A new method for determining the minimal curing period

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CONCRETE CURING

OBJECTIVE : to provide an appropriate environmental condition within a concrete structure to ensure the progress of hydration reactions.
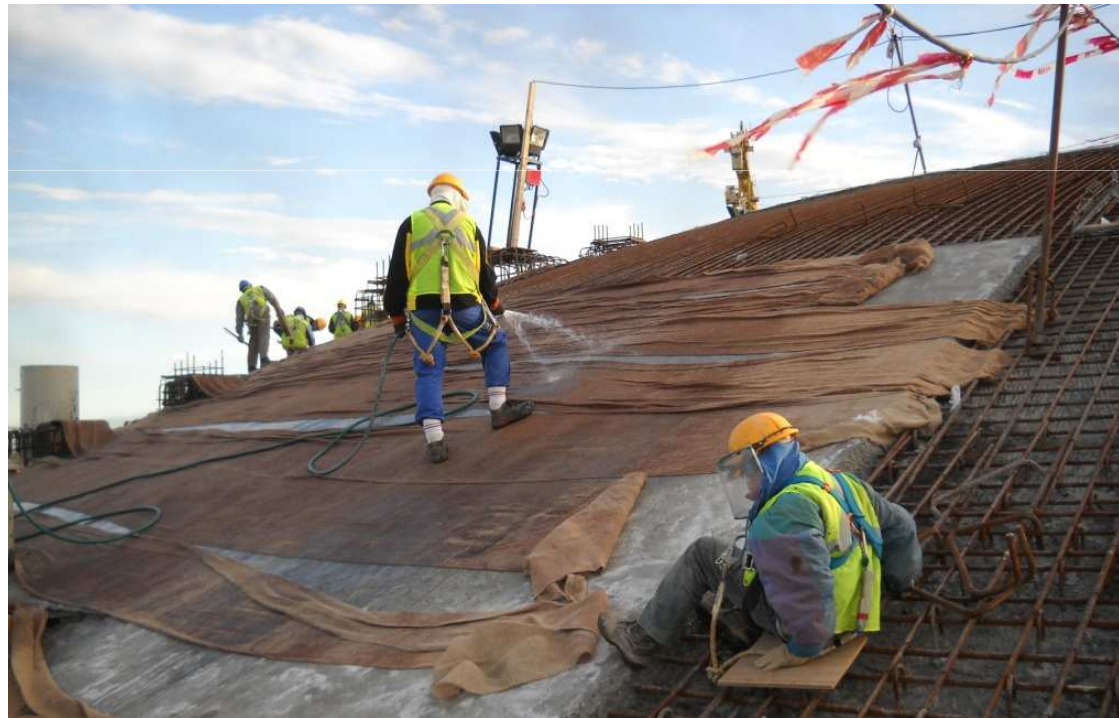
CONCRETE CURING DURATION

The curing period is defined as the time period beginning at placing, through consolidation and finishing, and extending until the desired concrete properties have developped.
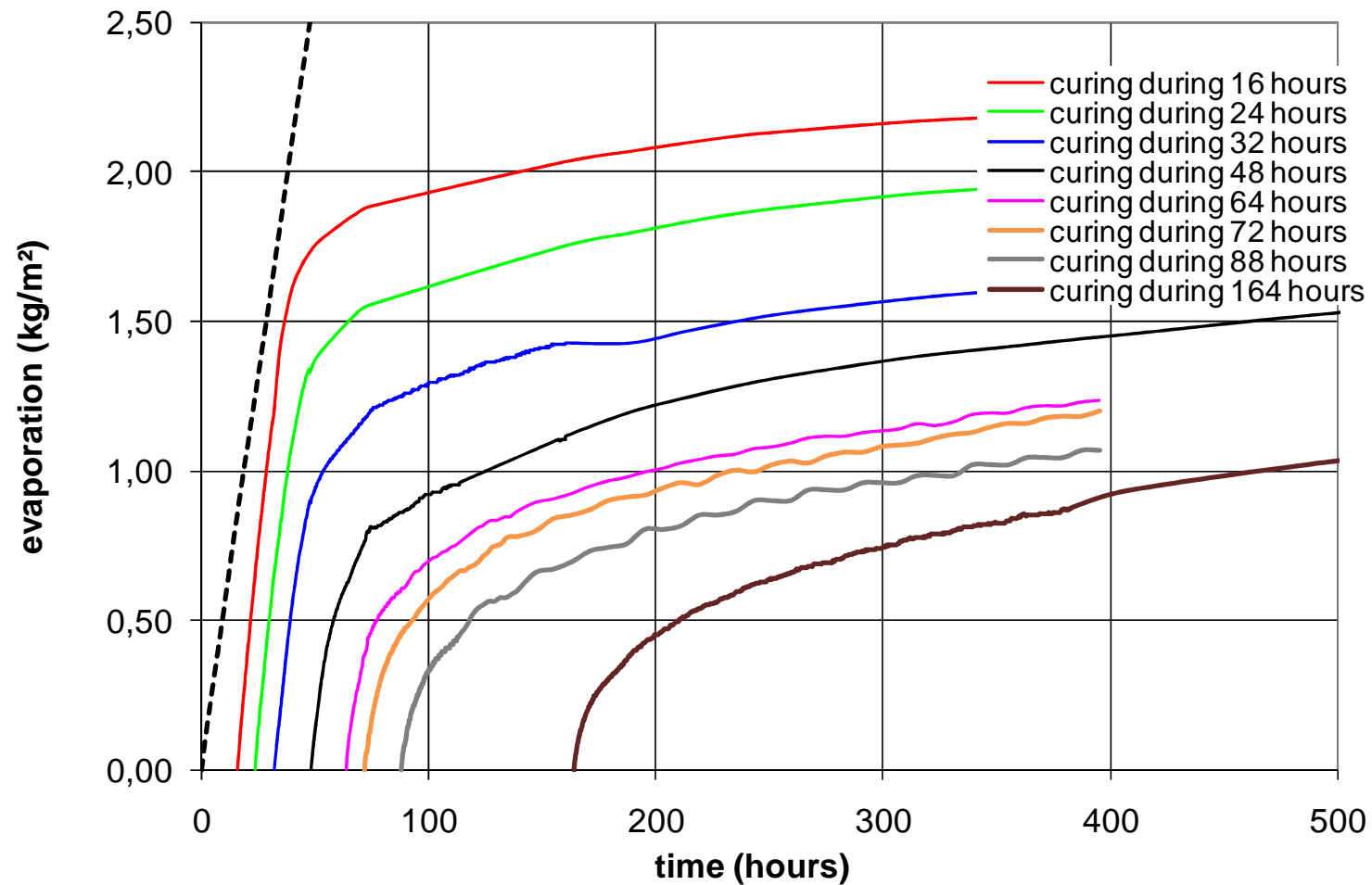
A minimal curing period (depending on both concrete type and external conditions) is compulsory to achieve a concrete with sufficient quality.

