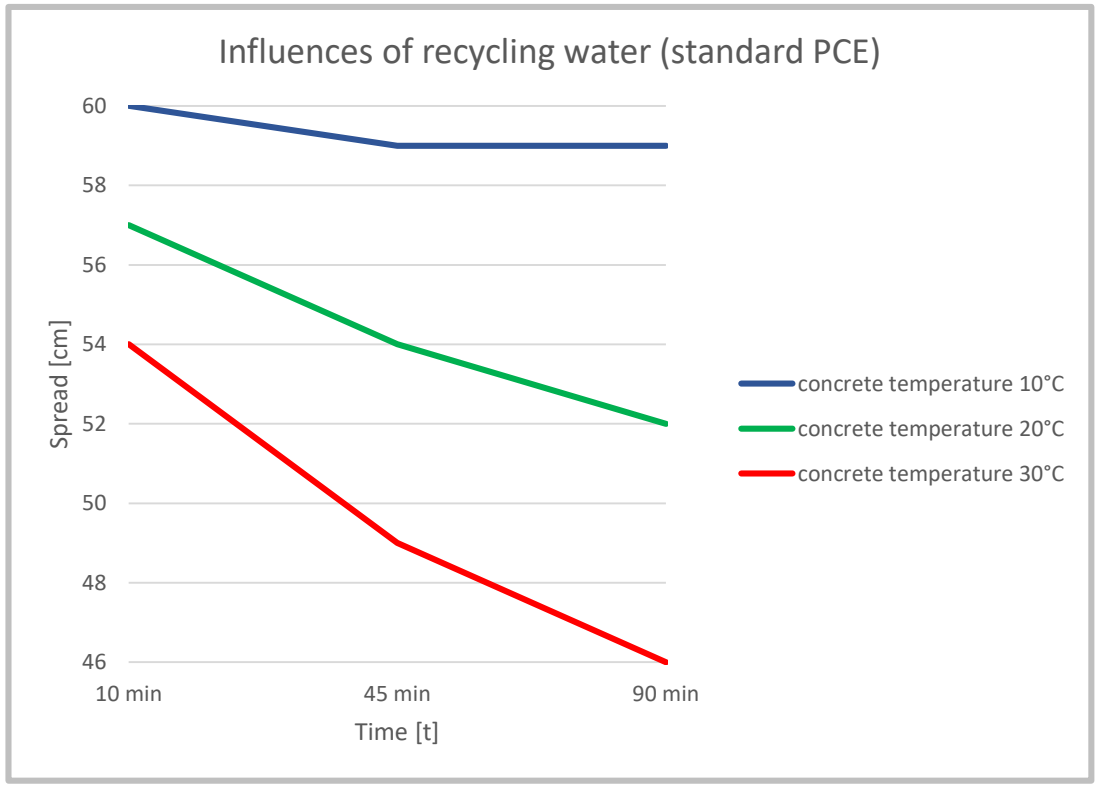
$$\vartheta_{b,0}[°C] = \frac{z \times c_z \times \vartheta_z + g \times c_g \times \vartheta_g + w_{zug} \times c_w \times \vartheta_w + w_g \times c_w \times \vartheta_g}{z \times c_z + g \times c_g + (w_{zug} + w_g) \times c_w}$$

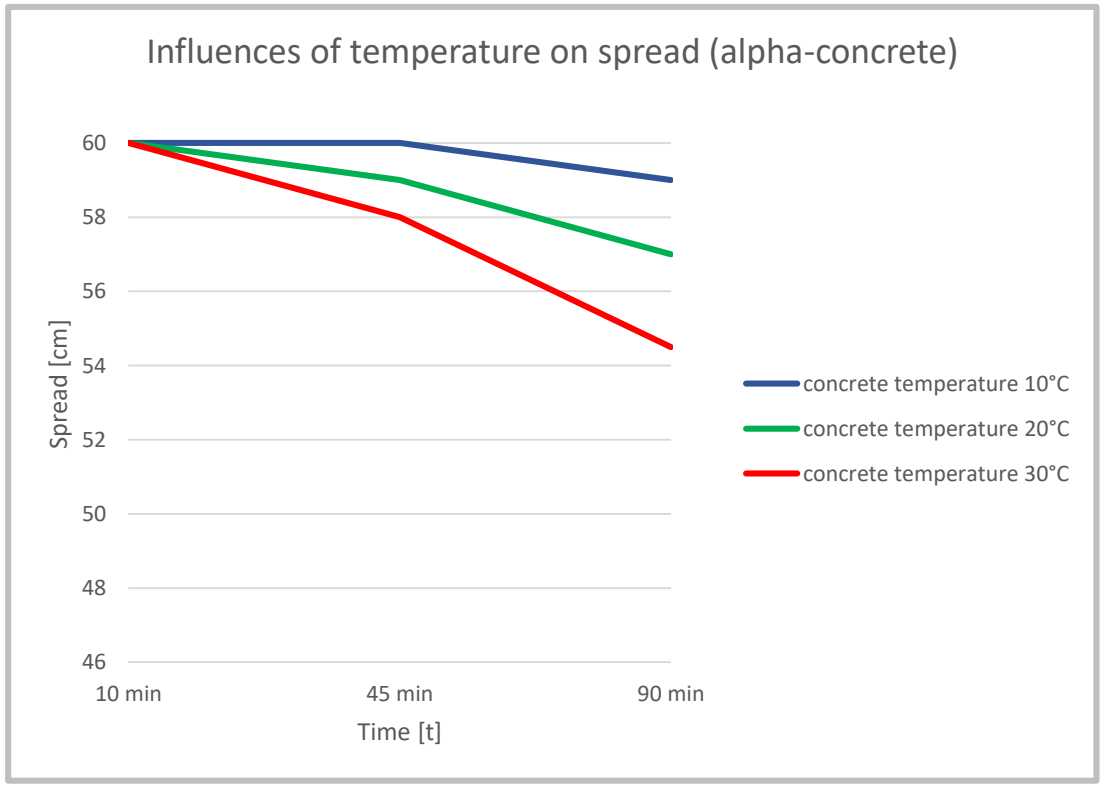
z	cement content [kg/m³]
g	aggregate content [kg/m³]
w_{zug}	mixing water [kg/m³]
w_g	water content on the surface of the aggregates and absorbed by them [kg/m³]
ϑ_z	cement temperature [°C]
ϑ_g	aggregate temperature [°C]
ϑ_w	mixing water temperature [°C]
c_z	specific heat of cement = 0,72 – 0,92 kJ*kg^{-1}*K^{-1}
c_g	specific heat of aggregates [kJ*kg^{-1}*K^{-1}]
	quartz = 0,8
	limestone = 0,85 – 0,92
	granite = 0,75 – 0,85
	basalt = 0,71 – 1,05
c_w	specific heat of water = 4,19 kJ*kg^{-1}*K^{-1}

$$\vartheta_{b,0} = \frac{320 \times 0{,}72 \times 60 + 1920 \times 0{,}8 \times 25 + 140 \times 4{,}19 \times 20 + 30 \times 4{,}19 \times 25}{320 \times 0{,}92 + 1920 \times 0{,}8 + (140 + 30) \times 4{,}19} = 27{,}1°C$$

Problem - Temperature

Higher concrete temperature → faster hydration → less slump retention → less workability time





Alpha Concrete - Dosing Table

Initial flow chart

Depends on:

- Consistency class
- Recycling water density

Dosage is interpolated

Consistency class	Recycling water density [g/l]	Dosage PCE Type-P [% of cement]
F2 / S2	1000	0,20
F2 / S2	1050	0,25
F2 / S2	1100	0,30
F3 / S3	1000	0,35
F3 / S3	1050	0,40
F3 / S3	1100	0,45
F4 / S4	1000	0,45
F4 / S4	1050	0,50
F4 / S4	1100	0,55
F5 / S5	1000	0,55
F5 / S5	1050	0,60
F5 / S5	1100	0,65