➔ **Assessment of minimal curing time with an appropriate method is necessary.**
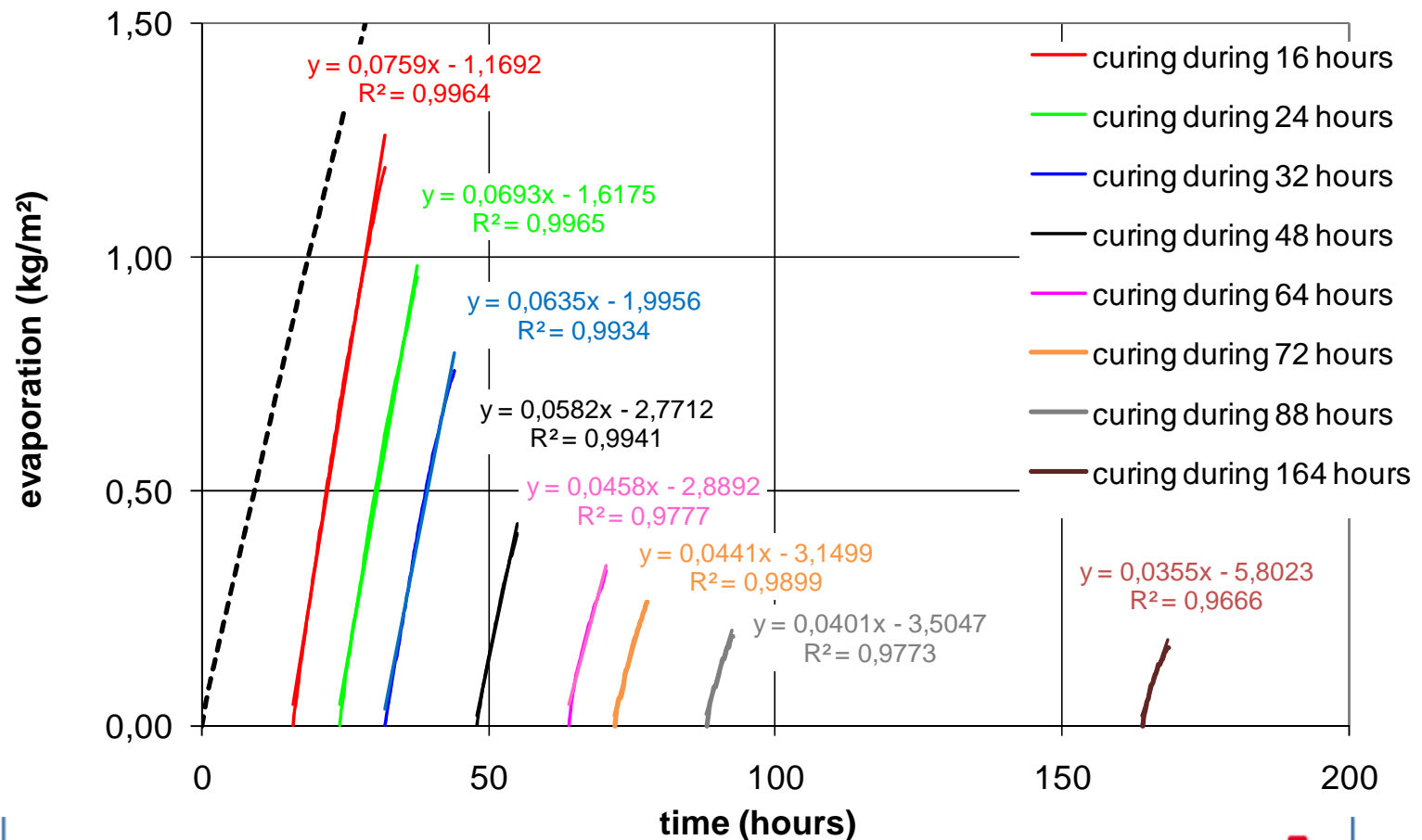
WHY MINIMAL CURING PERIODS ARE NECESSARY?
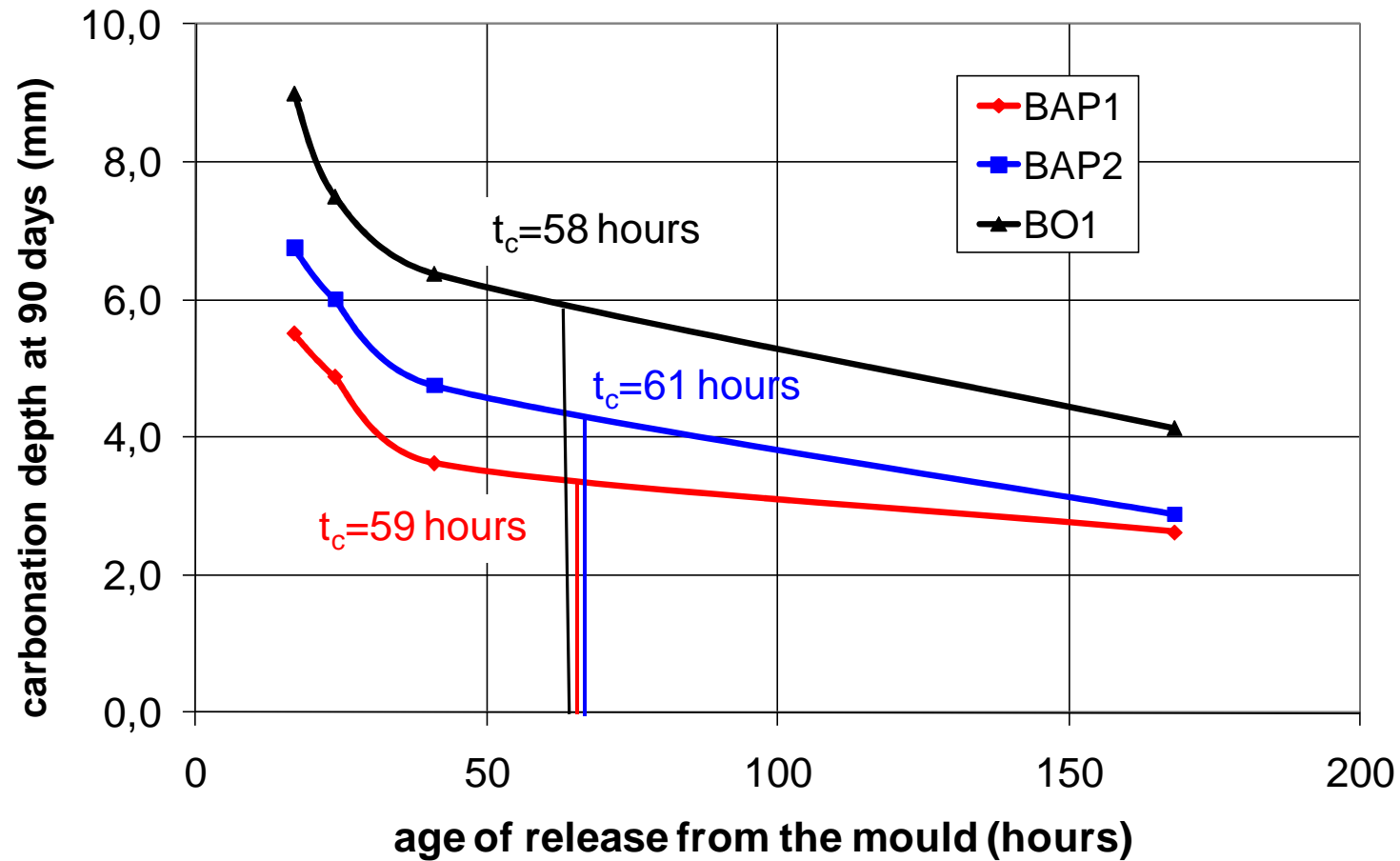
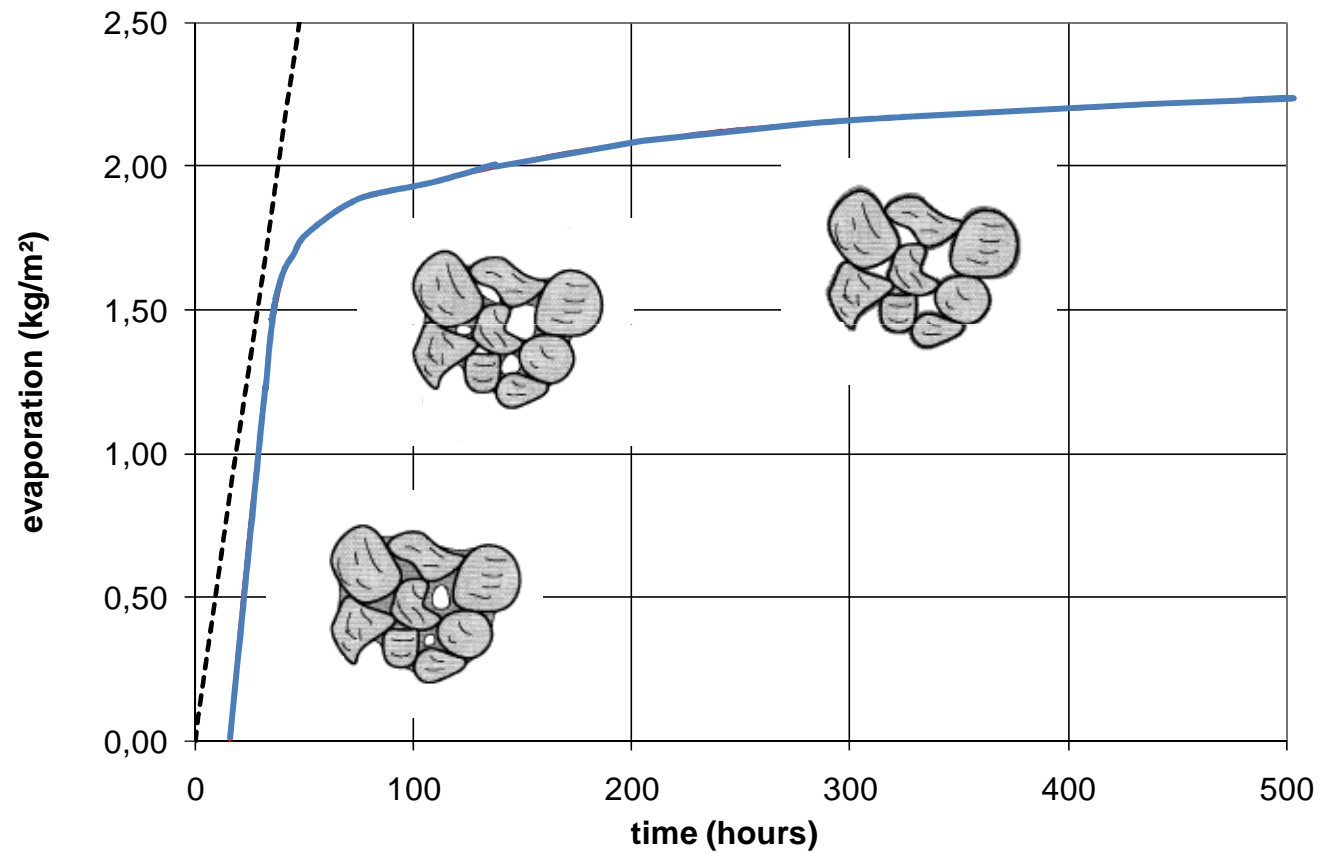# CONCRETE MEAN MASS LOSSES' EVOLUTION