Slump retention chart

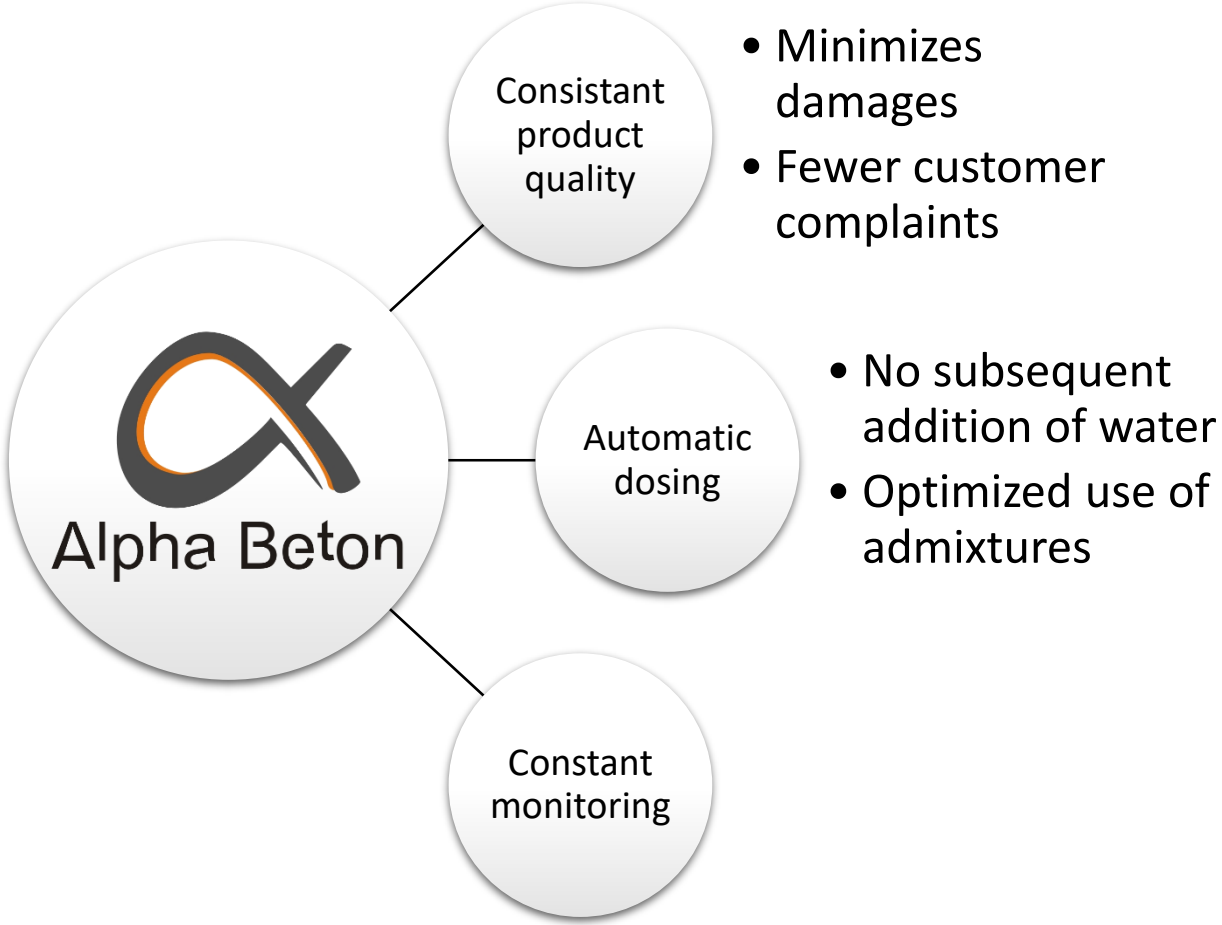
Depends on:

- calculated concrete temperature
- recycling water density

Dosage is interpolated

Calculated concrete temperature [°C]	Recycling water density [g/l]	Dosage PCE Type-E [% of cement]
10	1000	0,15
10	1050	0,20
10	1100	0,25
20	1000	0,25
20	1050	0,30
20	1100	0,35
30	1000	0,40
30	1050	0,45
30	1100	0,50

Alpha Concrete - Advantages



- Minimizes damages
- Fewer customer complaints

- No subsequent addition of water
- Optimized use of admixtures

Versions of Alpha Concrete

FEATURES	LIGHT	MEDIUM	PREMIUM
Dosage of Admixture: **measured concrete temperature**			X
Dosage of Admixture: **calculated concrete temperature**	X	X	
Density Sensor: **Recycling Water**	X		
Temperature Sensor: **Cement**	X	X	
Temperature Sensor: **All Aggregates**	X	X	
Humidity sensor: **All Aggregates**	X	X	

Implementaton on a concrete mixing plant

- Adjustment of the dosage settings for the fresh concrete temperatures from 10°C up to 30°C
- Duration of the calibration approximately 6 Months

THANK YOU
FOR YOUR ATTENTION!

a.trenkwalder@bt3.at