EVOLUTION OF THE MEAN EVAPORATION SPEEDS

Free water surface **0,054 kg/m²/heure**

Chart: evaporation (kg/m²) vs time (hours)

- $y = 0{,}0759x - 1{,}1692$, $R^2 = 0{,}9964$
- $y = 0{,}0693x - 1{,}6175$, $R^2 = 0{,}9965$
- $y = 0{,}0635x - 1{,}9956$, $R^2 = 0{,}9934$
- $y = 0{,}0582x - 2{,}7712$, $R^2 = 0{,}9941$
- $y = 0{,}0458x - 2{,}8892$, $R^2 = 0{,}9777$
- $y = 0{,}0441x - 3{,}1499$, $R^2 = 0{,}9899$
- $y = 0{,}0401x - 3{,}5047$, $R^2 = 0{,}9773$
- $y = 0{,}0355x - 5{,}8023$, $R^2 = 0{,}9666$

Legend:
- curing during 16 hours
- curing during 24 hours
- curing during 32 hours
- curing during 48 hours
- curing during 64 hours
- curing during 72 hours
- curing during 88 hours
- curing during 164 hours

THE THREE PERIODS OF DRYING

PRINCIPLE OF THE METHOD

The experimental method will allow the determination of the minimal curing period before reaching the **change of drying regime**, i.e. sufficient maturity to minimize a strong early desiccation.

↪ The method is based on the monitoring of mass loss from samples placed in desiccative environment shortly after release from the mould

↪ Determination of times t_i during severe desiccation can occur for the three earliest expiries of release from the mould
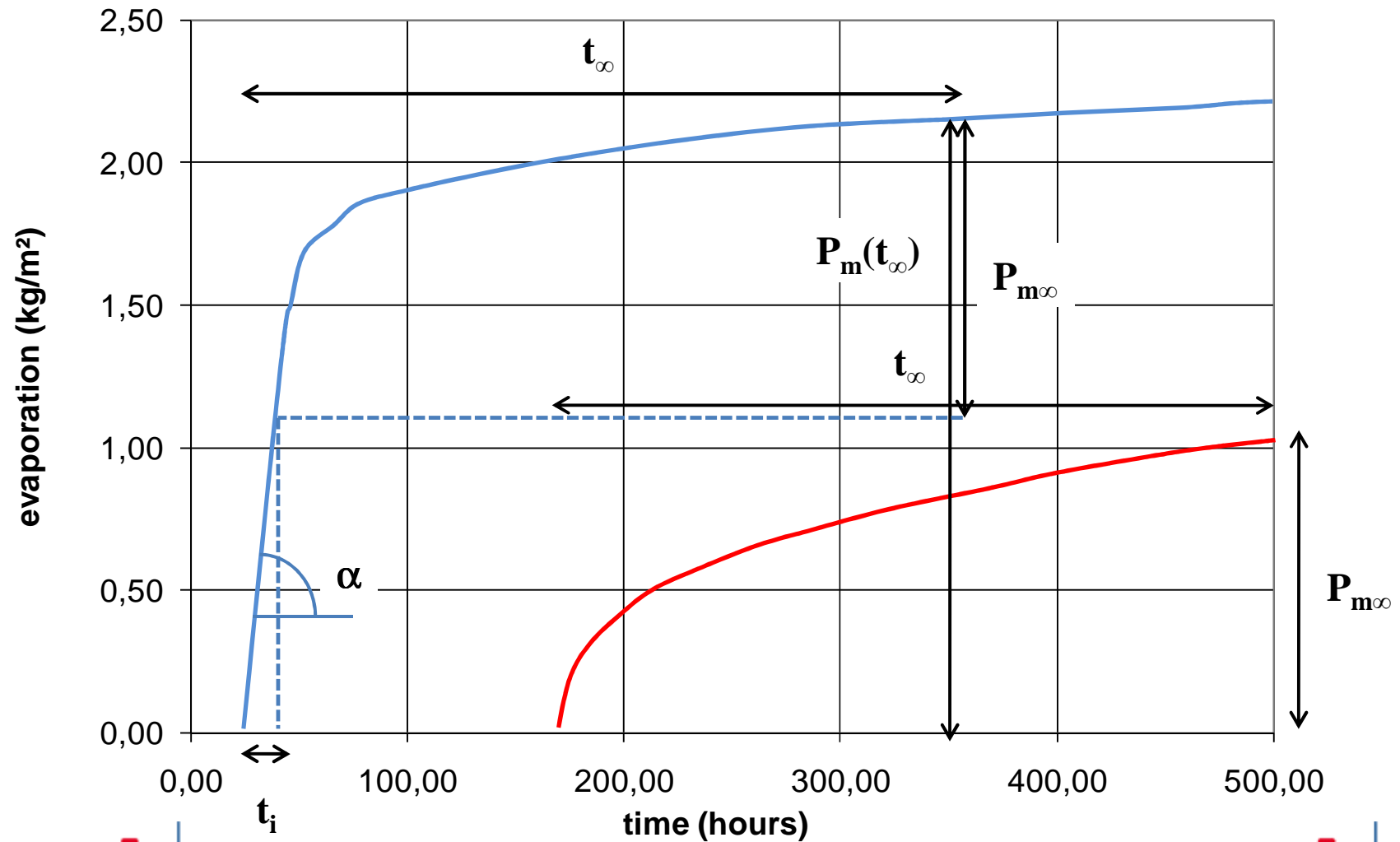
↪ Determination of the time t_c, corresponding to a sharp decrease of concrete drying susceptibility, by linear extrapolation as from time t_i

# WEIGHING DEVICE OF THE PRISMATIC SAMPLES

DETERMINATION OF TIME t_i

APPLICATION OF THE EXPERIMENTAL METHOD

	BAP 1	BAP 2	BO1
Cement	CEM I 52,5 N	CEM V/A (V-S) 32,5 N	CEM III/A 42,5 N
Cement content	350 kg	400 kg	330 kg
Calcareous filler	-	120 kg	-
Superplasticizer	7 kg	10,2 kg	3,4 kg
Total water	214 kg	198 kg	178 kg
Effective water	200 kg	185 kg	163 kg
$W_{eff}/(C + kA)$	0,57	0,43	0,49

VALUES OF TIME t_i

Age of release from the mould	BAP 1	BAP 2	BO 1
16 hours	-	10,3	-
17 hours	-	-	8,6
24 hours	10,0	7,7	6,6
32 hours	6,9	-	-
40 hours	-	4,8	-
41 hours	-	-	3,6
48 hours	3,2	-	-

DETERMINATION OF THE TIMES t_c
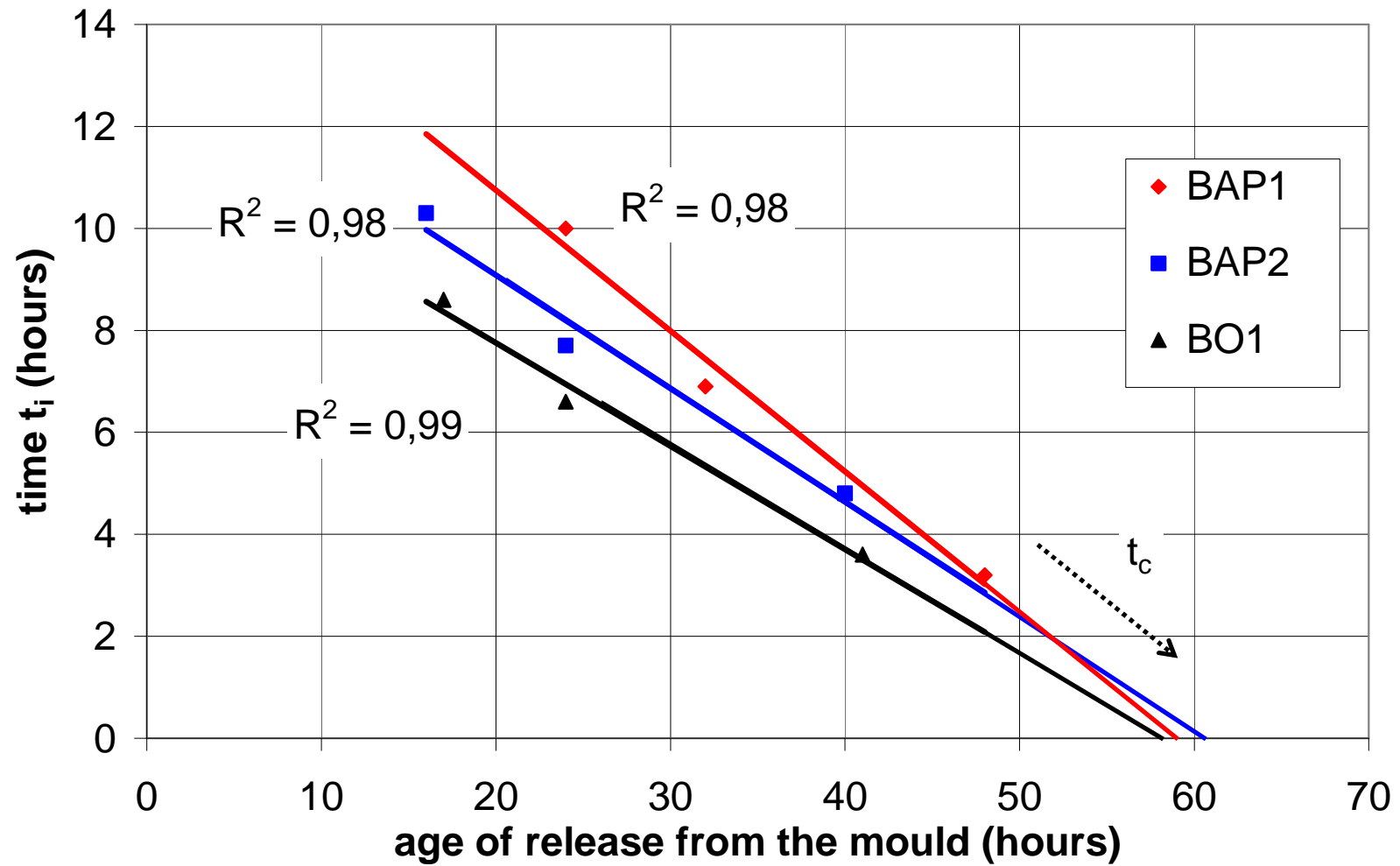
EVOLUTION OF COMPRESSIVE STRENGTH WITH TIME
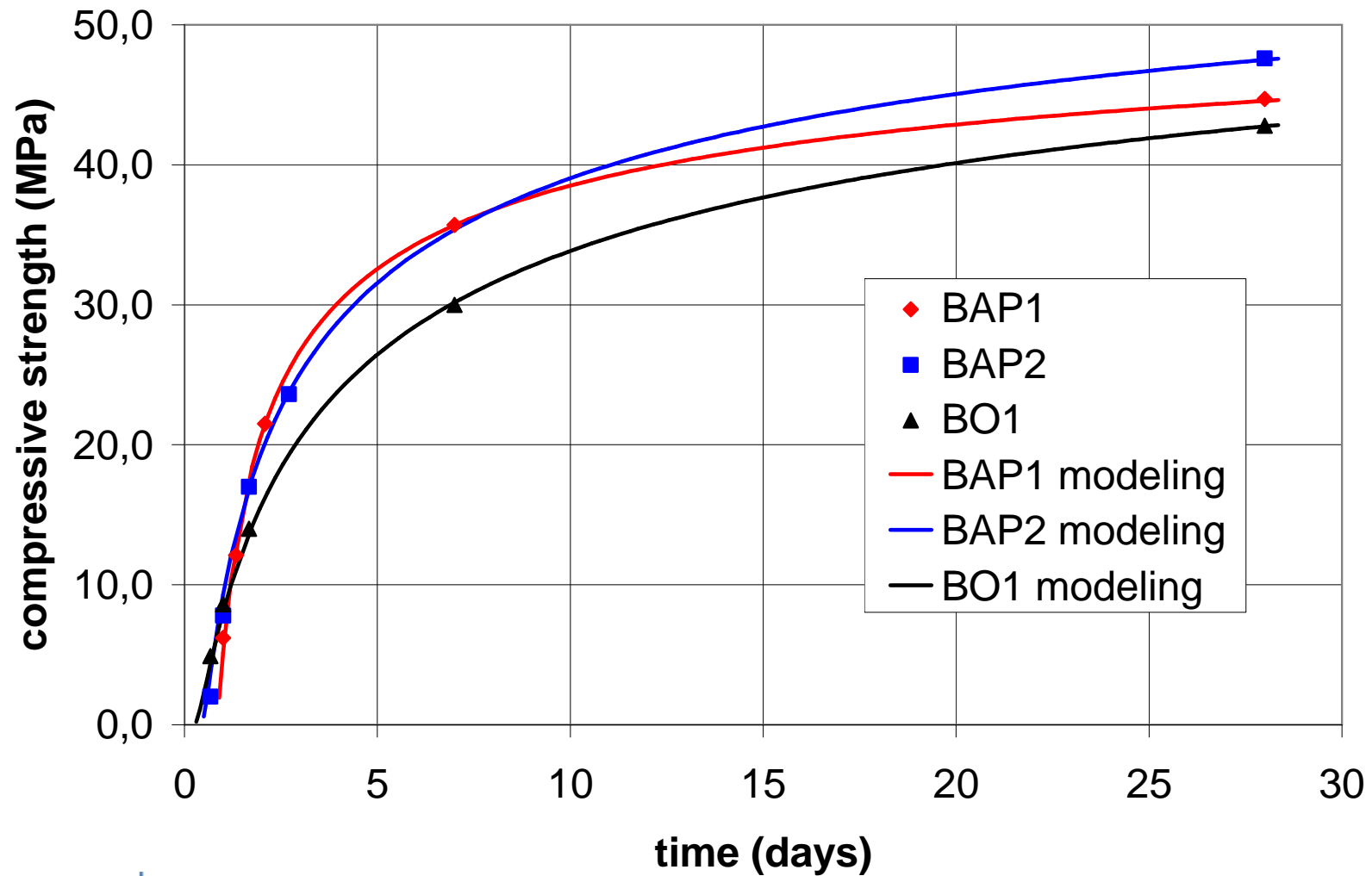
VALUES OF THE TIMES t_c

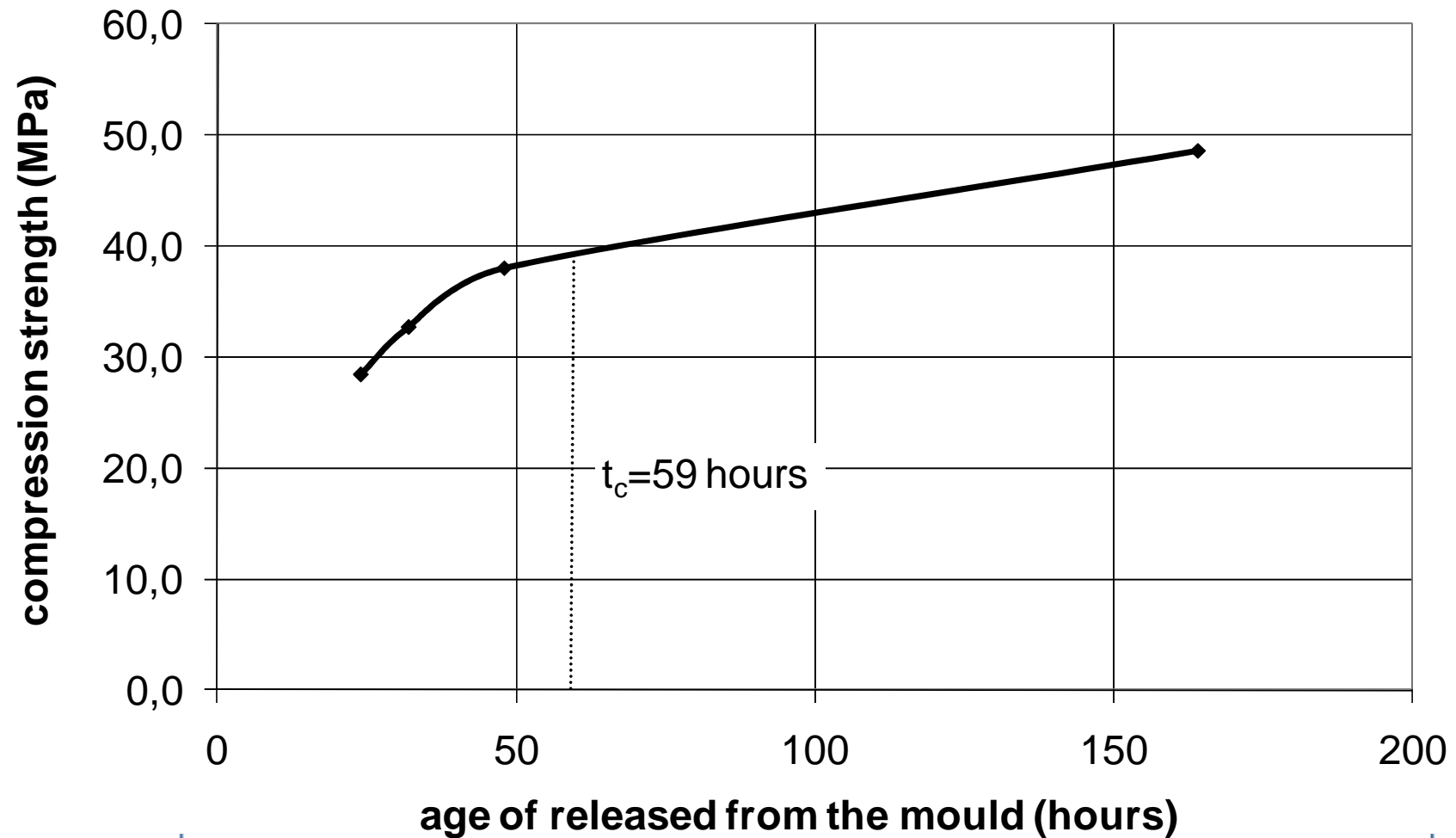|	BAP 1	BAP 2	BO 1
time t_c (hours)	59	61	58
Maturity $R_c(t_c)/R_c(28d)$ (%)	54	48	42
W_{eff}/C	0,57	0,46	0,49
Type of cement	CEM I 52,5 N	CEM V/A (V-S) 32,5 N	CEM III/A 42,5 N

INFLUENCE OF THE CURING PERIOD
ON THE CARBONATION DEPTH AT 90 DAYS
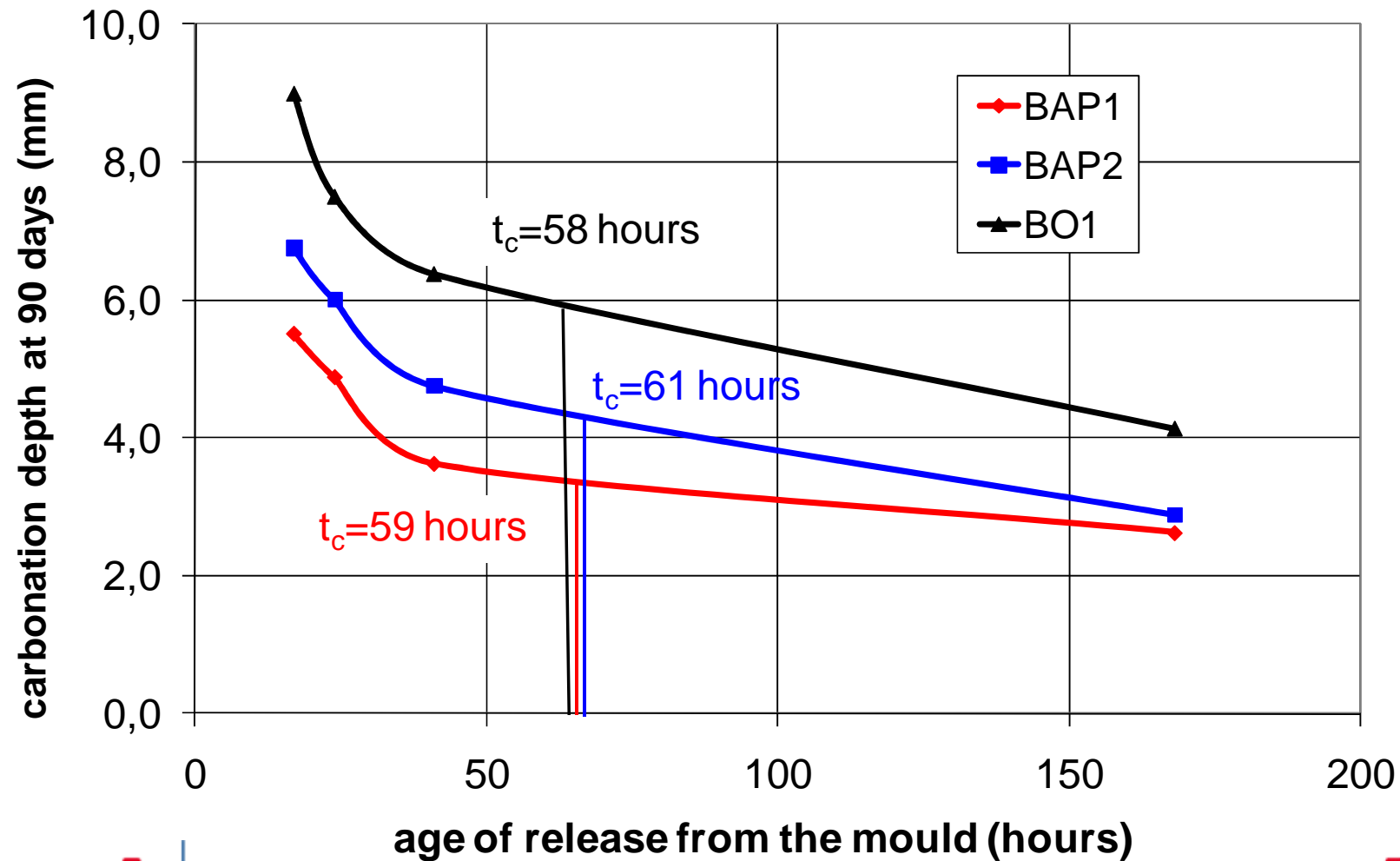
INFLUENCE OF THE CURING PERIOD ON THE CAPILLARY SORPTION
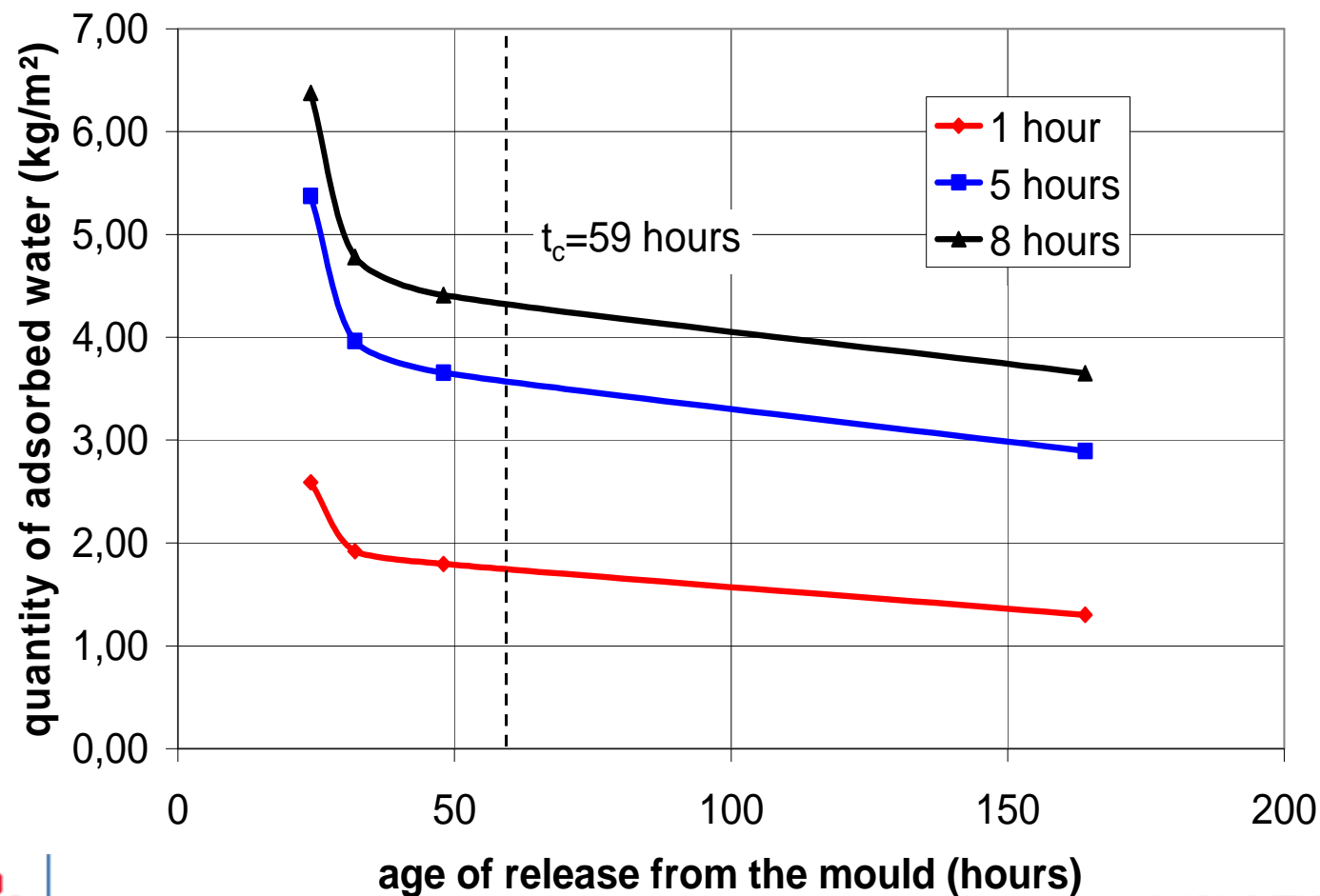
CONCLUSION

A methodology was developed to determine the threshold of drying regime (and the corresponding maturity) starting from follow-up of mass loss of prisms placed in desiccative environment and released from the mould at various terms.

Durability indicators measurements show that the curing period strongly influences the physical properties of concrete

This study shows that further rules concerning curing are necessary for durability design if the potential of concrete with regards to strength and durability is to be fully realized